Chapter 5
Assessment of Skill and Technology Indicators

Abstract This chapter uses the results of the macro and firm surveys to show the interaction between the deficient educational system and the high incidence of unskilled workers and their implications.

We find that the major reasons for heavy dependence on foreign technologies at the micro level are low levels of both skill and technology due to the deficient educational system and the high incidence of unskilled workers. We find that the deficient educational system – due to low quality of education – and the excessive share of unskilled workers has led to low skill levels, poor provision of training, serious skills mismatch, weak linkages, lack of a networks and hindered the transfer of knowledge. These factors have interacted with each other and led to poor technology indicators, poor indigenous capability to build the local technology and a heavy dependence on foreign technology. These results prove hypotheses 3.a–3.b in Chap. 1 above concerning the low skill and technology indicators at the micro–macro levels: the serious implications of the interaction between the causes and consequences of the deficient educational system and the high use of unskilled workers. We confirm hypothesis 3.c. in Chap. 1 above that the major causes of low level of local technology are low/a lack of R&D activities due to a lack of skills, transfer of knowledge, networks and collaborations between universities and industry/firms.

5.1 Introduction

In this chapter we use the data and results of the firm and macro surveys set out in Chap. 4 to examine the third hypothesis in Chap. 1 about the serious implications of the interaction between the deficient educational system and the high incidence of unskilled workers and skill mismatch. In particular, we use the results of the macro survey to show the causes of the deficient educational system and consequences on low skill levels, poor provision of training, skills mismatch and low transfer of knowledge at the macro level. In addition, we use the results of the firm survey to illustrate that the high incidence of unskilled workers leads to low skill level, poor

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provision of training, skills mismatch, poor technology indicators and a heavy dependence on foreign technologies. The rest of this chapter is organised as follows: Sect. 5.2 shows the causes and consequences of the deficient educational system and the high incidence of unskilled workers and their implications on low skill levels, poor provision of training, skills mismatch, lack of knowledge transfer, low level of local technology and heavy dependence on foreign technology. Section 5.3 presents the micro–macro views about the upgrading of skill and technology and their potential implications. Section 5.4 provides the conclusions.

5.2 Causes and Consequences of Deficient Educational System

The results of the macro survey indicate that, at the aggregate level, the official efforts to promote and upgrade the levels of local skill have been relatively successful only in some sectors.[1] In general, there has been a serious failure and shortcoming of the upskilling process, which is mainly attributed to: (1) inadequate availability and misallocation of resources; (2) the deficient educational system; (3) failure of educated and trained workers to transfer knowledge; and (4) inadequate training provision.[2]

We begin our discussion with the second reason, i.e. the deficient educational system, because we want to argue that both inadequate training provision and the failure of educated and trained workers to transfer knowledge are direct implications of deficient education, while the misallocation of resources is indicated as one cause of both deficient education and the poor provision of training.

5.2.1 Causes of Deficiency in the Educational System

With respect to the second cause, Table 5.1 shows that the deficiencies of the educational system appear in all the basic, technical, secondary and tertiary educational systems. Major causes are the low quality and internal efficiency of the educational system, the lack of infrastructure (due to inadequate investment/public spending on education) and the lack of teachers and mentors.[3] Other important factors are the inadequate assessment and monitoring of educational needs, the lack of modernisation and dynamism and inadequate planning for educational needs.[4]

[1] As reported by 56 % of the respondent policy makers and experts to the macro survey.

[2] As indicated by 100 %, 97 %, 94 % and 92 % of the respondent policy makers and experts respectively.

[3] As reported by 92 %, 92 % and 91 % of the respondent policy makers and experts to the macro survey respectively.

[4] As indicated by 87 %, 86 % and 84 % of the respondent policy makers and experts to the macro survey respectively.

Table 5.1 The causes of deficient educational system in the Sudan, 2010

Causes of deficiency	General educational system (basic + technical + secondary + tertiary) (%)	Basic education (%)	Technical education (%)	Secondary education (%)	Tertiary education (%)
Inadequate assessments and monitoring of educational needs	87	86	94	86	83
Low quality/efficiency of educational system	92	86	92	94	94
Inadequate planning for educational needs	84	81	94	78	81
Lack of flexibility of educational institutions	83	81	78	81	92
Low spending and weak incentives for enrolment in technical education	94	–	94	–	–
Lack of modernization and dynamism	86	78	94	83	89
Low involvement and spending by private sector	79	78	89	72	78
Weak linkages [networks] between universities, colleges, technical and the training institutes	83	–	–	–	83
Lack of infrastructures due to inadequate investment (public spending on education)	92	97	97	92	81
Lack of teachers and mentors	91	94	97	86	86

Source: Own calculation based on the macro survey (2010)

Finally, the lack of flexibility of educational institutions and the weak linkages/networks between universities, colleges, technical and training institutes are also mentioned, but are of somewhat less importance.[5] That also holds good for the low involvement and spending by the private sector.[6] Moreover, the major serious problem for the technical education is the weak incentives for spending and enrolment in technical education.[7] For instance, the share of public spending on education in GDP in Sudan (0.9 %) is low compared to Arab Gulf countries like Saudi Arabia (9.5 %) and other advanced Asian countries such as Korea (3.6 %) and Malaysia (7.9 %) (UNDP 2004) – see our discussion of the supply side of educational policies in Chap. 9. Moreover, according to the twin-peaks analysis in Ziesemer (2004), which compares the distribution of public spending on education across countries, the Sudan's less than 2 % public spending on education falls below the average 4.6 % of public spending on education to improve the accumulation of human capital in 1998. Furthermore, from the official perspective, the other important problems related to basic education level include the lack of interest in using modern technologies, lack of attention to update the curriculum in line with the requirements of the phase, weak financial incentives and motivation for teachers and mentors in basic education, weak laws and regulations under the federal government and the lack of enrolment in the basic education system for some of the population for reasons related to war and displacement, and so on. The other important problems related to technical education level include the lack of priority, facilities, comprehensive government policies for development of technical education, the lack of modernisation in the curriculum of the technical education level, the focus on theoretical aspects of technical education rather than practical aspects of technical education and the negative cultural view towards the technical education level. The other important problems related to secondary education level include the low priority of secondary education, the lack of attention to update the curriculum in line with the requirements of the phase, the lack of interest in using modern technologies, the focus on quantitative aspects of secondary education rather than qualitative aspects of secondary education, the lack of training for teachers, the low commitment to regulations and legislation in secondary education. The other important problems related to tertiary and university education level include the lack of attention to scientific research as a prerequisite of the requirements of university education, the lack of attention to training in and use of modern technical means and ways of education (such as computer, Internet, etc.) learning and self-learning methods in tertiary education. In addition other problems are related to the focus on quantitative aspects of university education rather than qualitative aspects of university education, poor coordination between the agencies of education (academic/technical), the mismatch between the outputs of university education with the requirements and needs of the labour market and employment

[5] As reported by 83 % and 83 % of the respondent policy makers and experts to the macro survey respectively.

[6] As indicated by 79 % of the respondent policy makers and experts to the macro survey.

[7] As reported by 94 % of the respondent policy makers and experts to the macro survey.

opportunities, the lack of periodical review of the contents of educational curriculum in universities and the lack of harmony, uniformity, consistency and match in the system used in different public and private universities.

We observe that, according to 92 % of the respondents to the macro survey, the low quality and efficiency of the educational system appears from the low quality at technical, tertiary, higher secondary and basic education relative to international standards respectively.[8] Important causes are the low rates of accomplishments and motivation at technical, higher secondary and basic education levels relative to international standards, but the problem is somewhat less at the tertiary education level.[9] Other serious problems are the low quality of teachers and mentors, the low public current expenditure per pupil, the low survival rates and high drop-out and the high pupil/teacher ratios,[10] while less important causes include the high repetition rates.[11] Furthermore, from the official perspective, the other important problems related to poor quality of education include the poor curriculum in basic and secondary education, which in some cases do not conform to the students' abilities and seems beyond the capacity of students and their families; for the students the courses include a lot of useless and extra information, including not only basic knowledge but additional redundant courses in family studies, military, agricultural, and so on, therefore, the large number of unrequired courses come at the expense of the basic knowledge. Other problems are related to the subordination of spending on education to localities, poor working conditions for teachers which make the teaching profession unattractive, a lack of proper understanding of the meaning of quality education, a lack of interest in addressing the phenomenon of dropout and leakage from education which is most probably caused by some important reasons including rising poverty, lack of equity and equal opportunities for competition, lack of commitment to offering free access to education and the educational environment, and a lack of follow-up records for students enrolled in the public educational institutions.

5.2.2 Consequences of the Deficient Educational System

5.2.2.1 Mismatch Between the Output of Education and the Market Needs

We find that both the deficient basic (primary and secondary) and tertiary educational systems together lead to a serious mismatch between the output of education and the market needs. In particular, about 92 % and 72 % of the respondents to the

[8] As reported by 92 %, 89 %, 89 % and 86 % of the respondent policy makers and experts to the macro survey respectively.

[9] As indicated by 97 %, 89 %, 89 % and 86 % of the respondent policy makers and experts to the macro survey respectively.

[10] As reported by 100 %, 94 %, 89 % and 89 % of the respondent policy makers and experts to the macro survey respectively.

[11] As indicated by about 81 %, of the respondent policy makers and experts to the macro survey.

macro survey reported that the mismatch is mainly attributed to the deficiency of both tertiary and basic education respectively. Moreover, the follow-up interviews with policy makers and experts show that the mismatch is attributed to the deficient educational system,[12] the lack of coordination and planning to meet the critical skill needs and the cultural/social reasons: preference for white collar jobs and bias against technical education and technical jobs. For instance, the deficiency of tertiary educational system is caused by the inconsistent structure: the share of students enrolled in Sudan in 2000 in all social sciences, humanities and art faculties (65 %) was much higher than those of sciences, math and engineering (35 %). The share of students enrolled in sciences, math and engineering in Sudan is also low compared to both Algeria (50 %) and China (53 %) (UNDP 2002, 2003; UNDP-AHDR 2002, 2003) – cf. our discussion on the demand for education in Chap. 9.[13]

5.2.2.2 Lowering Skill Levels

From Sudan population census data (2008) and the educational matrix for the period 1960–2008 set out in Table 5.2, we observe the low skill levels, defined by the educational level of the total population. The share of low educated (99–95 %) is much higher than that of high educated (1–5 %) in the total population over the period 2000–2008. That also indicates a minimal skill upgrading, defined by the relative rise in the share of the high educated population and the relative decline of the share of low educated population during the period 1960–2008.[14] In addition, Sudan Central Bureau of Statistics statistical data (2004–2008) on the distribution of the economically active population by occupational classification (2004–2008) shows the low skill level, defined by occupational levels; for instance, the share of the unskilled population (86–83 %) is much higher than that of the high skilled population (14–12 %). That also implies that rather than improvement there was even a slight deterioration in skill upgrading, defined by the decreasing share of high skilled, despite a falling share of unskilled during the period 2004–2008. Furthermore, as we explain below, the low skill levels at the macro level is consistent with that at the micro level.

[12] As in most other developing countries, the mismatch is attributed to deficiency in the educational system.

[13] These results are also consistent with the findings of El Sabaa (1997), Haan (1999), Nour (2005a, b) and Muysken and Nour (2006) in the UAE. See for instance El Sabaa (1997), pp. 20–21 and Haan (1999), p. 37.

[14] At the aggregate level, the educational matrix implies the distribution of population according to educational level: low level of education refers to illiterate, literate, primary and preparatory school; medium level of education includes secondary, post-secondary and below university; and high level of education includes university and postgraduate levels.

Table 5.2 The Sudan educational matrix: The distribution of population by educational level (1960–2008)

Total population[a,b]		Low	Medium	High	Not stated	Total
1960[a]	Total	0.996000	0.004000	0.000000	0.000000	1
1965[a]	Total	0.994000	0.006000	0.000000	0.000000	1
1970[a]	Total	0.992000	0.007000	0.001000	0.000000	1
1975[a]	Total	0.988000	0.010000	0.002000	0.000000	1
1980[a]	Total	0.981000	0.018000	0.003000	0.000000	1
1985[a]	Total	0.971000	0.027000	0.002000	0.000000	1
1990[a]	Total	0.972000	0.023000	0.004000	0.000000	1
1995[a]	Total	0.966000	0.029000	0.005000	0.000000	1
2000[a]	Total	0.959000	0.034000	0.007000	0.000000	1
2008[b]	Total	0.768000	0.139300	0.053200	0.039700	1
2008[b]		**Low**	**Medium**	**High**	**Not stated**	**Total**
Total Sudan (gender)[b]	Male	0.432900	0.078000	0.029100	0.021500	0.561500
	Female	0.335000	0.061300	0.023900	0.018200	0.438400
	Total	0.768000	0.139300	0.053200	0.039700	1
Total Sudan (mode of living)[b]	Rural	0.295600	0.085200	0.039800	0.018300	0.438900
	Urban	0.454200	0.053200	0.013000	0.020200	0.540600
	Nomad	0.018100	0.001000	0.000200	0.001200	0.020500
	Total	0.768000	0.139300	0.053200	0.039700	1
Total population[b]		0.768000	0.139300	0.053200	0.039700	1
North (gender)[b]	Male	0.375400	0.068200	0.027800	0.021500	0.492900
	Female	0.295300	0.056900	0.023600	0.018200	0.394000
	Total	0.670600	0.125100	0.051300	0.039700	0.886700
South (gender)[b]	Male	0.057700	0.009800	0.001500	0.000000	0.069000
	Female	0.039800	0.004300	0.000500	0.000000	0.044600
	Total	0.097200	0.014100	0.001800	0.000000	0.113100
Total population[b]		0.768000	0.139300	0.053200	0.039700	1
North (mode of living)[b]	Rural	0.268000	0.079300	0.038800	0.018300	0.404400
	Urban	0.384600	0.044900	0.012400	0.020200	0.462100
	Nomad	0.018100	0.001000	0.000200	0.001200	0.020500
	Total	0.670600	0.125100	0.051300	0.039700	0.886700
South (mode of living)[b]	Rural	0.027700	0.005900	0.001100	0.000000	0.034700
	Urban	0.069600	0.008200	0.000700	0.000000	0.078500
	Nomad	0.000000	0.000000	0.000000	0.000000	0.000000
	Total	0.097200	0.014100	0.001800	0.000000	0.113100
Total population[b]		0.768000	0.139300	0.053200	0.039700	1

Note: Figures for 2008 refers to total population with six (6) years old and over

[a]Own calculation from Barro and Lee (2000), cited in Ali Abdel Gadir Ali (2006) "On Human Capital in Post-conflict Sudan: Some Exploratory Results", API/WPS 0602, p. 14

[b]Adapted from Sudan Central Bureau of Statistics Population Census Data (2010): The Fifth Sudan Population and Housing Census (2008)

5.2.2.3 Hampering Transfer of Knowledge

Our results in Table 5.3 show that the low quality of education hindered the easy transfer of knowledge and external schooling effects. According to the macro survey, only 36 % of the respondent policy makers and experts reported that the incidence of

Table 5.3 The factors constrained the transfer of knowledge/external schooling effect in the Sudan, 2010

Factors constrained the transfer of knowledge/external effect of schooling	Officials (%)
Low quality/return from education	89
Low return form/quality of training compared to international standard	92
Prevailing conditions in the Firm conditions do not encourage the external effect	89
Failure of skilled workers to deliver their knowledge and experiences to benefit unskilled workers.	78
Failure of unskilled workers to acquire the knowledge and experience from skilled workers	75
Lack of awareness on the importance of the external effect	92

Source: Own calculation based on the macro survey (2010)

knowledge transfer/external schooling effect is successful, while around 61 % reported that the transfer of knowledge/the external schooling effects are constrained by several factors. The major important factors include: the low quality of training, the lack of awareness about the importance of the external effect of schooling, the low quality of education, the prevailing conditions in the firms do not encourage external effects, failure of skilled workers to deliver knowledge to unskilled workers and failure of unskilled workers to acquire knowledge from skilled workers.[15] Furthermore, from the official perspective, others less important factors or causes hindering the external effect of schooling include the social factors, deficiency in the policy of selection of trainee for training in areas not relevant to their functions and finally, the lack of internal acquisition of education and skills.

In strong contrast to this view, the results of the firm survey show that, at the micro/firm level, the incidence of knowledge transfer/external schooling effect is successful among about 77 % of the respondents firms. It is only unsuccessful within about 23 % of the respondent firms because of the following: the low quality of training, failure of skilled workers to deliver knowledge to unskilled workers and failure of unskilled workers to acquire knowledge from skilled workers, the low quality of education and the prevailing conditions in the firm do not encourage the external effects within firms.[16] From the firm perspective other factors for lowering the external effect of schooling includes the lack of local physical drive, physical motivation, culture, the high illiteracy rate for most of the workers, lack of attention and funding for training.

This contradicting optimistic-pessimistic view at the micro and macro levels regarding the incidence and success of knowledge transfer/external schooling effect implies that the transfer of knowledge/the external schooling effects is probably successful within firms but unsuccessful between firms and within society at large. This is

[15] The transfer of knowledge and external schooling effects refers to knowledge transferred from knowledge holders (high skilled workers/people) to knowledge recipients (low skilled workers/people) – cf. Cowan et al. (2001), p. 9. Knowledge in this sense refers to know how or tacit knowledge embodied in people, and is different from the broad definition of technology, which refers to both embodied and disembodied knowledge.

[16] Another possible explanation for the low transfer of knowledge can be interpreted in relation to the prevailing conditions within private firms. Since within private firms there may be fewer incentives for the incidence of transfer of knowledge from high to low skilled workers.

consistent with our observations from the follow-up interviews that the transfer of knowledge is hindered by both the low quality of education and the lack of cooperation with university sector due to inadequate awareness and lack of social partnership between public sector, private sector, university sector and society. The weak linkages and lack of networks between universities, colleges, technical and training institutes and the productive sectors is mentioned by 83 % of the respondents to the macro survey as factor that constrains the efficiency of educational system – it probably also constrains the transfer of knowledge. An additional factor is that the transfer of knowledge within society at large is probably hindered by the incidence of high illiteracy rate and incidence of high mismatch between educational output of population and labour market. This is mainly due to the excessive share of unskilled workers that probably hindered their sufficient benefit from high skilled workers and population.[17] This is probably also due to a lack of incentives at the aggregate level.[18]

Finally, the macro survey indicates that the contribution of both the educated and trained population to promote the local skills is constrained by several causes. Major causes are the inadequate incentives for trainers, the lack of interaction to market needs (mismatch), the lack of information on educational and training needs in the productive sectors and their demand for graduate students and the uncertainties about the future value of investment in education and training.[19] Other important causes are the uncertainties about future skill needs and the high costs to finance education and training.[20] Relatively less important causes include the lack of a system of certification of skills acquired and risk aversion, in other words the preference of more certain short term returns to available jobs than long-term skill investments.[21] These factors probably also contribute to hinder the transfer of knowledge within society at large.

[17] This result is consistent with the finding of the UAE as reported by El Sabaa (1997), who notes: "It is widely observed that industrial entrepreneurs in the technically advanced projects are strictly against leakage of their technologies outside their factories. Thus, they minimally contribute to developing the technology environment in the country. This adverse impact has been amplified by the unwillingness of foreign as well as local entrepreneurs to employ local manpower, to train them in their factories, either because they doubt their capabilities, or for fear to leaking their technology secret to other competitors. The limited supply of local industrial manpower, coincided with the unwillingness to employ them in both foreign and local industries applying advanced technologies, resulted in constricting the role supposed to be played by expatriate manpower in transferring technology to the industrial sector in the Gulf region. Moreover, the large scale industries despite using more sophisticated advanced technologies, however, they minimally contribute to elevate the technology transfer to the local industrial sector, as they strictly keep their operational and managerial techniques as top confidential secrete and prevent their leaking outside their units. To some extent, the chance of their flow to the rest of the operating factories seems better in the medium size factories". El Sabaa (1997), pp. 22, 24–25.

[18] The lack of transfer of knowledge can be interpreted as a lack of absorptive capacity, mainly related to deficiencies of education and continued dependence on imported technologies.

[19] As indicated by 97 %, 92 %, 92 % and 92 % of the respondent policy makers and experts respectively.

[20] As reported by 86 % and 86 % of the respondent policy makers and experts.

[21] As indicated by 83 % and 78 % of the respondent policy makers and experts respectively.

5.2.2.4 Poor Provision of Training

Both the deficient educational system and the excess supply of low skilled workers lead to a low skill level and hinder the provision of training. Table 5.4 shows that both the policy makers and experts (officials) and firm managers mentioned the low educational qualifications of workers among the important factors constraining the provision of training. Other important factors are the lack of appreciation/information about training, the lack of finance to cover the high cost of training, the lack of trainers and mentors, inadequate assessment and planning for training programmes and the mismatch problem. Furthermore, from the official perspective other factors for the low provision of training in Sudan include the lack of stimulating environment, the lack of interest in development and continuous training initially as a way of skill formation, the low priority given to training, inadequate incorporation of training in the government policy and the strategic plan or programme and the difficulties of coordination and organisation of training activities due to inadequate resources and facilities offered to the National Council for Training to coordinate and organise the public and private training activities and training institution.[22] In addition to deficiency in the selection of management for training departments, deficiency in determining and setting the goal and the level of requirement of training and deficiency in the selection of learners and trainees for suitable training programmes according to their training needs. In addition, from the firms' perspective the lack of training provision is attributed due to the absence of government support, which is apparent from the lack of regulations from the Ministry of Industry and Ministry of Labour to oblige firm owners and mangers to make the establishment of training units mandatory. Further to the lack of financial resources, only a few firms reported the presence of a budget for the provision of training; for the majority of the firms there is no budget for the provision of training, especially, external training. Moreover, in view of the scarce resources for the industrial firms, the provision of training is most probably hindered by the payment of large number of taxes, fees and levies imposed on the industrial firms, which implies their inability to address skill development issues such as training. In addition from the firms' perspective other problems for the limited provision of training are probably due to: the lack of development; absence of a culture of the importance and need for training given the believe that the nature of the prevailing industrial activities that do not need training; preference for readymade well trained and experienced skilled workers; and lack of important jobs for training for promoting a culture of commitment and affiliation to firms. Moreover, from the perspective of new and relatively new established firms, the lack of the importance of training and R&D over the short-term can be attributed due to their recent establishment; their focus and priority in their early years aims to ensure survival in the market and therefore they believe that both training and R&D are not priorities until after establishment

[22] For instance, the insufficient resources and facilities hindered the ability of the National Council for Training to organise training activities, and most probably lead to existence of chaos and messiness in training activities; there are 195 training institutions and the council does not know about their activities and is unable to organise them due to the lack of necessary resources.

Table 5.4 The factors constrained the provision of training in the Sudan, 2010

Factors constrained the provision of training	Official	All firms	Chemical	Food	Metal	Textile	Large	Medium	Small
Inadequate planning for training programme	94 %	59 %	57 %	55 %	75 %	67 %	81 %	37 %	54 %
Inadequate assessment of training needs.	92 %	65 %	65 %	65 %	63 %	67 %	86 %	47 %	54 %
Mismatch between training programme and changing technical needs	89 %	50 %	48 %	50 %	50 %	67 %	76 %	26 %	38 %
Mismatch between training programmes and changing skill needs	94 %	50 %	43 %	50 %	63 %	67 %	81 %	21 %	38 %
Low quality of trainers and mentors	94 %	50 %	46 %	50 %	78 %	0 %	76 %	33 %	31 %
Low educational qualifications of workers	89 %	67 %	67 %	70 %	63 %	67 %	81 %	55 %	62 %
Lack of trainers and mentors	97 %	60 %	58 %	55 %	88 %	33 %	76 %	40 %	62 %
Lack of appreciation/information about training	94 %	69 %	75 %	70 %	63 %	33 %	86 %	55 %	62 %
Lack of specialized training institutions	86 %	63 %	78 %	50 %	50 %	67 %	71 %	53 %	69 %
Lack of full appropriability of the return from training investment.	92 %	57 %	61 %	60 %	38 %	67 %	62 %	58 %	54 %
Lack of interactions between training institutions and firms	94 %	61 %	61 %	60 %	63 %	67 %	67 %	47 %	77 %
Lack of finance to cover the cost of training	97 %	69 %	74 %	60 %	63 %	100 %	76 %	68 %	54 %
Lack of training materials and equipment	97 %	64 %	71 %	55 %	63 %	67 %	86 %	35 %	69 %
High rate of mobility of trainers to move for better paid jobs after training	89 %	69 %	61 %	75 %	63 %	100 %	76 %	63 %	62 %
Lack of a system of training certification of skills acquired	92 %	50 %	52 %	55 %	38 %	33 %	71 %	37 %	38 %
Total response		56	24	20	9	3	21	21	13

Source: Own calculation based on the macro survey (2010), firm survey (2010)

in the market. Moreover, the results of the firm survey illustrate that the low provision of training appears from the following: (1) The lack of an inhouse training unit – only 27 % of the respondent firms have an inhouse training unit; (2) The complete absence of public financial support: for instance, none of the respondent firms received any government subsidies to support training provision; (3) The selective training provision: in the year 2008, the priority for training among the respondent firms was mostly given to production workers, production engineering staff, management staff and services workers[23]; and for few firms the limited provision of training is also extended to include the provision of training for university students and (4) The limited type of training: most of training provision is focused to on the job training, and on the job and off the job combined, which are preferred by 72 % and 56 % of the respondent firms respectively. The other types of training such as: off the job within the firm (training centre), off the job outside the firm (specialist training centre inside the country) and (outside the country) are very limited[24]; (5) The limited sources of information about training opportunities, as most of the information about training opportunities is provided by private trainers (local and foreign companies) and the chambers of commerce. Few firms find information from government and semi government units, other firms working in the same sector and public educational institutions/universities.[25,26] Few firms

[23] As reported by 51 %, 48 %, 36 % and 21 % of the respondent firms respectively.

[24] As indicated by 42 %, 48 % and 38 % of the respondent firms respectively.

[25] As reported by 46 %, 32 %, 27 %, 26 % and 21 % of the respondent firms respectively.

[26] These results seem consistent with the findings of the earlier studies in the UAE conducted by Nour (2005b), the UAE University (1994, 1997), Gray (1999) and Abdelkarim and Haan (2002). For instance, the UAE Education Assessment Report (1994) shows that both technical and vocational education and training provision are unregulated, uncoordinated and unplanned, while the results of the UAE University (1997) show the limited contribution to private sector training provision by both the public and government sectors. Moreover, the findings of Gray (1999) show that only 30 % of the respondent firms provide systematic training. The provision of training is selective in most cases – focused on some occupational groups, but not others – and for two thirds of the respondent firms, the provision of training was limited to on the job training. The study concluded that the UAE does not have a training-led employment culture. Employers have become used to bringing in their workers from outside the country with readymade skills and replacing them with similarly skilled workers. There has been little incentive to provide skill upgrading except in response to immediate needs such as the introduction of new technology. The local training industry has suffered from the uncoordinated nature of provision and the very limited contribution by public sector organisations and higher education institutions to this variety of provision. Most of training provision has been in low-investment, low-cost and quick-profit areas such as marketing, public relations, sales, computer awareness and management development. The private sector training is relatively undeveloped and uncoordinated, and has limited market due to both limited demand and limited supply. Moreover, the provision of public sector training is constrained by the inadequate involvement of public education institutions. For instance, the Higher Colleges of Technology (HCTs) had little involvement in the important area of adult technical education, including vocational training and retraining. See Gray (1999), pp. 15, 33, 34, 43. Additionally, the findings of Abdelkarim and Haan (2002) show that the UAE public sector training is still limited due to less attention, awareness and resources. See Abdelkarim and Haan (2002), p. 15.

obtained information about training from other sources for example, firms self searching for training, from private Sudanese universities, few public and private institutions and finally foreign expertise.

5.2.3 *Consequences of the Low Educational Qualifications of Unskilled Workers at the Micro/Firm Level*

In Chap. 2 we explained that one well-known fact about Sudan is the high share of unskilled workers in total employment. In this section we show that next to the consequences of the deficient educational system at the macro level, the high incidence of unskilled workers also causes several serious implications at the micro/firm level.

5.2.3.1 Low Skill Level and Skills Mismatch at the Micro/Firm Level

From the demand perspective, the results of the firm survey can be used to argue that firm demand for low skilled workers leads to an excessive share of low skilled workers.[27] On the other hand, from the supply perspective, our findings from the firm survey show that the excessive share of low skilled workers has direct implications in lowering skill levels at the micro/firm level. For instance, Table 5.5 below shows that across firms the average percentage share of low skilled workers (66 % and 74 %) is much higher than that of high skilled workers (34 % and 26 %), defined by both educational and occupational classifications respectively. Moreover, Tables 5.4 and 5.5 show that the poor educational qualifications of firms workers lead to poor provision of training – see our discussion above – and a serious skills mismatch across firms, as we will explain in detail in the next chapter.[28]

[27] It is convenient in this chapter to briefly indicate the consequences with respect to low skill and skills mismatch at the micro level and to discuss this more fully later in Chap. 7. That serves our aim in this chapter to compare and integrate the macro–micro consequences of low skill level. This brief discussion in this chapter also substantiates the third hypothesis in Chap. 1 above about the interaction between the deficient educational system at the macro level and the high incidence of unskilled workers at the micro level and the serious implications on low skill levels and skills mismatch. It is appropriate to discuss the skills mismatch problem more extensively later in Chap. 7, where we provide a broader, more indepth and coherent analysis of skill problem and the implications of the prevalence of low-skilled workers at the micro/firm level.

[28] We define the mismatch as the differences between the required and actual education. Actual education refers to high (university and above), medium (secondary) and low (below secondary) levels of attained years of education that represent the supply of skills. We define the required education by the required qualifications for each of the occupational classes translated into average years of schooling that represent the demand for skills. We observe that the inconsistency between the required and actual education implies inconsistency between demand for and supply of skills, which we interpreted as skills mismatch (cf. the detailed discussion in Chap. 7 below).

Table 5.5 Main technology and skill indicators defined by firm size and industry in the Sudan, 2010

		Industry				Size		
Indicator	All firms	Chemical	Food	Metal	Textile	Large	Medium	Small
Skill and skills mismatch indicators								
Share of high skilled (education) (%)	34 %	35 %	33 %	31 %	39 %	42 %	32 %	25 %
Share of high skilled (occupation) (%)	26 %	27 %	25 %	21 %	32 %	25 %	26 %	29 %
Share of low skilled (education) (%)	66 %	65 %	67 %	69 %	61 %	58 %	68 %	75 %
Share of low skilled (occupation) (%)	74 %	73 %	75 %	79 %	68 %	75 %	74 %	71 %
Share of firm conducting R&D (%)	20 %	23 %	13 %	17 %	40 %	29 %	10 %	19 %
High skilled wages/low skilled wages	3.5	3.7	3.45	2.96	3.6	4.2	3.1	2.98
Share of firm with skills mismatch (%)								
The high skilled group (%)	40 %	38 %	44 %	22 %	60 %	58 %	36 %	17 %
The medium skilled group (%)	31 %	24 %	38 %	44 %	20 %	30 %	40 %	13 %
The low skilled group (%)	45 %	39 %	39 %	71 %	60 %	43 %	53 %	38 %
Technology indicators								
Share of R&D expenditure/total output (sales value) (%)	0.17	0.12	0.36	0.01	0.11	0.19	0.05	0.225
Average R&D expenditure (× 1 million Sudanese Pound)	0.5	0.65	0.5	0.5	0.1	0.6	0.002	0.5
Number of R&D employees (R)	$1 \leq R \geq 11$	$1 \leq R \geq 11$	$1 \leq R \geq 11$	$1 \leq R \leq 10$	$2 \leq R \geq 11$	$1 \leq R \geq 11$	$1 \leq R \leq 10$	$1 \leq R \geq 11$
Number of full time R&D employees	$1 \leq R \geq 11$	$1 \leq R \leq 10$	$1 \leq R \leq 10$	0	$2 \leq R \geq 11$	$1 \leq R \geq 11$	$1 \leq R \leq 10$	$1 \leq R \leq 10$
Number of full time R&D employees	1–11	1–10	1–10	0	2–11	1–11	1–10	1–10
Number of part time R&D employees	$1 \leq R \geq 11$	$1 \leq R \geq 11$	$1 \leq R \geq 11$	$1 \leq R \leq 10$	0	$1 \leq R \geq 11$	$1 \leq R \leq 10$	$1 \leq R \geq 11$
Number of part time R&D employees	1–11	1–11	1–11	1–10	0	1–11	1–10	2–11
Share of firm applying for patents (%)	6 %	8 %	3 %	8 %	0 %	6 %	8 %	5 %
Share of firm in total spending on ICT (%)	100 %	50 %	30 %	11 %	9 %	37 %	33 %	30 %
Share of firm in total spending on ICT training (%)	100 %	13 %	63 %	13 %	13 %	50 %	25 %	25 %
Share of firm in total spending on ICT (%)	62 %	71 %	52 %	46 %	100 %	57 %	62 %	76 %
Share of firm with spending on ICT training (%)	9 %	3 %	16 %	8 %	20 %	11 %	7 %	10 %

Average spending on training (× 1 million Sudanese Pound	14.42	21.28	2.65	2.00	5.01	18.38	1.06	10.00
Number of training employees	5.77	2.25	2.33	0	25	7	2.5	3.5
The degree of automation/use of sophisticated technologies[a] (%)	54 %	35 %	67 %	61 %	80 %	68 %	55 %	35 %
Dependence on foreign technology[b] (%)	49 %	49 %	58 %	25 %	60 %	51 %	38 %	63 %
Dependence on foreign technology (%)	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Share of firm providing training (%)	27 %	34 %	15 %	27 %	40 %	34 %	26 %	17 %
Incidence of external schooling effect (%)	77 %	72 %	74 %	91 %	100 %	81 %	74 %	74 %
Dependence on foreign technology-1-q-21	56 %	58 %	56 %	46 %	57 %	57 %	48 %	62 %
Dependence on foreign technology-2-q22	45 %	35 %	46 %	65 %	51 %	45 %	53 %	31 %
Factors constrained the contribution of R&D unit to adaptation of imported technologies								
(a) Shortage of finance	78 %	71 %	83 %	83 %	75 %	82 %	81 %	65 %
(b) Shortage of human resources skilled and qualified workers	74 %	68 %	80 %	75 %	75 %	81 %	67 %	70 %

Source: Own calculation based on the firm survey (2010)

[a]We measure the degree of automation/sophisticated technologies qualitatively, we asked firms about their own appreciation or evaluation of the level of technologies they are using in their production

[b]We measure the dependence on foreign technologies qualitatively, we asked firms if they have an adequate capacity/ability to produce and develop local technologies and if they have purchased equipment, machines and techniques from abroad. Our definition also includes quantitative measurement of the value of imported capital equipment to total capital equipment, the percentage value of capital equipment to total capital equipment that has been build by foreign companies. Finally technology transfer is also an indicator of dependence on foreign technologies – see Table 5.7 below

5.2.3.2 Weak Technology Indicators

From the demand perspective, the results of the firm survey can be used to argue that weak technology indicators lead firms to demand and rely heavily on low skilled workers. On the other hand, from the supply perspective, the excessive share of unskilled workers leads to weak technology input–output indicators across firms. From Table 5.5 above, we observe that a weak R&D indicator appears from the following: (a) The limited R&D activities/efforts performed continuously or occasionally amongst only 20 % of all the respondents firms; the limited prevailing research includes for example the marketing research; (b) The limited R&D activities and expenditures particularly devoted/aimed at improving firm product and to produce a new product; (c) The low R&D expenditures and R&D expenditures as a percentage of total output expenditures. For instance, amongst all the respondent firms, average R&D expenditure was around 0.5 million Sudanese pounds,[29] while the average R&D expenditures as a percentage of total output (sales value) amongst all the respondents firms accounted for only 0.2 %; (d) the low number of both full time and part time R&D employees. For instance, a large majority (91 % and 89 %) of the respondents firms with R&D activities have no or a low number (1–3) of full time research employees and/or part time research employees respectively. Only few (9 % and 11 %) of total firms have more than three full and part-time research employees respectively. Only few firms have more than 11 full and part-time research employees.[30] Only few firms have (6–10) full and part time research employees.[31] Moreover, the contribution of research units in adapting the imported technologies is constrained by a shortage of skilled and qualified workers amongst 74 %, 68 %, 80 %, 75 % and 75 %, 81 %, 67 % and 70 % of all firms, chemical, food, metal, textile, large, medium and small firms respectively (see Table 5.8 below).[32] In addition, the contribution of research units in adapting the imported technologies is constrained by a shortage of finance amongst 78 %, 71 %, 83 %, 83 % and 75 %, 82 %, 82 % and 65 % of all firms, chemical, food, metal, textile, large, medium and small firms respectively. Moreover, the follow up interviews with the officials and firms managers revealed that R&D activities are constrained by several factors such as high costs and low public and private spending, lack of information systems, and the absence of an R&D culture due to inadequate awareness and concern. In addition the very limited cooperation between industrial firms in terms of R&D that appears for example from the only limited cooperation in exchange of information within specific

[29] The value is measured in Sudan's local currency, Sudanese Pounds, which equalled US$ 2.50 Dollars when the survey was held (2010).

[30] As reported by 5 %, 3 % 7 %, 20 %, 9 % and 5 % of the all firms, chemical, food, textile, large and small respondent firms respectively.

[31] As reported by 15 %, 22 %, 10 %, 17 %, 20 %, 14 % and 10 % of the all firms, chemical, food, metal, large, medium and small respondent firms respectively.

[32] We measured the contribution of a research unit to adapt the imported technologies qualitatively, by asking firms how the research unit contributed to adapting imported technologies. In addition to a lack of qualified workers, there may also be other factors such as a lack of incentives or pressure to adapt or master imported technologies as firms can always opt to buy the required technologies or techniques.

limits is most probably limited because of the intense competition between industrial firms. Additional constraints relate to the poor coordination between the institutions engaging in R&D activities, either due to the absence of explicit government policy or the ineffective role of a central body (e.g. the government) to coordinate and promote R&D efforts and motivate collaborative research efforts between the industrial firms and universities. In addition to weak network systems, R&D efforts, in particular, are limited across firms because of weak contact and collaboration with universities; this is probably attributable to the fact that the university sector is lacking resources or concern and interest to conduct joint applied research with industrial firms.[33] Moreover, from the firms' perspective the main problem facing firm strategy to encourage the development of R&D and build of local technology is that research is not a fundamental goal, the primary goal is profit, in addition to the lack of entrepreneur perspective and dominance of commercial perspectives, lack of government policies and support, lack of efficient organisational management and lack of relevant workers. Moreover, from the firms' perspective the development of technology industry in Sudan is hindered by the acute shortage of local raw materials.

Moreover, Table 5.5 above shows the weak technology output indicator as measured by patent applications.[34] For instance, in the year 2008, only 6 % of all respondent firms applied for a patent; the low degree of patenting may be attributable to low R&D efforts.

In addition, a lack of R&D efforts may hinder innovative activities across firms. The increasing uses of technology has encouraged the incidence of product and

[33] This can also be interpreted as a lack of demand-pull since firms can buy all technologies or techniques. Our findings are consistent in some respects with the findings in the UAE as discussed in Nour (2005b) and Haan (1999), who notes "R&D capacity in the UAE is presently very limited. While some research is taking place at the University and other institutes of higher education, it is - as usual in such institutions – more geared towards pure science and tends to have only limited relevance for the productive sector. While the Higher Colleges of Technology place emphasis on more practical training, hardly any R&D takes place, only as a byproduct of the training. Within the private sector in the UAE likewise very few R&D activities are going on. Most manufacturing and other firms tend to rely on imported technologies (both in terms of hardware and software), as well as imported materials and even expatriate manpower. There is very little interest in carrying out research, and the R&D activities are small-scale in nature and mostly only concern minor adaptations to the companies' own products. In all it is estimated that less than 1 % of turnover is used for this purpose. The parastatal sector, in which a number of large basic industries are operating, will do better. There is also some agricultural research ongoing. Without such R&D facilities and efforts, the UAE is almost completely dependent on imported technologies. And without the necessary adaptations to local conditions (e.g. temperatures, effects of dust and sand winds, special cultural aspects, the country's socio-political system, etc.), even these technologies cannot be optimally applied. Moreover, a genuine technology culture to motivate the involvement in R&D and promotion of local technology is now absent in the UAE. The UAE society is geared more predominantly to non-technical education, training and employment. Technical qualifications and occupations are not rated very high by its social values and cultural traditions. The UAE only has a limited industrial tradition (e.g. trade), and lacks explicit policies to stimulate and direct technological development". See Haan (1999), p. 37, 38.

[34] As reported by 6 %, 8 %, 3 %, 8 %, 6 %, 7 % and 5 % of the all firms, chemical, food, metal, large, medium and small respondent firms respectively. This includes five firms: one small chemical, one medium chemical, one medium metal, two large chemical and one large food firms applied for patents.

process innovations, in particular, the incidence of incremental product innovation, namely, improvement of product quality amongst 59 % of all firms. It has also encouraged the incidence of new products, new organisational methods, new combinations of old output, new methods of production, and new processes.[35] It has also encouraged the incidence of great effect on increasing total sales and profits, but it has only slight effect on reducing total costs (see Table 5.6 below).[36]

5.2.3.3 Dependence on Foreign Technology

From the demand perspective, the results of the firm survey can be used to argue that the dependency on foreign technology leads firms to demand and rely heavily on low skilled workers. On the other hand, from the supply perspective, the deficient educational and training system and high supply of low skilled workers lead to low skill levels, lack of knowledge transfer and low capability to build and promote the local technology. The results of the firm survey show that this condition leads to weak technology indicators and dependence on imported technology that appears from the following: (1) The high dependence on the imported equipment, machines and techniques among all of the respondent firms (100 %); (2) The high percentage value of capital equipment to total capital equipment that has been built by foreign companies (56 %) among the respondent firms; (3) The considerable percentage value of imported capital equipment to total capital (45 %) among the respondent firms in the year 2008; (4) The short run plan for 92 % of the respondent firms is based/depends on imported technology[37]; The main reasons for the dependence on foreign technology are the lack of local technology from local suppliers, better quality and better price of foreign technology in that order.[38] Despite the high dependency on imported technologies, it is somewhat surprising that the level of technology used is below international standards amongst the majority of the respondent firms (53 %) and a high level of technology used similar to international standards is limited only within 47 % of all the respondent firms. Moreover, somewhat surprising a high degree of automation through the use of sophisticated and advanced technology is limited only within 54 % of all the respondent firms (see Table 5.5 above). The degree of automation/sophisticated use of advanced technologies is determined by both firm size and industry/activity.[39]

[35] As reported by 66 %, 44 %, 43 %, 40 % and 35 % of all respondent firms respectively.

[36] The terms "new product" and "new process" refer to new products and processes intended even just for local firms or for local markets and not necessarily for the international market.

[37] Short, medium and long run refers to next 3 years, next 3–5 years and next 10 years respectively.

[38] As reported by 71 %, 42 % and 14 % of the respondent firms respectively.

[39] These results are consistent with the findings in the UAE as indicated by Nour (2005b) and El Sabaa (1997), who notes "The adoption of different approaches in transferring technology differs according to certain criteria, such as: the scale of industry and its activity. Large size and some specific sectors, namely chemical and petrochemicals industries have better use of sophisticated advanced technologies". See El Sabaa (1997), p. 21, 22.

Table 5.6 The effects of increasing use of technology product and process innovations across firms in the Sudan, 2006–2009

Product/process innovation (2006–2009)	All firms	Firm industry				Firm size		
		Chemical	Food	Metal	Textile	Large	Medium	Small
Improvement of product quality	59 %	69 %	55 %	33 %	60 %	68 %	50 %	53 %
Production of a new method of production	40 %	44 %	30 %	42 %	60 %	49 %	25 %	47 %
Production of a new combination of old output	43 %	50 %	38 %	25 %	60 %	59 %	29 %	37 %
Production of a new process	35 %	22 %	40 %	33 %	100 %	46 %	18 %	37 %
Production of a new product	66 %	50 %	73 %	83 %	100 %	60 %	68 %	74 %
Production of new organizational method	44 %	56 %	31 %	33 %	60 %	53 %	32 %	42 %
Improvement of training within the firm	52 %	57 %	45 %	42 %	80 %	59 %	46 %	44 %
Improvement of communication within the firm	57 %	66 %	52 %	42 %	60 %	65 %	54 %	44 %
Production of more output with low cost	57 %	61 %	50 %	50 %	80 %	74 %	43 %	42 %
Production of the same output with low cost	37 %	44 %	38 %	25 %	0 %	38 %	36 %	32 %
Open of a new market	50 %	58 %	52 %	25 %	40 %	62 %	50 %	32 %
Production of a new service	28 %	33 %	21 %	17 %	60 %	35 %	25 %	21 %
Improvement of process of personal selection	38 %	40 %	38 %	25 %	60 %	50 %	21 %	39 %
Total response	83	36	30	12	5	35	28	19
Reduction in per unit material costs	21 %	22 %	19 %	29 %	25 %	24 %	14 %	28 %
Reduction in per unit energy costs	28 %	36 %	21 %	17 %	20 %	20 %	25 %	46 %
Reduction in total cost	35 %	37 %	29 %	50 %	25 %	25 %	37 %	46 %
Increase in total sales	85 %	92 %	68 %	100 %	100 %	87 %	78 %	93 %
Increase in total profit	81 %	86 %	76 %	72 %	100 %	85 %	76 %	85 %
Total response	64	28	24	7	5	26	24	14

Source: Own calculation based on the firm survey (2010)

The dependence on foreign technologies also appears from the reported information on the transfer of foreign technology that is made through different channels. For instance, Table 5.7 below illustrates that hiring foreign skills/technologically advanced workers/consultants and FDI are more common channels of technology transfer, while strategic alliances, technology licensing and joint ventures are less preferred channels. For a few firms other methods of the transfer of technologies include bringing foreign expertise, the use of Internet and making the self search as needed or according to the nature of the work. The transfer of technology, mainly the transfer of technologically advanced workers/consultants,

Table 5.7 The channels of technology transfer and their effects on firm production and development of local technology across firms in the Sudan, 2010

	All firms	Chemical	Food	Metal	Textile	Large	Medium	Small
(a) Channels of technology transfer (2005–2009)								
Hiring foreign skills/ technologically advanced workers/consultants	48 %	56 %	35 %	62 %	40 %	57 %	39 %	50 %
FDI	31 %	28 %	32 %	31 %	40 %	40 %	29 %	20 %
Strategic alliance	18 %	22 %	20 %	8 %	0 %	21 %	11 %	25 %
Licensing	15 %	19 %	13 %	8 %	20 %	18 %	21 %	5 %
Joint ventures	7 %	8 %	7 %	0 %	20 %	9 %	7 %	5 %
Others (e.g. in house technology development by hiring technologically advanced persons)								
Total response (2005–2009)	85	36	31	13	5	35	28	20
(b) The effects of technology transfer in (2005–2009)								
Enhancing firm production	96 %	95 %	96 %	100 %	100 %	100 %	97 %	90 %
Enhancing the capacity to develop the local technologies	85 %	90 %	73 %	93 %	100 %	92 %	82 %	75 %
Total response (2005–2009)	85	37	30	13	5	35	29	20
(c) The effects of technologically advanced workers in								
Enhancing firm production	91 %	95 %	90 %	85 %	100 %	91 %	93 %	90 %
Enhancing the capacity to develop the local technologies	81 %	89 %	70 %	85 %	80 %	92 %	75 %	70 %
Total response (2005–2009)	84	36	30	13	5	35	28	20

Source: Own calculation based on the firm survey (2010)

has induced important effects in enhancing firm production but has slight less effect in enhancing the capacity to develop the local technologies.[40]

[40] These results are consistent in some respects but differ in others with the findings in the UAE as indicated by Nour (2005b), El-Sabaa (1997) and Haan (1999) respectively. "The major channels of technology transfer are: joint ventures, and industrial foreign projects, the latter accounts for the first source of technology transfer. The turn-key projects are preferred channel of technology transfer in the Gulf region mainly because of the keenness to avoid defects of execution and to guarantee the maximum consistency of the project's design, lines of production, quality of the products, facilities of training, etc. But it has very limited role in transferring technology to local industry, because it is confined to their plants, with no minimum leakage allowed. Thus they contribute nothing to implant advanced technologies in the country. Technology transfer to the UAE has obviously contributed to accelerating industrial and economic growth, elevating the standard of national products both quality-wise and quantity-wise. In particular, the transfer of technology contributed to rapid growth of local industrial sector. However, a number of negative factors are still adversely affecting the transfer of technology; the technologies transferred could hardly approach its target of constituting an autonomously developing local technological base, similar to those in the Far East industrial countries. Because of: the inadequate awareness of the end target of technology transfer, the lack of a constitutional framework or comprehensive plan for transferring technology, the insufficient local base of technological data, the lack of qualified local

In the firm survey questionnaire the question on the channels of technology transfer allows for multiple answers, assuming that firms may choose more than one channel to transfer technology.[41] Our results indicate that all respondent firms are less interested in transferring technologies through formal licenses. These may not be often requested, probably because of more liberalised and open market policies that led to considerable presence of foreign capital investment and allowed for foreign and mixed ownership (cf. Table 7.1 in Chap. 7 below).[42]

manpower necessary for transferring technology and the contracts of technology transfer". See El Sabaa (1997), pp. 23–26. "The UAE is almost completely dependent on imported technologies. And without the necessary adaptations to local conditions (e.g. temperatures, effects of dust and sand winds, special cultural aspects, the country's socio-political system, etc.), even these technologies cannot be optimally applied". See Haan (1999), p. 38.

[41] Our assumption and respective findings are plausible and consistent with the results in the UAE as indicated by Nour (2005b) and the results of El-Sabaa (1997), which indicate numerous different channels of technology transfer to the UAE, such as: foreign industrial investments, offset programs, training missions, technological imports, industrialisation licenses, patents, technological products, foreign manpower and industrial consulting offices. See El Sabaa (1997), p. 26.

[42] For instance, according to Sudan Ministry of Investment, among the efforts that aim at promoting foreign investment, the government has issued the investment encouragement law, which grants encouraging exemptions to investors and indicates that the investor has the right to operate without a Sudanese partner. In addition, in order to promoting foreign investment the government has established free zones including: Suakin Free Zone and Aljaily Free Zone. The Free Zones and Free Markets Law (1994) represents the legislative framework for the establishment and operation of free zones and markets in Sudan. The rules resultant from this law represent the organisational framework for operating and managing free zones in Sudan. This law provides several advantages of investment in free zones, for instance the industrial, commercial or service investments, which are licensed to be established in the free zones enjoy several advantages. This includes the following: exemption of the projects from profits tax for a period of 15 years, renewable for an extra period dependant on the decision made by the concerned minister commencing from the 1 year period of grace which follows the year of commencement of production; salaries of expatriates working in projects within the free zones will be exempted from the personal income tax; exemption of products imported into the free zone or exported abroad from all customs fees and taxes except service fees and any other fee imposed by the board of Sudan Free Zones Company; real estate establishment inside the free zones area are exempted from all taxes and fees; invested capital and profits are transferable from Sudan to abroad through any bank licensed to operate in the free zone and exemption of products of industrial projects established in the free zones from customs fees; depending on materials used and local costs incurred in production, provided that the value be estimated by a committee assigned for this purpose by the board of Sudanese Free Zones Company. See Sudan Ministry of Investment: http://www.sudaninvest.org/English/Sudan-Invest-FreeZone.htm, accessed January 30, 2011. These results are consistent with the findings in the UAE as indicated in Nour (2005b). For instance, Fasano (2002) indicates that other than Abu Dhabi, the emirates have established free zones that allow 100 % foreign ownership of companies. These zones are particularly important in Dubai, where they have attracted a large number of foreign companies. See Fasano (2002), p.331. El Sabaa (1997) finds that the adoption of open market philosophy, supported by the existence of nine free zones in the seven emirates and the advantage of 100 % foreign ownership and control, encourages foreign industrial investors to set up their projects and to promote technology transfer to the UAE. See El Sabaa (1997), p. 23.

These findings on weak technology indicators and dependence on foreign technologies at the micro level are consistent with those at the macro level and the interaction of these findings lead to a large technological gap (see also our later discussion in Chap. 6 below). Our results in this chapter and Chap. 6 below verify the second hypothesis in Chap. 1 above that, in the short- and medium-term, Sudan is unable to rely on local technologies and remains heavily dependent on foreign technologies.

Our findings from the firm survey show that both skill and technology indicators, product and process innovations, the channels of technology transfer and their respective effects vary enormously across firms and seem determined by both firm size and industry level. For instance, Table 5.5 above shows that skill levels, technology input–output indicators (R&D and patent), the provision of training (upskilling), the dependence on imported technology, the degree of automation and the use of sophisticated and advanced technology vary across firms and increase with firm size and industry level. Moreover, the use of ICT and provision of ICT training increase with firm size, while the transfer of knowledge/external effects of schooling increase with industry level.

5.2.3.4 Shortage of Skilled Workers and Weak Adaptation of Imported Technologies

From the demand perspective, the results of the firm survey can be used to argue that a low supply of skilled workers lead firms to demand and rely heavily on low skilled workers. On the other hand, from the supply perspective, our findings show that the excessive share (supply) of low skilled workers and low supply of high skilled workers lead to some shortage of skilled workers, since firms are experiencing increasing demand for skilled workers (see Fig. 5.1 below). We find that the increasing demand for high skilled workers is related to increasing use of new technologies, which has not only raised the demand for these workers in the past few years, but has also encouraged firms to predict a future/long run increase in this demand. For instance, Fig. 5.1 identifies and compares past and future trends of the demand for skilled workers, which vary enormously across firms according to size and industry level. According to 68 % of the respondent firms, the interpretations of the predicted long run increase in the demand for skilled workers are related to change in the investment policy and project plans to increase the level of existing skills, the expansions of production (increase in existing products, new products and new production line), expansion in firms size, work, capacity, facility, activities and employment, increase in seasonal demand, increasing use of technology, modern techniques and new machines, improvement of financial conditions and the

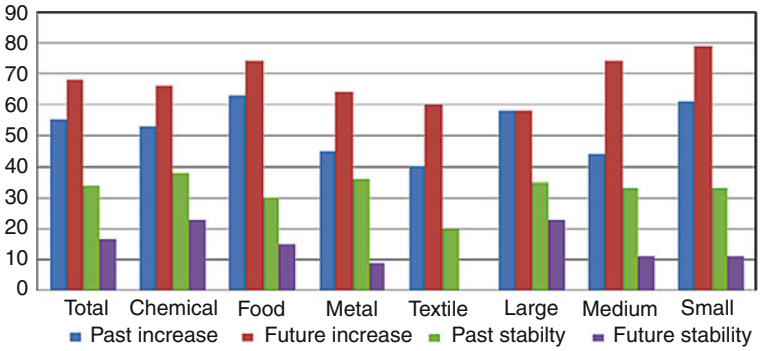

Fig. 5.1 Past and future trends (increase or stability) in the demand for skilled workers across firms (Source: Firm survey 2010)

increasing need for development and for training new workers. In addition the potential future increase is also caused by the economic reasons related to economic recession, deterioration of the industry and increased costs of industrial production, which implies the need for increasing the demand for skilled workers due to increasing motivation to reduce faults, reduce production costs, in addition to increasing industrial awareness for increasing firms efficiency by raising the quality, efficiency and productive skill of local workers. Further to potential vertical expansion, improvement in marketing opportunities and share in the local and global markets, in addition to the increasing need for specialisation and development of manufacturing industries and increasing R&D activities, implementation of new processes, output technologies, advanced control systems and purchases of new machines and equipment. Additional reasons for the rising demand are the increasing need to meet the new requirements of the market and new phase of development despite its slow occurrence, increasing adoption of international standards and enhancement of production, product improvement, diversification and varieties, competition, achieving high standard precision work and improving productivity and quality of work and demand for more specialised skills in IT. On the other hand, the major explanations for the predicted long run stability in the demand for skilled workers across 17 % of all respondent firms is related to the stability in quantity of production, sales, business, demand and market; as well as to the lack of a plan for critical expansion of product operations, stability of seasonal demand, stability of the proportion of machinery, stability of the use of technology, suitability and sufficiency of the available workers, instability of local market conditions, limitations of firms space, inability to add new machines and dependence on the development of the already available products. Moreover, from few firms' perspective the major explanations for the predicted long run decrease in the demand for

skilled workers across 15 % of all respondent firms is attributed to upgrading unskilled workers to technicians after selection by the competent authorities which imply that the remaining need for skilled workers will decrease due to increase in the qualifications and training facilities. Other factor for the potential decrease is related to the nature of the industry, for example the decrease in textile industries expected to occur as always in the textile industry it is normal to hire unskilled workers and to train them on the appropriate method of production inside the factory according to firm strategy (in that case the use of skilled workers from other factories is not preferred so as to avoid the transfer of the negative habits from other old firms due to potential conflict to new training strategy in the new firms).

We observe that the expected future rise in the demand for high skilled workers across firms is reasonable since increased use of skilled workers in the past has had significant effects. In particular, there has been increase in firm production, improvements in product quality, improvement in the level of competitiveness in the local market, utilisation of technology and faster adaptation of foreign technology.[43] Further to the introduction of networks, the increasing intensity in the use of modern new technologies, new and more sophisticated machines and machinery, updated equipment, readymade programmes applications and specialised production systems and operating machines related to industrial activities and production all imply the need to hire skilled and trained workers to work with them and that led to increased demand for skilled workers in the firm.[44] In addition, from the firms' perspective the other positive impacts of hiring skilled workers, scientists and engineers include for example, the positive impacts on those Sudanese affected by the positive performance of foreign skilled workers and experts in organisation,

[43] As indicated by 83 %, 81 %, 73 %, 73 % and 65 % of the respondent firms respectively.

[44] For instance, from the firms' perspective the increasing need for updating or upgrading the packing machine, the use of communication and information technology and computer technology in production for productive work and the use of production or work-related machines led to increase in production and all has increased the demand for skilled workers. In addition, the introduction of new production lines, the increasing use of modern packaging and covering machines, the use of modern (cut and wrap) machines, the use of modern tagged machines all require a high-technical skilled workers and all led to increase in the demand for skilled workers to facilitate work and increase production. From the firms' perspective for the previous 3 years the important factors for the impact of the use of new technology on causing constant demand for skilled workers related to the use of machines is relatively new, as the introduction of new machinery reduced the number of workers. In addition, from a few firms' perspectives, for the previous 3 years the important factors for the stability in the demand for skilled workers are due to the stability or limited increasing use of new technologies, machines and other technology-related production, that have no effect on increasing the demand for skilled workers and also because the use of the automatic packing machines motivated few firms to reduce employment. Moreover, from a few firms' perspectives, for the previous 3 years the important factors for the impact of the use of new technology on decreasing demand for skilled workers is attributed either due to the decreasing use of machines, equipment and new technology that required the use of high skilled workers for few firms, or because the limited use of new technology replaced the use of workers because the use of new technology is easy to operate in wide areas.

Table 5.8 The shortage of skilled workers and effects across firms in the Sudan, (2006–2009)

Shortage of skilled workers and effects on firm projects	All firms	Chemical	Food	Metal	Textile	Large	Medium	Small
Shortage of skilled workers	41 %	44 %	43 %	36 %	20 %	47 %	39 %	37 %
Effects of shortage of skilled workers on firm projects								
Serious delay of firm project	31 %	39 %	21 %	45 %	0 %	31 %	25 %	42 %
Abolishment/cancellation of firm project	24 %	23 %	21 %	9 %	0 %	22 %	22 %	16 %
Constrained the R&D units to adapt the imported technologies	74 %	68 %	80 %	75 %	75 %	81 %	67 %	70 %
Total response	82	36	29	12	5	32	28	20

Source: Own calculation based on the firm survey (2010)

management and administration. In addition, others positive impacts include the technical update, acquisition of experience in manufacturing of products and the introduction of new industrial activities that were not available in the past, enhancing the local maintenance, educating and learning or teaching of workers new ways to work faster and better and increase the need for continuous development.[45] On the other hand, our results from the firm survey indicate that the relative shortage of skilled workers amongst 41 % of the respondent firms leads to serious delay, slight abolishment/cancellation of project implementation and constrains the R&D units in adapting imported technologies (see Table 5.8 below).[46]

Our analysis of the shortage in skilled workers is based on the economic interpretation and definition of 'skilled shortage' as scarcity or lack of sufficient skilled workers needed, mainly because the supply of skills (as shaped by systems of education and training) has not responded fully to the rising demand across firms. However, managers may have a different interpretation and understand this as a lack of sufficient skilled workers in conjunction with wages constraints, due to limitations on their ability to pay higher wages for the high skilled workers they demand. This may constitute a limitation and appropriate caution should be exercised in interpreting our results with respect to skilled shortage, mainly because the firms answered the questionnaires do not really make it very clear how they have perceived the shortage of skilled workers and their further consequences.

[45] From the firms' perspective the negative impacts of skilled workers are reported by few firms and seems to be limited; this includes for example: the potential increasing unfair and intense competition between workers that probably caused a decline in productivity; the shortage of some skilled workers that probably caused high wages and that probably caused increase in production cost, and the increasing possibility of sagging employment because skilled workers do not continue to work for a long time in the same firm and move to work in other competing firms that probably caused increasing uncertainty and instability of production.

[46] As indicated by 31 %, 24 % and 74 % of the respondent firms respectively.

5.3 The Impacts of Skill Upgrading and Technological Upgrading: Micro–Macro Views

In view of the above findings and our results in Chap. 6 below on poor skill and technology indicators, it is therefore essential to recommend further incentives to upgrade both skill and technology levels at both micro and macro levels. From that perspective, our findings in Table 5.9 below show that at the micro level the upskilling plan amongst 54 % of the respondent firms induced significant effect in enhancing firm production, facilitating the effective utilisation and upgrading of technologies and upskilling national workers in the firm. But it has only a slight effect on reinforcing the employment for the national Sudanese workers, hiring more skilled national workers and reducing the future demand for foreign workers. Moreover, technological upgrading induced significant effects in enhancing firm production and upskilling via raising skill levels and upskilling national workers in the firms, but it has a relatively slight effect on both reinforcing firm ability to promote the local technology and hiring more skilled national workers.

At the micro level, Fig. 5.2 below compares the plans of public and private firms to depend on national skills. It predicts consistency between private and public firms that appears from the potential strong commitment to completely rely on national skills in the short, medium and long run plans in the large public firm. Moreover, our results from the firm survey and Fig. 5.2 below show that managers of private firms have a somewhat optimistic view regarding self-reliance on local skills and the potential role of both technological upgrading and upskilling in reinforcing the self-reliance strategy. For instance only 90 % of the respondent firms have supported the argument in favour of adequate availability of Sudanese national skilled workers and 94 % of the respondent firms have plans to rely on national skilled workers even in restricted fields. Amongst all the respondent firms the plan for completely depending on national skills (by 100 %) over the long run reached 74 % of the total skilled workers. From the firms' perspective since there is no difference between Sudanese workers and foreign workers in the industry, it is better to rely on Sudanese workers, so raising Sudanese workers would imply commitment to work for bringing all the benefits to contribute to their country's progress. This also implies the possibility of bringing in more skilled workers and new foreign engineers for a specific period on a temporary basis provided that they return back after achieving the work.

In strong consistency and similarity to the above view, the macro survey shows that the respondent policy makers and experts are highly optimistic regarding the interactions between technological upgrading and upskilling and their roles in reinforcing economic growth, self-reliance on local skills and restructuring the labour market at the aggregate/macro level. For instance, Table 5.10 below shows that the large majority of all respondent policy makers and experts predict strong linkages between both upgrading of technology and upskilling of labour force to reinforce each other and to have a similar large significant effect on reinforcing the self-reliance strategy and reducing the unemployment rate. The official view

Table 5.9 The effect of upskilling plan and technological upgrading across firms in the Sudan, 2010: micro view

	All firms	Chemical	Food	Metal	Textile	Large	Medium	Small
(a) Upskilling plan and its impacts, self-reliance strategy								
General upskilling plan	54 %	46 %	52 %	82 %	60 %	55 %	59 %	42 %
Self-reliance on national skills-adequate availability of national workers	90 %	89 %	93 %	91 %	80 %	81 %	96 %	94 %
Self-reliance on national skills: plan for dependence on national skill even in restricted fields	94 %	92 %	93 %	100 %	100 %	94 %	96 %	89 %
Self-reliance on national skills – in the short, medium and long run	86 %	85 %	91 %	80 %	92 %	85 %	91 %	92 %
(b)The effect of general upskilling on								
Enhancing firm production	92 %	92 %	89 %	100 %	100 %	94 %	89 %	95 %
Facilitating effective utilization and upgrading of technologies	95 %	97 %	89 %	100 %	100 %	97 %	100 %	82 %
Hiring more skilled national workers	63 %	64 %	59 %	64 %	80 %	69 %	59 %	58 %
Upskilling national workers in the firm	89 %	89 %	81 %	100 %	100 %	94 %	78 %	95 %
Reducing future demand for foreign workers	61 %	53 %	70 %	55 %	80 %	78 %	52 %	42 %
Reinforcing the employment of Sudanese national skill workers	79 %	88 %	67 %	73 %	100 %	81 %	78 %	76 %
(c) The effects of technological upgrading in:								
Enhancing firm production	99 %	100 %	100 %	92 %	100 %	100 %	96 %	100 %
Raising skill level	94 %	92 %	100 %	83 %	100 %	91 %	93 %	100 %
Reinforcing firm ability to promote the local technology	83 %	89 %	80 %	83 %	60 %	80 %	89 %	80 %
Upskilling national workers in the firm	93 %	95 %	97 %	75 %	100 %	97 %	93 %	85 %
Hiring more national skill workers	82 %	78 %	80 %	92 %	100 %	89 %	75 %	80 %
Total response	84	37	30	12	5	35	28	20

Source: Own calculation based on the firm survey (2010)

predicts that the effect of upskilling is stronger than the effect of technological upgrading in both reinforcing economic growth and solving the mismatch and imbalances in the labour market and so reducing the future demand for foreign

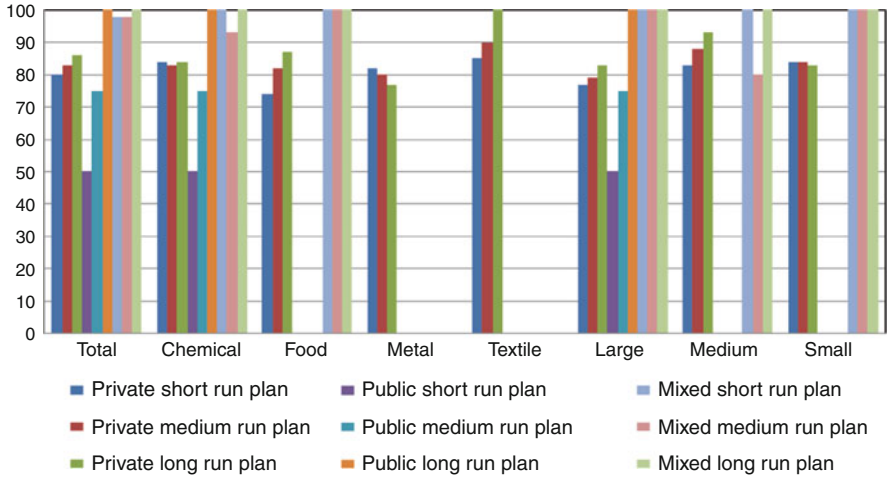

Fig. 5.2 Short, medium and long run plans of self-reliance on national skills across public, mixed and private firms in Sudan (Source: Firm survey 2010)

Table 5.10 The effects of technological upgrading, skill upgrading at the aggregate level in the Sudan 2010: macro view

The effects of technological upgrading	%	The effects of skill upgrading	%
Enhancing/accelerating upskilling	94	Enhancing/accelerating technological upgrading	100
Increasing/reinforcing economic growth	97	Increasing/reinforcing economic growth	100
Reinforcing self-reliance strategy	97	Reinforcing self-reliance strategy	94
Reducing the future demand for foreign skilled workers	92	Reducing the future demand for foreign skilled workers	94
Reducing unemployment rate	94	Reducing unemployment rate	94
Solving the mismatch problem in the labour market: by increasing the match between educational and training output to match with the needs in labour market	97	Solving the mismatch problem in the labour market: by increasing the match between educational and training output to match with the needs in labour market	100

Source: Own calculation based on the macro survey (2010)

skilled workers. Moreover, upskilling is also essential for enhancing productivity, poverty alleviation and for supporting a comprehensive plan on sustainable balanced development for Sudan.

This consistency in optimistic views at the macro and micro levels, regarding the self-reliance on local skills and the role of both technology and upskilling in reinforcing it, imply that the self-reliance strategy is probably not only a preferred government strategy, but also probably favoured by firms. This is consistent with the observation that 92 % of the respondent firms are private firms dominated by low skilled workers and probably realise the negative consequences of the lack the incentives/interests to rely on upskilling workers, mainly due to high costs of

training and high salary requirements for high skilled workers. The majority of the respondent firms probably are confronted with the challenge to initiate new plans for skill upgrading, while few of the respondent firms probably faced with the difficulties to maintain the already existing upskilling efforts. For instance, our findings from the firm survey indicate that the lack of finance to cover the high cost of training is mentioned by 69 % of all the respondent firms amongst the important factors hindering the provision of training and hence upskilling of workers across firms at the micro level (see Table 5.4 above). The respondent firms, which are costs minimisers/profits maximisers, are probably willing to continue hiring cheap ready-made skilled workers instead of incurring expensive costs by hiring, training and upskilling unskilled workers. From the firms' perspective, for a few firms skill upgrading is not important for affecting the strategies of firms because few firms are mainly focusing on private profit goals; skill upgrading is not important because the nature of the production in these few firms does not need for raising the skills and the lack of attention to spend on skill upgrading because of the expectation from the past experiences that both the workers and staff are not continuing in the work for a long time period in these few firms.

5.4 Conclusions

This chapter uses the results of the macro and firm surveys to show the interaction between the deficient educational system and the high incidence of unskilled workers and their implications.

Our results confirm a part of the second hypothesis in Chap. 1 above: that in the short- and medium-term, Sudan is unable to rely on local technologies and remain heavily dependent on foreign technologies at the micro level. The major reasons are low levels of both skill and technology due to the deficient educational system and the high incidence of unskilled workers and their implications.

On the one hand, from the demand perspective, the results of the firm survey can be used to argue that firm demand for low skilled workers, weak technology indicators and dependency on foreign technology led firms to demand and rely heavily on low skilled workers. On the other hand, from the supply perspective, our findings in Sect. 5.2 show that the deficient educational system – due to low quality of education – and the excessive share of unskilled workers has led to low skill levels, poor provision of training, serious skills mismatch, weak linkages, lack of a networks and hindered the transfer of knowledge. These factors have interacted with each other and led to poor technology indicators, poor indigenous capability to build the local technology and a heavy dependence on foreign technology. These results prove hypotheses 3.a−3.b in Chap. 1 above concerning the low skill and technology indicators at the micro–macro levels: the serious implications of the interaction between the causes and consequences of the deficient educational system and the high use of unskilled workers. We confirm hypothesis 3.c. in Chap. 1 above that the major causes of low level of local technology are low/a

lack of R&D activities due to a lack of skills, transfer of knowledge, networks and collaborations between universities and industry/firms.

Our findings show one surprising contradicting macro–micro view. Notably, contradicting optimistic–pessimistic micro and macro views regarding the incidence and success of knowledge transfer/external schooling effect implies that, probably, the transfer of knowledge/the external effects of schooling is successful within firms but is unsuccessful within society at large. This is probably because the transfer of knowledge is hindered by: low quality of education; the weak linkages and lack of networks between universities, colleges, technical and training institutes and the productive sectors; and the imbalanced structure of population and labour market. We show that the major cause behind the low transfer of knowledge/external schooling effect is low educational qualifications, and deficient educational and training systems. The major consequences are the lack of networks and collaboration between universities and firms, low R&D efforts and low technology indicators. These results prove part of the sixth hypothesis in Chap. 1 above with respect to the failure and the factors hindering the transfer of knowledge/external schooling effect at the macro level. But, on the other hand, our findings surprisingly reject a part of the sixth hypothesis in Chap. 1 above concerning the failure of the transfer of knowledge/external schooling effect at the micro level.

Our results prove part of our hypothesis 8.c. in Chap. 1 above concerning the consistency and similarity optimistic macro and micro views concerning the self-reliance on local skills, and the role of both technological upgrading and upskilling in reinforcing it, implies that the self-reliance strategy is probably not only a preferred government strategy, but probably is also one followed by private firms. Though driven by profit-maximising considerations, private firms are likely to continue in hiring cheap readymade skilled workers rather than in hiring, training and upskilling workers with expensive costs. From these observations, our results accept hypothesis 8.c. in Chap. 1 above about the consistency of upskilling and transfer of knowledge at the macro–micro levels.

References

Abdelkarim, A., & Haan, H. (2002). *Skills and training in the UAE: The need for and the dimensions of institutional intervention* (Policy Research No. 5). Dubai: Centre for Labour Market Research and Information.

Ali, A. A. (2006). *On human capital in post-conflict Sudan: Some exploratory results* (Working Paper Series No. API/WPS 0602). Kuwait: Arab Planning Institute.

Barro, R., & Lee, W. -J. (2000, April). *International data on educational attainment*: *Updates and implications*. Cambridge, MA: Department of Economics, Harvard University. Data set at International Development at Harvard University (CID). http://www.cid.harvard.edu/cidwp/pdf/042.pdf

Cowan, R., Soete, L., & Tchervonnaya, O. (2001). *Knowledge transfer and the services sector in the context of the new economy* (p. 9) (MERIT-INFONOMIC Research Memorandum No. 2001–021). Maastricht: Maastricht University.

El Sabaa, S. (1997, November) Linking technology to industrial development in the United Arab Emirates. *Trade and Industry Magazine* – Dubai, *22*(263), 16–29

Fasano, G. (2002, October 21). *With open economy and sound policies, U.A.E. has turned oil "Curse" into a blessing* (pp. 330–332). IMF survey. Washington, DC: International Monetary Fund.

Firm Survey. (2010, June). *Technological change and skill development*: *A comparative study of chemical, food, metal and textile small, medium and large scale enterprises in the Sudan*. Khartoum.

Gray, L. (1999). *Private sector training and employment: Evaluation and intervention strategies* (Specialist Report No. 4). Dubai: The Ministry of Labour and Social Affairs National Strategy for Labour Force Development and Employment Project.

Haan, H. (1999, January–March). *The UAE: Assessment of technology use in some selected sectors – Towards introduction and explaining capital and skill intensive technologies* (Specialist Report No. 6). National Human Resources Development and Employment Strategy Project. Dubai/Amsterdam.

Macro Survey. (2010). *Skill creation, human resources development and policy intervention*: *Interviews with policy makers and experts in the Sudan*. Khartoum.

Muysken, J., & Nour, S. (2006). Deficiencies in education and poor prospects for economic growth in the Gulf countries: The case of the UAE. *Journal of Development Studies*, *42*(6), 957–980. UK: Taylor and Francis Ltd.

Nour, S. (2005a, September). Science and Technology (S&T) development indicators in the Arab region: A comparative study of Arab Gulf and Mediterranean countries. *The Journal of Science, Technology and Society, 10*(2), 249–274. SAGE Publications. (Published in *UNU - INTECH Discussion Paper Series* UNU-INTECHDPS2005-3, Maastricht, the Netherlands, August 2005).

Nour, S. (2005b). *Technological change and skill development in the Arab Gulf countries*. Doctoral dissertation, Maastricht University Press, Maastricht, The Netherlands.

Sudan Central Bureau of Statistics Population Census Data. (2010b). *5th Sudan population and housing census (2008)*. Khartoum: Sudan Central Bureau of Statistics.

The Arab Human Development Report (AHDR). (2003, July). *Arab human development report (2003): Building a knowledge society*. New York/Amman/Jordan: UNDP/Regional Bureau for Arab States (RBAS)/National Press. P. 56, Table 5.1, p. 102.

The UAE University. (1994). *The UAE education assessment report*. The UAE University, Al-Ain, UA.

The UAE University. (1997). *Private sector employment and labour market in the UAE*. The UAE University, Al-Ain, UA.

UNDP. (2002). *Human development report (2002): Deepening democracy in a fragmental world*. New York/Oxford: UNDP/Oxford University Press.

UNDP. (2003). *Human development report (2003): Millennium development goals: A compact among nations to end human poverty*. New York/Oxford: UNDP/Oxford University Press.

UNDP-AHDR. (2002). *Arab human development report (2002): Creating opportunities for future generations*. Regional Bureau for Arab State (RBAS), United Nations Development Programme (UNDP), New York. Amman: Icons Printing Services.

United Nations Development Programme (UNDP). (2004). *United Nations millennium development goals in Sudan "Sudan millennium development goals interim unified report, 2004*". http://www.sd.undp.org/mdg_sudan.htm. Accessed 1 June.

Ziesemer, T. (2004). Multiple-steady-state growth models explaining twin-peak empirics? In G. Grözinger & A. van Aaken (Eds.), *Inequality: New analytical approaches* (pp. 145–168). Marburg: Metropolis-Verlag.