THE EFFECTS OF EDUCATIONAL EXPANSION ON THE ECONOMIC OUTPUT IN THE SUDAN

By

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1. INTRODUCTION

Education plays a very significant role in the socioeconomic development of any country. It discovers and improves potential talents, experiences, increases the capabilities of people and instructs students in the different scientific specialities.

In this paper, we will investigate the relationship between the educational expansion and the economic output in the Sudan, in order to find out the effects of educational expansion on the economic output from one hand, and on the skills, productivity, and upgrading of workers and technicians on the other.

In view of all these concepts and other effects of education in the Sudan, the importance of the study arises.

2. REVIEW OF LITERATURE

Most prior researches which dealt with the effects of education on the economic output have adopted the framework of marginal productivity theory.

Denison (1967) has used the relationship between schooling and earnings for individuals to estimate the contribution of educational expansion on national economic output.

Engerman (1971) stated that education is a political institution, and may be instrumental in maintaining the social and political framework necessary for increased economic growth.

Meyer (1977) advocated that the aggregation models for educational expansion do not capture possible direct effects of the educational institution on the economic output.

Ramirez and Meyer (1981) mentioned that the educational expansion may affect jobs across time rather than to contribute in changing the economic output structure.

Carnoy (1982) reported that education is part of the ideological superstructure with which the state maintains the conditions for capital expansion.

Walters and Robinson (1983) have used an aggregate production function framework to estimate directly the educational effects on the economic output.

Walters (1984) advocated that the occupational and labour market have direct effects on the educational expansion of secondary and higher educational levels.

Ching and Yanagida (1985) confirmed that education enables workers to produce more with the given level of resources, and to increase their ability for

acquiring information resulting in better management of factors of production.

Diewert and Morrison (1986) focussed their research on defining index numbers for productivity, based on production theory, and the effects of technical change on the total factor of productivity changes.

At last, Blomqvist (1986) reported that emigrants are supposed to be educated employees. Hence, the departure of each emigrant implies the loss of a certain quantity of human capital. The increase in emigration rate will lead to the decrease in return of education and cause low productivity of domestic workers and technicians.

The previous arguments concentrated on the following:

(1) Education affects the earnings of individuals rather than to contribute in changing the economic output structure.

(2) Education creates, in part, a stable political and social environment that facilitates economic development.

(3) Education has significant effects on the economic output through its interaction with both labour and capital, which in turn, will lead to the economic output growth.

(4) Education enables workers and technicians to produce more with the given resources, and to acquire new tatents and experiences for better management of production.

(5) Education is mainly affected by the occupational and labour market, and by the increase of emigration rate.

3. SPECIFICATION OF THE MODEL

The model is consisted of one structural (technical) equation. It was mainly designed to show the relationship of variables, which constitute the principal components of the Sudanese Economy and the future of these variables. The model covers the whole economy and educational expansion aggregatively in the Sudan, during the period of study from the year 1956 to the year 1984. This period has been divided into two sub-periods according to the two educational ladders applied in the Sudan. The attempt will help us to identify several economic, statistical and econometric problems which are involved in estimating the model.

To estimate the effects of educational expansion on economic growth, output is modeled as a function of labour and capital inputs and the various measures of educational expansion. We specify the relationship as the Cobb-Douglas model because it has a constant elasticity of substitution between the factors of production equal to one. In addition, the Cobb-Douglas model is a multiplicative model which is fully interactive, and the effect of any individual variable varies according to the levels of the other explanatory variables in the model.

The exponent of each term is a partial elasticity of the explanatory variable. Beside that,

the elasticities are constant over the ranges of the variables.

Our multiplicative specified model can be formulated as follows:

$$Y_t = \beta_o X_{1t}^{\beta_1} X_{2t}^{\beta_2} X_{3t-g}^{\beta_3} e^{ut} \quad \ldots\ldots\ldots\ldots \quad (3\text{-}1)$$

Where Y is the economic output, and X_1, X_2, X_3 are the labour, capital and educational expansion respectively. β_o is a constant, and β_1, β_2, β_3 are the parameters of the model for labour, capital and education respectively. (u) is the disturbance term, (g) is the number of years lagged, and (t) is the current time period.

In our analyses, no time lags are used to model the effects of labour and capital since their measures are expected to have their significant effects on the economic output in the same time period. But since our educational expansion variables are influenced by the employment policies, graduates planning and development projects, we need to measure their effects after some lagged periods. We report here the one year up to five years lagged effects, and the four years up to ten years lagged effects.

Finally, although there are many other factors that may influence the economic output and could be included in our model, many of those factors ultimately affect the economic output through the labour and capital inputs.

The estimating equation for our model can be obtained by taking the natural logarithms of both sides of equation (3-1), yielding:

$$\log_e Y_t = \log_e \beta_o + \beta_1 \log_e X_{1t} + \beta_2 \log_e X_{2t} + \beta_3 \log_e X_{3t-g} + ut \quad \ldots\ldots\ldots \quad (3\text{-}2)$$

Since the estimating equation is now linear and additive, the parameters can be estimated by the ordinary least squares (OLS) method.

The economic output represents the value of all goods and services produced in the Government and private domestic economy. This value is measured in Sudanese pounds.

As for the labour input, we have used numbers of persons per year. We have not used labour quality, wages and salaries, because their data are not available.

The investment value of capital input is measured in Sudanese pounds.

As for the educational expansion, the measure that would affect productivity, is the mean educational attainments. But the data for this measure, are not available annually, however, for an extended period of time. Therefore, we use a variety of measures of educational expansion in order to capture different dimensions for the effects of education on the economic output. We use a measure of education enrollments , because if students spend more time in school become more skilled and knowledgeable and consequently more

productive workers. Hence, an increase in educational enrollments will introduce more productive workers and technicians into the economy, and this process should eventually lead to increase in productivity and then economic growth. Also, we use a measure of educational graduates who represent successful students in General Education and degree holders in Higher Education. Graduates represent the educational system output which affects the occupational and labour market, and provides the labour force sector with skilled, efficient, qualified and productive workers and technicians. Moreover, we use a measure of educational expenditures because they represent human investments and socioeconomic development.

In addition, we have an index based on the values of the year 1971, as a base year, for the gross domestic product, capital input, and educational expenditures. The year 1971 had been considered as a base year, because it had no economic depression, no financial inflation and it had fixed prices.

4. RESULTS OF ANALYSES

We do not expect that the process we are studying was stable throughout the entire period from the year 1956 to the year 1984. This period has been divided into two sub-periods according to the two educational ladders applied in the Sudan. The first sub-period which represents the former educational ladder started from the year 1956 to the year 1970. The second sub-period which represents the latter

educational ladder has been extended from the year 1971 to the year 1984.

According to these divisions, we have interpreted the results of our regression analyses.

We report here lagged effects of educational expansion on the economic output for one year lag to five years discrete lags for both graduates and expenditures. But the educational enrollments for discrete lags of four years up to ten years were considered, for the distinct educational stages in the two historical periods, in addition to, the estimates of the educational expansion coefficients without lags, distributed lag models, and none of them show significant effects. Therefore, the results of their analyses are not reported here.

The Durbin-Watson (d) statistic shows the existence of autocorrelation in the data used first. Therefore, we have used the generalized difference equation which adjusts the data, for avoiding first-order autocorrelation, and yielding unbiased and minimum variance estimators.

Table (1) shows the effects of primary education on the economic output in the two historical periods. The primary educational graduates have significant effects in equation (3) with two years lags and equation (5) with four years lags. The primary educational expenditures have significant effects in equations (7) and (8) with one year lag and two years lags respectively during the period from the year 1956 to the year 1970.

Table (1): Estimates of the Effects of Primary Education on the Economic output in the Sudan during (1956-1984)

Measure	Eq. No.	Const.	Coefficients of:			(1) g	F	R'	d	(2) df
			Labour	Capital	Primry					
1956-1970	1	2.67	1.01 (3.27)	0.02 (0.11)	-	-	25.34	0.89	2.41	11
Graduates:	2	3.64	1.14 (4.17)	0.05 (0.11)	0.48 (1.23)	1	12.67	0.84	2.83	9
	3	3.59	1.23 (5.06)	0.03 (0.12)	0.32* (1.94)	2	11.44	0.81	2.97	8
	4	2.79	1.09 (2.85)	0.02 (0.17)	0.22 (0.45)	3	8.41	0.79	2.22	7
	5	3.32	0.84 (2.65)	0.46 (0.36)	0.79* (2.86)	4	6.15	0.75	2.81	6
	6	2.89	1.08 (2.79)	0.02 (0.97)	0.21 (0.27)	5	2.67	0.62	2.58	5
Expenditures	7	2.69	1.00 (2.72)	0.01 (0.78)	0.14 * (2.15)	1	24.53	0.86	2.06	9
	8	2.20	1.02 (4.46)	0.01 (0.85)	0.25 * (3.22)	2	15.59	0.85	2.77	8
	9	2.41	1.36 (2.93)	0.07 (0.98)	0.19 (0.89)	3	14.09	0.84	2.17	7
	10	2.18	1.68 (2.65)	0.06 (0.32)	0.17 (0.93)	4	12.39	0.82	2.69	6
	11	2.76	1.91 (2.41)	0.03 (0.96)	0.28 (1.62)	5	10.75	0.80	2.37	5
1971-1984	12	6.93	3.72 (2.55)	0.59 (2.93)	-	-	55.84	0.91	1.95	11
Graduates	13	2.80	4.45 (2.89)	0.50 (2.01)	0.46 (1.12)	1	31.90	0.90	1.55	9
	14	0.94	3.66 (2.34)	0.73 (3.11)	0.35 (0.88)	2	26.99	0.89	1.81	8
	15	0.33	4.34 (2.40)	0.70 (2.60)	0.06 (0.14)	3	13.98	0.85	2.01	7
	16	0.46	3.81 (1.98)	0.71 (2.47)	0.01* (1.99)	4	18.42	0.81	1.91	6
	17	4.01	3.89 (2.85)	0.45 (1.98)	0.86* (2.22)	5	12.63	0.88	2.98	5
Expenditures	18	0.99	2.25 (6.20)	0.53 (2.34)	0.66* (2.22)	1	32.65	0.92	1.89	9
	19	0.55	1.53 (6.72)	0.47 (1.90)	0.90* (1.95)	2	24.58	0.90	1.81	8
	20	0.65	3.15 (2.17)	0.52 (1.31)	0.48 (0.57)	3	14.73	0.86	1.86	7
	21	0.29	3.72 (2.17)	0.66 (1.31)	0.82 (0.57)	4	8.44	0.81	1.84	6
	22	1.78	3.87 (3.27)	1.06 (1.28)	0.60 (0.45)	5	5.84	0.78	1.83	5

The analyses during the period from the year 1971 to the year 1984 indicate that the primary educational graduates have significant effects on the economic output, in equation (16) with four years lags and equation (17) with five years lags, while the primary educational expenditures have significant effects in equations (18) and (19) with one year lag and two years lags respectively.

The analyses of table (2) in the period from the year 1956 to the year 1970, show that the secondary educational graduates have significant effects on the economic output, in equation (3) with two years lags and equation (6) with five years lags. The secondary educational expenditures have significant effects in equations (7) and (8) with one year lag and two years lags respectively.

The analyses in the period from the year 1971 to the year 1984 indicate that the secondary educational graduates have significant effects on the economic output in equation (13) with one year lag and equation (16) with four years lags, while the secondary educational expenditures show significant effects in equations (21) and (22) with four years lags and five years lags respectively.

Table (3) presents the effects of higher educational graduates having significant effects on the economic output in equation (3) with two years lags and equation (6) with five years lags. The higher educational expenditures show significant effects in equations (8) and (9) with two years lags and three years lags respectively, in the period from 1956 to 1970.

Table (2): Estimates of the Effects of Secondary Education on the Economic output in the Sudan during (1956-1984)

Measure	Eq. No.	Const.	Coefficient of:			(1) g	F	R^2	d	(2) df
			Labour	Capital	Second-ary					
1956-1970	1	2.67	2.67 (3.21)	1.01 (0.11)	0.02	-	-	25.34	2.41	11
Graduates:	2	2.40	0.98 (2.84)	0.16 (0.61)	0.57 (1.05)	1	6.21	0.86	2.08	9
	3	2.53	1.27 (4.20)	0.07 (1.16)	0.67 * (1.88)	2	6.45	0.84	2.23	8
	4	2.55	1.24 (2.98)	0.02 (0.15)	0.18 (0.29)	3	4.31	0.82	1.98	7
	5	2.97	0.98 (2.35)	0.03 (0.13)	0.39 (0.49)	4	3.49	0.80	2.72	6
	6	3.74	0.92 (3.19)	0.11 (0.76)	0.11 * (2.17)	5	6.65	0.80	2.20	5
Expenditures:	7	2.43	0.89 (2.98)	0.03 (0.87)	0.32* (2.01)	1	16.79	0.88	2.63	9
	8	2.06	0.87 (3.41)	0.02 (0.16)	0.27* (3.11)	2	14.86	0.85	2.48	8
	9	3.12	1.02 (2.94)	0.04 (0.42)	0.38 (1.4)	3	12.71	0.83	2.30	7
	10	2.69	0.98 (4.01)	0.05 (0.54)	0.68 (0.98)	4	11.97	0.80	1.97	6
	11	4.02	0.88 (4.13)	0.05 (0.9)	0.43 (1.08)	5	10.03	0.78	2.44	5
1971-1984	12	6.93	3.72 (2.55)	0.59 (2.93)	-	-	55.84	0.91	1.95	11
Graduates:	13	1.18	3.87 (2.51)	0.61 (2.14)	0.10* (2.27)	1	27.87	0.90	2.02	9
	14	2.57	4.61 (2.74)	0.49 (2.37)	0.38 (1.41)	2	24.25	0.90	1.75	8
	15	2.54	3.68 (2.99)	0.61 (2.77)	0.56 (1.45)	3	18.86	0.89	1.73	7
	16	3.07	4.01 (2.27)	0.52 (2.16)	0.49* (2.66)	4	13.18	0.87	1.98	6
	17	2.60	3.83 (2.52)	0.78 (2.4)	0.19 (0.44)	5	5.83	0.78	1.64	5
Expenditures:	18	0.33	3.64 (2.37)	0.58 (2.06)	0.14 (0.41)	1	28.19	0.91	2.08	9
	19	0.48	3.67 (2.42)	0.36 (1.07)	0.47 (1.16)	2	22.41	0.89	1.68	8
	20	0.27	4.32 (2.43)	0.69 (2.02)	0.12 (0.29)	3	13.98	0.86	1.99	7
	21	0.44	3.81 (2.77)	0.70 (1.13)	0.57* (1.99)	4	8.42	0.81	1.91	6
	22	0.95	5.72 (5.25)	0.02 (0.09)	1.01* (5.17)	5	44.10	0.96	2.09	5

.ble (3): Estimates of the Effects of Higher Education on the Economic output in the Sudan during (1956-1984)

Measure	Eq. No.	Const.	Coefficients of:			(1) g	F	R^2	d	(2) df
			Labour	Capital	Higher					
1956-1970	1	2.67	1.01 (3.27)	0.02 (0.11)	-	-	25.34	0.89	2.41	11
Graduates:	2	2.68	1.00	0.01	0.08	1	14.53	0.85	2.05	9
	3	4.16	0.89 (3.22)	0.01 (0.13)	0.16* (2.66)	2	12.27	0.82	1.68	8
	4	3.01	1.23 (3.56)	0.02 (0.17)	0.04 (0.56)	3	9.51	0.66	2.40	7
	5	3.20	1.03 (2.90)	0.04 (0.26)	0.07 (0.63)	4	7.86	0.64	2.76	6
	6	4.49	0.93 (3.18)	0.04 (0.31)	0.19* (2.09)	5	6.35	0.79	2.98	5
xpenditures:	7	2.98	1.08 (3.02)	0.07 (0.49)	0.31 (1.63)	1	15.08	0.87	2.07	9
	8	3.70	1.26 (5.55)	0.08 (0.78)	0.20* (2.87)	2	13.47	0.84	2.58	8
	9	3.09	1.78 (3.13)	0.13 (0.29)	0.48* (1.98)	3	11.92	0.82	1.93	7
	10	4.18	0.97 (4.01)	0.26 (0.56)	0.73 (0.84)	4	10.13	0.80	2.40	6
	11	2.14	1.69 (2.74)	0.32 (0.34)	0.43 (1.03)	5	9.53	0.76	2.87	5
1971-1984	12	6.93	3.72 (2.55)	0.59 (2.93)	-	-	55.84	0.91	1.95	11
raduates:	13	6.06	2.39 (2.51)	0.41 (1.67)	0.73 (0.13)	1	36.74	0.89	1.64	9
	14	6.95	3.36 (2.01	0.65 (2.82)	0.19 (0.02)	2	19.38	0.88	1.75	8
	15	6.54	3.96 (1.86)	0.70 (0.91)	0.14 (0.36)	3	14.20	0.86	2.63	7
	16	6.69	1.98 (2.79)	0.63 (2.66)	0.58 (0.15)	4	10.74	0.84	2.24	6
	17	6.34	4.30 (2.36)	0.76 (2.35)	0.20 (0.11)	5	5.68	0.77	2.06	5
enditures:	18	0.28	4.29 (2.72)	0.72 (3.25)	0.31 (0.84)	1	30.05	0.91	1.96	9
	19	0.52	2.42 (2.32)	0.41 (1.41)	0.36 (1.03)	2	23.46	0.89	1.84	8
	20	0.29	3.79 (2.71)	0.60 (1.77)	0.13 (0.41)	3	14.39	0.86	1.82	7
	21	0.27	4.84 (2.59)	1.15 (1.16)	0.38 (0.46)	4	10.79	0.85	1.98	6
	22	0.10	5.17 (2.23)	0.17 (0.28)	0.63 (1.52)	5	8.90	0.84	2.05	5

The analyses during the period from the year 1971 to the year 1984 indicate that the higher educational graduates and expenditures having no significant effects on the economic output from one year lag up to five years lags.

From these results, we conclude that higher educational graduates and expenditures have significant effects on the economic output in the former historical period, and they have insignificant effects in the later historical period.

The analyses of table (4) show that the general educational graduates, in the period from the year 1956 to the year 1970, having significant effects on the economic output in equation (3) with two years lags and equation (5) with four years lags. The general educational expenditures have significant effects in equations (7) and (8) with one year lag and two years lags respectively.

The general educational graduates have significant effect on the economic output in equation (16) with four years lags, while the general education expenditures show no significant effects during the period from the year 1971 to the year 1984 in the Sudan.

The analyses of table (5) show that the whole educational graduates have significant effects on the economic output, during the period from 1956 to 1970, in equation (3) with two years lags and equation (5) with four years lags. The whole educational expenditures have significant effects in equations (7) and (8) with one year lag and two years lags respectively.

Table (4): Estimates of the Effects of General Education on the Economic output in the Sudan during (1956-1984)

Measure	Eq No.	Const.	Coefficients of:			(1) q	F	R^2	d	(2) df
			Labour	Capital	General					
1956-1970	1	2.67	1.01 (3.27)	0.02 (0.11)	-	-	25.34	0.89	2.41	11
Graduates:	2	3.16	0.99 (3.71)	0.03 (0.15)	0.17 (1.08)	1	16.30	0.86	2.53	9
	3	3.35	1.00 (3.48)	0.02 (0.14)	0.22* (2.06)	2	9.91	0.83	2.49	8
	4	2.97	1.10 (3.32)	0.04 (0.29)	0.08 (0.79)	3	8.81	0.80	2.50	7
	5	3.37	1.06 (4.10)	0.04 (0.39)	0.16* (2.24)	4	7.69	0.79	2.58	6
	6	2.40	1.08 (2.76)	0.05 (0.28)	0.03 (0.23)	5	2.66	0.61	2.35	5
Expenditures:	7.	3.02	1.04 (3.14)	0.05 (0.18)	0.28* (2.18)	1	15.33	0.86	2.43	9
	8	2.26	1.01 (3.91)	0.03 (0.31)	0.25* (2.64)	2	12.19	0.82	2.81	8
	9	2.80	0.98 (2.82)	0.01 (0.81)	0.21 (0.84)	3	10.64	0.80	2.92	7
	10	4.12	1.02 (3.41)	0.03 (0.36)	0.86 (0.79)	4	8.92	0.78	2.83	6
	11	2.96	1.03 (4.02)	0.04 (0.86)	0.26 (1.03)	5	7.32	0.76	2.13	5
1971-1984	12	6.93	3.72 (2.55)	0.59 (2.93)	-	-	55.84	0.91	1.95	11
Graduates:	13	6.41	3.84 (2.50)	0.58 (1.35)	0.15 (0.22)	1	27.79	0.90	0.90	9
	14	6.32	3.85 (2.73)	0.60 (1.93)	0.15 (0.32)	2	25.16	0.16	0.87	8
	15	6.12	4.50 (2.61)	0.72 (2.64)	0.90 (0.17)	3	24.05	0.86	2.00	7
	16	6.65	3.46 (2.53)	0. 80 (0.31)	1.25* (2.95)	4	23.49	0.92	2.58	6
	17	4.58	3.58 (2.66)	0.29 (0.79)	0.94 (1.43)	5	18.51	0.84	2.81	5
Expenditures:	18	0.49	2.51 (2.51)	0.67 (1.68)	0.84 (1.63)	1	36.74	0.92	1.96	9
	19	0.30	3.67 (2.69)	0.59 (1.62)	0.14 (0.24)	2	19.04	0.88	1.89	8
	20	0.22	4.45 (2.59)	1.03 (1.65)	0.48 (0.56)	3	14.73	0.86	2.07	7
	21	0.44	4.32 (2.82)	0.19 (0.37)	0.79 (1.36)	4	11.66	0.85	1.80	6
	22	0.06	3.17 (2.35)	0.43 (1.24)	0.58 (1.12)	5	7.35	0.81	2.33	5

Table (5): Estimates of the Effects of Whole Education on the Economic output in the Sudan during (1956-1984)

Measure	Eq. No.	Const.	Coefficients of:			(1) g	F	R^2	d	(2) df
			Labour	Capital	Whole					
1956-1970	1	2.67	1.01 (3.27)	0.02 (0.11)	-	-	25.34	0.89	2.41	11
Graduates:	2	2.92	0.96 (2.04)	0.01 (0.04)	0.04 (0.29)	1	16.59	0.86	1.98	9
	3	3.69	1.04 (4.23)	0.09 (0.78)	0.28* (1.99)	2	13.05	0.83	2.52	8
	4	2.95	1.10 (3.31)	0.04 (0.27)	0.71 (0.73)	3	9.73	0.81	2.48	7
	5	3.36	1.07 (4.14)	0.04 (0.39)	0.16* (2.21)	4	7.58	0.79	2.73	6
	6	2.66	1.06 (3.70)	0.03 (0.14)	0.01 (0.07)	5	5.61	0.61	2.48	5
Expenditures:	7	3.02	1.02 (2.42)	0.02 (0.51)	0.32* (2.03)	1	12.34	0.83	2.63	9
	8	2.34	1.04 (3.87)	0.04 (0.37)	0.23* (2.38)	2	10.89	0.80	2.59	8
	9	2.64	0.97 (2.81)	0.01 (0.23)	0.41 (1.04)	3	8.46	0.78	1.97	7
	10	2.89	1.03 (3.06	0.08 (0.29)	0.56 (0.98)	4	7.79	0.76	2.42	6
	11	3.63	1.02 (2.74)	0.06 (0.82)	0.37 (0.47)	5	5.86	0.74	2.83	5
1971-1984	12	6.93	3.72 (2.55)	0.59 (2.93)	-	-	55.84	0.91	1. 59	11
Graduates:	13	2.72	3.77 (2.54)	0.45 (1.04)	0.40 (0.64)	1	28.74	0.90	1.87	9
	14	2.59	3.74 (2.37)	0.47 (1.43)	0.40 (0.78)	2	20.56	0.88	1.82	8
	15	2.95	4.11 (2.66)	0.66 (2.01)	0.13 (0.21)	3	14.09	0.86	2.02	7
	16	6.86	3.43 (2.34)	0.02 (0.53)	1.26* (2.60)	4	20.14	0.91	2.49	6
	17	5.19	3.89 (2.81)	0.20 (0.48)	1.01 (1.46)	5	8.61	0.83	2.83	5
Expenditures:	18	0.49	2.58 (2.46)	0.47 (1.79)	0.53 (1.12)	1	31.91	0.92	1.92	9
	19	0.24	1.84 (2.63)	0.29 (0.99)	0.90 (1.05)	2	26.62	0.91	1.69	8
	20	0.59	4.68 (3.91)	0.63 (2.71)	0.86 (1.04)	3	19.96	0.89	1.70	7
	21	0.87	4.18 (2.54)	0.85 (1.18)	0.23 (0.20)	4	12.50	0.86	1.99	6
	22	0.29	4.47 (2.13)	0.27 (0.39)	1.27 (1.51)	5	8.83	0.84	1.86	5

The whole educational graduates have significant effect on the economic output in equation (16) with four years lags, while the whole educational expenditures have insignificant effects on the economic output during the period from 1971 to 1984.

From the five previous tables, we conclude that the distinct educational, levels have different significant effects on the economic output according to the number of years lagged. Also, the value of the F-statistic and the value of the coefficient of determination (R^2), had been reduced according to the reduction in the number of degrees of freedom, when lags were included to education.

4-1. The Effects of Education in Earlier Period (1956-1970):

Table (6) presents the estimates of the effects of educational graduates and expenditures from one year lag to five years lags. Equation (1) is the basic production function, with labour and capital. The estimates of capital coefficients are not significant. The estimates of labour and capital are fairly stable with the addition of the graduate variables in equations (2) to (6).

We note, however, the labour and educational graduates have significant positive effects, while the capital input has no significant effect on the economic output.

The effects of educational expenditures for the equations (7) to (11) are similar to those of the graduates. We see that there are no significant effects of capital while the labour and educational expenditures are statistically significant.

Table (6) : Estimates of the Effects of Education on the Economic output in the Sudan during the period (1956-1970).

Type of Education and measure	Eq. No.	Constant	Coefficients of: Labour	Capital	Education	(l) g	F	R^2	d
Labour and Capital	1	2.6741	1.0127	0.0166	-	-	25.34	0.89	2.41
			(3.27)	(0.11)					
Graduates:									
Primary	2	3.3249	0.8350	0.4649	0.7889*	4	6.15	0.75	2.81
			(2.65)	(0.36)	(2.86)				
Secondary	3	3.7360	0.9179	0.1108	0.1107*	5	6.65	0.80	2.20
			(3.19)	(0.76)	(2.17)				
Higher	4	4.1564	0.8940	0.0139	0.1629*	2	12.27	0.82	1.68
			(3.22)	(0.13)	(2.66)				
General	5	3.3701	1.0588	0.0436	0.1642*	4	7.69	0.79	2.58
			(4.10)	(0.39)	(2.24)				
Whole	6	3.3564	1.0731	0.0442	0.1631*	4	7.58	0.79	2.73
			(4.14)	(0.39)	(2.21)				
Expenditures:									
Primary	7	2.2046	1.0174	0.0082	0.2472*	2	15.59	0.85	2.77
			(4.46)	(0.85)	(3.22)				
Secondary	8	2.0598	0.8698	0.0155	0.2669*	2	14.86	0.85	2.48
			(3.41)	(0.16)	(3.11)				
Higher	9	3.7046	1.2582	0.0765	0.1979*	2	13.47	0.84	2.58
			(5.55)	(0.78)	(2.87)				
General	10	2.2555	1.0087	0.0339	0.2532*	2	12.19	0.82	2.81
			(3.91	(0.31)	(2.64)				
Whole	11	2.3454	1.0366	0.0441	0.2329*	2	10.89	0.80	2.59
			(3.87)	(0.37)	(2.38)				

(.) : The values in parantheses show the t-statistics.

* : Indicates that education has significant effects on the economic output.

g : Lags in years for education.

4-2. The Effects of Education in the Later Period (1971-1984):

The estimated effects of educational expansion on the economic output in the Sudan, in the later period, are given in table (7). Equation (1) is the basic production function, with both labour and capital having their significant and positive effects as expected. The estimates of labour are fairly stable and significant in equations (2) to (6) with the addition of the graduate variables, while the capital coefficients have significant effects in equation (2) to equation (4), and has no significant effects in both equations (5) and (6).

The educational graduate variables have significant effects in equations (2) to (6), except equation (4), which shows that Higher Educational Graduates have no sigrificant effect on the economic output.

The educational expenditures have significant effects in both equations (7) and (8), while equations (9), (10) and (11) show that there are no significant effects on the economic output. The labour input has significant positive effects in equations (7) to (11), while the capital input has significant effect in equation (7) only.

5. CONCLUSION

In order to sum up our results, we ensure that our research analyses, the effects of educational expansion on the economic output in the Sudan from 1956 to 1984, is a departure from the individual level inferences often used in prior researches. We have used an aggregate production function framework to estimate directly educational effects on the economic output by using aggregate time series analysis.

Table (7): Estimates of the Effects of Education on the Economic Output in the Sudan during the Period (1971-1984)

Type of Education and measure	Eq. No.	Constant	Coefficients of: Labour	Capital	Education	(1) g	F	R^2	d
Labour and Capital	1	6.9292	3.7227 (2.55)	0.5867 (2.93)	-	-	55.84	0.91	1.95
Graduates:									
Primary	2	4.0091	3.8947 (2.85)	0.4517 (1.98)	0.8636* (2.22)	5	12.63	0.88	2.98
Secondary	3	3.0709	4.0149 (2.27)	0.5182 (2.16)	0.4916* (2.66)	4	13.18	0.87	1.98
Higher	4	6.5388	3.9582 (1.86)	0.6967 (0.91)	0.1370 (0.36)	3	14.20	0.86	2.63
General	5	6.6467	3.4579 (2.53)	0.0817 (0.31)	1.2463* (2.95)	4	23.49	0.92	2.58
Whole	6	6.8610	3.4335 (2.34)	0.0168 (0.53)	1.2567* (2.60)	4	20.14	0.91	2.49
Expenditures:									
Primary	7	0.9960	2.2549 (6.20)	0.5312 (2.34)	0.6578* (2.22)	1	32.65	0.92	1.89
Secondary	8	0.9494	5.7161 (5.25)	0.0167 (0.09)	1.0084* (5.17)	5	44.10	0.96	2.09
Higher	9	0.1005	5.1754 (2.23)	0.1719 (0.28)	0.6310 (1.52)	5	8.90	0.84	2.05
General	10	0.2170	4.4508 (2.59)	1.0287 (1.65)	0.4766 (0.56)	3	14.73	0.86	2.07
Whole	11	0.2896	4.4740 (2.13)	0.2694 (0.39)	1.2714 (1.51)	5	8.83	0.84	1.86

( ) : The values in parantheses show the t-statistics.

* : Indicates that education has significant effects on the economic output.

(1) g : Lags in years for education.

(2) df: Number of degrees of freedom of errors.

In this section, we are going to summarize the findings of our results of analyses in concluding remarks, to be submitted, to the educational planners and the labour force authoritie

According to our model regression analysis, the estimates of its parameters and statistical tests, during the period of study, we report the following results:

1. Educational expansion has significant effects on the economic output in the Sudan, especially, at the primary and secondary levels of schooling in the two historical periods. We have found, however, significant effects of educational expansion for the post-secondary level in the first historical period only.

2. Educational expansion has positive interactions and interrelated effects on both labour and capital when it has been added to the model.

3. Educational expansion has a contribution ratio, as a factor share, in the economic output in the Sudan together with labour and capital inputs. These factor shares are 73%, 3% and 24% for labour, capital and educational expansion respectively, using graduate and expenditure measures.

4. The compatibility of our model to the sample size used for prediction has been tested by Chi-sguare statistic (χ^2). The computed values of χ^2, using graduates and expenditures for the period from 1975 to 1984, found to be less than the tabulated values of χ^2, then the difference is insignificant.

From these results, we conclude that our model is highly predictive.

5. In order to increase the economic output, graduates and expenditures have to be increased in the distinct educational stages, by increasing the numbers of schools, teachers, other physical facilities, educational current and investment budgets.

Finally, we report here that, in order to maximize the economic output in the Sudan, the human capital has to be developed and improved from one hand, and the educational institutions should equip and qualify their students according to the occupational and labour market demand on the other.

6. REFERENCES

1. Althusser, L. "Ideology and Ideological State" Apparatus, Lenin and Philosophy and Other Essays, Londe, New Left Books, 1971, pp. (121-173).

2. Bendix, R., "Nation-Building and Citizenship", New York, Wiley, 1964.

3. Bridge, J., "Applied econometrics", Amesterdam, Holland, 1971.

4. Carnoy, M., "Education, Economy and the State", Routledge and Kegan Paul, Michael, W. Apple, London, 1982, pp. (79-126).

5. Ching, C. and Yanagida, J. "Production Economics", New Brunswick (U.S.A.), Oxford (U.K.), 1985.

6. Dale, R., "Education and the Capitalist State", Michael W. Apple, Routledge and Kegan Paul, London, 1982, pp. (127-160).

7. Denison, E., "The Sources of Economic States and the Alternatives", New York, 1982.

8. Engerman,S., "Human Capital, Education, and Economic Growth", American Economic History, Harper and Row, New York, 1971.

9. Faaland, J. and ILO Mission, "Growth, Employment, and Equity: A Comprehensive Strategy for the Sudan", ILO Publications, Geneva,1976.

10. Hebden, J., "Applications of Econometrics" Oxford, 1983.

11. Iyer, R., "Unesco Educational Simulation Model", Bankok, 1975.

12. Johnston, J., "Econometric Methods", 3rd Edition, McGraw-Hill, Tokyo, Japan, 1984.

13. Meyer, J., "The Effects of Education as an Institution", American Journal of Sociology, Number 83, 1977, pp.(55-77).

14. Ramirez, F., and Meyer, J., "Comparative Education: Synthesis and Agenda", The State of Sociology, Beverly Hills, 1981, pp.(215-238).

15. Scultz, T., "Investment in Human Capital", New York, Free Press, 1971.

16. Walters, P. and Robinson, R., "Educational Expansion and Economic Output in the United States", American Sociological Review, Number 4, 1983, pp.(480-493).