

The Private Rate of Return to Schooling: Evidence from Eritrea

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Abstract

The extent of links between education and earnings is a determining factor in making decisions about investment in education. The purpose of this study is to estimate the private rate of return to education in Eritrea using sample data from employees working in public and private sector of the economy. The main result obtained with the help of extended Mincerian earnings function indicates the financially rewarding effect of education. It is also found that the rates of return to education increase with the increase in levels of education. The findings imply a need for expanding access to education and the possibility of sharing the cost burden of education, especially at tertiary level of education.

Introduction

Education is often considered as the single most important determinant of a person's economic and social achievement. Education provides both direct and indirect benefits for the individual who receives the education and the society with which this individual connects. At a national level, the effect of investment in human capital on productivity, technology and growth has long been stressed by economists. For poor countries like Eritrea education plays a key role in poverty alleviation.

Recognizing these benefits, the government of Eritrea has been making an effort to increase access to education, thereby improving children's school participation. Between the academic year 1990/91 and 2001/02, the number of elementary, middle and secondary schools owned by the government increased 4.5, 3.5 and 2.3 times respectively. Within this period of time, the number of students enrolled in government schools increased 4.0 times in elementary, 3.5 times in middle and 2.1 times in secondary level of education. This is good progress considering that Eritrea is a newly independent country. However, research on the economic benefit that arises from acquiring education is non-existent in the country. There is no documented information on the incentives for human capital accumulation. There is no research on whether acquisition of education provides individuals enough incentive to invest.

The focus of this paper is on private returns to education for formal sector workers only and thus it should be interpreted as conditional on having a wage/salary earnings job in the formal sector of the economy. Empirical evidences of the return to investment in education can be used as a reliable guide to design educational policy in

Eritrea, mainly concerning the efficient allocation of scarce resources between the different levels of education.

The structure of the paper is as follows. Section two provides review of literature on the economic theory of education and earnings. Section three provides basic facts about education in Eritrea. Section four focuses on method of estimating the model. The database is described in section five. Section six offers the estimated results of regression analysis. Finally, section seven presents conclusion, implication and recommendation.

Review of Literature

Returns to years of education in different countries are heavily influenced by the supply of workers with different amount of education (Schultz, 1999). In turn the supply of workers with different levels of education is influenced by government policy choices. The concept of human capital refers to the fact that human beings invest in themselves to raise their future income by increasing their lifetime earnings. Given that people freely choose to invest, perfect capital markets exist and mobility of labour is not hindered, the human capital framework assumes that wage differentials reflect returns to investment in human capital (Terrell, 1989). Though it might not be true for each and every individual and the correlation is far from perfect, it is true for the average person that the amount of education an individual possesses is positively correlated with personal earnings. The first model of this kind that was developed by Mincer (1958, 1970, 1974) assumes a complete absence of environmental inequalities and takes the length of schooling as a basic source of heterogeneity of labour incomes.

The theory assumes that in the absence of serious market imperfections earnings are equivalent to worker's marginal product and that the greater the worker's stock of human capital the greater is his/her productivity and hence earnings (Shah, 1986).

There are several estimates of the returns to schooling for wage workers that do not consider the selection bias issue as a serious limitation (van der Gaag & Vijverberg, 1989; Griffin & Edwards, 1993; Vieira, 1999; Duraisamy, 2002; Trostel, Walker, & Woolley, 2002; Bjorklund & Kjellstrom, 2002; Li, 2003; Moock, Patrinos, & Venkataraman, 2003; Hawley, 2004; Martins & Pereira, 2004; Silles, 2005; Yang, 2005). Reasons for excluding the self-employed or unpaid family workers are non-availability of data, which is the case in this paper, low proportion of employees outside the wage employment, the presumption that a failure to adjust for selection bias has little or no impact on estimates of schooling returns, as written by Dearden (1998), and intentional focus on the wage labour force, particularly on the formal sector employees.

Based on a Mincerian earnings function method a number of studies on education and earnings in Africa found that the private rate of return to an additional year of schooling was quite high. For countries in Africa it is commonly asserted that the private returns to investment in education are highest at primary level and thus primary education should be the number one investment priority (Psacharopoulos, 1985, 1994). However, a number of recent studies on education in Africa have found that the private rates of return

not only are relatively lower than suggested in the conventional pattern but also increase with the level of education. Challenging the view expressed by Psacharopoulos, Bennell (1996) argues that the conventional rate of return on education patterns almost certainly do not prevail in Sub-Saharan Africa (SSA) under current labor market conditions. Surveys of estimates for Botswana by Siphambe (2000), for Cameroon, Ghana, Kenya, Zambia and Zimbabwe by Bigsten, Isaksson, Soderbom, Collier, Zeufack, Dercon et al. (2000), for South Africa by Mwabu & Schultz (2000), for Ghana by Jones (2001), for Kenya by Wambugu (2001), for Nigeria by Armolaran (2002), for Burkina Faso, Cote d'Ivoire, Ghana, Kenya, Nigeria and South Africa by Schultz (2003), for Kenya and Tanzania by Soderbom, Teal, Wambugu, & Kahyarara (2004), for Burkina Faso by Kazianga (2004), for Cameroon by Amin & Awung (2005), and for Rwanda by Lassibille & Tan (2005) show that returns to education rise with educational attainment.

The links between education and earnings are of deciding factor to decisions about the efficient allocation of resources. However, due to omitted variables, interpretation of such estimates is usually qualified by comment on possible upward biases. Behrman & Deolalikar's (1993) criticism is that the studies which typically attribute the association between years of schooling and wages do not include a host of other factors that plausibly may be correlated with years of schooling that affect wages.

Moll (1998) stressed the point that years of schooling, as an input measure of human capital, may influence the wage if it captures other elements. Topel (1991) has concluded that, other things remaining constant, 10 years of job tenure raise the wage of the typical worker by over 25%. The strong positive relationship between tenure and wage rates was also assessed by Altonji & Williams (1997). The strong long term employer-employee relationship conditioned by promotion provisions was mentioned by Theodossiou (1996) to specify the significant effect of tenure on wages. Firms, in order to discourage labour turnover and inter-firm mobility, establish long-term employment relationships with their most highly valued employees. Thus, employees with longer tenure with their current employer have higher earnings than other employees with the same total work experience but relatively shorter tenure.

Opposing the significant effect of tenure on wages, Altonji & Shakotko (1987) argued that the partial effect of tenure on wages was small because the strong relationship between tenure and wages was due primarily to heterogeneity bias across individuals and across job matches. Similarly, Jacobson, Lalonde, & Sullivan (1993) have found that high tenure workers separating from distressed firms suffer long term losses averaging 25% per year. Re-examining the wage-tenure relationship, Williams (1991) has found that tenure increases wages only in the first several years of employment.

The occupation in which a worker is employed has an important effect on the level of his/her wages and salaries. Disparities in earnings between different occupations have been often noticed in less developed countries than in developed countries (Kothari, 1970). Earnings differentials would not indicate compensating differentials but rather signal enlarged inequalities because some individuals not only are denied the possibility of working at high and satisfied job levels but also have to accept lower wages (Hartog,

1986). For that reason the reward for education differs substantially by the job level at which an individual is occupied. The argument against the above assertion is that occupation and jobs are irrelevant entities in explaining earnings differentials because market forces tend to equate rates of return throughout and thus equilibrium situation will exist in the long-run.

It is widely accepted that family background affects education by influencing the amount of education individuals obtain. Family background and influences are more important in determining education and earnings (Krishnan, 1996). Altonji & Dunn (1996) explored the possibility that the education slopes of wage equations are influenced by family background as measured by father's and mother's education. Beach & Finne (1988) have also researched the positive effects of parents' education on son's educational attainment, which this ends-up increasing importance of indirect and total effects of the family background variables on earnings. Controlling the workers' own schooling and the schooling of other relatives, Lam & Schoeni (1993) have discovered the relationship between having a father with a university education and getting a 20% wage advantage when compared with illiterate father, and a 9% wage advantage when compared to a father with 4 years of schooling. Sahn & Alderman (1988) have pointed out that the wage offer in developing countries is influenced by other genetic and environmental influences captured in the wage of one's father. Thus, the significant impact of family background on earnings could mean that family background determines the quality of education and learning environment at home (as educated parents can improve the educational opportunities of their children through their absorption of attitudes and acquisition of human capital) or would indicate that individuals from a better family background are able to get the better jobs through family connections and influences.

The partial cause of earnings differentials may also be sector of employment. Mann & Kapoor (1988) have explored that, on the average, public sector workers are paid much higher wages than the private and joint sector workers. Rees & Shah (1995) have reasoned that the private wage determination is subject to profit constraint, whereas the public sector wage determination is subject to an ultimate political constraint. Thus, wages in the public sector are higher than in the private sector. Pritchett (1999) highlighted the situation in which governments are taking resources away from non-governmental activity in the form of taxes so as to pay additional workers whose marginal product in the public sector is very low but are paid much higher wages than workers in the private sector.

On the whole, even if it is widely accepted that level of schooling is positively correlated with level of earnings, it is not acceptable to understate the effects of other influential factors on earnings. This implies that the basic Mincerian approach to estimate return to education should be extended.

Education in Eritrea

Before the Italian domination, education in Eritrea had been divided into two broad categories, namely local and religious. While local education was composed of training children in practical and productive skills, religious education for small numbers of children was provided by Christian and Muslim clerical hierarchies.

During the Italian colonial period (1890-1941), education in Eritrea was not widely available for Eritreans. Even if for Italians living in Eritrea schooling was compulsory to age 16, the highest level allowed for an Eritrean to reach was only fourth grade. After almost sixty years of Italian colonization in Eritrea only a small, predominately male segment of the population could claim rudimentary schooling (Stefanos, 1997).

Unlike Italians, the British were less strict about educational opportunities. Under the British Administration (1941-1952) Eritreans were allowed to work in lower administrative positions and to form political parties and trade unions, and thus the number of elementary schools was increased and new middle and secondary schools were opened (Rena, 2003). During this time, not only education was expanded in villages and towns but also textbooks, in both local and foreign languages, became available. As a result, the desire for education increased very rapidly.

Educational facilities in Eritrea were far better than in Ethiopia at the time when Eritrea passed from British Administration to the federal arrangement in 1953. However, the Ethiopian government began to weaken Eritrean education. Eritrean languages were banned and substituted by the Ethiopian language and all education decisions began to be made in the capital of Ethiopia (Gottesman, 2002). Besides, remuneration to Ethiopian teachers was more than Eritrean counterparts. The strikes by Eritrean teachers for more pay didn't bring about a positive change; to the contrary, a number of Eritrean teachers were arrested or transferred to Ethiopia (Gottesman, 2002). In consequence of this, the quality of education in Eritrea further deteriorated.

During the Ethiopian socialist regime (1974-1991) educated Eritreans were a particular target of harassment and violence. Intolerably, many Eritrean teachers and students began to join the armed struggle for independence; and this made worse the already deteriorated quality of education in Eritrea. During the war, the Eritrean People's Liberation Front (EPLF), by establishing educational programs, facilitated the provision of education in regions under its control. Education was seen by EPLF leaders as integral to the national liberation struggle. Educational efforts, which primarily focused on the freedom fighters, diversified with the provision of education to orphans, refugees, children of fighters and those who had run away to join the front but were too young to fight. In addition to this, adult literacy campaign and regular schools were maintained in liberated areas.

After the 1991 liberation and the 1993 vote for independence, a macro policy document that incorporated educational policy was designed by the Government of the

State of Eritrea (GSE). Eritrea's main educational goals for the next years will emphasize the importance of early childhood education care and development, formal basic education, and adult literacy (MOE, 1999). To achieve these general objectives and feature goals, various policies have been designed to: make universal primary education (up to seven years) available to all; increase enrolments at the secondary, technical and vocational schools (to meet skilled manpower requirement of both public and private sector); promote education through formal and informal channels (to achieve higher literacy rate and enhance competence); expand selective tertiary education through the utilization of training opportunities (to meet manpower requirement of the country); expand technical and vocational training (to enhance the job adaptability and retaining potential of the students); promote equal educational opportunity in terms of access, equity, relevance and continuity of education; make elementary education accessible to children in their mother tongue; promote and encourage pre-primary education in all zones; provide a minimum of three years of adult education; encourage education through private sector; and to provide middle and secondary school in English (GSE, 1994; MOE, 2000a). In adopting these policies, the government, the community and the direct beneficiaries will be made to contribute varying amounts towards financing costs of education.

In Eritrea, schools are administered either by the Ministry of Education (MOE) or by other institutions (MOE, 2000b). Those schools that are administered by the MOE are called Government schools, whereas those schools that are managed by institutions other than the MOE are called Non-government schools. Educational provision in Eritrea begins at pre-school level and ends at tertiary education. Children in the age group 5-6 are expected to enroll in pre-primary school and the length of time in this level of education is two years. The elementary level of education covers 5 years and a theoretical age range of 7 to 11. As a second part of compulsory schooling, the middle level takes two years (grade 6 and 7) to complete and includes students within a theoretical age category of 12 to 13. In this level of education, the medium of instruction is English. The time during which secondary level lasts is four years (8-11) and a theoretical age range of 14-17. Similar to middle level, the medium of instruction at this level of education is English.

Since independence education in Eritrea has expanded enormously. Between 1990/91 and 2001/02, the number of schools in elementary, middle and secondary levels increased by around 225%, 158%, and 132% respectively, and the number of students enrolled increased by around 203%, 194%, and 118% respectively (see Table 1). Though it is still low in comparison with other low income countries, Eritrea reached 66% Gross Enrolment Ratio (GER) in primary level of education in 2004 (see Table 2). But, despite improvements, access to education is still limited. There exists gender and regional disparities in education.

Table 1

Eritrea: Schools and enrolment by level of education and ownership

Level	1990/91 ^a				2001/02			
	Schools		Enrolment		Schools		Enrolment	
	Total	Gov ^b	Total	Gov	Total	Gov	Total	Gov
Elementary	214	137	109087	74878	695	610	330278	303009
Middle	59	37	27556	21671	152	130	80882	75124
Secondary	19	16	32141	31519	44	36	70183	67511

^a 1990/91 indicates the last pre-liberation academic year in Eritrea.^b Gov is an abbreviation for government.

Source: MOE, 2004

Table 2

Gross Enrolment Ratio (GER)^a by level of education

Level	Eritrea	Low-income countries
Pre-primary	7	27
Primary ^b	66	100
Secondary	28	46
Tertiary	1	9

^a GER is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.^b Primary level covers grade 1 to 7.

Source: World Bank, 2006

Empirical Model

The specification of the econometric model of the private rates of return to education can be based on economic theory and on any available information relating to the phenomenon being studied. Hence, on the basis of information on the economic theory of education and earnings, we may write the basic earnings function in the general form:

$$E = (S, EX),$$

where E is wage and salary earnings, S indicates years of schooling and EX is number of years of work experience.

The basic earnings function method is due to Mincer and involves the fitting of a semi-log ordinary least squares regression using the natural logarithmic of earnings as a dependent variable and years of schooling and potential years of labour market experience and its square as explanatory variables. In an equation form:

$$\ln E = b_0 + b_1 S + b_2 EX + b_3 EXSQ + u,$$

where $\ln E$ stands for logarithm of monthly earnings, S for years of educational attainment, EX for number of years of work experience, and u for measurement error. In this equation, number of years of work experience is squared ($EXSQ$) to capture the declining effects of experience as individual ages.

The above model has been widely criticized for its shortcomings. First, using this method one cannot estimate returns to education at different levels because the

coefficient on years of schooling can only be interpreted as the average private rate of return to one additional year of education, regardless of the educational level in which this year of school refers to. Second, a person's earnings can also be determined by factors other than years of schooling and years of labour market experience. Because of these points, the extended earnings function method, which converts the continuous years of schooling variables into a series of dummy variables and includes other additional variables, is found to be the best way of estimating returns to education. Thus, the earnings function becomes:

$$\ln E = (ED_i, EX, EXSQ, \sum X_n),$$

where ED_i is a series of educational dummy variables (that allows for wage differences among four levels of education) and $\sum X_n$ is a vector of other wage determining characteristics. The estimated regression equation for the extended version of Mincer's model can be stated as:

$$\ln E = b_0 + b_1 ED_i + b_2 EX + b_3 EXSQ + b_4 OCC_i + b_5 \ln MHW + b_6 TE + b_7 FE + b_8 ME + b_9 GE + b_{10} SE + u,$$

where OCC_i is a dummy variable indicating occupation, $\ln MHW$ is logarithm of hours worked per month, TE is number of years of tenure in the current job, FE is father's level of education, ME is mother's level of education, GE is a dummy variable indicating gender and SE is a dummy variable signifying sector of employment.¹

The above earnings equation is developed in the context of wage and salary income in the formal sector of the economy and thus the returns to education estimated here are for formal sector workers only and give no explanation of the rates of return in other sectors.

Data and Descriptive Analysis

The data is drawn from 363 employees (salary and/or wage earners) working in public and private sectors of the Eritrean economy. The sample does not include the self-employed because (besides lack of data) it is difficult to separate their wages from profit income.² In addition, unregulated wage workers are excluded, since data were not available.³ Data collection was carried out by the author during 2001-2002. The population was first divided into two groups, namely public and private sector employees; then a sample of 212 public sector employees and a sample of 151 private sector employees were drawn randomly and proportionately. Again, a simultaneous proportional stratification for a variable gender was done with separate simple random sample. Out of the total respondents, 184 were female.

¹ Due to shortage of data the model does not control for all explanatory variables that affect individual's earnings.

² It is known that earnings data for self-employed also include returns to physical capital and to risk and uncertainty bearing, which are difficult to disentangle from returns to human capital.

³ The exclusion of data on employees working in the informal sector cannot significantly alter the results, as it is almost impossible in Eritrea to run a business without having a license.

In this study, the dummy explanatory variable for education (ED_i) is categorized as primary (grade 1 to 7), secondary (8-12), post secondary non tertiary (13-14) and tertiary (15+). The mnemonic names that are given for primary, secondary, post secondary non tertiary, and tertiary level are $ED1$, $ED2$, $ED3$, and $ED4$ respectively. Concerning occupation dummy (OCC_i), it is difficult to classify respondents according to the International Standard Classification of Occupations (ISCO) because most of the respondents did not know clearly what their occupation called.⁴ Some of them perform different tasks, so it was not easy to find one occupational group that fits the ISCO. Thus, a summary of five occupational categories has been made and classified as $OCC1$, $OCC2$, $OCC3$, $OCC4$, and $OCC5$. $OCC1$ stands for legislators, senior officials, managers and professionals; $OCC2$ is a symbol for technical and associate professionals; $OCC3$ is an abbreviation for clerks; $OCC4$ stands for service workers, agricultural and fishery workers and those who do elementary occupations; and $OCC5$ is a symbol for craft and related trade workers and plant and machinery operators.

⁴ The ISCO refers to the classification of the International Labour Organisation (ILO).

Table 3
Descriptions, means and standard deviation of variables

Variables	Description	Mean	S. D.
<i>E</i>	Monthly earnings (in Nakfa) ^a	981.3146	601.44455
<i>S</i>	Years of schooling	10.8609	3.92654
<i>ED1</i>	Primary level, 1 if the employee attained primary level, 0 otherwise	0.2534	0.43558
<i>ED2</i>	Secondary level, 1 if the employee attained secondary level, 0 otherwise	0.3912	0.48869
<i>ED3</i>	Post secondary non tertiary level, 1 if the employee attained post secondary non tertiary level, 0 otherwise	0.2259	0.41875
<i>ED4</i>	Tertiary level, 1 if the employee attained tertiary level, 0 otherwise	0.1295	0.33619
<i>EX</i>	Years of work experience	14.3778	11.56204
<i>MOH</i>	Monthly hours worked	191.8579	37.17504
<i>TE</i>	Number of years of tenure	8.4836	9.39882
<i>FE</i>	Father's level of education	3.9752	4.59365
<i>ME</i>	Mother's level of education	1.6253	3.32455
<i>SE</i>	Sector of employment, 1 if the employee works in public sector, 0 otherwise	0.5840	0.49357
<i>GE</i>	Gender, 1 if the employee is male, 0 otherwise	0.4931	0.50064
<i>OCC1</i>	Legislators, senior officials, managers and professionals, 1 if the employee belongs to OCC1, 0 otherwise	0.1433	0.35081
<i>OCC2</i>	Technical and associate professionals, 1 if the employee belongs to OCC2, 0 otherwise	0.2039	0.40342
<i>OCC3</i>	Clerks, 1 if the employee is a clerk, 0 otherwise	0.3113	0.46366
<i>OCC4</i>	Service workers, agricultural and fishery workers and those who do elementary occupations, 1 if the employee belongs to OCC4, 0 otherwise	0.2176	0.41320
<i>OCC5</i>	Craft and related trade workers and plant and machinery operators, 1 if the employee belongs to OCC5, 0 otherwise	0.1240	0.330

^a Nakfa is the standard unit of money in Eritrea. In 2001, 1 Nakfa = 0.0738 USD.

As can be noted from Table 3, the mean of schooling of the respondents was 10.9, and their average monthly salary was 981.3 Nakfa. The average of years of work experience and job tenure was 14.4 and 8.5 respectively. If classified by level of education, 25.3% of the respondents had some primary education; 39.1% had reached secondary level; 22.6% had post secondary non tertiary education; and 13.0% had tertiary education. On average, employees worked 191.8 hours per month.⁵ By type of occupation, 14.3% of the interviewees were *OCC1*; 20.4% were *OCC2*; 31.1% were *OCC3*; 21.8% were *OCC4*; and the rest 12.4% were *OCC5*. On average, the number of years of schooling parents completed was around 4 years for the father and 1.6 years for the mother.

As can be seen in Table 4, there is a positive relationship between level of education and average monthly earnings. For instance, on average those with some

⁵ The standard workweek is 44.5 hours in Eritrea.

secondary education earn 1.46 times than those who have some primary education. When one level of education is compared with its subsequent level, the highest wage difference is found between those with tertiary education and those with post secondary non tertiary education.

Table 4

Mean monthly earnings of workers by level of education

	Overall	ED_{i+1} / ED_i
<i>ED1</i>	576.5	-
<i>ED2</i>	840.1	1.46
<i>ED3</i>	1189.5	1.41
<i>ED4</i>	1881.2	1.58
Total	981.3	-

Source: Author's calculation.

Results of Regression Analysis

In Table 5, the regression results are presented in three columns. While the first column shows the estimates from the basic Mincerian earnings function, the second column presents the results of the extended model. The third column, which includes a quadratic term in schooling, shows that earnings are convex in education. In column 1, an additional year of schooling increases monthly earnings by 11%. Similarly, one more year of work experience adds 2% to earnings (but at a decreasing rate -0.000119). The negative sign of the variable *EXSQ* indicates that the impact of experience on earnings is like a hill-shaped parabola. In studies of earnings functions, it is suggested that the impact of experience diminishes as the amount of experience increases. This is based on notions of physical and mental ageing, diminishing returns, and optimal investment in human capital. In this model, the proportion of the variation in earnings which is explained by years of schooling and work experience is 55.8%. The *F*-test of goodness of fit of regression shows that the explanatory variables do actually have a highly significant influence on earnings.

The education dummy variables in column 2 show the differential earnings for an individual with primary or secondary or post secondary non tertiary education relative to an individual with tertiary education. Accordingly, the earnings differential for an individual with primary education relative to an individual with tertiary education is -55.4%, whereas for secondary and post secondary non tertiary the earnings differentials relative to tertiary education are -46.1% and -28% respectively. These coefficients show that the rates of return to education increase with the increase in levels of education. The first year of work experience is worth 2.5%. Holding other explanatory variables constant, the peak wage occurs after about 38 years of work experience. When the coefficient on *EX* is positive and the coefficient on *EXSQ* is negative, the quadratic has a parabolic shape. There is always a positive value of *EX*, where the effect of *EX* on $\ln E$ is zero. Before this point (the point that makes the effect of *EX* on $\ln E$ zero) *EX* has a positive effect on $\ln E$; after this point *EX* has a negative effect on $\ln E$. This point is

known as the turning point. To know the turning point we have to divide the coefficient on *EX* by 2 times the absolute coefficient on *EXSQ*. From column 2 of Table 5, we find that the turning point for *EX* is 37.95 years.⁶ This implies that the return to *EX* becomes zero at around 38 years. This is due to the fact that few employees in the sample (only 3.7% of the interviewees) had more than 38 years of experience, and so the part of the curve to the right of 38 can be ignored.⁷

Table 5
Earnings regression^a

Variable ^b	(1)	(2)	(3)
Constant	5.278 (73.115)	6.642 (15.697)	6.156 (14.134)
<i>S</i>	0.110 (19.845)***		-0.039 (-1.757)*
<i>SSQ</i>			0.004 (3.736)***
<i>ED1</i>		-0.554 (-5.509)***	
<i>ED2</i>		-0.461 (-5.354)***	
<i>ED3</i>		-0.280 (-3.315)***	
<i>EX</i>	0.02037 (3.365)***	0.025 (4.373)***	0.023 (4.028)***
<i>EXSQ</i>	-0.000119 (-0.770)	0.0003 (-2.476)**	0.0003 (-2.095)**
<i>lnMOH</i>		0.114 (1.437)	0.103 (1.304)
<i>TE</i>		-0.004 (-1.832)*	-0.005 (1.928)*
<i>FE</i>		0.012 (2.390)**	0.013 (2.537)**
<i>ME</i>		-0.009 (-1.220)	-0.009 (-1.248)
<i>GE</i>		0.099 (2.383)**	0.114 (2.744)***
<i>SE</i>		-0.047 (-1.154)	-0.046 (-1.152)
<i>OCC2</i>		-0.143 (-1.765)*	-0.131 (-1.487)*
<i>OCC3</i>		-0.366 (-4.401)***	-0.384 (-4.936)***
<i>OCC4</i>		-0.924 (-9.503)***	-0.868 (-8.68)***
<i>OCC5</i>		-0.463 (-4.794)***	-0.417 (-4.274)***
R ² (adjusted)	0.558	0.701	0.705
F-value	153.255***	57.513***	62.487***
Durbin-Watson	1.708	1.736	1.761
Sample size	363	363	363

^a Values in parentheses are *t*-statistics. Asterisks indicate level of significance; *, significant at 10 percent; **, significant at 5 percent; ***, significant at 1 percent.

^b In our model, *ED4* and *OCC1* are the omitted reference groups.

The coefficient on *TE* in column 2 paradoxically shows a negative sign, which this implies a negative relationship between earnings and tenure. This can be an indication of the advantage of labour mobility over job tenure. According to Ransom (1993) the reason why employees stay more years in their current job despite the advantage that could be got from job mobility is because mobility cost is high or employers have monopsony power. In the case Eritrea, however, it is difficult for public servants, especially higher-

$$^6 \left[\frac{0.0250906}{2 \times (-0.0003306)} = 37.95 \right]$$

⁷ For more information refer to Mirer (1983) and Wooldridge (2003).

skilled employees, to leave their jobs after having accepted civil service employment (UNIDO, 2003). The effect of father's education on employee's earnings is around 1.2%, and this implies that father's educational achievement is important in motivating children to invest in education and hence higher future earnings. The coefficient on variable *GE* indicates that, for the same levels of explanatory variables inserted into the model, male employees earn about 10% more than female ones. The dummy coefficients on occupation show that earnings in *OCC2*, *OCC3*, *OCC4* and *OCC5* are lower by 14.3%, 36.6%, 92.4% and 46.3% respectively when compared with earnings in *OCC1*.

While *ED4* in our model is assumed as reference group, the rate of return to the *K-1* level of education (r_{k-1}) is estimated by subtracting the coefficient of ED_k from that of ED_{k-1} and divided by the average number of years of schooling (*AS*) at the *K* level.⁸ For instance, to calculate the annual private rate of return to schooling for *ED1* (versus *ED2*) based on the estimated coefficients column 2 of Table 5,

$$r_{k-1} = \frac{ED_{k-1} - ED_k}{AS_k},$$

where r_{k-1} is the rate of return to *ED1* level of education, ED_{k-1} is estimated coefficient of *ED1*, ED_k is estimated coefficient of *ED2* and AS_k is average years of schooling at *ED2* level.

$$r_{k-1} = \frac{-0.43 - (-0.37)}{4.25} = -0.01411 \text{ or } -1.41\%$$

In this fraction, numbers above the line (i.e. coefficients of *ED1* and *ED2*) are adjusted by $[\exp(b_i) - 1]$.⁹ Using the above calculation procedure, the annual private rate of return to schooling for *ED2* (versus *ED3*) is less by 9.09%, and for *ED3* (versus *ED4*) it is less by 10.43%.

Even if the data limit us from analysing the annual private rate of return of those with no education (versus primary level), it seems that the highest annual private rate of return is in *ED4*. The above estimates imply that the annual private rates of return to different levels of schooling are increasing. In *ED4*, the rate of employment creation is adequate to absorb all the graduates entering the labour market. One can say that primary

⁸ For further understanding see the writings of Halvorsen & Palmquist (1980) and Siphambe (2000). In our sample study, the average number of years of schooling for *ED1*, *ED2*, *ED3* and *ED4* is 5.20, 4.25, 1.43, and 2.30 respectively.

⁹ The straight interpretation of slope coefficients in log-linear and semi-log models is appropriate only when a change in explanatory variables and the accompanying change in dependent variable are small. For large changes, it is advisable to interpret after correcting the estimates using the formulas $[\exp(b_i \cdot \ln 2) - 1]$ for log-linear and $[\exp(b_i) - 1]$ for semi-log (The number "exp" is the base of natural logarithms and it is approximately equal to 2.7183. "ln" stands for logarithm and b_i for parameters associated with respective variables). This implies that the former formula has an effect of reducing the values of both negative and positive coefficients, whereas the latter has an effect of reducing the values of negative coefficients and increase the values of positive coefficients when compared with the original estimates. (For more information refer to Mirer (1983).

education is the most affected because the earnings differentials between employees with primary education and those with secondary education are very small. Since monetary losses of not going to secondary level are relatively very small (1.41%) those whose level of education is primary are financially less motivated to achieve secondary level and thus they are the most affected.

In the above calculation, one can observe that the direct costs of education are not taken into account. The standard earnings equation (that was developed by Mincer) assumes that earnings foregone while attending school are the only costs of education. It assumes no direct costs of education. It is generally known that the direct costs of education are insignificant when compared with indirect costs, but it is not reasonable to assume that all foregone earnings are obvious. One should not forget that even a person who invested in education could be unemployed. Therefore, the calculated results are only applicable when one assumes that the direct costs of education are nominal and those who decide to proceed with their education would certainly lose income from employment.

The estimated results of one level of education versus the other can be confirmed when a quadratic term in schooling (SSQ) is inserted into the model to allow for a systematic change in schooling coefficient with changing levels of schooling. According to Mincer (1974), a significant negative coefficient at SSQ implies that rates of return are lower at higher levels of education. In our case, the coefficient on SSQ is highly significant and positive, which this implies higher rates of return with higher levels of schooling (see column 3 of Table 5). When the coefficient on S is negative and the coefficient on SSQ is positive, the quadratic has a convex shape. To know the turning point for the education variable we have to divide the coefficient on S by 2 times the absolute coefficient on SSQ , and the approximate result is equal to 4.5. In our data, about 8.5% of the interviewees in the sample had less than 5 years of schooling, and this is not so small a percentage to ignore. However, it is also difficult to believe that starting at three and increasing to four years of schooling actually reduces the return to education. One possible explanation is that few employees in the sample, despite having less years of schooling than the turning point, had extremely high earnings associated with long-term work experience. Another explanation is that our model does not capture all independent variables.¹⁰ The evidence that earnings are convex in education implies that the assumptions made by Mincer regarding linearity in schooling and separability between education and experience cannot be applied.

The findings of this paper are consistent with the estimated results for most SSA countries (see Tables 6 and 7). Two decades ago, it had been asserted that returns to education in developing countries decreased with the increase in levels of schooling and thus governments of these countries should heavily invest in primary education. But, recent studies have revealed that the completion of primary level does not guarantee higher earnings, as many countries in SSA have already made great progress in promoting primary education. Since returns to education are highest at higher education

¹⁰ For more information on possible explanations refer to Wooldridge (2003)

this level of education should also be expanded and students at this level should pay tuition fees so as to offset part of the huge government expenditure on tertiary education.

Table 6

Spline estimates of wage return per year of schooling in selected SSA countries

Country	Year	Coefficient (in %)	Source
Botswana	1979	19.1	Lukas & Stark (1985)
	1993-1994	12.0	Siphambe (2000)
Cote d'Ivoire	1986	20.1	van der Gaag & Vijverberg (1989)
Eritrea	1996-1997	8.2, for male heads 10.4, for female heads	Arneberg (1999)
Ethiopia	1972	8.0	Psacharopoulos (1985)
Ghana	1989	8.5	Glewwe (1991)
Kenya	1970	16.4	Psacharopoulos (1985)
Rwanda	1999-2001	17.5	Lassibille & Tan (2005)
Tanzania	1980	11.9	Psacharopoulos (1985)

Table 7

Implied private rate of return in percent per annum, selected SSA countries

	Botswana ^a	Cameroon ^b	Cote d'Ivoire ^c	Ghana	Kenya ^d	Rwanda ^e
Year	1993-1994	1994	1985-1987	1998	1994	1999-2001
Primary vs. None	7	5.2 (Pooled) 11.8 (Male) 1.9 (Female)	15.0 (Male) 4.5 (Female) 17.0 (Male) 10.0 (Female)	8.4 (Male) 2.5 (Female)		19.4
Middle vs. Primary	83	---	14.0 (Male) 9.6 (Female) 12.0 (Male) 3.8 (Female)	4.6 (Male) 4.9 (Female)	11.0 (Male) 8.1 (Female) 10.0 (Male) 5.8 (Female)	12.5
Secondary vs. Middle	185	26.3 (Pooled) 28.3 (Male) 1.9 (Female)	22.0 (Male) 12.0 (Female) 26.0 (Male) 28.0 (Female)	9.8 (Male) 15.0 (Female)	7.4 (Male) 20.0 (Female) 12.0 (Male) 19.0 (Female)	29.0
University vs. Secondary	38	27.2 (Pooled) 29.3 (Male) 21.8 (Female)	16.0 (Male) 3.6 (Female) 3.6 (Male) 28.0 (Female)	25.0 (Male) -0.1 (Female)	21.0 (Male) 26.0 (Female) 13.0 (Male) 16.0 (Female)	33.3
Source	Siphambe (2000)	Amin & Awung (2005)	Schultz (2003)	Schultz (2003)	Schultz (2003)	Lassibille & Tan (2005)

^a The comparison is between primary and none, lower secondary and primary, upper secondary and lower secondary and between tertiary and upper secondary.

^b The comparison is between primary and none, secondary and primary and between university and secondary.

^c In each row the first figures for male and female are for those within age category of 24 to 34 and the latter figures are for those in the age group 35-54.

^d The comparison is between middle and none, secondary and middle and between university and secondary. In each row the first figures for male and female are for those within age category of 24 to 34 and the latter figures are for those in the age group 35-54.

^e The comparison is between primary and none, technical and vocational education and primary, secondary general education and technical and vocational education and between higher education and secondary general education.

Conclusion, Implication and Recommendation

Much research work on the private rates of return to education reveals the positive correlation between the amount of education an individual possesses and his/her earnings. The familiar argument of the proponents of human capital theory is that people invest in education and training so as to increase their future earnings. In his seminal work on the subject, Mincer has estimated the relationship between education and personal income distribution by developing an earnings function. However, the standard Mincer regression, though it was a major breakthrough in labour economic research, has attracted criticism from different scholars in the field. The standard earnings function (which uses log earnings as dependent variable and years of schooling and years of work experience as independent variables) was criticised because the model did not include other productivity related variables, such as job tenure, type of occupation, sector of employment and family background. The exclusion of such variables from the earnings model, therefore, could create an upward bias. Besides, the basic earnings function is inadequate to measure the private rates of return to education at different levels. Due to these points, it is important to extend the basic human capital model.

Using this estimation technique and based on the data collected the estimated results show that the private rate of return to investment in education in Eritrea is high. From an individual perspective, the causal effect of education is large enough for education to be beneficial. Not only every additional year of schooling causes a significant rise in earnings but higher rates of return are found to be associated with higher levels of education. Given that Eritrean workers do still benefit from large private returns to their schooling, it may be argued that education is still a valuable investment from the private point of view. Besides, the estimated private rate of return can be used to explain the demand for education and assess the equity or poverty alleviation effects of public education expenditures. An increase in years of work experience has also a positive impact on earnings. The negative sign of the tenure coefficient implies the comparative advantage of labour mobility. The statistically significant negative coefficient on tenure signifies that the free movement of labour should not be restricted, especially by public sector. Another alternative is rewarding tenure, thereby increasing job satisfaction and labour productivity. The positive coefficient of the dummy variable for gender implies that the wage differential between male and female employees is due to gender or factors associated with gender that we have not controlled for in the regression.¹¹

There are two main policy implications of these findings. First, the large private economic return to schooling in Eritrea suggests the further need for public expenditure on education. Second, the increasing pattern of private rate of return to education by level of education also suggests that a shift of part of the education cost burden (specially in

¹¹ Though it is beyond the scope of this study, male-female wage differentials can further be analysed using a decomposition technique to estimate the portion of the wage gap due to discrimination and that part of the gap due to differences in productivity related factors.

tertiary level) from the government to the individual and/or his/her family could be done through loan schemes. Therefore, there is an opportunity for private financing at the tertiary level of education. As reported by the World Bank (2002), in year 2000, the total spending per university student in Eritrea was 14.3 times as large as the spending per student in elementary level, or 27.3 times the spending per student in middle level. In 2004, Eritrea's public expenditure per student, as percentage of GDP per capita, was 9.8% in primary, 17.4% in secondary and 855.5% in tertiary level of education (World Bank, 2006). This indicates that government spending per student is much higher in tertiary level. However, if the government tries to share part of the total cost at tertiary level (for instance by introducing a loan scheme), the outcome will be a cost effective increase in stock of human capital.

The high private rates of return to investment in education in Eritrea, but on the other hand the low stock of human capital, entail multifarious policy measures. Not only there is a need for expanding access to education (by way of double or multiple shift at school, multigrade classes, class size increase, and construction and rehabilitation of schools) but also government subsidy or credit system should be introduced to motivate people to attain higher levels of education. So as working children have a chance of school enrolment evening classes or flexible school system should be introduced.¹² For those who are not young, adult education is a necessary strategy for increasing their levels of education and thus getting higher earnings.

In Eritrea, the government's strong desire to expand education, together with the adoption of long-term plan for expanding education, can be taken as encouraging factors. However, the existence of high population growth, poverty and opportunity cost of education is still a worrying factor.¹³ Therefore, besides policy on poverty and population and allocation of resources in favour of education, the government should promote private schools, integrate different forms of education, expand early child development programs, expand adult education, and let non-government organisations involve in education. Simultaneously, education research program and follow-up and evaluation of the education system need to be strengthened. Finally, by developing community awareness of the advantage of education, it is possible to motivate parents to send their children to school.

The paper acknowledges that the exclusion of the self-employed wage from the analysis might create selectivity bias. For further work, therefore, it is required to model and estimate an auxiliary equation that explains self-employment status using selectivity correction techniques.

¹² In Eritrea, the percentage of children under 14 working in the labour force is around 38% (World Bank, 2004).

¹³ While the annual population growth rate is around 2.3%, the percentage of population living under US\$1 a day is 69% (world Bank, 2004)

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