Real Wages and Returns to Education in Kenyan manufacturing

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Abstract: Increase in real earnings is one way to improve employees' welfare and private returns to education shape demand for education. Four waves of data drawn from surveys of Kenya's manufacturing sector are used to explore changes in real earnings and to estimate returns to education. The semi-parametric quantile regression and least squares methods are used to estimate human capital earnings functions. The results suggest, that real hourly and monthly earnings increased by 5-6 per cent per year between 1993 and 2000. This occurred at the mean, median, lower quantile and upper quantile of the conditional earnings distribution. The marginal return to primary education stands at 4-5 per cent while that to secondary education is approximately 13 per cent. The return to university education is 26 per cent. However, there is variation in returns to education along the conditional earnings distribution. Although the standard finding that returns to education increase with education is replicated here, education has greater return for employees in the upper part of the distribution.

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The data used in the paper are taken from surveys of Kenyan manufacturing firms. The surveys from 1993 to 1995 were part of the Regional Program on Enterprise Development (RPED) organised by the World Bank. The United Nations Industrial Development Organization (UNIDO) funded the survey in 2000. I would like to thank Prof.Arne Bigsten and Dr. Måns Söderbom for availing the data and for comments on earlier versions of the paper. I also thank Dr. Francis Teal and Prof. Henry Ohlsson for their comments on earlier versions of the paper. Sten Dieden provided much help in using STATA and I thank him also.

1 INTRODUCTION

Human resource development is widely cited as key to economic growth and poverty reduction (World Bank, 2000). Since Shultz T.W. (1961) highlighted the role of human resources in the development process, research has focused on the determinants and returns to investments in education, health, and nutrition. There are comprehensive surveys of the literature by Shultz, T.P. (1988), Strauss and Thomas (1995), and Appleton, Hoddinot, and McKinnon (1996)[1]. In the case of education, the available evidence suggests that there are positive economic and social benefits to be had from educational investments.

In Kenya, one of the main features of the education system is the rapid expansion that has occurred since 1963. Primary enrollment was close to 6 million children in 1999, while secondary enrolment was about two-thirds of a million. At university level, enrollments stood at 42 000 students in 199 from 27, 000 students in 1990. Rapid expansion was confined to primary and secondary levels in the 1960s and 1970s, but the late 1980s and early 1990s witnessed expansion at the university level too. At the same time, the country's record in economic performance is mixed. Up to 1973, the growth in GDP averaged 6.5 per cent and then fell to 4.4 per cent between 1974 and 1992. The 1990s have been marked by serious downturn in the country's economic fortunes, with near zero growth in some years.

Given this economic performance and expansion in supply of educated labor, returns to education are likely to fall. This is what Appleton, Bigsten and Kulundu (1999) found for 1978-95. Returns to education declined at all educational levels except at university level. In this paper, the human capital approach is adopted with two objectives: The first objective is to explore changes in real manufacturing sector earnings during the 1990s. The second objective is to estimate the education effect on earnings.

The paper extends previous work by exploring changes in real earnings and the effect of education on earnings not only at the mean but also at three other points along the earnings distribution. For this purpose, data from the World Bank's regional program on enterprise development (RPED) for 1993-95 are used. An additional wave of data not considered previously is available from a recent survey financed by United Nations Industrial Development Organisation (UNIDO). The four waves of data cover a period characterized by disappointing economic performance. Since real earnings are an indicator of economic

[1] The latter survey focuses exclusively on education and health in Sub-Sahara Africa while the former surveys focus on other developing world regions in addition to SSA.

welfare, it is important to document how this measure changed during this period. Both real hourly earnings and real monthly earnings are considered.

Three questions are posed: (i) how did real manufacturing sector earnings change in the 1990s? (ii) Was the change the same for employees at different points of the earnings distribution? (iii) What is the marginal rate of return to education in the manufacturing sector? (iii) Do the marginal rates of return to education vary across the earnings distribution? (iv) Do the estimated marginal returns to education depend on the measure of earnings adopted?

This paper has the following structure. The next section provides a brief review of Kenya's economic performance during the last decade. It also describes the Kenyan education system and enrollments during the 1990s. Section 3 contains a short survey of the literature on returns to education in Sub-Sahara Africa. In Section 4 the two main methods typically used to estimate the wage effects of education are described. The data are described in Section 5 while Section 6 explores earnings differentials. Section 7 presents the econometric model and Section 8 presents the results. The paper is concluded in Section 9.

2 BACKGROUND

To provide the context within which the rates of return are obtained, this section provides a brief review of Kenya's economic performance in the 1990s. Table 2 reports key economic indicators of the Kenyan economy for 1991-1999.

TABLE 2
SELECTED INDICATORS 1991 to 1999

Economic indicator	1991	1992	1993	1994	1995	1996	1997	1998	1999
Macro economic indicators									
GDP growth (%)	2.1	0.5	0.2	3.0	4.8	4.6	2.4	1.8	1.4
Inflation rate (%)	19.6	27.3	46.0	28.8	1.6	9.0	11.2	6.6	3.5
Real private consumption	5119	5020	3953	3525	4409	4311	4739	4873	4804
Population									
Growth (%)	3.1	3.0	2.9	2.8	2.7	2.6	2.5	2.4	-
Size (millions)	22.7	23.4	24.0	24.8	25.2	26.3	27.1	27.9	28.7
Employment									
Formal sector (000)	1,442	1,462	1,475	1,505	1,557	1,619	1,647	1,665	1,674
Informal sector (000)	1.063	1,238	1,467	1,792	2,241	2,644	2,987	3,354	3,739
Sector performance									
Manufacturing growth (%)	3.8	1.2	1.8	1.9	3.9	3.7	1.9	1.4	2.4
Agricultural growth (%)	-1.1	-3.7	-4.1	2.8	4.8	4.4	1.2	1.5	1.2

Source: Economic surveys, 2000, 2001

Evidently, in more ways than one, the 1990s could be termed a lost decade for Kenya. Despite the economic reforms starting in 1993, the economic performance record has been poor. The GDP growth rate was close to zero in 1992 to 1993. Thereafter it picked up but a slow down

started in 1997. Inflation was highest in 1992-93 but declined thereafter to single digit level. Population growth rate exceeded GDP growth rate for most of the decade resulting in declining per capita GDP. Living standards (or welfare) as measured by real per capita private consumption (1990 = 100) declined by 6 percent in 1991-1999 and did not match the population growth.

Growth in the agricultural sector declined by 3 percent in 1991-1993. It recovered in 1994-1996, but in 1997 decline set in again. The manufacturing sector, from where the data we have used in this study have been collected, appears to have maintained positive but low growth during the decade. Formal wage employment grew very slowly. It has increased by less than quarter of a million new jobs in almost 10 years. As formal employment creation slackened, a dramatic expansion has occurred in informal sector (excluding small-scale farming) employment. It has expanded from 1 million participants in 1991 to 4.2 million participants in 2000 (Economic survey 2001), a 300 percent increase.

Table 3 reports number of students at various levels of education in the 1990s. The present formal education system consists of 8 years of primary education, 4 years of secondary education, and 4 years to qualify with a first degree at the university. Before 1985 it consisted of 7 years of primary education, 4 years of middle secondary education, 2 years of high school education, and 3 years for a first university degree.

TABLE 3
ENROLLMENT IN EDUCATION IN THE 1990S (MILLIONS)

Education level	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Primary	5.39	5.46	5.56	5.43	5.56	5.54	5.60	5.68	5.92	5.87
Primary GER	101.8	91.4	91.0	87.8	88.5	86.8	86.4	87.7	88.8	-
Secondary	0.62	0.61	0.63	0.52	0.62	0.63	0.66	0.69	0.70	0.64
Secondary GER	24.1	27.9	27.3	25.7	24.8	24.4	-	-	-	-
University	0.027	0.039	0.042	0.040	0.040	0.040	0.037	0.040	0.044	0.042
Polytechnics	0.006	0.009	0.009	0.009	0.011	0.008	0.009	0.009	0.009	0.010
Tech. institutes	-	0.007	0.008	0.008	0.008	0.008	0.010	0.009	0.008	0.010

Source: Economic surveys, various issues. Gross enrollment ratio (GER) for primary is from Education for all (EFA) draft report. GER for secondary is from UNESCO statistics.

Primary school enrollment rose by close to half a million children from 5.39 million in 1990 to 5.87 million in 1999. However, gross enrollment ratio, an indicator of participation declined. At secondary level, enrollment rose by 20,000 students in the same period. Enrollments appear to be fairly stable up to 1995, except in 1993 when there was a decline. In 1996-1998 enrollment was high relative to the other years although a decline is recorded in 1999. Participation rate is low mainly because transition rates from primary to secondary are

also low. At university level the expansion in the early 1990s is evident. From 27, 000 students in 1990 enrollment expanded to 42, 000 in 1992. It has remained at around 40, 000 since, except for a small decline in 1996 and a small increase in 1998. Enrollments at technical and polytechnic have remained below 20,000 students throughout the decade.

3 LITERATURE

The idea that schooling is an investment gained prominence in economic analysis through the work of Shultz T.W. (1961) and Becker (1964). Subsequent work by Becker and Chiswick (1966) and Mincer (1974) developed the human capital model. Willis (1986) surveys the early literature on the human capital earnings function.

A survey of the literature on returns to education by Psacharopoulos (1994) showed that across world regions rates of return to education depict a pattern with several elements. Some of these are as follows: (i) Returns to education in the private sector exceed those in public sector. (ii) Returns decline by level of education, with primary education having the highest return and tertiary level having the lowest[2]; (iii) In developing countries especially in Africa returns to education exceed those in developed countries; (iv) The return to female education exceeds that to male education. Bennell (1996) argues that the diversity in methods, data quality, country sizes, and records of economic performance in SSA makes such a pattern of returns untenable under current labor market conditions. He proposes, that it is better to search for patterns in returns to education at country level.

A survey of more recent estimates for several SSA countries by Appleton et al (1996) shows that returns to education are relatively lower than suggested in the conventional pattern and they rise with education attainment. Moreover, recent estimates of returns to education are in line with this survey. For example, Bigsten et al (2000), Mwabu and Shultz (2000), Jones (2001), and Nielsen (2001) found that not only do returns to education rise with educational attainment, but also they are more modest than in the conventional pattern[3].

Another issue that has been investigated is whether left out variables such as individual ability, family background characteristics, and school quality injects bias into point estimates

[2] Private returns to primary education are 41 percent, while returns to secondary and tertiary education are 27 and 28 percent respectively. Social returns are 24 percent for primary education, 18 percent for secondary education, and 11 percent for tertiary education.

[3] The estimates surveyed by Appleton et al (1996) and the other recent ones are based on the traditional Mincer (1974) equation. They are comparable to those in the conventional pattern only under certain assumptions (see section 3).

used to derive returns. To control for individual ability differences, Boisserie, Knight and Sabot (1985) and Glewwe (1996) included test scores from Raven's test as a proxy for employee's ability. They found, that human capital (measured by cognitive skills) retained its significance. Evidence from farm (Pinckney and Kimuyu, 1995; Appleton and Balihuta, 1996) and manufacturing (Jones, 2001; Bigsten et al, 2000) production functions also shows that human capital has positive impact on output. Behrman and Birdsall (1983) and Glewwe (1996) took up the issue of school quality and found substantial returns to school quality improvements. Family background proxied by parents' education and occupation also affects returns to education (Armitage and Sabot, 1987; Lam and Schoeni, 1993).

With regard to benefits of education, standard estimates are mainly based on wage benefits. However, as noted by Shultz T.P. (1988), education is demanded because it has features of an investment good, a consumption good, and a public good also. But education externalities and direct consumption benefits of education are usually left out in the conventional method of estimating returns. Clearly such benefits, for example, better health and nutrition, and better citizens are difficult to measure. But Appleton and Balihuta (1996) and Weir and Knight (2000) have attempted to estimate such benefits in farm production. They find positive impact of neighbors' education on individual farmer output in Uganda and Ethiopia respectively.

A few studies have addressed another important issue, namely changes in returns to education over long periods of time. Moll (1996) finds, that in South Africa return to primary schooling for Africans declined between 1960-1975 and stabilized afterwards. Canagarajah and Thomas (1997) find, that private rate of return to primary, secondary and post-secondary schooling in Ghana rose in 1987-1991. Krishnan, Sellassie and Dercon (1998) found, that despite labor market reforms, no change in returns to education occurred in Ethiopia in 1990-1997. Appleton, Bigsten and Kulundu (1999) found, that private returns to primary and secondary schooling for Kenyan manufacturing employees declined in 1978-1995. But returns to university education did not decline. These trends provide one potential explanation of the difference between the large returns to education in Psacharopoulos (1994) and the relatively smaller returns surveyed in Appleton et al (1996) as well as those estimated in recent studies.

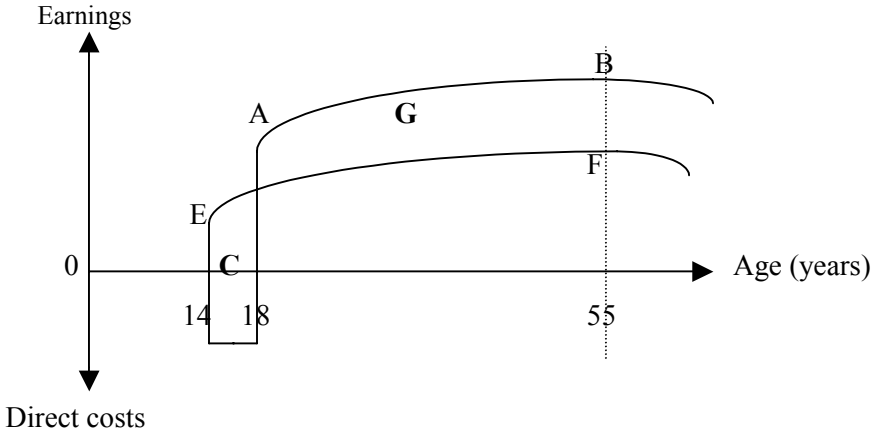
Besides the above issues, some recent work on returns to education suggests that the partial association between education and earnings might differ at different parts of the distribution. Returns to education may differ among employees with same level of education. Even after controlling for various employee characteristics some heterogeneity might remain. This line

of investigation has been pursued in developed countries. Two studies from Sub-Sahara Africa, Mwabu and Shultz (1996), and Nielsen and Rosholm (2001), found that returns to education differ across the wage distribution in South Africa and Zambia respectively. This paper explores this aspect using data from Kenya and adopting the human capital approach.

4 METHOD

Investments in education, like any other investment maybe assessed on the basis of cost-benefit analysis. The evaluation method directly based on this idea is referred to as the "elaborate method" or the "Full method"(Psacharopoulos, 1995). The core tool in this method consists of age-earnings profiles of individuals with different levels of educational attainment. An employee falls in one of three schooling categories: (i) completed a schooling level, (ii) did not attend school at all, (iii) dropped out of school. Figure 1 depicts age-earnings profiles of two employees with different schooling levels.

Figure 1: Illustration of Age-earnings profiles



Consider two employees. One is a primary graduate who enters the labor market at the age of 14 years. His/her earnings increases with time as experience is gained on the job up to some turning point (for example 55 years in figure 1). The age-earnings profile may look like EF. The other is a secondary graduate who enters the labor market at the age of 18 years after studying for 4 years beyond primary school at a cost (C), where the cost has two components: direct cost in form of books, uniforms, boarding fees, and transport expenses, and foregone earnings for the 4 years he/she was in secondary school. On entry into the labor market, the age earnings profile may look like AB. It is above the one for the primary school graduate. The gain from undertaking secondary schooling is G.

The rate of return to educational investment is defined as the discount rate that will equalize the sum of present discounted stream of educational costs, to the sum of present discounted stream of benefits. In this illustration, the rate of return to secondary education would be the discount rate (r_s) that solves the following expression

$$\sum_{t=1}^{37}(W_s - W_p)/(1+r_s) = \sum_{t=1}^{4}(W_p + C_s)/(1 + r_s)$$

Where W_s is the earnings of a secondary graduate and W_p is the earnings of a primary graduate. The difference ($W_s - W_p$) is the gain labeled G in figure 1 which the graduate will receive for 37 years. It is obtained after incurring a cost ($W_p + C_s$) for 4 years.

The other method is the "earnings function method" or the "Mincerian method" after the influential work by Mincer (1974). It is based on four main assumptions: (i) The private cost of attending school is the opportunity cost (foregone earnings) of the student's time; (ii) there are no market imperfections that hold back the individual from making desired schooling investments; (iii) earnings differentials reflect productivity differentials; and (iv) individuals receive the gain from education for ever.

The basic model relates earnings (W) to schooling (S), post-school experience (E). A quadratic term in post-school experience is also added to pick up the concave relationship depicted in figure 1. The model is semi log form.

(1) $\ln W = \beta_0 + \beta_1 S + \beta_2 E + \beta_3 E^2$

Assuming weak separability between the rate of earnings growth and post-school experience the model may be approximated by an equation containing a quadratic term in schooling (Willis, 1986). Hence equation (1) becomes:

(2) $\ln W = \beta_0 + \beta_1 S + \beta_2 S^2 + \beta_3 E + \beta_4 E^2$

The marginal internal rate of return to education is equal to the partial logarithmic derivative of equation (2) with respect to schooling. It is possible that returns to education are not uniform across the earnings distribution. For example, in a model of optimal schooling choice Card (1995) shows, that individuals may derive different marginal rates of return to same amount of schooling and face different marginal costs of investing in schooling.

5 THE DATA

The data are taken from the 1993, 1994, and 1995 World Bank Regional Enterprise Program surveys in Kenya (see Bigsten and Kimuyu, 1998). The Departments of Economics at the University of Gothenburg, and at the University of Nairobi implemented the surveys. A follow-up survey was implemented in 2000 and was financed by the United Nations Industrial Development Organization. It was implemented by the Center for the Study of African Economies at the University of Oxford and the Department of Economics at the University of Gothenburg, together with several Kenyan collaborators.

The data were collected in face-to-face interviews with firm managers. As the manager was interviewed a sample of up to 10 employees were interviewed in a separate room or at their workstation. The sample of employees was drawn in a manner to cover the range of occupations in the firm. Employees were asked to provide information on their age, wages, non-wage benefits, schooling attainment and gender among other information. The sample employed in this study contains all employees between 15-65 years. Table 4 shows the sample means and standard deviations of the variables used in the analysis for the pooled sample and for each survey wave separately.

Male employees constitute over 80 percent in each of the four surveys. The average age across the survey waves is 34 years and the range is 33-35 years. The employees also have an average tenure of 7-8 years with their current firm. Like the age variable tenure does not show notable change overtime. With regard to the distribution of employees across urban centers, over 60 percent work in firms located in the capital, Nairobi. However, in the fourth wave, relatively more employees were surveyed in Mombasa (23 percent) and in Eldoret (12 percent) compared with less than 20 percent and 10 percent respectively in earlier surveys.

Education is measured in two ways. The first is the total number of years of formal education completed (Education in years). It is computed using the information reported on the highest level of formal education completed. The second is the level of formal education attained. The latter takes four categories: (1) primary dropout: did not complete primary; (2) primary graduate: completed primary; (3) secondary graduate: completed secondary; and (4) university: completed university.

Table 4 shows, that in the 7-year period between the first and fourth survey waves, the educational composition of the manufacturing labor force changed. In particular, the mean

years of education increased from 8.8 years in 1993 to 9.6 years in 2000. The distribution of the employees by education level also shifted. Few employees (less than 1 percent) have not attended formal schooling and whereas 16 percent of the employees in wave 1 had not completed primary schooling, the proportion is 8 percent in wave 4. The proportion of primary completers is 45 percent in wave 1 compared to 39 percent in wave 4. Secondary completers constituted 38 percent of wave 1 sample and 48 percent in wave 4. The proportion of university graduates is 4 percent in wave 4 compared to 1 percent in wave 1.

Two measures of earnings are defined. The first is real monthly earnings[4]. The second is gross hourly earnings. It is constructed by normalizing the real monthly earnings by the reported number of hours work. Real monthly earnings increased from Ksh 1718 in 1993 to Ksh 2554 in 2000. Real hourly earnings increased from Ksh 8.70 in 1993 to Ksh 13.3 in 2000. This implies a 48 per cent (53 per cent) increase in real monthly (hourly) earnings. A detailed examination of real earnings is in the next section.

[4] Earnings were deflated by the Nairobi consumer price index (1990=100)

TABLE 4
SAMPLE DESCRIPTIVES STATISTICS OF VARIABLES USED IN THE ANALYSIS

	Overall		Wave 1		Wave 2		Wave 3		Wave 4	
Variable	Mean	Std dev	Mean	Std dev	Mean	Std dev	Mean	Std dev	Mean	Std dev
Hourly earnings	9.926	12.642	8.715	9.855	7.276	8.031	10.471	13.820	13.346	16.489
Log of hourly earnings	1.969	0.716	1.876	0.680	1.721	0.651	2.045	0.673	2.240	0.758
Monthly earnings	1939.650	2437.665	1717.600	1953.624	1453.661	1538.320	2051.905	2690.347	2553.634	3137.607
Log of monthly earnings	7.262	0.692	7.158	0.678	7.038	0.621	7.338	0.646	7.521	0.724
Male employee*	0.851	0.356	0.887	0.317	0.851	0.356	0.847	0.360	0.814	0.390
Age of employee	33.912	9.009	34.579	8.957	32.851	8.662	33.426	8.821	34.737	9.470
Years of tenure	7.910	7.178	8.126	7.074	7.320	6.860	7.671	7.106	8.513	7.621
Education in years	9.090	2.875	8.816	2.964	8.783	2.888	9.183	2.901	9.607	2.649
No education*	0.004	0.064	0.007	0.085	0.004	0.064	0.001	0.031	0.004	0.064
Primary dropout*	0.132	0.338	0.161	0.368	0.155	0.362	0.128	0.334	0.078	0.269
Primary graduate*	0.429	0.495	0.446	0.497	0.434	0.496	0.443	0.497	0.390	0.488
Secondary graduate*	0.411	0.492	0.378	0.485	0.392	0.489	0.396	0.489	0.483	0.500
University graduate*	0.024	0.154	0.008	0.090	0.014	0.120	0.032	0.177	0.044	0.206
Firm in Nairobi*	0.642	0.480	0.681	0.466	0.663	0.473	0.649	0.477	0.567	0.496
Firm in Mombasa*	0.166	0.372	0.134	0.341	0.146	0.353	0.154	0.361	0.234	0.423
Firm in Nakuru*	0.098	0.297	0.096	0.295	0.104	0.305	0.110	0.313	0.081	0.274
Firm in Eldoret*	0.095	0.293	0.089	0.285	0.088	0.283	0.087	0.282	0.117	0.322
Wave 2*	0.236	0.425		-		-		-		-
Wave 3*	0.258	0.437		-		-		-		-
Wave 4*	0.237	0.425		-		-		-		-
Number of observations	4096		1104		966		1055		971	

Note: Variables with a "*" are categorical variables taking 0 or 1. The mean for such variables is the proportion of employees with the identified characteristic.

6 CHANGES IN REAL EARNINGS

This section explores real earnings in more detail. Table 5 sets out average and median real monthly and hourly earnings by levels of education for the four survey waves.

TABLE 5
MEAN & MEDIAN REAL HOURLY (MONTHLY) EARNINGS BY EDUCATION

	No. of obs.	Monthly earnings		Hourly earnings	
		Mean	Median	Mean	Median
Wave 1					
Primary dropout	178	1140.89	987.36	5.83	5.12
Primary graduate	492	1327.10	1002.21	6.77	5.18
Secondary graduate	417	2338.49	1484.76	11.88	7.44
University graduate	9	6488.93	5939.02	29.54	30.69
Overall	1104	1717.60	1088.82	8.71	5.63
Wave 2					
Primary dropout	150	1031.98	881.28	5.13	4.38
Primary graduate	419	1236.25	940.07	6.08	4.55
Secondary graduate	379	1719.36	1181.51	8.78	6.08
University graduate	14	5360.01	4081.05	25.94	21.09
Overall	966	1453.66	1025.63	7.28	4.98
Wave 3					
Primary dropout	135	1525.72	1346.13	7.78	6.75
Primary graduate	467	1567.55	1307.06	7.91	6.68
Secondary graduate	418	2277.75	1534.09	11.82	7.93
University graduate	34	7991.68	5295.05	39.61	29.02
Overall	1055	2051.91	1397.21	10.47	7.20
Wave 4					
Primary dropout	76	1664.69	1563.26	7.78	6.75
Primary graduate	379	1648.88	1411.19	8.71	7.07
Secondary graduate	469	2855.61	1978.91	15.04	10.06
University graduate	43	8931.75	5778.59	43.10	29.86
Overall	971	2553.63	1614.36	13.35	8.28

From Table 5 a number of points stand out. First, median earnings are lower than mean earnings. Secondly, as would be expected, mean and median earnings increase with schooling attainment. Thirdly, as pointed out at the end of the previous section, overall average monthly (hourly) earnings rose by 47 percent (53 percent): The corresponding median earnings rose by 48 percent (47 percent).

In the same period, average monthly earnings of primary graduates increased by 46 percent and by 58 percent at the median. Corresponding increases in hourly rates were 33 percent and 31 percent. Monthly earnings of primary graduates rose by 24 percent and 41 percent at the mean and median respectively. Their average and median hourly rates rose by 29 percent and 36 percent respectively. The average and median monthly earnings for secondary graduates, rose by 22 percent and 33 percent respectively. Corresponding hourly earning rates rose by 26 percent and 35 percent.

Table 5 was used to compute earnings differentials between earnings of each education level as a ratio of the earnings of the immediate lower education level. The differentials in first and fourth waves are shown in Table 6. Such differentials may serve as crude indicators of returns to education.

TABLE 6
REAL EARNINGS DIFFERENTIALS BETWEEN ADJACENT SCHOOLING LEVELS

	Monthly earnings		Hourly earnings	
Schooling comparison groups	Wave 1	Wave 4	Wave 1	Wave 4
Primary graduate/Primary dropout	1.16 (1.02)	0.99 (0.90)	1.16 (1.01)	1.12 (1.05)
Secondary graduate/primary graduate	1.76 (1.48)	1.73 (1.40)	1.75 (1.44)	1.73 (1.42)
University graduate/Secondary graduate	2.75 (3.99)	3.13 (2.92)	2.48 (4.13)	2.87 (2.97)

Note: Figures in parentheses are median earnings differentials

Primary graduates' monthly earnings at the mean (median) were 16 percent (2 percent) above those of primary dropouts in wave 1. But in wave 4 primary graduates earned 1 percent (10 percent) less at the mean (median). The differential in hourly earnings was identical to that in monthly earnings in wave 1. However, in wave 4, primary graduates had an hourly earnings advantage of 12 percent (5 percent) at the mean (median). The earnings differentials between secondary graduates and primary graduates are large. At the mean (median) the former earned 76 percent (48 percent) more per month than the latter in wave 1. In wave four they earned 73 percent (40 percent) more at the mean (median). The hourly earnings differential at the mean is identical to the monthly earnings differential while at the median it was 44 percent in survey 1 and 42 percent in survey 4. The earnings advantage for university graduates are huge (more than 100 percent) over secondary graduates.

The message in this section is threefold. First, it suggests that real earnings increased for all employees regardless of their education level. However the increases varied at the mean and median. Secondly, the earnings differential is larger for the more educated. Thirdly, the earnings advantage for primary graduates over primary dropouts is not large and has declined, but the earnings advantage of secondary graduates over primary graduates is still large although it declined. It is also observed that the earnings differential in favor of university graduates is very large. In the following sections the data are explored more using multivariate regression technique.

7 ECONOMETRIC MODEL

The estimated empirical models are based on equation (2) in section 4 and take a semi-logarithmic form. The ordinary regression model is

$$(3) \qquad \ln w_i = \mathbf{x}_i'\beta + u_i \ , \quad i = 1, 2, ...n$$

Where w_i is real hourly earnings or monthly earnings for employee i. The vector x contains values (assumed fixed in repeated samples) of independent variables and β is a vector of parameters to be estimated. u_i are residuals that capture the stochastic nature of the relationship and they are assumed to be independently and normally distributed with mean zero and variance σ^2.

In addition to the least squares estimator, the quantile estimator introduced by Koeneker and Basset (1978) is employed to describe the conditional earnings distribution. The basic quantile regression model is (Buchinsky, 1994, 2000).

$$(4) \qquad \ln w_i = \mathbf{x}_i'\beta_\theta + u_{\theta i} \text{ with } \text{Quant}_\theta (\ln w_i|\mathbf{x}_i) = \mathbf{x}_i'\beta_\theta \qquad \theta \in (0, 1)$$

Where x is defined as in equation (3) and β_θ is the parameters vector to be estimated. $\text{Quant}_\theta(\ln w_i|x_i)$ is the θth sample quantile of lnw given x_i. The θth regression quantile is the solution to the minimization of the sum of absolute deviations residuals.

$$(8) \qquad \text{Min} \left\{ \sum \theta|\ln w_i - \mathbf{x}_i'\beta_\theta| + \sum(1-\theta)|\ln w_i - \mathbf{x}_i'\beta_\theta| \right\}$$

The variation in value of θ from 0 towards 1 traces the entire distribution of log of earnings and one can estimate the education effect on earnings at any given percentile. For example when $\theta = 0.50$, this is the median regression or least absolute deviation (LAD) estimator. Quantile regression has some attractive features (Deaton, 1997; Bushnisky, 2000). First, the LAD estimator gives less weight to outlier data points on the dependent variable. This has the advantage of weakening the impact such data points might have on the results. Secondly, with quantile regression it is possible to analyze the effect of explanatory variables at different parts of the distribution of the dependent variable.

Two variants of (3) and (4) each are estimated. One is based on log hourly earnings as the dependent variable, and the other on log monthly earnings. While the human capital model is derived in terms of hourly wages and Shultz (1988) stresses this, two measures of earnings are compared in this paper to assess the difference it makes to the estimated returns. This is because data on hours worked may not be available outright in developing countries and still returns to schooling have to be estimated. Moreover, a substantial number of employees in a given survey may fail to report hours of work. Use of hourly earnings would mean the loss of a substantial proportion of the sample. Another reason of using monthly earnings data is that it is likely to have least measurement error.

We start with a simple pooled regression model that includes dummy variables for survey waves. The second part estimates earnings functions to derive returns to education. In each case, a major concern

is whether the changes in real earnings described in section 5 are also present from the simple regression and the earnings functions estimated from the data. In addition, it is explored if the changes in real earnings and the education effect are uniform across the earnings distribution.

8 ESTIMATION RESULTS

This section has two parts. The first part reports the results of simple regression and the implied changes in real earnings. Part two reports the point estimates from earnings functions and derives the education effect.

Changes in real earnings from simple regression

In section 5 changes in real hourly and monthly earnings were computed from raw average and median earnings. A simple regression model with controls for survey waves as the only explanatory variables is now used to derive implied changes in real earnings over time. Table 7 shows OLS and quantile point estimates with log hourly (monthly) earnings as the dependent variable. The earnings differentials associated with the time dummies are summarized in Table 8 Panel A. The reference is survey wave 1, undertaken in 1993.

TABLE 7
SIMPLE REGRESSION WITH NATURAL LOG OF HOURLY (MONTHLY) EARNINGS AS THE DEPENDENT VARIABLE AND SURVEY WAVE DUMMY VARIABLES ONLY

	Hourly Earnings (Equation 1)				Monthly Earnings (Equation 2)			
	OLS	0.25	0.50	0.75	OLS	0.25	0.50	0.75
Intercept	1.876**	1.420**	1.728**	2.192**	7.158**	6.687**	6.993**	7.457**
	(91.70)	(84.42)	(84.13)	(45.22)	(350.56)	(301.45)	(222.70)	(146.91)
Wave 2	-0.155**	-0.132**	-0.123**	-0.130*	-0.120**	-0.075*	-0.059	-0.096
	(-5.31)	(-6.02)	(-5.31)	(-2.15)	(-4.19)	(-2.39)	(-1.38)	(-1.30)
Wave 3	0.169**	0.221**	0.246**	0.133**	0.180**	0.256**	0.249**	0.135*
	(5.79)	(9.73)	(11.57)	(2.73)	(6.33)	(8.28)	(7.44)	(2.14)
Wave 4	0.364**	0.317**	0.386**	0.435**	0.364**	0.348**	0.394**	0.435**
	(11.44)	(11.85)	(15.40)	(5.43)	(11.76)	(11.08)	(11.30)	(5.43)
R-squared	0.070	0.053	0.051	0.032	0.067	0.057	0.052	0.033
F-statistic	98.48				96.42			
RMSE	0.691				0.668			
No. of obs	4096				4096			

Notes: The 10%, 5%, and 1% significance levels are indicated by +, *, and ** respectively
Robust t-statistics reported for least squares regression and bootstrapped t-statistics reported for quantile regression.

Consider changes in earnings with reference to wave 1, conducted in 1993. Start with the least squares estimates hourly earnings equation (equation1). The point estimate on wave 2 variable implies, that average hourly earnings declined in 1994 by 17 per cent, while the point estimate on wave 3 variable

implies, that average hourly earnings increased by 18 per cent in 1995[5]. In 2000, the point estimate on wave 4 variable implies, that average hourly earnings increased by 44 per cent from 1993. Turning to changes across quantiles of the earnings distribution, an F-test rejected the null hypothesis that the point estimates on wave variables are equal across quantiles (F =8.01; P-value = 0.00). The implied increase in real hourly earnings over the four surveys is 47 per cent at the median. The rises at the 25 (75) percentiles are 37 percent (54 percent).

TABLE 8
IMPLIED PERCENT CHANGES IN REAL HOURLY AND MONTHLY EARNINGS

	Hourly Earnings				Monthly Earnings			
	OLS	0.25	0.50	0.75	OLS	0.25	0.50	0.75
Panel A								
Wave 2	-14	-12	-12	-12	-11	-7	-6	-9
Wave 3	18	25	28	14	20	29	28	14
Wave 4	44	37	47	54	44	42	48	54
Panel B								
Wave 2	-9	-10	-9	-10	-6	-7	-9	-7
Wave 3	19	24	23	15	20	27	24	19
Wave 4	37	37	35	34	37	39	38	38

Source: The implied changes in Panel A are computed from point estimates on dummy variables in Table 7. The implied changes in Panel B are computed from point estimates on dummy variables in Tables 9 and 10

In the identical model with log monthly earnings as the dependent variable (equation 2), the point estimates on wave dummy variables are also significant except in the median and upper quantile where the point estimates on wave 2 dummies are not significant. However, the estimates are jointly significant across quantiles (F = 2.58; P-value = 0.017). The least squares estimates imply that real monthly earnings decreased in 1994 by 11 per cent. 1n wave 3, real monthly earnings rose by 20 per cent while the estimates on wave 4 dummy variable imply that real monthly earnings rose by 44 percent (48 percent) at the mean (median), and by 42 percent (54 percent) at the 25 (75) percentiles.

To summarize, the message in this section tallies with the message in section 5. It is that real earnings increased between the first wave and the fourth wave. In addition, results from quantile regression show that real earnings increased at the median and also at the upper and lower parts of the earnings distribution. The increases in hourly and monthly earnings are identical except at the lower quantile where monthly earnings increased more than hourly earnings. It may be the case that the increase in the monthly earnings of those who hold low pay jobs was accompanied by increased hours of work. Changes in real earnings will be considered again in the earnings functions of the next section.

[5] Point estimates on dummy variables are interpreted as percent effect = 100(expc-1) where c is the relevant point estimate (Halvorsen and Palmquist (1980)

Estimates from earnings function

The models in (3) and (4) are estimated including controls for human capital (measured by schooling attainment, tenure, and age), being a male employee, and the town in which the employee is working in addition to survey rounds dummy variables. Quadratic terms in schooling and age are also included. The objective is to estimate the earnings effect of education at the mean and within three quantiles (θ = 0.25, 0.50, 0.75) along the earnings distribution. The changes in real earnings are also explored after adding these controls. Start with the point estimates from the earnings function with log hourly earnings as the dependent variable (Table 9).

TABLE 9
EARNINGS FUNCTIONS ESTIMATES. DEPENDENT VARIABLE IS NATURAL LOGARITHM OF HOURLY EARNINGS

	OLS	0.25	0.50	0.75
Education	-0.081**	-0.059**	-0.096**	-0.094**
	(-6.03)	(-4.03)	(-4.78)	(-4.97)
$(\text{Education})^2$	0.0106**	0.0074**	0.0112**	0.0128**
	(13.32)	(9.13)	(9.45)	(11.38)
Age	0.055**	0.047**	0.045**	0.054**
	(7.65)	(7.93)	(7.54)	(7.54)
$(\text{Age})^2/100$	-0.048**	-0.046**	-0.039**	-0.045**
	(-4.96)	(-5.47)	(-4.87)	(-4.36)
Tenure	0.010**	0.011**	0.009**	0.009**
	(5.26)	(4.43)	(4.19)	(2.87)
Male	0.050+	0.097**	0.058	0.041
	(1.91)	(3.79)	(1.66)	(1.34)
Firm in Mombasa	-0.170**	-0.145**	-0.141**	-0.172**
	(-7.35)	(-5.68)	(-4.94)	(-6.08)
Firm in Nakuru	-0.495**	-0.434**	-0.468**	-0.479**
	(-18.94)	(-21.23)	(-16.87)	(-13.88)
Firm in Eldoret	-0.393**	-0.362**	-0.388**	-0.393**
	(-13.43)	(-20.19)	(-16.96)	(-9.93)
Wave 2	-0.096**	-0.103**	-0.094**	-0.108**
	(-3.96)	(-4.12)	(-3.46)	(-4.95)
Wave 3	0.173**	0.219**	0.203**	0.144**
	(7.32)	(8.12)	(10.69)	(3.83)
Wave 4	0.314**	0.318**	0.297**	0.295**
	(12.40)	(12.55)	(13.67)	(8.15)
Intercept term	0.373**	0.284**	0.621**	0.592**
	(2.72)	(2.18)	(4.51)	(5.60)
R-squared	0.406			
Pseudo R-squared		0.211	0.232	0.265
F-statistic	181.69			

Notes: Robust t-statistics reported for least squares regression and bootstrapped t-statistics reported for quantile regression. Significance level at 10%, 5%, and 1% is indicated by +, *, and ** respectively

TABLE 10
EARNINGS FUNCTIONS ESTIMATES. DEPENDENT VARIABLE IS NATURAL LOGARITHM OF MONTHLY EARNINGS

	OLS	Q25	0.50	0.75
Education	-0.086**	-0.061**	-0.104**	-0.110**
	(-6.55)	(-6.10)	(-5.96)	(-5.19)
$(Education)^2$	0.0108**	0.0073**	0.0115**	0.0135**
	(13.67)	(11.93)	(11.52)	(10.20)
Age	0.046**	0.038**	0.044**	0.043**
	(6.62)	(4.95)	(6.52)	(5.62)
$(Age)^2/100$	-0.038**	-0.036**	-0.038**	-0.029**
	(-3.99)	(-3.67)	(-4.07)	(-2.72)
Tenure	0.008**	0.009**	0.007**	0.005*
	(4.21)	(4.51)	(3.69)	(2.35)
Male	0.080**	0.126**	0.076**	0.067*
	(3.17)	(4.15)	(3.03)	(2.00)
Firm in Mombasa	-0.137**	-0.110**	-0.125**	-0.143**
	(-6.05)	(-4.07)	(-4.77)	(-5.52)
Firm in Nakuru	-0.450**	-0.402**	-0.417**	-0.469**
	(-17.75)	(-15.45)	(-15.65)	(-10.72)
Firm in Eldoret	-0.370**	-0.345**	-0.378**	-0.385**
	(-12.88)	(-16.61)	(-13.83)	(-10.16)
Wave 2	-0.064**	-0.071**	-0.064**	-0.070**
	(-2.67)	(-3.14)	(-2.57)	(-1.95)
Wave 3	0.183**	0.237**	0.214**	0.175**
	(7.83)	(10.01)	(8.07)	(5.46)
Wave 4	0.314**	0.332**	0.325**	0.320**
	(12.86)	(11.19)	(10.05)	(7.10)
Intercept term	5.821**	5.740**	5.950**	6.142**
	(43.49)	(42.43)	(43.17)	(38.21)
R-squared	0.394			
Pseudo R-squared		0.200	0.222	0.259
F-statistic	168.51			

Notes: Robust t-statistics reported for least squares regression and bootstrapped t-statistics reported for quantile regression. Significance level at 10%, 5%, and 1% is indicated by +, *, and ** respectively

Table 9 shows the point estimates from the model with log hourly earnings as the dependent variable. Although most of the covariates do not individually differ significantly across the three quantiles (see Table 11 for the tests) the null hypothesis of equality of all point estimates across quantiles may be rejected (F = 6.64; P-value = 0.00). In Table 10 the point estimates from the model with log of monthly earnings as the dependent variable are shown. In this case also most of the point estimates are singly not significantly different across quantiles (see Table 11 for tests). But the null hypothesis of equal point estimates across quantiles may be rejected also (F = 50.49; P-value = 0.00).

Age and tenure have positive and significant effect on earnings at the mean and across quantiles. There is an inverted U-shaped relationship between age and earnings as depicted in figure 1 in section 3. The turning points are 57 years and 58 years in the mean and median regressions in Table 9. The

corresponding turning points in Table 10 are 61 years and 59 years. Perhaps employers in Kenyan manufacturing value increased experience until late in the working career of an employee. The point estimate on tenure is approximately 0.01. It would imply that an increase of one year in tenure would increase real hourly (monthly) by a modest 1 percent.

Now consider the effect of being a male employee. The second column in Table 9 shows that on average a male employee has a 5 percent point earnings premium over female employees. However, this effect is not very significant (t = 1.91; P-value = 0.057). In Table 9 the point estimate on this variable is shown to differ across quantiles. The percentage effect is highest (10 percent) at the lower quantile where the point estimate is very significant (t = 3.79; P-value = 0.00). At the median the percent effect is 6 percent but the point estimate is not very significant (t = 1.66; P-value = 0.097). In the upper quantile there is no significant effect of this variable on hourly earnings (t = 1.34; P-value = 0.18). In Table 10 the point estimates are significant at less than 1 percent level except in the upper quantile where it is significant at 5 percent level. Male employees are associated with a monthly earnings premium of 8 percent over female employees on average and at the median but the highest percent effect is in the lower quantile (13 percent).

Turning to location-specific effects, working in firms located in Mombasa, Nakuru, and Eldoret has a negative and significant association with earnings. Using Nairobi as the point of reference, the point estimates on these variables in Table 9 imply that working in Mombasa is associated with 16 percent lower hourly earnings on average. Working in Nakuru and Eldoret entails even higher earnings disadvantage of 39 percent and 32 percent respectively. The corresponding percentage effects for the three towns at the median are 13 percent, 37 percent, and 32 percent. Similarly, in Table 10 the point estimates on location dummies imply that average and median real monthly earnings are 13 percent, 36 percent, and 31 percent lower in Mombasa, Nakuru and Eldoret respectively than in Nairobi.

Tables 9 and 10 also show that even after adding control variables for human capital, location of the firm and male employee, the point estimates on survey wave dummy variables are still very significant. An F-test showed that the null hypothesis of equal point estimates on wave dummy variables across quantiles may be rejected (F = 1.99; P-value = 0.06) in Table 9. The implied changes are in Table 8, Panel B. The rise in real hourly earnings over the four survey rounds was 37 percent (35 percent) at the mean (median). The increase at the 25 (75) percentile was 37 percent (34 percent). In Table 10 the F-test did not reject the null hypothesis that point estimates on wave dummies are equal across quantiles (F = 1.08; P-value = 0.37). The implied change in real monthly earnings is 37 percent at the mean and approximately 38 percent at the three conditional quantiles (0.25, 0.50, and 0.75). Compared with the increases derived in Tables 5 and 7, controlling for sample composition reduces the implied changes in real earnings.

The increase in real earnings is in line with official statistics (Government of Kenya, 1996-2001) that have recorded increases in overall real average earnings per employee in private and public sector. The increase is larger in the former sector. The trend is attributed to low inflation and upward wage adjustments. Bigsten et al (2000) also documented an increase in real average earnings for Kenyan employees between 1993 and 1995[6]. Real per capita private consumption (Table 2) fell in 1994 (wave 2) by 11 per cent from the 1993 (wave 1) level. In 1995(wave3) it was 12 per cent higher than in 1993, and by 2000 (wave 4) it was 27 per cent higher. So real manufacturing earnings rose by relatively greater percentages than real private consumption in 1995 and 2000.

Now consider the schooling variable. The results show that the point estimates on education and on the quadratic in education are significant at the mean and across quantiles. The tests in Table 11 also suggest that these variables singly differ across quantiles. Further, the null hypothesis that this pair of point estimates jointly differ across the three quantiles may not be rejected (F = 34.25; P-value = 0.00 in Table 9) and (F = 54.30; P-value = 0.00 in Table 10). Figures 2 and 3 show the predicted convex relationship between education and earnings holding other factors constant. They show that at the mean and within the three quantiles, earnings increase monotonically with educational attainment. Also, at higher levels of education, the curves for the 25 percentile and the 75 percentile diverge. We return to this point below.

TABLE 11
TESTS OF EQUALITY OF POINT ESTIMATES ACROSS QUANTILES

	Natural log of real hourly earnings		Natural log of real monthly earnings	
	F-statistic	Prob-value	F-statistic	Prob-value
Education	**2.45**	**0.09**	**6.86**	**0.00**
$(\text{Education})^2$	**11.13**	**0.00**	**24.14**	**0.00**
Age	0.76	0.47	0.39	0.68
$(\text{Age})^2/100$	0.31	0.74	0.46	0.63
Tenure	0.31	0.73	1.14	0.32
Male	**2.65**	**0.07**	1.51	0.22
Firm in Mombasa	0.70	0.50	0.51	0.60
Firm in Nakuru	0.96	0.38	1.22	0.30
Firm in Eldoret	0.80	0.45	0.70	0.50
Wave 2	0.18	0.84	0.06	0.94
Wave 3	2.24	0.11	1.78	0.17
Wave 4	0.54	0.58	0.10	0.91

[6] Other countries in their study (Zambia, Zimbabwe, Cameroon, and Ghana) recorded falls in real manufacturing sector earnings in this period.

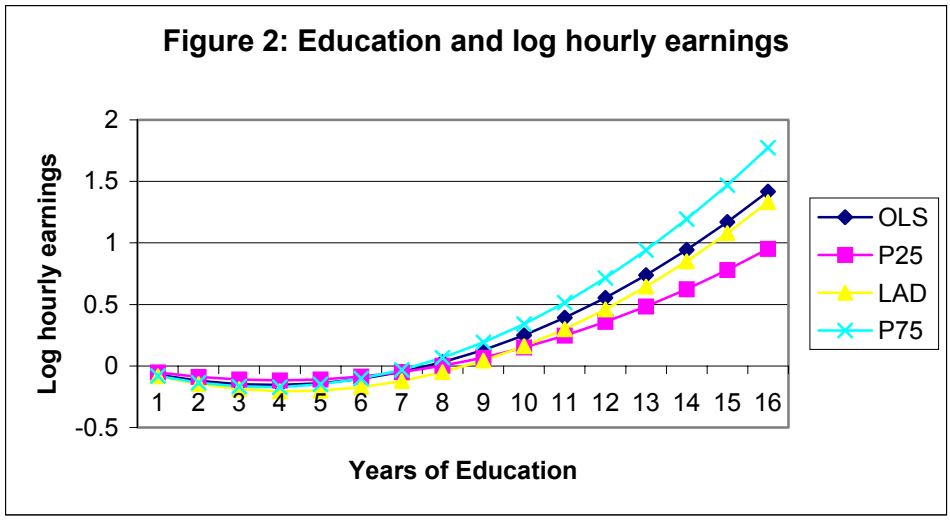


Figure 2: Education and log hourly earnings
Log hourly earnings
2
1.5
1
0.5
0
-0.5
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Years of Education
OLS
P25
LAD
P75

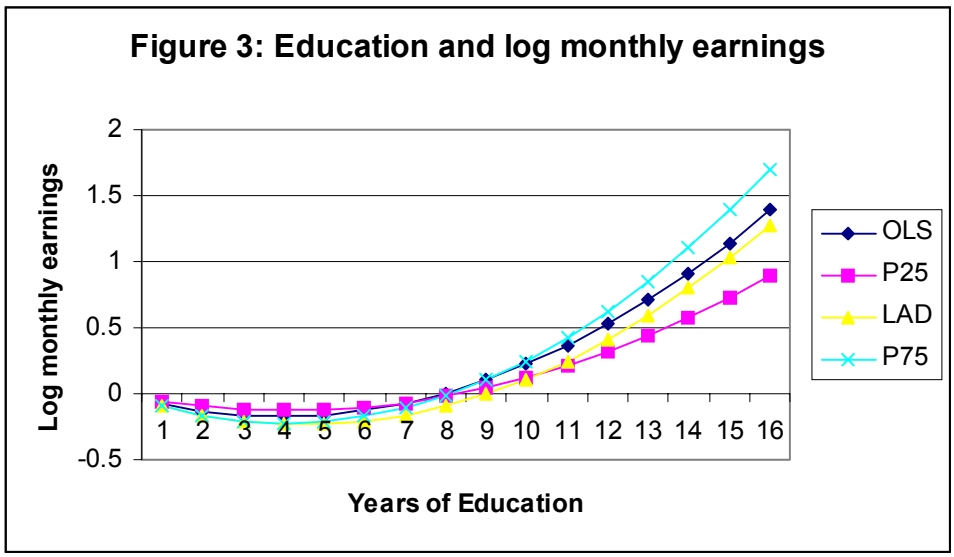


Figure 3: Education and log monthly earnings
Log monthly earnings
2
1.5
1
0.5
0
-0.5
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Years of Education
OLS
P25
LAD
P75

Under the assumptions of the Mincer model (section 3), the partial logarithmic derivative of the earnings function with respect to schooling yields the partial association between education and earnings. We evaluate the partial derivative at 4, 6, 10, and 16 years of education and also at the overall pooled sample average years of schooling. The rate of return to education is this derivative multiplied by 100 to convert it into a percentage. The computed OLS and quantile rates of return are presented in Table 12[7].

TABLE 12
RETURNS TO SCHOOLING IN KENYA'S MANUFACTURING SECTOR

Education attainment	OLS	0.25	0.50	0.75
Panel A				
4 years	0.4	0.0	-0.6	0.8
6 years	4.6	3.0	3.8	6.0
10 years	13.1	8.9	12.8	16.2
16 years	25.8	17.8	26.2	31.6
Average years	11.2	7.6	10.8	13.9
Panel B				
4 years	0.0	-0.3	0.0	-0.2
6 years	4.4	2.7	3.4	5.2
10 years	13.0	8.5	12.6	16.0
16 years	26.0	17.3	26.4	32.2
Average years	11.0	7.2	10.5	13.5

Source: Computed from estimates on schooling and its quadratic in Tables 9 (Panel A) and 10 (Panel B)

The results imply that an employee with the pooled sample mean years of education has a return to education of 11 percent at the mean and median of the distribution. Further, returns to education are lowest for employees with 6 years of education at 4-5 percent and highest for those with 16 years of education (university graduates) at about 26 percent. Since in Kenya direct costs are highest at university level the rate of return is likely to be over-estimated[8]. In contrast, it is unlikely that primary school children forego adult wages and so the cost of primary education may be overestimated and returns to education underestimated by the Mincer model. Nevertheless, the finding that mincerian returns to education increase with education is common in recent studies in different SSA countries (Bigsten et al, 2000 for Ghana, Kenya, Zambia, Zimbabwe, and Cameroon; Mwabu and Shultz, 2000 for South Africa; Nielsen, 2001 for Zambia; Jones, 2001 for Ghana).

The additional result that is obtained by using quantile regression is that returns to education are highest within the 75 percentile and lowest within the 25 percentile. The average and median returns to education do not deviate very much. The spread in estimated returns to 6 years of education

[7] The models were also estimated including firm size (proxied by the natural log of number of employees in the firm). However, close to 30 percent of the employees could not be matched with firm size because the number of employees in their firm was missing. The elasticity of earnings with respect to firm size is about 0.1and the effect of schooling declined by about 1 percent. To investigate effects of firm size and human capital on earnings it is more appropriate to use panel data to keep out unobserved factors. Söderbom and Teal (2001) address this issue using data from Ghana and find a minimal role for human capital in earnings determination.

[8] This assumes people pay the university loan advanced by the Higher Education Loans Board (HELB).

between the 25 and 75 percentiles is 3 (2.5) percent points in the upper (bottom) panel of Table 12. It becomes wider at 10 years of education where it is 7.3 (7.5) percent points and is widest at university (16 years) where it is 13.8 (14.9) percent points. This might imply that education positively affects earnings dispersion. Figures 2 and 3 show the divergence in log earnings between 75 and 25 percentiles increases as one moves up the education distribution. Secondly, although more educated employees earn more than other employees, the larger returns at the upper quantile suggest that education is more valuable in highly paid occupations.

One interpretation of this finding is that, if residuals in the conditional earnings function mainly reflect ability differences, then education and ability are compliments (Mwabu and Shultz, 1996; Harmon, Oosterbeek and Walker, 2000). Higher returns to education for employees within the upper quantile suggests that these employees are able to derive more from any given quantity of education than those within the lower quantile. Mwabu and Shultz (1996) found that returns to education for White South Africans did not increase with quantiles. But for Black South Africans returns to education increased with quantiles. They conclude that for the former group, schooling and ability are substitutes while for the latter they are compliments. Harmon, Oosterbeek and Walker (2000) conclude that in the U.K. education and ability are compliments.

Thirdly, using either log of real hourly earnings or log of real monthly earnings as the dependent variable in the earnings equation does not result in large differences in the computed returns to education. However, within the upper quantile returns calculated using the latter are lower than those calculated using the former dependent variable for employees with 6 years of education[9].

Table 13 shows a comparison between rates of return to education estimated in the present study with other estimates using Kenyan data sets. The other estimates using Kenyan data are OLS estimates. The present study has both least squares (OLS) and quantile returns to education. However, in Table 13 only the least square and least absolute deviation (LAD) returns to education are reproduced from Table 12. The bold figures are returns based on manufacturing sector employees. The studies differ in terms of the dependent and independent variables as well as the samples used. We use two alternative dependent variables (natural log of real hourly earnings and natural log of monthly earnings).

[9] Controlling for firm fixed effects reduced the returns to education. For example OLS returns to 6 years of education with log monthly earnings as the dependent variable fell from 4.4 percent to 3.1 percent. Returns to 10 years fell from 13 percent to 10 percent while returns to 16 years fell from 26 percent to 20 percent.

TABLE 13
RETURNS TO EDUCATION IN KENYA: ESTIMATES FROM DIFFERENT STUDIES

Study	Data	Primary	Secondary	University
Bigsten et al (2000)[a]	**1993-95**	**4**	**12**	**22***
Appleton, Bigsten & Manda (1999)[b]	**1978**	**10**	**34**	**61**
	1986	**5**	**16**	**20**
	1995	**2**	**12**	**69**
Manda (1997)[c]	1978	18	56	-
	1986	13	37	-
	1993-95	**5**	**13**	**53**
Milne & Neizert (1994)[d]	1978	9	11	-
	1986	7	16	-
Present study[e]	**1993-00**	**OLS: 4.6 (4.4)**	**OLS: 13.1 (13.0)**	**OLS: 25.8 (26.0)**
		LAD: 3.8 (3.4)	**LAD: 12.8 (12.6)**	**LAD: 26.2 (26.4)**

NOTE: (a) Dependent variable is log of real monthly earnings. Earnings function includes schooling, a polynomial term in schooling, age, age squared, tenure, tenure squared, and being male dummy. Sample consists of manufacturing sector employees.

(b) Dependent variable is log of real monthly earnings. Earnings function includes schooling in dummy variable form, potential experience, a second and third order polynomial in potential experience, being a male employee dummy, and location dummy variables. Only returns for manufacturing sector employees are shown here.

(c) Dependent variable is log of real hourly earnings. Includes age, age squared, vocational training dummy, occupational dummy variables, and location dummy variables. Earnings functions estimated separately for each educational level. Only the 1993-95 returns are based solely on manufacturing sector employees.

(d) Dependent variable is log of real hourly earnings. Variables included are schooling, schooling squared, age, age squared, being female dummy, location dummy variables, and occupational dummy variables. The schooling effect reported is for an employee aged 30 years. Urban labor force survey data

(e) Dependent variables are log of real hourly (monthly) earnings. The earnings function contains education, education squared, age, age squared, tenure, being a male dummy, firm location. The estimates in parentheses are based on log real monthly earnings as the dependent variable.

* computed by this author from their estimated model

The estimates in the present paper do not deviate very much from studies that have used the manufacturing data in the 1990s. The return to primary education ranges from 4-5 percent and that to secondary education from 12-13 percent. Returns to university education differ across studies but they are relatively high. However, it is worth noting that the estimates in Table 13 are mincerian returns to education. Appleton, Bigsten, and Kulundu (1999) went further and made adjustments for direct costs of education and obtained private returns to education of 25 percent at primary level, 7 percent at secondary level, and 35 percent at university level in the 1995 data. If it were possible to capture education externalities the picture could change as well.

The finding that returns to education increase with educational attainment is common in all the studies. Furthermore, the recent studies show more modest rates of return to education. This is in line with studies surveyed by Appleton et al (1996). Invoking the Mincer (1974) model assumptions, the Kenyan evidence suggests that the conventional pattern, where returns are highest at primary level and lowest at tertiary level no longer holds. A comparison of returns to secondary education in 1978 and 1986 with the returns computed for the 1990s by the other studies and in the present study suggests

that returns to education have declined over time. But at the university level returns appear to have increased. This decline (collapse) in returns to education could help reconcile the high private returns found in Psacharopoulos (1994) and the more modest returns in recent studies.

9 SUMMARY AND CONCLUSIONS

This paper set out to find answers to three questions. (i) How did real manufacturing sector earnings in Kenya change in 1993-2000 in the context of weak economic performance? (ii) What is the level of returns to education? (iii) Do returns to education vary across the earnings distribution? These questions were addressed with data drawn from four surveys of Kenya's manufacturing sector. The latest wave of data collection concluded in November 2000. In addition to exploring real earnings and estimating returns to education at the mean of the earnings distribution like previous studies, the paper has explored these aspects at other points on the earnings distribution. For this purpose the semi-parametric quantile regression method is used to supplement the least squares method.

The results show, that real average monthly and hourly earnings have increased for all employees. However, a part of the earnings differential observed across the survey waves in our study may be attributed to differences in human capital, firm location, and being a male employee. Once these are controlled for real hourly and monthly earnings increased by 37 per cent in a 7-year period, which approximates to an annual increase of 5 per cent. The quantile regressions show that the increase in real earnings occurred not only at the mean, but also at the upper and lower quantiles of the earnings distribution. The quantile increases in real earnings are between 35-39 per cent. The increases in real manufacturing earnings exceeded the increase (27 per cent) in real per capita private consumption.

The results also reveal that mean and median mincerian return to primary education ranges from 4-5 percent while the return to secondary education is approximately 13 percent. The return to university education is about 26 percent. Further, the paper replicates the standard result in recent papers that returns to education increase with educational attainment. A comparison of estimates based on more dated data with estimates from more recent data suggests that returns to education in Kenya have declined at primary and secondary levels. Returns were high in the past but have declined probably because the supply of primary and secondary educated labor has outstripped the demand for graduates from these two levels. Returns to university education are still substantial and this might be the explanation for the increased demand and political pressure to expand existing universities and to convert diploma colleges into universities in the 1990s just like there was pressure to expand secondary education in the 1970s and 1980s when return to this level of education was much higher. The increased demand for university education is also seen in the expansion of private universities.

Quantile regression shows, that returns to education differ across the earnings distribution. Returns are highest within the upper quantile and lowest within the lower quantile. Therefore, although returns to education increase with educational attainment, the larger returns at the upper quantile appear to suggest that education is more valuable to those employees in highly paid positions. This may suggest that education and unobserved employee characteristics are compliments. But it is also possible that the increased supply of educated labor leads to filtering down of the more educated into low-pay occupations such that employees with same level of education obtain varying returns to their education. The gap in returns to education between the upper quantile and the lower quantile is widest for university graduates and narrowest for primary graduates.

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