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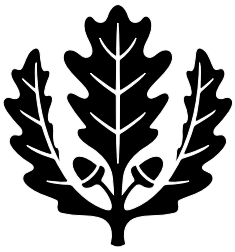

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## Abstract

We use micro data to analyse the effect of human capital externality on earnings and private returns to education. The earnings equations are estimated using the OLS method for a sample of full-time workers. The results show that human capital has a positive effect on earnings, indicating that an increase in education benefits all workers. However, men benefit more from women's education than the women do from men's. The effects of human capital externality on private returns to schooling are shown to vary substantially between rural and urban areas and across levels of the education system.

**Journal of Economic Literature Classification:** I20

**Keywords:** Human capital externality, returns to education, earnings, Kenya

# 1. Introduction

At the time of independence shortage of skilled labour was a major constraint to the achievement of the nation's development goals. To improve this situation the Kenyan government has consistently devoted a large share of its budget to education expansion. For instance, the education sector share of total government budget in 1998 was 29 percent, one of the highest in Africa. In the earlier decades after independence, most of the expansion took place at the primary and secondary education levels. With time and especially since the late 1980s, there has also been a rapid expansion in the number of public and private universities. Student enrolments in primary and secondary schools increased from 0.9 and 0.03 million in 1963 to 5.9 and 0.7 million in 2000, respectively. The number of primary and secondary schools also increased from 6,058 and 150 in 1963 to about 18,617 and 3,207 in 2000, respectively. The number of schools may, however, understate the extent of expansion in the education system since within the existing schools, expansion was in form of increased number of classes.

At the primary level, the expansion was partly due to free primary education introduced in 1974, while at the secondary level, the increase was due to the large number of schools, built through self-help initiatives in response to the high demand for secondary education.[1] Given the large amounts of resources devoted to education by both government and parents, it is fitting to investigate whether the education system yields returns to individuals that justify the resources they invest in schooling.

Estimates of returns to education conventionally measure the benefits of education in the form of higher wages. Private rates of return to education include only private benefits and costs, while social rates of return to education differ from the private returns only by inclusion of direct cost of education to the society as well as the benefits to it in terms of higher tax revenues.

In terms of policy making, returns to education are useful in a number of ways. For instance, social returns are useful in giving an indication of which sector of the education system the government should invest in most. If there are significant differences in returns to primary and secondary education, this is a signal to policy

makers and households to invest relatively more in the education level that yields higher returns.

An analysis of returns to education can also help in the evaluation of broad education policies. It is, for example, well established that human capital development is crucial to economic development (Ranis et al. 2000). Government should therefore seek to adopt policies that are consistent with human capital development. To the extent that returns to education in a particular country may show a declining trend, it is necessary to evaluate the causes of such decline. On the one hand, declining returns may influence private choices on education as evidenced by high drop-out rates and low enrolments. On the other hand, it could be that government policies themselves are responsible for the decline in enrolment. For example, it has been shown that the policy of cost-sharing in education in Kenya has had a negative impact on primary school enrolments (Bedi et al., 2004). Further, households evaluate benefits of schooling decisions in terms of the future income returns. If these benefits are too low, then policies advocating for the use of education services as part of the poverty alleviation package may be ill-conceived. Alternatively, if these returns are very high despite low enrolments, it could be evidence that individuals are not able to obtain the optimal amount of education. Thus, a study on returns to education has several important policy implications.

A large number of studies from various parts of the world show that educational returns for an additional year of schooling are positive and range anywhere from 5 percent in developed countries to as high as 29 percent in developing countries (see Psacharopoulos, 1985, 1994). In the 1994 survey, Psacharopoulos, finds that returns to education in Africa are higher than for other regions. This finding has generated debate about whether the reported estimated rates of return prevail for some African countries given the existing labour market conditions. For instance, Bennell (1996) suggests that the findings by Psacharopoulos (1994) for Africa are heavily influenced by a few dated studies some of which were based on poor data. Besides, estimates of returns to schooling in Africa since the 1980s have been moderate (Appleton, 1999). Given the inconclusiveness of these studies, policy makers are unclear as to where to invest the limited resources at their disposal. Consequently more accurate estimates of returns to education are useful for purposes of informing policy makers. There is

need, therefore, for refined estimates of returns to education based on elaborate and more recent data. This is important because rates of return to education in Kenya have been shown to vary over time (see Appleton *et al* 1999 and Manda 1997) and therefore estimates based on old data may be of little value in terms of informing policy today.

When estimating private returns to education, it is normally assumed that returns to an individual are independent of the human capital endowments of others. This assumption, which dominates most of the previous studies, ignores a major aspect of human capital theory - namely human capital externalities. Human capital externality suggests that increasing the human capital of one person will have some impact not only on the earnings and returns to education for that individual but also on earnings and returns to education for other individuals.

In a competitive economy, where workers are paid the value of their marginal product, increasing the average human capital induces an increase in the demand for skilled labour (the demand effect). Similarly, a direct consequence of a large share of the population, which is educated is to increase the supply of skilled labor. The net effect on earnings is positive when human capital externalities are such that the demand effect dominates the supply effect (see Michud and Vencatachellum, 2003). Failure to control for human capital externalities in the earnings equation can therefore lead to biased estimates of the parameters of the earnings function.

An interesting extension of the idea of human capital externalities concerns the impact of male (female) education on the earnings for women (men). If in fact it is the case that there are significant positive female human capital externalities on, for example, male earnings, then the limited emphasis on women's education in Africa could actually have the effect of lowering the earnings of men, ceteris paribus. On the other hand, providing education opportunities to both men and women has salutary effects on overall earnings.

A number of studies have previously analyzed returns to education in Kenya (e.g., Bigsten 1984, Knight and Sabot 1990, Knight, Sabot and Hovey 1992, Manda 1997, Appleton, Bigsten and Manda 1999). To some extent this paper builds on these

studies and estimates private returns to education using a comprehensive micro dataset of full-time workers collected by the Government in 1994. In addition to estimating the private returns to education, the paper focuses on effects of human capital externalities on earnings.

## 2. Data and Methods

We use data from the Welfare Monitoring Survey (WMS) of 1994 undertaken by the Central Bureau of Statistics (Ministry of Finance and Planning, Government of Kenya). The survey aimed at collecting data, which would assist the government to assess the status of the welfare of the population. The survey covered all the eight provinces in Kenya and gathered information from each district on employment status, health, fertility, household size, crops and livestock, household incomes and expenditure on various items, children's nutrition, and social amenities. The data set also has information on individual characteristics such as education level, age and marital status. We supplement this information in the survey with district level measure of education for males and females (measure of human capital externality). The WMS of 1994 provides information on individual earnings, education and age, which is useful in the estimation of returns to education. The sample used in our study includes only individuals in the working age group 15 to 65 years and who are full-time employees. The sample size used consists of 6,140 observations covering individuals both in the rural (4,878) and urban areas (1,262).

A worker's specific human capital is approximated by the highest education level attained and by years of potential experience. We define a worker's potential experience as his age minus six years and number of years of schooling.[2] We capture the effect of education on earnings using dummy variables to represent levels of schooling. Average years of education in a district (for males and females) are used as a measure of human capital externality. Using this variable as a measure of human capital externality could be criticised on the grounds that it may be a proxy for other things such as quality of education or different labour market conditions in various districts other than human capital externality. We use pupil-trained teacher ratio for primary schools as a proxy for quality of education. A high pupil-trained teacher

ratio indicates low quality of education and vice versa. Since people do not necessarily work in districts where they went to school, the variable may not capture differences in public education investments or variations in regional quality of education. However, it is possible that if a quality of education exists in a particular district (especially in primary schools), it could attract people to work in such a district so that their children could benefit from the quality education.

In general, differences in the quality of labour market conditions are likely to exist between rural and urban areas or between public and private sector. We control for these differences by including regional dummies in the earnings equation. Also, since we use data on full-time employees only, this is likely to reduce the heterogeneity problem because there isn't much difference among these employees in rural and urban areas and between public and private sector.[3] Other control variables include regional (provincial) dummies. The variables used in the analysis are defined in Appendix Table 1 and the descriptive statistics are presented in Appendix Table 2.

## 2.1 The Model

We follow Mincer (1974) in estimating a semi-logarithmic equation for the determinants of earnings

$$\ln(W_i) = \alpha + \Sigma\beta_k S_{ki} + \lambda A_i + \delta Z_i + U_i \qquad (1)$$

where

$W_i$ is monthly earnings for worker i; $S_k$ are dummy variables representing the highest level of schooling attained; A is potential experience; Z is a vector of control variables such as (sex and region) and U is an error term. It would have been useful to use hourly earnings, but information on hours of work was not available in the data set. To minimise the error in monthly earnings due to variations in hours worked by full-time and non full-time employees, we make use of data on full-time employees only.

Our main interest in estimating equation (1) is to calculate the private rate of return to education. Estimates of private returns to education conventionally measure the benefits of education in the form of higher wages. From equation (1), the rate of return to a given level of education is derived as shown in equation (2).

$$\textbf{Rate of return to a year of education} = [\exp(\beta_h - \beta_l) - 1]/(E_h - E_l) \qquad (2)$$

Where $\beta_h$ is the estimated coefficient of a higher level of education dummy (e.g., a dummy for completed secondary education); $\beta_l$ is the estimated coefficient of a lower level of schooling dummy (e.g. a dummy for completed primary education); $E_h$ is the total number of years taken to attain a particular level of *higher* education; and $E_l$ is the total number of years spent schooling at a *lower* level of the education system. For instance, to calculate the return to secondary education, $E_h$ will be 12 years (i.e., eight years of primary schooling plus four years of secondary education); and $E_l$ will be 8 years (i.e., eight years of primary education) so that $(E_h - E_l) = 4$ years. More generally, equation (2) computes the rate of return for a year of schooling at *any* level of the education system. For example, if everyone has primary education, and the highest education attainment at that level is 5 years, the *lower* level of education is necessarily 4 years so that $(E_h - E_l) = 1$. If $(E_h - E_l) = 0$, it means that the highest level of educational attainment, $E_h$, is zero. In other words, there is no investment in schooling and therefore the rate of return to education is undefined, as is evidently clear from expression (2).

## 2.2 Estimation Issues

Estimates of returns to education may suffer from several drawbacks. These include omission of relevant variables and endogeneity of schooling. Although several approaches to these problems have been developed, this study does not fully benefit from them due to data limitations.

*Omitted Variables*

Omission of unobserved characteristics such as ability can bias conventional OLS estimates (see Blackburn and Neumark, 1995). Including ability proxies tends to

lower the estimated returns to schooling indicating that OLS estimates are biased upwards. Other studies (e.g., Ashenfelter and Krueger, 1994; Ashenfelter and Zimmerman, 1993; Taubman, 1976) have used panel data for twins to estimate returns to schooling. The idea behind this approach is that differencing eliminates the effects of common ability and family-background so that the estimates are purged of these time-invariant effects. Studies using this approach display varying results, with some reporting slightly lower and others reporting slightly higher educational return estimates as compared to conventional OLS estimates. Using data on workers in Kenyan and Tanzanian urban enterprises, Knight and Sabot (1990) test whether human capital (measured as cognitive skill) has an independent effect on earnings or if it simply signals inborn ability (measured by ability test scores). They find that, though ability might have a role in wage formation, controlling for it does not diminish the effect of human capital on earnings.

OLS estimates of the effect of education on earnings are consistent only if, for example, unobserved variables are not correlated with both education and earnings. However, if an unobserved characteristic, say 'ability' has a positive effect on earnings and schooling, then OLS estimates of the returns to schooling will be biased upwards. Another source of bias is measurement error in schooling. This may generate a negative correlation between the earnings and schooling equation error terms and induce a negative bias in OLS estimates (see Griliches, 1977 and Blackburn and Neumark, 1995).

A negative bias could also arise if workers with low schooling have a higher earnings capacity (and higher returns to schooling), but curtailed their education due to higher discount rates. This negative correlation is implied in the Becker model of human capital investment in which schooling is acquired until the marginal return to schooling equates the discount rate (see Card, 1995).

Other studies find that family background such as parent's education and income (another commonly omitted set of characteristics) has a positive impact on wages and that returns to education decline when family background variables are included in

the earnings regressions (e.g., Wambugu 2003). Armitage and Sabot (1987) examined how parental education interacted with employees' earnings in establishments located in Nairobi, Kenya and Dar es Salaam, Tanzania. They find that the private return to secondary education increased monotonically with parental education. Wambugu (2003) using data on Kenyan manufacturing firm employees, finds that controlling for parental education in the earnings function reduces the level of returns to workers education only by a small percentage.

The data set used in this study does not provide information that can be used to control for ability, family background, or personal discount rates. Also, as is the case in most developing countries, panel data of workers in Kenya is not available. However, we make the assumption that though unobserved ability might have a role in wage formation, it does not significantly diminish the effect of human capital on earnings (e.g., see Knight and Sabot, 1990). In this study it is not possible to control for unobserved ability or eliminate its effect using panel data. This may bias our OLS estimates upwards. However, we use pupil-trained teacher ratio for primary schools as a proxy for quality of education at the district level, and thus at least mitigate the bias due to omission of this variable from the estimating equation.

*Endogeneity of education*

If a person takes into account how educational attainment will affect his earnings, then the person's educational level is endogenous to the determination of those earnings. The schooling endogeneity problem can be taken into account by constructing a 'selectivity-correction' term from a schooling attainment equation and then including the correction term in the earnings equation. Studies using this method typically report higher returns as compared to OLS estimates (e.g., Gaston and Tenjo, 1992; Hansen, 1997). An alternative way of solving schooling endogeneity relies on using exogenous (or 'natural') variation in educational attainment (such as differences in educational attainment across siblings) to provide instrumental variable (IV) estimates of returns to education. In this case, one has to look for variables that are strongly correlated with education but that do not directly

influence earnings (see Card, 1993; Angrist and Krueger, 1991; Harmon and Walker, 1995; Bedi and Gaston, 1999).[4] The main finding in these studies is that returns to education that take into account the potential endogenous nature of education often exceed standard estimates and the difference is large in some studies.

Unfortunately, information on variables that can be used in the analysis of schooling attainment function such as family background is not available, and we do not have any information on twins or siblings. We do not therefore attempt to control for endogeneity of schooling. This means that our estimates for returns to education based on OLS will be biased downward compared to results from studies that control for schooling endogeneity. However, results based on instrumental variable estimation may also be sensitive to the quality of variables used as instruments (Wambugu, 2003). We do not expect the level of education attainment in Kenya to be determined by level of earnings because most students drop out of school as a result of poor performance in national examinations.

## 3. Results

The estimated results are presented in full in appendix Tables 3A to 3F. The estimations are done for national, urban and rural areas and, for males and females. The results are based on ordinary least squares (OLS) estimation of Equation (1).

Education, potential experience, sex and location dummy variables explain about 30 percent of the log monthly earnings for all workers, 22 percent for males, and 34 percent for females at the national level. In the rural and urban areas, the variables explain between 26 and 42 percent of the variations in earnings as shown in appendix Tables 3A to 3F. The coefficients for most of the independent variables are statistically significant and have the expected signs. The coefficient of pupil–trained teacher ratio is negative as expected, and statistically significant in most of the equations. This shows that this variable is inversely related to earnings. Earnings are high in districts where quality of education is high (i.e., where the pupil-trained teacher ratio is low). Therefore the quality of education at the primary level in a given district has some positive impact on earnings in the region.

### 3.1 Effects of Human Capital Externality on Earnings

Our first contribution in this paper is the use of district-level education attainment of workers to capture the direct effect of human capital externality on earnings. Since the male and female average human capital variables are highly correlated, we investigated their effects by including them in separate equations. At the national level, the female human capital externality has a positive statistically significant effect on earnings while the male human capital externality has a positive but insignificant effect on earnings. The estimates show that an increase in average human capital for females has a positive impact on earnings of all workers. At the national level men benefit more from the increase of female human capital than from the accumulation of their own human capital. In the rural areas male human capital externality has a negative and significant effect on earnings while female human capital externality has a positive but insignificant effect.

The effect of district level average education for males and females on earnings is positive and statistically significant for all workers in the urban areas. This suggests that in the urban areas, the supply effect of skill accumulation on wages does not dominate the demand effect. For instance, an increase in the supply of skilled men and women is accompanied by an increase in the demand for their respective labour services in such a way that the positive demand effect on wages exceeds the negative supply effect, leading to a net increase in earnings. Consequently, increasing the proportion of workers who are educated has two effects on returns to education. First, as explained in Mwabu and Schultz (2000), the marginal return to education falls as more people are educated so that the new earnings function is flatter. Second, the returns to earnings function shifts upwards such that for a given level of education, a worker earns more. We consider in greater detail the effect of human capital externalities on returns to education in the next subsection. Our results find support in Griliches' (1977) work as well as in the endogenous growth literature (Barro and Sala-i-Martin, 1995).

Next, we consider the cross effects of male human capital on female earnings and

vice-versa. At the national level, when the model is estimated on the sample of male workers, an increase in the average education of female labor force has a significant positive effect on male earnings. Also, when the model is estimated on a sample of females, an increase in the education of males has a positive but insignificant effect on female earnings. In the rural areas, the cross effect of human capital externality on earnings is insignificant.

In the urban areas, when the model is estimated on the sample of male workers, an increase in the average education of female labor force has a significant positive effect on male earnings. Also, when the model is estimated on a sample of females, an increase in the education of males has a significant positive effect on female earnings. One explanation for this result is that, ceteris paribus, if male (female) workers education increases, the demand for female (male) workers increases. The increase in the demand for male workers may be due to the fact that when female human capital increases, it increases male productivity. Also, if female earnings increase, it must be due to the demand effect originating from male human capital externalities, which increases female productivity. Thus, it appears that education levels of males and females reinforce each other in the urban labor market thereby raising productivity and wages of both sexes. Thus policies or social norms that restrict education opportunities of one group have three deleterious effects. First, such policies or norms lower earnings of the disadvantaged group. Second, since the positive externalities that would have arisen from human capital accumulation of the disadvantaged group are stifled, the full labor market productivity of the favored group is never attained. Finally, discriminatory policies have the undesirable effect of lowering average earnings and hence, the welfare of the two groups. In general, equitable public and private investment in both male and female education is justified on Pareto efficiency grounds.

## 3.2 Returns to Education

Table 1 shows returns to education at the national level and by region and gender before taking into account the effect of human capital externality. The private returns to education generally increase with the level of education. At the national level, the

rate of return to primary education is 7.7 percent, 23.4 percent for secondary education and 25.1 percent for university education.[5] Returns to education in the urban areas are higher than returns to education in the rural areas. Thus, it is more beneficial for those with formal education to work in the urban areas than in rural areas. In the rural areas, returns to university education are lower than returns to secondary education, an indication that university graduates are worse-off working in the rural than in the urban areas. Those individuals with secondary education do not lose as much as those with university education when employed in the rural areas. In general returns to college education are lower than returns to secondary and university education in the urban areas, but higher than return to secondary and university education in the rural areas.

Returns to education in the urban areas compare very well with those of previous studies (e.g., Appleton, Bigsten and Manda1999; Manda 1997).[6] It is important to note however, that our estimates of returns to education for urban areas are greater that those estimated by Wambugu (2003) for the same period. We can nevertheless among other things attribute this difference to differences in the data sets used in the two studies, as Wambugu's study uses data on employees in manufacturing firms only.

Although our estimates of private returns to education may deviate slightly from the true rates of return (due to estimation biases considered in section (2.2)), they serve as a baseline for comparing the rates of return in a specification that includes a proxy for educational externalities, which is the focus of this paper.

Table 1: Private Returns to Education (%)

| | Completed Primary | Completed Secondary | College | University |
|---|---|---|---|---|
| National | 7.7 | 23.4 | 23.6 | 25.1 |
| Urban | 9.3 | 34.4 | 26.2 | 34.8 |
| Rural | 7.8 | 21.0 | 22.4 | 14.2 |
| All males | 4.4 | 21.2 | 12.8 | 23.3 |
| Urban males | 6.1 | 25.6 | 17.9 | 30.7 |
| Rural males | 4.2 | 20.2 | 12.4 | 12.6 |

| | | | | |
|---|---|---|---|---|
| All females | 13.2 | 36.3 | 43.5 | 62.5 |
| Urban females | 6.2 | 44.9 | 28.0 | 66.0 |
| Rural females | 16.0 | 30.3 | 51.5 | 18.6 |

The returns to education for females are relatively higher than the returns to education for males both at the national and regional level. At the primary education level, the returns to primary education for females are about triple the returns for males at the national and for rural areas. In the urban areas, returns to primary education for men and women are similar. At the national level, returns to college and university education are much higher for women than for men. For instance, returns to women's college and university education are about triple that for men at the national level. Returns to college and university education are higher for women than for men in both rural and urban areas.

Generally, it is more beneficial for men with primary, secondary, college and university education to work in the urban areas than in the rural areas. On the other hand it is more beneficial for women with primary and college education to work in the rural areas while those with secondary and university education to work in the urban areas.

Tables 2 and 3 show returns to education after taking into account male and female human capital externalities respectively. First, taking into account the human capital externality generally reduces the estimated coefficients for the education dummies. However, the decline in the coefficients is not uniform across the education levels (see Tables 3A to 3F in the Appendix). The decline in the estimated coefficients at certain levels of education is much greater than for others. As a result, there are changes in the returns to education for certain levels of education.

As shown in the Tables 2 and 3, returns to education still increase with the level of education. The rate of return to university education increases while the rate of return to primary and college education declines when human capital externality is taken into account in the earnings equation. However, there is negligible change in the returns to education in the rural areas, and on secondary education when human

capital externality is taken into account. In most cases, the returns to primary education in the rural areas either increase by negligible amounts or remain about the same.

Table 2: Returns to Education Taking into Account Male Human Capital Externality (%)

| | Completed Primary | Completed Secondary | College | University |
|---|---|---|---|---|
| National | 8.0 | 23.3 | 23.8 | 24.9 |
| Urban | 9.0 | 38.3 | 23.7 | 38.7 |
| Rural | 8.6 | 20.9 | 22.8 | 14.1 |
| All males | 4.6 | 21.1 | 13.2 | 23.0 |
| Urban males | 3.9 | 26.5 | 16.8 | 35.0 |
| Rural males | 4.7 | 20.3 | 12.9 | 16.7 |
| All females | 11.9 | 37.4 | 41.5 | 61.5 |
| Urban females | 0.7 | 61.9 | 18.4 | 60.6 |
| Rural females | 17.8 | 29.0 | 51.6 | 20.9 |

Table 3: Returns to Education Taking into Account Female Human Capital Externality (%)

| | Completed Primary | Completed Secondary | College | University |
|---|---|---|---|---|
| National | 7.2 | 23.5 | 23.2 | 25.7 |
| Urban | 5.9 | 35.0 | 23.7 | 37.7 |
| Rural | 7.6 | 21.1 | 22.2 | 14.4 |
| All males | 3.8 | 21.3 | 12.4 | 24.0 |
| Urban males | 3.5 | 26.8 | 15.8 | 36.0 |
| Rural males | 4.0 | 20.3 | 12.1 | 18.8 |
| All females | 13.4 | 36.3 | 42.5 | 62.5 |
| Urban females | 1.4 | 56.7 | 22.5 | 67.8 |
| Rural females | 18.3 | 30.2 | 50.4 | 21.7 |

These results have several implications. First, previous studies on private returns to education especially in the urban areas by not taking into account human capital externalities overestimate private returns to primary and college education, and

underestimate private returns to university education, especially in the urban areas. Human capital externality can be interpreted as capturing the net benefit to an individual derived from the schooling of other individuals. Controlling for human capital externality therefore isolates this net benefit from the usual measure of the rate of return to education to give a pure private return to education. In other words, holding constant the average schooling of other workers (Tables 2 and 3), the rate of return to a year of primary education is lower than the rate obtained when there is no control for the effect of average schooling in the earnings function for urban areas (Table 1). Similarly, controlling for the effect of the average years of schooling in an earnings equation raises the private rate of return to a year of university education above that estimated without this control (Table 1). Starting with the latter case, we explain these findings as follows.

An increase in the average level of schooling of all workers, which is excluded from the earnings function reduces the scarcity premium associated with university education (Table 1). Consequently, when human capital externality is taken into account, we eliminate its effect on the scarcity premium, and as a result, the private rate of return to university education increases (Tables 2 and 3). In contrast, private returns to primary education decline when a variable that controls for the effect of human capital externality is included in the earnings regression (see Tables 2 and 3) because the beneficial effect of education of others is removed. In this case, average schooling is a complement to productivity of those with primary level education in the labour market so that when this complementarity is removed, the rate of return falls.

## 4. Conclusion

This study analyses returns to education and the associated effects of the externality of an individual's education (human capital externality) on earnings. Several OLS regressions for the entire sample, and by gender and region are estimated. The results show that human capital externality has a positive effect on earnings in the urban areas. Human capital externality can be interpreted as representing the net benefit to an individual arising from education of others. At the national level, the human

capital externality for women's education has a significant impact on earnings compared to that associated with men's schooling.

The private returns to education generally increase with the level of education. In the rural areas, returns to university education are lower than returns to secondary and college education. However, it is important to note that there are very few university graduates working in the rural areas (see Appendix Table 2). Controlling for human capital externality reduces returns to primary education but increases returns to university education in the urban areas. However, human capital externality has negligible effects on private returns to secondary education. The decline in returns to primary education in urban areas when human capital externality is taken into account reflects the decline in productivity of individuals with primary level of education when beneficial effects of education of other individuals are removed. Similarly, the increase in private returns to university education reflects the scarcity premium of workers with that level of education.

In general, the results of our analysis show that public policies that expand schooling opportunities for underprivileged social groups benefit the whole society via the externality effects of education. The benefits are in terms of improved productivity and earnings. Also, the fact that private returns to education increase with the level of education supports the current emphasis of government on free primary education. Since, the returns to college and university education are higher than for lower levels, they indicate that individuals would be willing to invest in higher education. However, since the returns come only after completing education at these levels of education, and given the fact that most Kenyans do not have resources to finance higher education, loans should be provided to those individuals who choose to pursue college and university education. Such loans should be extended especially to women since they are grossly under-represented in institutions of higher learning. However, considering the fact that Kenya's capital markets are under-developed, government role in extending or guaranteeing the loans is necessary.

## Notes

1 With the introduction of free primary education in 1974, enrolment in primary school increased by 40 percent. However, the introduction of cost sharing in education in the mid-1980s meant that parents were to spend more on textbooks, stationery, development fund, activity fees, examination fees and vacation tuitions fees, which partly led to a decline in primary school enrolment. The first decline in enrolment between 1984-85 may be attributed to the additional educational costs induced by the new educational structure and curriculum. Similarly, the second enrolment decline between 1989-90 also appears to be cost-driven and may be attributed to the re-introduction of school levies. This shows that in reality, primary education was not free. However, following the election pledges and the election of a new government in December 2002 general elections, primary education was made free and this has resulted in a big enrolment increase of about 1,500,000 additional students.

2 Potential experience is estimated here by taking age minus six years minus the number of years of education. This is based on the assumption that all individuals start schooling at age six. However, it is possible that some start school at an age earlier than six years. Also, we assume that individuals get employed immediately after completing school, which is a strong assumption, especially for women and youth who are underrepresented in the labor market.

3 Full-time workers include persons who work for all the hours of work and for all the working days as defined by the employer, except when on leave or otherwise officially away. This excludes self employed, part-time workers and casual workers. Part-time workers are employees who voluntarily work fewer hours than normal for an establishment. Casual workers are individuals who are engaged for a period not longer than 90 days and have no formal employment contract with the employer and their services can be terminated without notice. Our decision to use data on full-time employees is based on the fact that it helps eliminate the uncertainty associated with earnings for self employed, casual employees and also measurement errors in the earnings for this categories.

4 The other literature using instrumental variable approach to estimate returns to education include e.g., Uusitalo (1999) and Levin and Plug (1999) who use family background variables as instruments for education, Angrist and Krueger (1991) when estimating returns to education in the U.S use quarter of birth as an instrument. Harmon and Walker (1995) use change in minimum school leaving-age in the U.K and Card (1993) uses geographic proximity to college (the motivation being that if one is close to a college, the costs of attendance would be relatively lower and would acquire more education).

5 Using imputed data on years of education derived from the information on levels of education provided in the datasets we estimated the following

specification of the earnings equation: $\mathbf{ln(W_i) = \alpha + \beta Y_i + \beta Y_i^2 + \lambda A_i + \delta Z_i + U_i}$, where Y is the imputed years of education and W, A and Z are as earlier defined in the text. The results of the estimations are shown on Tables 4A, 4B and 4C. Comparison of returns to education at the national level, shows the private returns to education for secondary, college and university based on this specification are similar to those estimated based on equation (1) using education dummies. However, private returns to primary education using imputed years of education are higher than those based on primary education dummies. This is an indication that using primary education dummies may underestimate private returns to primary schooling. Using dummy variables for urban data only underestimates returns to primary education and overestimates returns to secondary and university education.

6 Note that comparison across studies even with data from the same country is not straightforward because of differences in data, time periods, specification of earnings functions and measurement errors. In this study we compare our private returns to education (see Table 1) with those of other studies based on data for the mid-1990s.

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APPENDIX TABLES

Appendix Table 1: Definition of variables

| Variable | Definition |
|---|---|
| Monthly earnings | Natural logarithm of monthly earnings |
| No education | 1 if an individual has no formal education, 0 otherwise |
| Incomplete primary education | 1 if an individual joined but did not complete primary education, 0 otherwise |
| Completed primary education | 1 if an individual completed primary education, 0 otherwise |
| Incomplete secondary education | 1 if an individual joined but didn't complete secondary education, 0 otherwise |
| Completed secondary education | 1 if an individual completed four years of secondary education, 0 otherwise |
| University education | 1 if an individual has university education, 0 otherwise |
| Potential experience | Number of years an individual has been working |
| Potential experience squared | The square of the number of years an individual has been working |
| Urban | 1 if an individual lives in the urban area, 0 otherwise |
| Rural | 1 if an individual lives in the rural area, 0 otherwise |
| Nairobi | 1 if an individual lives in Nairobi Province, 0 otherwise |
| Coast | 1 if an individual lives in Coast Province, 0 otherwise |
| Rift Valley | 1 if an individual lives in Rift Valley Province, 0 otherwise |
| Western | 1 if an individual lives in Western Province, 0 otherwise |
| Eastern | 1 if an individual lives in Eastern Province, 0 otherwise |
| North Eastern | 1 if an individual lives in North Eastern Province, 0 otherwise |
| Nyanza | 1 if an individual lives in Nyanza Province, 0 otherwise |
| Central | 1 if an individual lives in Central Province, 0 otherwise |
| Male | 1 if an individual is male, 0 otherwise |
| Female | 1 if an individual is female, 0 otherwise |
| Pupil/trained teacher ratio | Is the number of students per trained teacher in primary school |
| District average education for males (years) | District average years of education for men |
| District average education for females (years) | District average years of education for women |

Appendix Table 2: Descriptive Statistics-Mean

| Variable | National | Urban | Rural | Males | Females |
|---|---|---|---|---|---|
| Mean monthly earnings | 3192.2<br>(5829.1) | 4163.1<br>(7875.1) | 2939.98<br>(5137.7) | 3593.30<br>(6427.3) | 1960.56<br>(3076.5) |
| No education | 0.16 | 0.11 | 0.18 | 0.14 | 0.23 |
| Incomplete primary education | 0.28 | 0.20 | 0.30 | 0.29 | 0.26 |
| Complete primary education | 0.17 | 0.14 | 0.17 | 0.18 | 0.14 |
| Incomplete secondary education | 0.15 | 0.19 | 0.14 | 0.15 | 0.15 |
| Complete secondary education | 0.18 | 0.26 | 0.16 | 0.19 | 0.15 |
| College education | 0.04 | 0.0.06 | 0.04 | 0.03 | 0.06 |
| University education | 0.02 | 0.04 | 0.01 | 0.02 | 0.01 |
| Potential experience | 19.32<br>(9.96) | 17.35<br>(9.18) | 19.83<br>(10.1) | 20.80<br>(9.75) | 14.77<br>(9.19) |
| Potential experience squared | 472.52<br>(416.7) | 385.19<br>(368.0) | 495.21<br>(425.6) | 527.85<br>(425.4) | 302.65<br>(336.2) |
| Urban | 0.21 | - | - | 0.17 | 0.31 |
| Rural | 0.79 | - | - | 0.83 | 0.69 |
| Nairobi | 0.03 | 0.13 | - | 0.02 | 0.04 |
| Coast | 0.10 | 0.14 | 0.09 | 0.10 | 0.10 |
| Rift Valley | 0.24 | 0.21 | 0.25 | 0.24 | 0.26 |
| Western | 0.09 | 0.09 | 0.09 | 0.10 | 0.07 |
| Eastern | 0.18 | 0.16 | 0.19 | 0.18 | 0.20 |
| North Eastern | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 |
| Nyanza | 0.14 | 0.17 | 0.14 | 0.15 | 0.13 |
| Central | 0.19 | 0.07 | 0.23 | 0.20 | 0.18 |
| District average education for males (years) | 7.32<br>(1.33) | 8.13<br>(1.44) | 7.74<br>(1.28) | 7.82<br>(1.32) | 7.81<br>(1.37) |
| District average education for females (years) | 7.82<br>(1.82) | 7.56<br>(1.81) | 7.26<br>(1.82) | 7.32<br>(1.82) | 7.33<br>(1.82) |
| Pupil trained teacher ration | 36.8<br>(8.55) | 37.02<br>(8.26) | 36.81<br>(8.62) | 36.91<br>(8.58) | 36.67<br>(8.44) |
| Proportion of Males | 0.75 | 0.63 | 0.79 | - | - |
| Proportion of Females | 0.25 | 0.73 | 0.21 | - | - |
| Sample Size | 6140 | 1262 | 4878 | 4655 | 1485 |

Appendix Table 3A: Estimated Earnings Coefficients for (All Workers and Male Sub-sample)

| Variables | All Workers | | | Male Workers | | |
|---|---|---|---|---|---|---|
| | Coefficients | Coefficients | Coefficients | Coefficients | Coefficients | Coefficients |
| Constant | 6.118** (0.121) | 6.309** (0.187) | 5.869** (0.155) | 6.587** (0.138) | 6.984** (0.208) | 6.352** (0.176) |
| Potential experience | 0.093** (0.005) | 0.093** (0.005) | 0.094** (0.005) | 0.106** (0.005) | 0.106** (0.005) | 0.106** (0.005) |
| Potential experience Squared | -0.002** (0.0001) | -0.002** (0.0001) | -0.002** (0.0001) | -0.002** (0.0001) | -0.002** (0.0001) | -0.002** (0.0001) |
| Incomplete Primary Dummy | 0.195** (0.044) | 0.204** (0.044) | 0.176** (0.044) | 0.078 (0.050) | 0.096 (0.051) | 0.065 (0.051) |
| Completed Primary Dummy | 0.481** (0.050) | 0.496** (0.051) | 0.455** (0.051) | 0.286** (0.056) | 0.314** (0.057) | 0.268** (0.057) |
| Incomplete secondary dummy | 0.750** (0.052) | 0.765** (0.053) | 0.728** (0.053) | 0.517** (0.059) | 0.547** (0.060) | 0.502** (0.059) |
| Completed secondary | 1.142** (0.051) | 1.154** (0.052) | 1.118** (0.052) | 0.899** (0.058) | 0.927** (0.059) | 0.883** (0.058) |
| College dummy | 1.767** (0.077) | 1.693** (0.078) | 1.646** (0.078) | 1.225** (0.091) | 1.261** (0.092) | 1.200** (0.092) |
| University dummy | 1.702** (0.113) | 1.713** (0.113) | 1.688** (0.113) | 1.431** (0.116) | 1.451** (0.116) | 1.426** (0.116) |
| Pupil trained teacher ratio | -0.006** (0.002) | -0.007** (0.001) | -0.005** (0.002) | -0.007 (0.002) | -0.008 (0.002) | -0.006 (0.002) |
| Male Dummy | 0.586** (0.033) | 0.585** (0.033) | 0.589** (0.033) | | | |
| Urban Dummy | 0.181** (0.036) | 0.187** (0.036) | 0.172** (0.036) | 0.236** (0.042) | 0.247** (0.016) | 0.225** (0.042) |
| District Average Education for Males | | 0.019 (0.014) | | | 0.040 (0.016) | |
| District Average Education for Females | | | 0.026** (0.010) | | | 0.024** (0.011) |
| Provincial dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| Adj. R-Squared | 0.30 | 0.30 | 0.30 | 0.22 | 0.22 | 0.22 |
| No. of Observations | 6140 | 6140 | 6140 | 4655 | 4655 | 4655 |

**significant at 1%level; * significant at 5% level; Standard Errors in Parentheses

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Appendix Table 3B: Estimated Earnings Coefficients for Females Workers and Urban Workers

| Variables | Female Workers | | | Urban Workers | | |
|---|---|---|---|---|---|---|
| | Coefficients | Coefficients | Coefficients | Coefficients | Coefficients | Coefficients |
| Constant | 6.304** (0.246) | 5.733** (0.407) | 6.329** (0.094) | 5.887** (0.203) | 4.417** (0.371) | 4.968** (0.288) |
| Potential experience | 0.088** (0.010) | 0.089** (0.010) | 0.088** (0.010) | 0.087** (0.011) | 0.085** (0.024) | 0.085** (0.010) |
| Potential experience Squared | -0.002** (0.0003) | -0.002** (0.0001) | -0.002** (0.0003) | -0.001** (0.0003) | -0.001** (0.0003) | -0.001** (0.0003) |
| Incomplete Primary Dummy | 0.199** (0.094) | 0.161* (0.092) | 0.199** (0.094) | 0.285** (0.116) | 0.137 (0.119) | 0.146 (0.119) |
| Completed Primary Dummy | 0.722** (0.107) | 0.667** (0.112) | 0.727** (0.113) | 0.555** (0.126) | 0.381** (0.131) | 0.387** (0.131) |
| Incomplete secondary dummy | 1.146** (0.106) | 1.100** (0.110) | 1.150** (0.111) | 0.982** (0.121) | 0.819** (0.125) | 0.857** (0.123) |
| Completed secondary | 1.620** (0.108) | 1.528** (0.110) | 1.624** (0.115) | 1.421** (0.119) | 1.260** (0.123) | 1.263* (0.123) |
| College dummy | 2.442** (0.145) | 2.390** (0.147) | 2.447** (0.149) | 2.001** (0.159) | 1.797** (0.164) | 1.800 (0.164) |
| University dummy | 2.676** (0.374) | 2.628** (0.375) | 2.680** (0.376) | 2.120** (0.184) | 2.003** (0.185) | 2.021** (0.184) |
| Pupil trained teacher ratio | -0.007 (0.004) | -0.005 (0.004) | -0.007 (0.004) | -0.001 (0.004) | 0.001 (0.004) | 0.002 (0.004) |
| Male Dummy | | | | 0.470 (0.066) | 0.486 (0.066) | 0.481 (0.066) |
| Urban Dummy | 0.092** (0.070) | 0.072** (0.071) | 0.093 (0.070) | | | |
| District Average Education for Males | | 0.059** (0.034) | | | 0.158** (0.034) | |
| District Average Education for Females | | | -0.003 (0.069) | | | 0.109** (0.024) |
| Provincial dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| Adj. R-Squared | 0.34 | 0.34 | 0.34 | 0.41 | 0.42 | 0.42 |
| No. of Observations | 1485 | 1485 | 1485 | 1262 | 1262 | 1262 |

**significant at 1%level; * significant at 5% level; Standard Errors in Parentheses.

Appendix Table 3C: Estimated Earnings Coefficients for Rural Workers and Urban Male Workers

| | Rural Workers | | | Urban Male Workers | | |
|---|---|---|---|---|---|---|
| Variables | Coefficients | Coefficients | Coefficients | Coefficients | Coefficients | Coefficients |
| Constant | 5.973** (0.103) | 6.358** (0.155) | 5.885** (0.128) | 5.388** (0.149) | 5.388** (0.378) | 5.510** (0.318) |
| Potential experience | 0.093** (0.005) | 0.092** (0.005) | 0.093** (0.005) | 0.103** (0.013) | 0.102** (0.013) | 0.099** (0.013) |
| Potential experience Squared | -0.002** (0.0001) | -0.002** (0.0001) | -0.002** (0.0001) | -0.001** (0.0003) | -0.001** (0.0003) | -0.001** (0.0003) |
| Incomplete Primary Dummy | 0.202** (0.048) | 0.222** (0.048) | 0.194** (0.048) | 0.187 (0.148) | 0.111 (0.154) | 0.078 (0.151) |
| Completed Primary Dummy | 0.486** (0.054) | 0.522** (0.055) | 0.475** (0.055) | 0.399** (0.156) | 0.309 (0.163) | 0.269** (0.161) |
| Incomplete secondary dummy | 0.729** (0.058) | 0.766** (0.059) | 0.718** (0.059) | 0.685** (0.154) | 0.600** (0.160) | 0.591** (0.156) |
| Completed secondary | 1.096** (0.057) | 1.129** (0.058) | 1.086** (0.058) | 1.104** (0.148) | 1.019** (0.155) | 0.986** (0.152) |
| College dummy | 1.609** (0.089) | 1.650** (0.090) | 1.597** (0.090) | 1.535** (0.215) | 1.437** (0.216) | 1.386** (0.219) |
| University dummy | 1.450** (0.152) | 1.483** (0.152) | 1.446** (0.152) | 1.757** (0.199) | 1.698** (0.202) | 1.686** (0.199) |
| Pupil trained teacher ratio | -0.008** (0.002) | -0.009** (0.002) | -0.007** (0.002) | -0.006 (0.004) | -0.005 (0.004) | -0.003 (0.004) |
| Male Dummy | 0.595** (0.038) | 0.594** (0.038) | 0.5929** (0.019) | | | |
| District Average Education for Males | | -0.054** (0.016) | | | 0.072** (0.038) | |
| District Average Education for Females | | | 0.013 (0.011) | | | 0.086** (0.027) |
| Provincial dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| Adj. R-Squared | 0.26 | 0.27 | 0.26 | 0.28 | 0.28 | 0.28 |
| No. of Observations | 4878 | 4878 | 4878 | 801 | 801 | 801 |

**significant at 1%level; * significant at 5% level; Standard Errors in Parentheses.

Appendix Table 3D: Estimated Earnings Coefficients for Urban Female Workers and Rural Male Workers

| Variables | Urban female Workers | | | Rural Male Workers | | |
|---|---|---|---|---|---|---|
| | Coefficients | Coefficients | Coefficients | Coefficients | Coefficients | Coefficients |
| Constant | 6.330** (0.374) | 3.078** (0.099) | 4.781** (0.513) | 6.318** (0.184) | 6.646** (0.218) | 6.181** (0.204) |
| Potential experience | 0.084** (0.018) | 0.080** (0.018) | 0.086** (0.018) | 0.105** (0.006) | 0.105** (0.006) | 0.106** (0.006) |
| Potential experience Squared | -0.001** (0.0006) | -0.001** (0.0005) | -0.001** (0.0005) | -0.002** (0.0001) | -0.002** (0.0001) | -0.002** (0.0001) |
| Incomplete Primary Dummy | -0.009 (0.195) | -0.332 (0.196) | -0.277 (0.201) | 0.088 (0.053) | 0.107* (0.054) | 0.080 (0.054) |
| Completed Primary Dummy | 0.408** (0.219) | 0.051** (0.220) | 0.106** (0.227) | 0.288** (0.061) | 0.319** (0.062) | 0.277** (0.061) |
| Incomplete secondary dummy | 1.048** (0.203) | 0.716** (0.203) | 0.806** (0.207) | 0.522** (0.065) | 0.557** (0.066) | 0.510** (0.066) |
| Completed secondary | 1.586** (0.211) | 1.297** (0.209) | 1.290* (0.218) | 0.882** (0.064) | 0.913** (0.064) | 0.872** (0.064) |
| College dummy | 2.195** (0.246) | 1.736** (0.249) | 1.806 (0.258) | 1.200** (0.101) | 1.240** (0.102) | 1.182 (0.151) |
| University dummy | 2.677** (0.443) | 2.333** (0.430) | 2.400** (0.439) | 1.290** (0.151) | 1.319** (0.151) | 1.290** (0.006) |
| Pupil trained teacher ratio | -0.002 (0.008) | 0.0002 (0.008) | -0.0005 (0.008) | -0.007** (0.002) | -0.009** (0.002) | -0.006** (0.002) |
| District Average Education for Males | | 0.362** (0.061) | | | -0.049** (0.017) | |
| District Average Education for Females | | | 0.205** (0.048) | | | 0.019 (0.012) |
| Provincial dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| Adj. R-Squared | 0.43 | 0.47 | 0.45 | 0.20 | 0.20 | 0.20 |
| No. of Observations | 461 | 461 | 461 | 3854 | 3854 | 3854 |

**significant at 1%level; * significant at 5% level; Standard Errors in Parentheses.

Appendix Table 3E: Estimated Earnings Coefficients for Rural Male Workers

| Variables | Rural Female Workers | | |
|---|---|---|---|
| | Coefficients | Coefficients | Coefficients |
| Constant | 4.889**<br>(0.281) | 5.562**<br>(0.486) | 6.068**<br>(0.411) |
| Potential experience | 0.088**<br>(0.012) | 0.088**<br>(0.012) | 0.087**<br>(0.012) |
| Potential experience Squared | -0.002**<br>(0.0003) | -0.002**<br>(0.0003) | -0.002**<br>(0.0003) |
| Incomplete Primary Dummy | 0.232**<br>(0.103) | 0.260**<br>(0.105) | 0.279**<br>(0.106) |
| Completed Primary Dummy | 0.825**<br>(0.125) | 0.885**<br>(0.030) | 0.901**<br>(0.031) |
| Incomplete secondary dummy | 1.117**<br>(0.132) | 1.159**<br>(0.130) | 1.182**<br>(0.135) |
| Completed secondary | 1.619**<br>(0.132) | 1.654**<br>(0.133) | 1.694**<br>(0.137) |
| College dummy | 2.554**<br>(0.193) | 2.590<br>(0.194) | 2.614<br>(0.195) |
| University dummy | 2.062**<br>(0.798) | 2.143**<br>(0.799) | 2.195**<br>(0.799) |
| Pupil trained teacher ratio | -0.007<br>(0.004) | 0.009**<br>(0.004) | -0.010**<br>(0.004) |
| District Average Education for Males | | -0.071<br>(0.042) | |
| District Average Education for Females | | | -0.054<br>(0.028) |
| Provincial dummies | Yes | Yes | Yes |
| Adj. R-Squared | 0.29 | 0.29 | 0.29 |
| No. of Observations | 1024 | 1024 | 1024 |

**significant at 1%level; * significant at 5% level; Standard Errors in Parentheses.

Appendix Table 4A: Private Returns to Education (%) using imputed years of education

| Sub-sample | Completed Primary | Completed Secondary | College | University |
|---|---|---|---|---|
| National | 12.8 | 19.2 | 23.2 | 24.9 |
| Urban | 15.6 | 23.7 | 27.7 | 29.7 |
| Rural | 12.0 | 17.9 | 20.8 | 22.3 |
| All males | 10.4 | 13.0 | 21.0 | 22.8 |
| Urban males | 12.3 | 20.1 | 23.9 | 25.9 |
| Rural males | 10.0 | 16.4 | 19.7 | 21.3 |
| All females | 19.5 | 30.9 | 36.6 | 39.4 |
| Urban females | 19.6 | 33.5 | 40.4 | 43.9 |
| Rural females | 19.4 | 29.9 | 35.2 | 37.9 |

Appendix Table 4B: Private Returns to Education (%) Using Imputed Years of Education and Taking into Account Male Human Capital Externality

| Sub-sample | Completed Primary | Completed Secondary | College | University |
|---|---|---|---|---|
| National | 12.8 | 19.7 | 23.2 | 24.9 |
| Urban | 14.9 | 24.6 | 29.4 | 31.8 |
| Rural | 12.0 | 17.9 | 20.8 | 22.2 |
| All males | 10.4 | 17.3 | 20.7 | 22.3 |
| Urban males | 12.0 | 20.6 | 24.8 | 27.0 |
| Rural males | 10.1 | 16.3 | 19.4 | 21.0 |
| All females | 18.9 | 31.5 | 37.8 | 40.9 |
| Urban females | 18.0 | 34.7 | 43.1 | 47.2 |
| Rural females | 19.0 | 30.2 | 36.0 | 38.9 |

Appendix Table 4B: Private Returns to Education (%) Using Imputed Years of Education and Taking into Account Female Human Capital Externality

| Sub-sample | Completed Primary | Completed Secondary | College | University |
|---|---|---|---|---|
| National | 12.8 | 19.8 | 23.1 | 24.8 |
| Urban | 15.3 | 24.2 | 28.7 | 30.9 |
| Rural | 12.0 | 17.9 | 20.8 | 22.32 |
| All males | 10.5 | 17.4 | 20.7 | 22.4 |
| Urban males | 12.2 | 20.3 | 24.3 | 26.3 |
| Rural males | 10.0 | 16.4 | 19.5 | 21.1 |
| All females | 19.2 | 31.3 | 37.4 | 40.4 |
| Urban females | 18.6 | 34.7 | 42.7 | 46.8 |
| Rural females | 17.9 | 30.2 | 35.7 | 38.5 |