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HEALTH AND WAGES: PANEL EVIDENCE ON MEN AND WOMEN USING IV QUANTILE REGRESSION

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Abstract

Using panel data from a developing country on individuals aged 16 to 59 who reported their monthly wages, we estimated a relationship between health (nutrition) measures (i.e. height and BMI) and wages (which proxies productivity/growth). We controlled for endogeneity of BMI and found heterogeneous returns to different human capital indicators. Our findings indicate that productivity is positively and significantly affected by education, height and BMI. The return to BMI is important both at the lower and upper end of the wage distribution for men while women at the upper end of the distribution suffer a wage penalty due to BMI. Height has been a significant factor affecting men's productivity but not women. The results in general support the high-nutrition and high-productivity equilibrium story. Returns to schooling showed a declining trend as we move from lower to higher quantiles for both sub-samples. This might suggest that schooling is more beneficial for the less able. In addition, the returns to schooling of women are higher than men. The results have important implications for policy making in the form of nutrition interventions and targeted education on women.

Key Words: height, BMI, schooling, heterogeneity, endogeneity, quantile, IV
JEL Classification: C23,I12, J24, O12

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1. Introduction

This study is aimed at estimating the productivity impacts of different dimension of human capital investment in poor economy context from a microeconomic perspective. The innovative aspect of the paper lies in addressing the potential endogeneity of the health indicator used in the different econometric specifications estimated. We also shed some light on some interesting and policy relevant questions such as; *i.) Are returns to human capital (schooling, height and BMI) homogenous across the population? ii.) Do schooling returns depend on gender and the location of the individual in the wage distribution? and iii.) Do physical attractiveness (as captured by height and BMI) attract wage penalty or premium for men and women in the Ethiopian urban labour market?* iv) *What are the policy implications of our findings?* We attempt to give some answers to these and other related questions using an instrumental variables (IV) quantile regression framework which we fitted to our unique and rich panel data. We draw on a vast array of health, clinical nutrition, labour, development, social psychology and educational psychology literature to interpret our results.

There is a huge collection of literature using data from developing countries that estimates and demonstrates the substantial labour markets returns associated with schooling. Often, other dimensions of human capital such as health are ignored in the Mincerian regression models fitted to data from these countries. Most studies that attempt to link wages with height and BMI have been done using data from developed countries. And this literature focuses on the labour market discrimination experienced by individuals with undesirable physical attributes, such as being short and/or overweight or obese (Baum II and Ford, 2004). Case and Paxson (2008) argue that taller people earn more not only because they hold higher status jobs but because they are smarter while Cawley (2004) reported the wage penalties faced by white females due to weight.

In developing countries, the literature focuses on the impact of past and current nutritional investments (i.e. height and BMI respectively) on productivity mainly in the context of household data sets collected from rural areas. There is little work in urban data sets from developing countries (Thomas and Strauss, 1997) and none for Ethiopia.

Therefore, we will contribute to the existing literature by estimating the wage equations by controlling for schooling, height, BMI and other relevant variables for Ethiopia. In addition, we will make econometric estimation improvements by handling controversial simultaneity (endogeneity) issues and report heterogeneous returns to investments in schooling, height and BMI. We improve existing schooling returns measures by considering other dimensions of human capital investment (i.e. nutritional investments as captured by Height and BMI) which are often ignored in the literature. We adopt instrumental variables (IV) quantile regression model using a panel data collected in 4 waves from urban centres of Ethiopia in 1994, 1995, 1997 and 2000.

We found that productivity is positively and significantly affected by education, height and BMI. The return to BMI is important both at the lower and upper end of the wage distribution for men while women at the upper end of the distribution suffer a wage penalty due to BMI. Height has been a significant factor affecting men's productivity but not women. The results in general support the high-nutrition and high-productivity equilibrium story. Returns to schooling showed a declining trend as we move from lower to higher quantiles for both sub-samples. This might suggest that schooling is more beneficial for the less able. In addition, the returns to schooling of women are higher than men. The results have important implications for policy making in the form of nutrition interventions and targeted education on women.

The remainder of the paper is organised as follows. Section 2 briefly discusses the link between nutrition and productivity followed by a review of the empirical literature in section 3. Section 4 gives a theoretical motivation for the estimating equation. Sections 5 and 6 describe the data and the estimation results respectively. Then the paper concludes.

2. Nutrition and productivity

The specific way in which the poor participate in growth tends to be through a productive use of “their most abundant asset”, labour (Kanbur and Squire, 1999). The link between human development and economic growth can be ascertained if one finds a robust and significant relationship using data on nutrition, health and wages. Therefore, identifying factors that significantly affect productivity is crucial to assist the intellectual effort that attempts to understand the mechanism through which human capital investment at the household level contribute to overall economic growth.

The link between productivity and consumption and its impact on productivity (wages) has been explored, among others, by Leibenstein (1957), Stiglitz (1976), Mirrlees (1976), Bliss and Stern (1978) and Svedberg (1988) and is now commonly referred to as ‘efficiency wage theory’. In a recent survey, Deaton (2003) pointed out that the nutritional wage model provides an account of how inequality affects both health and earnings while explicitly recognising that health and earnings are simultaneously determined. Dasgupta (1993) argued that nutritional wage models can account for persistent poverty and destitution in poor countries.

Among economists, there is a consensus that recent periods of sustained growth in total factor productivity (TFP) are dependent on improvements in a population’s nutrition, health, education and mobility (Shultz, 1997). The investigation of the link between nutrition and productivity is useful to the study of poverty and inequality. Dasgupta (1997) shows the mechanism by which inequality determines malnutrition through the nutrition-productivity link. Therefore, a careful estimation of the link by addressing some of the key empirical issues contributes towards a deeper understanding of the link and provides insight to policy making.

A non-convex relationship between labour supply and consumption underlies the argument about the link between nutrition and productivity on the one hand and the persistence of poverty on the other. Due to this non-convexity multiple equilibria are possible. At the lower end of this spectrum of equilibria lies a low nutrition-low productivity point. At the other extreme lies the high nutrition-high productivity equilibrium where people enjoy high levels of productivity and better nutrition. Because of the fixed requirements, individuals could be trapped in the low equilibrium point where they stay poor.

Those who have access to non-labour income can secure some level of consumption while the poor require employment to finance the same level of consumption. The quality of labour that is supplied depends upon the level of caloric consumption. From the employers point of view, hiring the poor is therefore expensive, because the poor require a wage high enough to be able to consume what is required for basic metabolism rate-BMR- (Dasgupta, 1993) plus additional amounts needed to undertake external work.

3. Empirical Literature

It is theoretically conceivable and empirically supported to state that investments in nutrition and health increase the lifetime productivity of individuals and thereby contribute to economic growth and hence lower poverty (Shultz, 1997). If a worker is healthier, less susceptible to disease and more alert and more energetic, then he or she will probably be more productive and command higher earnings (Thomas and Frankenberg, 2002).

Macro and micro level nutrition-health-productivity links have been extensively investigated over the years using data from developing countries. One of the established links between investment in human capital and its impact on increases in productivity is based on examining farm level data (Strauss, 1986; Deolalikar, 1988; Haddad and Bouis, 1991).

There have been similar attempts using household survey data from rural Ethiopia (Ayalew, 2003; Croppenstedt and Muller, 2000; Kim et al, 1997). Croppenstedt and Muller (2000) estimated the impact of health and nutritional status on the efficiency and productivity of cereal growing Ethiopian farmers. They reported that both indicators of health (measured in travel time to the daily source of water) and nutrition (measured in terms of weight for height of the household head) have significant effects on farm production. Since they used cross-sectional data all the limitations identified by Strauss (1986) apply to their study. Ayalew (2003) went one step further by using a panel data set collected from the same rural localities investigated by Croppenstedt and Muller (2000).

Except for few applications in developing countries, most studies ignored the impact of nutrition and health on productivity of urban residents (Thomas and Strauss, 1997; Kedir, 2008). To the best of our knowledge, in Ethiopia no study has shown how investments in nutrition (health) affect productivity of individuals for urban households. There is a recent effort to estimate earnings functions with a focus on uncovering heterogeneous private returns to schooling without controlling for health indicator variables (Girma and Kedir, 2005).

Most studies that attempt to establish the relationship between labour productivity and nutrition are contaminated by simultaneity between calorie intake and labour productivity. The causation of the relationship could go in either direction. Variables that affect earnings or production affect nutrition consumption via the associated effect on income in which case consumption is rendered endogeneous (Ayalew, 2003). Body mass index (BMI) affects the current productivity of the individual, particularly at low levels of calories and for energy-demanding tasks. This indicator of nutritional status among adults, as argued by Shultz (1997), should be treated as simultaneously determined with increased current expenditures on nutrition and the performance of more demanding jobs. Finding unbiased estimates of the one-directional effect of improved adult nutrition on wage productivity requires valid instruments that predict current BMI.

Using data from rural Sierra Leone, Strauss (1986) tried to address the potential simultaneity problem using an instrumental variables (IV) estimation technique. The study found a statistically significant effect of calorie intake on farm productivity. To allow for heterogeneity in returns to human capital investment, we estimate quantile regression equations controlling for endogeneity of our human capital variables. A quantile regression framework allows variations of the returns to investments in nutrition and health at different quantiles of the earnings distribution (Koenker and

Basset, 1978). Specifically, we follow a 2-stage quantile regression approach. Since instrumental variable estimation within a quantile and panel framework is a non-trivial problem, the variance-covariance matrices of the resulting estimates are obtained using bootstrapping techniques.

4. Theoretical Motivation and Methodology

Most studies find that growth as captured by the growth rate of per capita GDP across countries is positively correlated with schooling (Bils and Klenow, 2000; Benhabib and Spiegel, 1994; Barro, 1991). To show the link from schooling to growth ignoring other dimensions of human capital, it is possible to start with production technologies without assumptions about preferences or capital markets.

Suppose we have an economy with the following production technology (Bils and Klenow, 2000),

$$Y(t) = K(t)^{\alpha}[A(t)H(t)]^{1-\alpha} \qquad (1)$$

Where Y is the flow of output, K is the stock of physical capital, A is a technology index, and H is the stock of human capital. The aggregate stock of human capital is the sum of the human capital stocks of working individuals[2] in the economy. Often, the only human capital variable considered is schooling which is responsible to produce knowledge, ideas and skills. Later, we will show how we can augment the estimating equation by including other dimensions of human capital using observable nutrition measures.

If individuals in cohort a go to school from age 0 to s and work from s to T, the human capital stock in the economy can be written as;

$$H(t) = \int_{s}^{T} h(a,t)L(a,t)da \qquad (2)$$

Based on extensive labour literature and the empirical work on earnings equations[3], suppose the human capital function of cohort a is given by;

[2] In our case, individuals aged 16 to 59.
[3] Extensive wage regression results show that, among other things, the log of wages is related to years of schooling and labour market experience.

$$h(a,t) = e^{f(s)+g(a-s)} \qquad (3)$$

The exponential portion shows the role of years of schooling (s) and labour market experience (a-s)[4] in human capital formation. It is postulated that f'(s)>0 and g'(a-s)>0. A parameterisation of eq(3) is required to arrive at an estimating equation in the Mincerian tradition by taking logs. Thus, we have,

$$\ln h(a,t) = f(s) + g(a-s) \qquad (4)$$

Let

$$f(s) = \theta(s)$$
$$(a-s) = \gamma_1(E) + \gamma_2(E)^2$$

Then, eq(4) will be

$$\ln h(a,t) = \theta s + \gamma_1(E) + \gamma_2(E)^2 \qquad (5)$$

Since the human capital stock of each individual brings private wage gain, the parameters θ, γ_1 and γ_2 can be obtained from a Mincerian wage equation of the form (including time and person subscripts):

$$\ln w_{it} = \alpha + \theta s_{it} + \gamma_1(E_{it}) + \gamma_2(E_{it})^2 + u_{it} \qquad (6)$$

Due to the panel nature of our data, we can control for unobserved individual heterogeneity (say v_i) in eq(6) as;

$$\ln w_{it} = \alpha + \theta s_{it} + \gamma_1(E_{it}) + \gamma_2(E_{it})^2 + v_i + \varepsilon_{it} \qquad (7)$$

Equation (7) is restrictive because it omits other important dimensions of human capital mainly the ones that indicate past and current nutrition investments such as height and BMI[5]. Height and BMI are important anthropometric indicators of health of individuals.

To motivate our empirical work, in the remaining part of this section we will show formally the importance of accounting for this omission. First, we start with a simple linear function of the form where the only control variable affecting the wage of individual i is schooling, s:

$$w_i = \theta s_i + \mu_i \qquad (8)$$

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[4] Often, experience is proxied indirectly by a-s-6. However, we directly observe it in our application.

[5] BMI is defined as weight divided by the square of height measured in meters. Some have just focused on it to shed light on the impact of obesity in developed economies on wage outcomes (Baum II and Ford, 2004).

All other relevant regressions are grouped in the unobservable, μ. The parameter estimate of θ will be biased if we have another determinant of wage which is correlated with schooling, s. Suppose we have height (h) as an omitted variables. We argue that height is correlated with schooling, i.e. $\text{cov}(s_i, h_i) \neq 0$. This is reasonable in light of existing literature which attempts to link height with cognitive ability. In fact, the precise link between height and cognition (and hence schooling) is not well understood yet. But studies on determinants of cognition suggest an important role for nutrition which is the mechanism for the connection (Kretchmer et al, 1996). Ignoring other regressors, we have

$$\mu_i = bh_i + e_i \qquad (9)$$

Where e_i is the idiosyncratic error uncorrelated with height. Dropping the subscript i, the probability limit of the OLS estimate of the returns to schooling is given as,

$$p\lim\hat{\theta} = \theta + p\lim(s's)^{-1}s'\mu = \theta + b\sigma_{hs} / \sigma_s^2 \qquad (10)$$

where $\sigma_{hs} = \text{cov}(h_i, s_i)$ and $\sigma_s^2 = \text{var}(s_i)$. Height is observed and if omitted our estimate, $\hat{\theta}$, will be overestimated and the bias $(\hat{\theta} - \theta)$ is $b\sigma_{hs} / \sigma_s^2$.

However, there is also another complication we would like to carefully consider here. This is due to the potential correlation of height with other productive attributes of individuals in the labour market of a developing economy such as Ethiopia. For instance, physical strength is an attribute with important labour market outcomes in poor societies and it is often captured by BMI. It is reasonable to say that the height premium in wages reflects the reward for physical health and productivity. Thus, eq (9) can take the form:

$$\mu_i = b_h h_i + b_w w_i + e_i \qquad (11)$$

So the vector μ_i should include both of our nutritional investment indicators height (h) and weight (w) (as captured by BMI). If both of these variables are omitted the probability limit of the estimate of the returns to schooling in eq(8) will be,

$$p\lim\hat{\theta} = \theta + [\frac{b_h\sigma_{hs} + b_w\sigma_{wh}}{\sigma_s^2}] \qquad (12)$$

Because taller individuals are more likely to be heavier, it is possible that $\sigma_{wh} \neq 0$. Therefore, the illustration from eq(8) to (12) indicates that eq(7) should look like as follows,

$$\ln w_{it} = \alpha + \theta s_{it} + \gamma_1 (E_{it}) + \gamma_2 (E_{it})^2 + \delta(h_{it}) + \phi(w_{it}) + v_i + \varepsilon_{it} \qquad (13)$$

with $\delta > 0$ and $\phi > 0$ [6]. We estimate (13) using Generalised Two Stage Least Squares (G2SLS) random effects (RE) IV regression. This RE estimator is equivalent to,

$$\begin{aligned}&(\ln w_{it} - \varphi \ln \bar{w}_i) = (1-\varphi)\alpha + \theta(s_{it} - \varphi \bar{s}_i) \\ &+\gamma_1 (E_{it} - \varphi \bar{E}_i) + \gamma_2 (E_{it} - \varphi \bar{E}_i)^2 + \delta(h_{it} - \varphi \bar{h}_i) \\ &+\phi(w_{it} - \varphi \bar{w}_i) + (1-\varphi) v_i + (\varepsilon_{it} - \varphi \bar{\varepsilon}_i)\end{aligned} \qquad (14)$$

Where φ is a function of σ_v^2 and σ_ε^2. If $\sigma_v^2 = 0$, meaning the unobserved heterogeneity term, v_i is always 0, $\varphi = 0$ and eq(13) can be estimated by OLS directly. Alternatively, if $\sigma_\varepsilon^2 = 0$, meaning ε_{it} is 0, $\varphi = 1$ and the within estimator returns all the information available. The RE estimator uses both the within and between information and produces more efficient results. The attraction of this estimator is that it takes account of the effects of both observed and unobserved effects that affect individual wages. It is appropriate because unobserved heterogeneity is best characterised as randomly distributed. In our context, individuals vary in their marital status, gender, culture, religion and ethnic background. Therefore, it is not unreasonable to assume that unobserved differences between our sampled individuals are randomly distributed. In our application, we account for potential endogeneity of BMI and heterogeneity of returns to s, h and BMI.

As argued above, we do not use the Ordinary Least Squares (OLS) estimator because it neither allows parameter heterogeneity nor corrects for endogeneity of regressors. The following gives a brief overview of the econometric framework underlying the final quantile-specific parameter estimates.

[6] Note that equation(13) includes other conventional determinants of wage such as age, age squared, location and other relevant variables.

Let y_i denote the log of monthly wage/salary of individual i measured in Ethiopian birr and let X be the vector of regressors which consists of health indicators, nutrition, schooling and the full set of gender, ethnicity and location dummies. The θ^{th} quantile of the conditional distribution of y_i given X is specified as:

$$Q_\theta(y_i \mid X) = \alpha(\theta) + X_i'\beta(\theta), \quad \theta \in (0,1). \tag{15}$$

where $Q_\theta(y_i \mid X)$ denotes the quantile θ of log wage conditional on the vector of regressors. Following Koenker and Basset (1978), the θ^{th} quantile estimator can be defined as the solution to the problem:

$$\min_\beta \frac{1}{n}[\sum_{i:y_i \geq x'\beta} \theta|y_i - X_i'\beta_\theta| + \sum_{i:y_i \prec x_i'\beta}(1-\theta)|y_i - X_i'\beta_\theta|] = \min_\beta \frac{1}{n}\sum_{i=1}^{n}\rho_\theta(u_{\theta i}) \tag{16}$$

where $\rho_\theta(.)$ is known as the 'check function' and is defined as $\rho_\theta(u_{\theta i}) = \theta u_{\theta i}$ if $u_{\theta i} \geq 0$ and $\rho_\theta(u_{\theta i}) = (1-\theta)u_{\theta i}$ if $u_{\theta i} < 0$. The minimisation problem can be solved by using linear programming methods (Buchinsky, 1998). Like standard OLS estimates, a quantile regression estimate can be interpreted as the partial derivative with respect to a particular regressor at the relevant quantile.

Due to the endogeneity of BMI, we used instrumental variables (IV) RE panel estimator. The next few paragraphs discuss our justification for the use of instrumental variables (IV) estimator. To demonstrate parameter heterogeneity, we also used a quantile regression model to estimate the underlying wage equation.

In the model developed by Becker (1964) and extended by Grossman (1972), it is suggested that health must be treated as an endogenous choice. In principle, the stock of education is also determined by endogenous choices. But education is often treated as predetermined since optimal investment profile dictates that most investment should occur early in the lifecycle (Weiss, 1986). But for health, it is different and this is because workers typically start with a large health endowment that must be continuously replenished as it depreciates and many investments in health occur later in life. Thus, the endogeneity of health may be a greater potential source of bias or measurement error than the endogeneity of education (Currie and Madrian, 1999).

There are convincing arguments why we should instrument health (i.e. BMI) in our case. First, exogenous changes in wages can influence health by affecting the probability of stress and risk-taking behaviour, by changing the opportunity costs of investments in health capital or by changing the return to health. In this case, the health measure may be correlated with the error in the structural (i.e. wage) equation, suggesting that health needs to be treated as an endogenous choice. Second, wages can affect investments in health just as they affect other human capital investment decisions (Willis and Rosen, 1979).

Therefore, our estimation (which is in two stages) is conducted in a framework of instrumental variables quantile regression using panel data from urban households. This framework allows for the endogeneity of human capital investment and possible heterogeneity in the impact of this investment. The human capital variables that is strongly suspected to be endogenous as argued in the literature is the Body Mass Index (BMI) and in our reported results we have used location and lagged values of BMI to instrument BMI. We argue that location can be a good proxy for food prices, disease environment and health infrastructure which are the variables indicated to be potential instruments for BMI (Currie and Madrian, 1999). Due to the predetermined nature of our schooling variable as discussed above, we have considered the variable as exogenous.

5. Data

This paper examined the returns to human capital investments for a sample of wage employed individuals in the age range from 16 to 59. Our reported regression results are based on the final set of individuals after we lost 15% of the original sample due to panel attrition._This study is based on urban household panel data for 1994, 1995, 1997 and 2000 which was collected by the Department of Economics of Addis Ababa University (Ethiopia) in collaboration with Department of Economics of Gothenburg University (Sweden) and Michigan State University (USA).

The survey covers 1500 households in each round, with the intention to resurveying the same households and individuals in subsequent rounds. In each round, household and individual level information were collected over a period of four successive weeks covering seven major cities in Ethiopia – Addis Ababa (the capital), Awassa, Bahar Dar, Dessie, Diredawa, Jimma and Mekele. The sample of households surveyed is intended to be representative of the main socio-economic characteristics of the cities. The total sample was distributed over the selected urban centres proportional to their populations, based on the CSA's (Central Statistical Authority) 1992 population projections.

For our application, we use individual data on monthly wage/salary, age, experience, location, years of schooling completed, height, BMI and other relevant explanatory variables such as the sector of employment. Unlike the experience variable, the years of schooling variable is not directly observed but is constructed by converting the reported schooling cycles completed. As is common in many anthropometric surveys, data on height and weight are subject to reporting error. We cleaned the data by removing prohibitively high values of height and weight.

6. Results

As discussed earlier, we have instrumented the BMI variable using a location dummy and lagged values of BMI. In the estimation, we first consider a linear IV regression which fits a model for the endogenous variable - BMI. What our estimator does is to model BMI as a function of all regressors plus location as an instrument which is equivalent, in principle, to a two stage least squares estimator but here in a panel context. Therefore, we used the RE IV panel estimator, in the first stage, to estimate the endogenous regressor (BMI). In the second stage we used quantile regression on the exogenous and the predicted (endogenous) variable in the structural equation. Because standard errors might be biased due to clustering, we followed bootstrapping which gives consistent standard error both in the first and second stages of estimation.

Table 1 presents the G2SLS RE IV estimates on the relationship between the logarithm of monthly wage and schooling, BMI, height and other important regressors. The results are reported for all individuals aged 16-59 as well as for men and women sub-samples. For men, women and the full sample, schooling, BMI, height, age and experience are positively associated with wage and all the coefficients are significant except BMI for women. According to the reported results, one extra years of schooling brings a higher return for women (10.8%) than men (7.5%) while an increase of height by 10 cm brings a higher return for men (18.5%) than women (14.2%). As expected, wage increases with age and experience. The values of σ_v and σ_ε are non-zero and this justifies our choice of a RE estimator. The instruments - lagged BMI and location - are valid according to the chi-squared statistic reported and the associated p-value. It is worth commenting on the magnitude of the returns to schooling which is overestimated in an earlier related work compared to our estimate here which control for other dimensions of human capital (see Girma and Kedir, 2005).

Table 1: G2SLS Random Effects IV Estimates, 16-59, 1994-2000

Variable	*Male*	*Female*	*Full sample*
Years of schooling	0.075 *** (0.009)	0.108*** (0.011)	0.092*** (0.007)
BMI	0.068** (0.031)	0.027 (0.033)	0.047** (0.024)
Height in meters	1.846*** (0.615)	1.429** (0.666)	1.929** (0.397)
Ln(age)	2.820* (1.730)	-0.160 (1.112)	0.013 (0.832)
- squared	-0.301 (0.243)	0.102 (0.171)	0.095 (0.121)
Ln(experience)	0.073** (0.028)	0.140*** (0.041)	0.101*** (0.023)
- squared	0.003 (0.009)	0.006 (0.014)	0.003 (0.008)
σ_v	0.567	0.710	0.629
σ_ε	0.613	0.591	0.608
Overidentification ($\chi^2_{(1)}$, p-value)	0.233 (0.629)	2.005 (0.157)	0.766 (0.381)
Observations	1062	674	1736

Notes:

(i) *Standard errors in parentheses;*

(ii) ** significant at 10%; **significant at 5%; *** significant at 1%; and*

Table 1 addresses the endogeneity of BMI but reports returns to human capital as if they are homogenous across the population. It is reasonable to argue that unobserved factors induce heterogeneity in the distribution of earnings conditional on education and nutrition investments through their effect both on the intercept and the slope coefficients. In this case, the labour market cannot be well characterised by a single rate of return to human capital investments. Therefore, in tables 2 to 4, we present regression quantiles which provide a more flexible approach to characterising the effect of education, height, BMI...etc on different percentiles of the conditional wage distribution.

Table 2: Quantile Regression Estimates, Male 16-59, 1994-2000

Variable	***25th quantile***	***50th quantile***	***75th quantile***	***90th quantile***	***95th quantile***
Years of schooling	0.083*** (0.009)	0.087*** (0.008)	0.073*** (0.007)	0.070*** (0.011)	0.059*** (0.015)
BMI	0.063** (0.027)	0.045* (0.027)	0.090*** (0.022)	0.092*** (0.033)	0.083 (0.088)
Height (m)	1.881*** (0.528)	1.533*** (0.553)	2.200*** (0.504)	1.610** (0.741)	2.351* (1.234)
Ln(age)	6.073*** (2.167)	4.508*** (2.267)	-1.628 (1.649)	-7.738** (3.022)	-9.579*** (4.010)
-squared	-0.795*** (0.305)	-0.564* (0.321)	0.296 (0.227)	1.191*** (0.440)	1.485** (0.572)
Ln(experience)	0.147*** (0.467)	0.098*** (0.036)	0.018 (0.038)	-0.008 (0.039)	0.019 (0.062)
-squared	0.023* (0.013)	0.019* (0.011)	0.014 (0.012)	-0.008 (0.013)	-0.024 (0.017)
Observations	1062	1062	1062	1062	1062

Notes:

(i) Bootstrapped Standard errors in parentheses;

*(ii) * significant at 10%; **significant at 5%; *** significant at 1%; and*

Table 3: Quantile Regression Estimates, Female 16-59, 1994-2000

Variable	*25th quantile*	*50th quantile*	*75th quantile*	*90th quantile*	*95th quantile*
Years of schooling	0.136*** (0.015)	0.114*** (0.011)	0.102*** (0.010)	0.080** (0.014)	0.056*** (0.018)
BMI	0.024 (0.030)	0.016 (0.024)	0.003 (0.027)	-0.060* (0.033)	-0.073* (0.038)
Height (m)	0.890 (0.793)	0.714 (0.459)	0.850* (0.520)	-0.269 (0.871)	0.991 (1.152)
Ln(age)	1.569 (3.679)	-0.477 (2.918)	0.401 (1.652)	-1.100 (2.369)	-0.816 (2.190)
-squared	-0.141 (0.542)	0.152 (0.420)	-0.003 (0.239)	0.299 (0.368)	0.204 (0.349)
Ln(experience)	0.223*** (0.066)	0.147** (0.058)	0.870** (0.040)	0.101*** (0.034)	0.158*** (0.042)
-squared	0.007 (0.022)	0.027 (0.017)	0.029** (0.014)	-0.014 (0.019)	-0.019 (0.022)
Observations	674	674	674	674	674

Notes:

(iii) Bootstrapped Standard errors in parentheses;

*(iv) * significant at 10%; **significant at 5%; *** significant at 1%; and*

Like the IV estimates, the quantile regression results in tables 2 and 3 show positive and significant returns to schooling, height and BMI for men. For women, schooling brings higher returns than men except at the 95th quantile. This might indicate to the fact that policy makers can use education as a tool to reduce gender income inequality. There is also another interesting pattern emerging which is worth discussing. There is a uniform declining trend in returns to schooling both for men and women as we move to higher quantiles. This suggests that schooling is more beneficial to the less able men and women. It is conceivable to think that the workers receiving low wage are more likely with primary or some secondary schooling and those earning higher wages are more likely the ones with completed secondary and higher education. Therefore, our results support the view that educational investment should focus on lower levels of education than tertiary education.

The declining returns also uncover the diminishing returns to educational investments. Meaning in poor economies such as ours there is less educational investment per worker (relative to the long run desirable educational investment per worker). In such a society, education tends to have higher returns and higher growth rates for each extra unit of educational investment. The results suggest for an increased investment in education at all levels especially with a targeted allocation to those individual with limited means of financing educational expenditure. Countries that heavily invest in education will not run out of ideas and continue to grow (Aghion and Howitt, 1992).

When we consider BMI, it is significantly and negatively associated with wage only at the upper quantiles for women. In particular, at the 95^{th} quantile, for women the wage penalty associated with being heavy is stronger than the wage premium associated with extra years of schooling. The opposite is true for men. Except at the 75^{th} quantile, women do not seem to enjoy a height premium as men do. This confirms the social-psychological evidence which emphasises the importance of height primarily among men (Jackson et al. 1995). There are also some unexpected results such as the positive and significant coefficient for the square of the logarithm of age in the upper quantiles for men and the square of the logarithm of experience at the 75^{th} quantile for women.

Table 4: Quantile Regression Estimates, Full Sample 16-59, 1994-2000

Variable	***25^{th} quantile***	***50^{th} quantile***	***75^{th} quantile***	***90^{th} quantile***	***95^{th} quantile***
Years of schooling	0.105*** (0.007)	0.104*** (0.006)	0.089*** (0.005)	0.0745*** (0.008)	0.065*** (0.013)
BMI	0.052*** (0.018)	0.024 (0.022)	0.046*** (0.016)	0.042 (0.027)	0.002 (0.058)
Height (m)	1.749*** (0.402)	1.505*** (0.386)	1.873*** (0.293)	1.239** (0.509)	1.401 (0.898)
Ln (age)	4.354*** (1.552)	0.311 (1.527)	-2.539** (1.272)	-4.996** (2.349)	-6.301** (2.520)
- squared	-0.538** (0.223)	0.037 (0.212)	0.435** (0.175)	0.808** (0.341)	1.027*** (0.360)
Ln (experience)	0.166*** (0.034)	0.115*** (0.033)	0.072** (0.035)	0.041 (0.029)	0.069 (0.046)

- squared	0.019* (0.011)	0.020** (0.009)	0.013 (0.009)	-0.009 (0.010)	-0.027** (0.012)
Observations	1736	1736	1736	1736	1736

Notes:

(v) Bootstrapped Standard errors in parentheses;

*(vi) * significant at 10%; **significant at 5%; *** significant at 1%; and*

When we consider the full sample (Table 4), the declining trend of the returns to schooling coefficient is maintained as found in the two sub-samples. BMI is positively and significantly linked to wage at two of the quantiles (i.e. 25^{th} and 75^{th}). Without any systematic pattern, height is also positively and significantly linked to wages except at the 95^{th} quantile and this finding might be driven by the fact that men constitute 61.2% of the total sample of working individuals. We also found unexpected significant coefficients for the age, its square and the square of experience.

Conclusion

This study provided evidence for the presence of a significant high-nutrition and high-productivity equilibrium using panel data on individuals from urban Ethiopia. In agreement with evidence elsewhere in the developing world, we got significant returns to schooling investment but the returns fall as we move to higher quantiles of the wage distribution. The returns for women are found to be higher than the ones for men and this has an important policy implication. Provision of education for all can be promoted but especially so for women.

In agreement with the social psychology literature, we found that height is more significant for men than women. Height is a cumulative measure reflecting both investment in nutrition during one's life (mostly as a child) and also, possibly, non-health human capital investment (Thomas and Strauss, 1997). Hence, our findings can be used to highlight the importance of improving children's nutrition from a policy point of view as it has productivity implications when children are adults.

The wage penalty associated with BMI for women might be an indication of labour market discrimination on the basis of attractiveness. However, BMI has been found to be positive and significant for men at all levels of the wage distribution except the last quantile. This strongly shows the importance of current nutritional status or current bodily strength for individuals earning lower wages. In terms of potential policy implications, improving access to food (e.g. food price subsidies) in the current climate of global food price hikes seems an urgent priority.

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