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**The Formation of Human Capital and
the Economic Development of Africa:
Returns to Health and Schooling
investments**

by

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The views and interpretations in this paper are those of the author
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ABSTRACT

This paper first outlines a framework within which to assess the contribution of health and schooling to increasing individual and aggregate income, as well as the possible feedback of increasing income on the demand for human resources. It then evaluates how African countries have fared from 1970 to 1985 in terms of survival and schooling, compared with other countries, to place in perspective areas of achievement and the aggregate composition of human capital formation in the African region. Several microeconomic studies are then described in more detail that illustrate the magnitudes of private returns to health and schooling in West Africa, some of the consequences of the rationed supply of schooling in South Africa, and evidence of returns to the quality of schooling. The concluding section extracts lessons as to how to conduct country-specific research based on merged household and community surveys to estimate the key parameters describing the private and social returns to marginal investments in health, education, and mobility.

RESUME

L'article fixe d'abord le cadre dans lequel doit s'évaluer la contribution de la santé et de l'enseignement à l'accroissement du revenu individuel et global ainsi que la rétroaction de l'accroissement du revenu sur la demande de ressources humaines. Il évalue ensuite le comportement des pays africains de 1970 à 1985 en termes de survie et de scolarité par rapport à d'autres pays pour mettre en relief les domaines de réussite et la composition globale de la formation du capital dans la région Afrique. Plusieurs études microéconomiques sont ensuite décrites de façon plus détaillée, montrant l'importance du rendement privé de la santé et de l'éducation en Afrique de l'Ouest, quelques conséquences du rationnement de l'enseignement en Afrique du Sud et la preuve du rendement de la qualité de l'éducation. L'auteur de l'article, en conclusion, tire quelques leçons de la manière de mener la recherche par pays en fonction des enquêtes faites auprès des ménages et des collectivités locales pour évaluer les paramètres essentiels du rendement privé et social de l'investissement marginal réalisé dans la santé, l'éducation et la mobilité.

Introduction

This paper first outlines a framework within which to assess the contribution of health and schooling to increasing individual and aggregate income, as well as the possible feedback of increasing income on the demand for human resources. It then evaluates how African countries have fared from 1970 to 1985 in terms of survival and schooling, compared with other countries, to place in perspective areas of achievement and the aggregate composition of human capital formation in the African region. Several microeconomic studies are then described in more detail that illustrate the magnitudes of private returns to health and schooling in West Africa, some of the consequences of the rationed supply of schooling in South Africa, and evidence of returns to the quality of schooling. The concluding section extracts lessons as to how to conduct country-specific research based on merged household and community surveys to estimate the key parameters describing the private and social returns to marginal investments in health, education, and mobility. Although country-specific studies of the individual returns to human capital could improve public policies, there is also a need to incorporate the effects of macroeconomic policies in the African region. The micro returns observed in recent years may change substantially as structural changes open hitherto protected economies to the opportunities and discipline of international trade, and deregulated economies reward more highly efficiency and innovation that some types of human capital facilitate. High micro level returns to human capital are a good indicator that the existing economic institutions place a high value on these assets, but low micro returns measured within a previous set of

economic institutions may not portray their scarcity value in a new institutional system. Methods are needed for combining basic micro survey evidence on human capital returns with macro plans for policy reforms. Until these new methods for combining micro and macro evidence, national and international agencies may be reasonably advised to rely on existing micro indicators of scarcity if they want to more efficiently create additional human capital and more effectively allocate existing stocks in Africa.

The Demand for Human Capital and its Effect on Wages

Most studies of human capital in the last half century have sought to interpret the relationship estimated at the individual level between the wage rate and schooling (and health status) as a measure of the private productive return to the supply of educational (and health) human capital that individuals, families, and society create through their economic investments. But the more general problem that development agencies and governments need to address is what factors determine the household investment demands (I) for the services of human capital. The economic determinants of these demands would typically include the private prices of inputs to produce these capital stocks, the value of these stocks reflected in the relative wages they command in the labor market, local public services and relevant conditions that facilitate or restrict demand, and if credit market are less than perfect, parent endowments, such as inherited physical capital, that might provide the collateral for such credit, determinants of other forms of human capital that could substitute for or complement the form of human capital under study, such as health and nutrition possibly increasing a child's capacity to learn in school, and finally, sources of nonearned income. A linear approximation for the household demand function is represented as follows:

$$I_{ji} = h + p_j X_{ji} + e_j Y_{ji}(Z_{ji}) + u_{ji}, \quad j=1,2,\dots,n; \quad i=1,2,\dots,m, \quad (1)$$

where j refers to the n types of human capital, including health H and education E , i the individual, and u the error that is assumed uncorrelated with the demand determinants, X and Y . A critical distinction between X and Y is that the Y might both affect demands for I , affect wages directly, and be affected by growth more generally. The demand for human capital as a consumer good could then be affected by Y , or Y could relax a credit constraint on investment demand, and it could impact on the structure of wages that is thought to be the primary motivation for investment in these forms of human capital. Socioeconomic constraints that modify the demands of the household without affecting wage opportunities are represented by X . One type of Y variable is household income. To avoid the possibility that this Y could also feedback on wages, W , it might be predicted on the basis of an instrumental variable that is independent of wages, such as a "global constraint", Z , one which unambiguously transmits an outside shock to household income.¹ Consequently, in the household demand equation (1), Y is expressed as being an implicit function of some instrumental variable Z .

A standard semi-logarithmic linear approximation of the wage function is expanded to include the n forms of human capital as inputs and Y which is anticipated to affect wages:

$$W_i = S r_j I_{ji} + d Y_i + v_i, \quad i=1,2,\dots,m. \quad (2)$$

The parameter vector r measures the proportional increase in wages associated with a unit increase in each form of human capital input I . In the case of schooling, a natural unit of capital might be years of school completed; indeed simplifying assumptions lead to r in this case being an approximation for the private internal rate of return on the student's opportunity cost of investing a year of their time in schooling (Mincer, 1974).

The human capital inputs, I , are commonly assumed to be exogenous in the wage function, or more formally that the error in the wage function (2) is uncorrelated with the error in the human capital demand functions (1), i.e. covariance $(e_i, u_i) = 0$. But this simplifying assumption may not be valid, in which case standard single-equation estimates of the wage function, such as ordinary least squares, are expected to lead to biased and inconsistent estimates of the critical returns to human capital, r , that should be an important factor in arriving at priorities among human capital investments (Hausman, 1978). To estimate these returns without bias it is common to identify the parameter of interest with an exclusion restriction, and equation (1) suggests that the exogenous constraints X might provide such an instrumental variable on which to base estimates of the wage function. For X to satisfy the requirements for an instrument, it must be correlated with I and not be correlated with v , the error in the wage function. For example, Strauss (1986) in his analysis of the effect of calorie consumption on labor productivity in Sierra Leone farm families used the local price of nutrients to predict family calorie consumption. This instrumental variable prediction of calories was then used to explain labor productivity. He thus sought to avoid including the possible feedbacks from increased family productivity and income to

the demand for food. He wanted to estimate only the human capital return to increased calorie intakes, and found they were large among the lowest income households.

Figures 1 and 2 illustrate in a flow diagram what variables might enter into the model outlined above for describing the household demands for human capital inputs and their effect on labor productivity or wages. In the case of educational capital in Figure 1, the constraints on household demands for schooling of their children would include the level and composition of public expenditures on education, and be restrained by teacher salaries which represent about 90 percent of public expenditures on education in low-income countries. The education of the parents may augment the demand for the schooling of their children, both because they may value it more highly, and because they are more efficient in helping their children learn from their experiences in school. Nonearned income or inherited wealth may also facilitate the parents' borrowing to finance the schooling, or give the family the opportunity to realize the benefits of an educated child managing a family farm or business. The policy problem is that the relationship between the child's education (E) and adult's wage (W) may subsume more than the human capital productivity effect. It could also include the effects of other unobserved human capital inputs and the child's innate ability on productivity, and of increased family wages and income feeding back on the demand for more education, due to either consumer motivations or credit constraints. A statistical solution to these problems is to predict education of the child on the basis of X_1 , as Strauss did in estimating the productivity effect of calories, and then obtain consistent estimates of the impact of this predicted E on W, which should approximate the true private wage return to schooling. This approach also corrects for the potential downward bias that would arise from random errors in measuring the human capital inputs (Schultz, 1995).

With relatively few modifications in model or variables, Figure 2 presents the flow diagram for health inputs that increase the worker's health status and thereby productivity. In both the case of health and schooling it is important to analyze the hourly wage, for increases in productive potential that raise the workers wage may also lead the worker to work fewer (or more) hours. The substitution effect of wages on labor supply would increase hours worked, whereas the income effect would decrease hours worked. The substitution effect appears to have been dominated by the income effect for the average male worker in most of the last century in high-income countries, because hours worked per year has fallen as real wages have risen (Schultz, 1981). The economic or efficiency return to human capital investments should hold labor supply responses constant. Therefore, analysis should focus, wherever possible, on the impact of human capital inputs on the hourly wage, and not on the combination of the effects due to wage changes and labor supply adjustments, which seem likely to understate the true long run private welfare returns, at least for males.

In the case of health returns in Figure 2, the relative prices of health inputs includes the corresponding salaries of health providers, such as nurses and doctors, but also the cost of drugs and other medical supplies and services as well as the relative prices of nutrients. It is widely noted that parent education is correlated with lower child mortality, holding household income constant, and the partial association is almost always larger for the mother's education than for the father's. This is commonly explained by the mother being more often than the father in charge of child care and more responsible for monitoring the child's health and influencing critical care decisions. Thus, a year of additional schooling for the mother is often associated in a low-income country with a 5 to 10 percent reduction in her child's likelihood of dying in the first few years of life (Cochrane et al., 1980; Schultz, 1981). Although the technology of producing schooling appears to change relatively slowly, health technology may be improving more rapidly. There are also some regions where particular diseases remain stubbornly prevalent, with consequences on child and adult health and nutritional status. For example, some tropical parasitic diseases, such as Malaria, Schistosomiasis and Onchocerciasis, have not been readily controlled by public health interventions in some settings. Diseases and their transmission vectors may also be dependent on certain climatic conditions that make some regions inherently more healthy than others, given available health technologies. In the case of both health status and schooling there may be lags during which the formation of human capital occurs before a worker evidences greater productivity. These potentially long gestation lags add to uncertainties about the precise quantitative payoff to policy interventions, for their full effect can only be measured with confidence after several decades have elapsed after the introduction of randomized interventions.

The microeconomic study of random sample surveys at the individual level reveal significant positive partial correlations between wages, earnings, and income, on the one hand, and a worker's schooling, current nutritional inputs, height - a proxy for infant and childhood nutritional status -, and weight given height - a proxy for recent nutritional status -, and current activity limitations of adult workers, on the other hand, stratified by sex and controlling for age (Strauss and Thomas, 1995; Schultz, 1995). Macro economic studies have also confirmed that periods of sustained growth in national output per unit of input

are closely associated with periods when improvements have occurred in a population's schooling, nutrition, health, and mobility (T.W. Schultz, 1961; Kuznets, 1966; Denison, 1967; Fogel, 1994).

Patterns in Health, Education and Fertility

Health Status and Survival Differences Across Countries

It is expected that the levels of health status and educational enrollment increase with per capita income as individuals and society have more resources to allocate to their needs, and they may also increase with urbanization when the cost of providing health and school services is density dependent (e.g. Schultz, 1987), and increase with the parents' schooling for the reasons discussed earlier and measured here as the expected years of school enrollment persons received a decade ago when about half of the current parents were in school.

All four indicators of health status analyzed here as dependent variables are derived from mortality risks, because there is less agreement on objective internationally comparable measures of morbidity or disability. The first is the probability that live births survive to their first birthday or infant survival. The second is the probability of child survival from live birth to the fifth birthday. The third and fourth are the expectation of life at birth for females and males. A disproportionate share of mortality in low-income countries occurs in the first few years of life, and this heavy burden of childhood mortality can be estimated with considerable accuracy even when death registration systems are incomplete as often is the case in low-income countries, by asking women about the survival of their children in a random sample survey of households (Brass, 1968). The expectation of life at birth subsumes the childhood survival rates as well as mortality at all later ages. The variation in adult morbidity may importantly affect a population's economic capacity and is expected to parallel adult mortality (Fogel, 1994). In the absence of reliable death registration systems, estimation of life expectation is probably subject to more measurement error than childhood survival rates, yet the expectation of life should reflect adult health status, and adult morbidity is thought to be particularly high in Africa and a serious limitation to economic development in the region (World Bank, 1993).

The expectations of life are reported by gender, because differences between males and females tend to reflect latent differences in their welfare, and are positively related to other forms of human capital, such as gender differences in education. Mortality at all ages tends to be substantially lower for females than for males in high-income countries, and this gender differential in favor women has tended to widen in these more developed countries during the 20th century, due perhaps to their income growth, or changes in medical technology, or changes in gender-related behavior, such as the decline in fertility and changing gender stratification in labor force activity. Some regions, such as South and West Asia, include countries where women's lives are shorter on average than men's. Existing data does not confirm that such a reversal in gender differences in mortality occurs in Africa, although income levels in Africa are often as low as found in the poorer parts of South Asia.

Table 1 reports the regression results first with all countries restricted to have the same linear relationship between the four indicators of survival and four explanatory variables: income, education by gender, and urbanization of the country. The second regression allows not only for the level (intercept) of survival to differ in Africa from the rest of the sample, but also for these four linear effects of country characteristics to differ across the quarter of the sample which are African countries. This two step approach is designed to assess whether living conditions exert distinctively different effects on the formation of human capital in the African region, or more specifically whether the patterns of health in Africa are roughly parallel to what has been achieved elsewhere in the world in countries at similar levels of income, education, and urbanization. Because repeated observations are available from each country in the panel and they are thus not independently sampled, the standard errors are suitably corrected accordingly to a procedure proposed by Huber (1967).

Increasing per capita income (GDP per capita evaluated across countries by purchasing power parity relative price indexes) by ten log points (or 10.5 percent) is associated with infant survival increasing from the sample mean of .9354 (i.e. infant mortality rate of 64.6 per 1000 live births) to .9371. Child survival rates tend to increase from .900 to .904 with such an increase in national income, while life expectation for females increases from the sample mean of 64.95 to 65.44 years, and male life expectation increases from 60.65 to 61.13 years. The impact of one more year of women's schooling, measured as expected years of school enrollment ten years earlier than when the mortality is assessed, is associated with infant survival increasing by .0084, child survival by .0177, female life expectation by 1.51 years and male life expectation by 1.08 years. Male education is not partially associated significantly with any of these national health indicators, which is more or less consistent with some studies at the family level that find

the mother's education is a more important determinant of child survival than the father's education (Mensch et al., 1985).

Urbanization, which averages in this sample 48.2 percent, is not significantly associated with differences in infant or child mortality, but an increase of 10 percentage points in urbanization is associated with an increase in female life expectation of .28 years and male life expectation of .25 years. It has been noted by other analyses that women appear to benefit more from living in an urban area than do men, at least in low income countries. This might be related to lower fertility in urban populations or women's improved access to health resources in urban compared with rural areas of the world, or women's improved opportunities to work in the labor force in urban compared with rural areas (Preston, 1975; Schultz, 1993b).

One empirical regularity noted in earlier studies is not confirmed by these data. Preston (1975, 1980) found that from 1930 to 1970, the expectation of life has shifted upward by a larger amount than could be explained by the growth in national per capita income, and this improvement in health that is unexplained by economic growth was attributed by him to unobserved advances in public health technology. Intercepts for the health regressions are allowed to shift for each five year cross section (i.e. 1970, 1975, 1980, 1985). However, the tendency is for all four survival indicators to drift downward with time, conditional on the country's four characteristics and not upward as Preston noted. One possible hypothesis for the overprediction of the improvements in longevity over time is that the price of health inputs actually increased more rapidly than the average price level after 1970. The reported empirical patterns provide little basis for assuming that unmeasured advances in public health technology are required to explain the evolving health improvement in the world since 1970. Increases in income, women's schooling, and urbanization appear more than sufficient, given the simple specification adopted in the first regression, to account for trends over time in longevity across countries.²

The second regression in Table 1 adds five additional parameters to accommodate the African countries in the sample. In all four measures of survival the African intercept is statistically significant at the 5 percent level. The estimates suggest that infant survival is 2.4 percent lower in Africa, child survival 11.3 percent lower, female life expectation is 5.9 years shorter in Africa, and male life expectation is 6.2 years shorter. The estimates of the effects of country characteristics on survival are also somewhat different for the African countries, but rarely to a significant degree.³

Although occasionally significant at the 10 to 15 percent level, urbanization is consistently related to better survival prospects in Africa, compared with the rest of the world. Only in the African sample is the urban proportion of the population a significant factor increasing survival, particularly among children. Apparently the delivery of effective medical care to the rural population of Africa is lagging behind what is achieved elsewhere in the world. According to the point estimates of life expectation, urban females in Africa live 8.4 years longer than rural females, and urban males in Africa live 10.3 years longer than rural males. There are insufficient reliable estimates of separate rural and urban life tables for men and women in Africa to reject out of hand these rough and imprecise estimates based on intercountry comparisons (United Nations, 1982). It does suggest that rural/urban differences in health status in Africa are probably more substantial, even when one holds constant for education and income differences, than observed in other parts of the world (Cf. Schultz and Tansel, 1993).

School Enrollment Differences Across Countries

The stock of educational human capital in a population can be measured from two types of data, both of which have their own strengths and shortcomings. One can use administrative data provided by the school system, which are typically translated into national estimates of enrollments by school level. There are obvious reasons why teachers and school administrators might be inclined to overreport enrollments. For example, they are not likely to adjust downward initial enrollments by attendance rates, nor is it simple to audit teacher enrollment reports and introduce centrally suitable adjustments. It is also likely that repetition and dropout rates would lead to lower grade completion rates than implied by merely scaling up the number of years enrolled to define the number of years of enrollment an individual might be "expected" to experience over an average lifetime.

The second source of data are collected from censuses and representative household surveys in which a respondent in the household reports the years of schooling completed by each individual who is enumerated as a permanent resident in the household. Economic historians have cautioned researchers from using Census responses as to adult literacy, because many of those responding that they are literate may in fact be unable to sign their name to legal documents, suggesting that they are in fact illiterate (Mitch, 1993). It seems likely, therefore, that reports of years of education completed might also be

biased upward. Moreover, education as reported in international censuses is often restricted to the levels of schooling completed, which leaves uncertain how many additional years of schooling individuals finished after their last completed level. Making reasonable guesses on how to treat such incomplete data to obtain estimates of average years of education may interject systematic errors, that could be substantially different for groups with different completion rates, such as males and females (e.g. Barro and Lee, 1994).

Because of inconsistencies I have encountered in trying to use available estimates of educational attainment of national populations over age 25, I have decided to analyze in this paper only enrollment data. The dependent variables are the UNESCO reported gross enrollment rates, which are constructed by dividing the number of student enrolled by the estimated number of children in the national population in the standard ages for attending that level of school. The age groupings for primary or secondary school will vary from country to country and over time within countries. To aggregate the primary, secondary and higher schooling enrollment rates, I sum the three enrollment rates multiplying each by the standard number of years of schooling at that level. This weighted sum of years enrolled is referred to as an "expected years of enrollment" that a child would experience if she or he were enrolled at the current year's enrollment rate at all school attending ages. About ten year after students have completed their schooling they are having children, and as parents they are most involved in the survival of their children. This is the young age group of adults for whom I prefer to measure educational management skills. Thus, it seemed appropriate to consider the expected enrollment levels about ten years ago to approximate the educational attainment of the current year's parents, and in particular the education of mothers of young children. The average (female) age of childbearing varies relatively little across countries at different levels of development, falling generally between age 24 and 28. For this reason, moreover, the educational attainment of the entire adult population over age 25, as estimated by Barro and Lee (1994) from UNESCO cross tabulations of the adult population, might be less appropriate than enrollments lagged ten years to our task of accounting for the education of the current year's parents of young children.

The regressions in Table 2 account for three gender specific measures of current enrollment rates by school level and one which sums them to the expected years of enrollment. The second set of education regressions has the same specification as the second health regression with African interactions. However, the ten year lagged expected schooling level introduces an explicit form of dynamic feedback that may also capture any omitted but persistent variable in a country that influences both enrollment rates now and a decade earlier. Such omitted country specific effects would tend to bias upward the lagged expected education coefficient and possibly bias down the other coefficients on income and urbanization. Consequently, the first specification of the education regressions in Table 2 excludes the lagged expected enrollment variables that are intended to measure the parents' educational attainment.

My primary interest is in how African enrollments differ from those in other countries, given their income and urbanization. The intercept terms for Africa in the first regressions are negative at the primary and secondary levels for both boys and girls, but insignificant. Income has a larger positive effect on primary enrollments in Africa for boys (and possibly girls), but a significantly smaller effect on secondary and higher educational enrollments in Africa for boys and girls, compared to the income effect in the rest of the world. When the three schooling levels are combined, however, the more continuous variable for the expected years of enrollment (the last set of regressions) is not significantly different in Africa than elsewhere. This suggests that the differences in African income effects by school level may be an artifact of the limitations on the dependent variable for the primary enrollment rate, and the heteroscedasticity it introduces.

The second regression adds the lagged expected enrollment rates of both females and males as a proxy for the school-aged children's mothers and fathers. The pattern is as expected in that the proxy for the mother's education has a larger effect on the enrollment of girls than of boys, and father's education has the larger effect on the enrollment of boys than of girls at the secondary school and higher education levels. The differences associated with the African region are still that of lower primary enrollment rates than can otherwise be explained, and now somewhat higher enrollment rates for both girls and boys at the secondary and higher levels in Africa than can otherwise be accounted for by income, urbanization and our proxies for parent schooling. These African differences in primary and post primary enrollment rates cancel out in the final regressions on the expected total years of enrollment.

These regressions suggest that primary enrollments are lower and secondary and higher enrollments are higher in Africa than we might otherwise expect. Income elasticities of primary enrollments may be somewhat higher in Africa than in the other countries and lower at the secondary and higher levels. These relatively weak patterns could be an artifact of primary enrollments in most countries being close to one, whereas they exhibit more variation in Africa. Gender specific enrollment patterns are intergenerationally persistent and may build on themselves, as explored by others at the micro level (Thomas, 1994).

Increases in female enrollment rates today is likely to foster further gains in enrollments in a decade or two, particularly among the next generation of girls.

Intercountry Differences in Total Fertility Rates

The last set of cross country regressions is reported in Table 3 for fertility based on the same second specification without and with African interactions. As known for some time, fertility is significantly lower among better educated women but is not affected as much by the education of fathers (Schultz, 1976, 1994, 1997a; Benefo and Schultz, 1996; Shapiro, 1996), just as previously observed in the case of health indicators of survival in Table 1 (Schultz, 1993a, 1994). A year more female expected enrollment ten years earlier is associated with a reduction in today's total fertility of .36, or a third of child, implying an elasticity of total fertility with respect to mother's education of $-.59$. The comparable elasticity of fertility with respect to male education is $-.03$, and is not statistically significantly different from zero. Increases in income per capita are also associated with declines in fertility, with the implied elasticity of $-.13$. Africa does not exhibit a notably different fertility level with respect to income or education variation (or intercept) than is estimated for the rest of the world. However, the effect of urbanization on fertility is insignificant in the rest of the world, controlling for income and adult education, but it is significantly negative in Africa, where a ten percentage point increase in urbanization is associated with nearly a ten percent reduction in total fertility rates of .41 children.

Studies of the demographic transition have shown that higher levels of female education are associated across countries and within countries over time with decreases in fertility and increases in child survival (e.g. Schultz, 1976, 1993a, 1997a). Although the increase in child survival associated with advances in women's education might contribute in the short run to an increase in population growth, the combined effects of female education on fertility and on child survival is to markedly slow the current rate of population growth in the period 1960 - 1990, when data are sufficiently reliable (Schultz, 1994). No special cultural explanations are required to account for Africa's late stage in the demographic transition, for the relatively low level of female primary education in the continent and the unusually high level of child mortality, along with the low level of income per capita, provides a satisfactory explanation for the current levels of fertility in the continent, and thus its current rapid rate of population growth. If reductions in child mortality and fertility are viewed as generating external benefits for African societies, then the link between female education and these demographic developments would warrants social subsidies and encouragement for basic primary and secondary female schooling in Africa.

In sum, cross country regressions of this form involve many of the limitations of aggregate evidence. Yet they suggest many of the same relationships that have emerged from recent micro-level studies, and may consequently be viewed as credible if not incontrovertible. The health conditions in Africa are worse than would be expected on the basis of national averages of income, education and urbanization, whereas schooling and fertility in Africa are not distinctly different from the levels observed elsewhere, except that perhaps primary school enrollments may be somewhat below average. Post-primary school enrollments may be somewhat higher in Africa than the rest of the world, other things equal, and these enrollment rates are less strongly related to income levels across countries in Africa than elsewhere, suggesting that some countries may have more students in post-primary school than aggregate conditions justify. These outcomes are also consistent with above average inequality in personal incomes in Africa (Schultz, 1997b) and a particularly strong bias in favor of urban elites. Although these rough comparisons across countries provide no direct insights into the relative quality of education in the African region, the weaker effects of mother's education on child survival and on fertility in Africa, compared with the other countries in the sample, might suggest that African education was less effective in improving the woman's health management skills and augmenting her market productivity which could account for why better educated women tend to have fewer children (Schultz, 1981). This possibility cannot be pursued for lack of more suitable data on the wage returns to education across countries and over time. The next section reviews a few studies that explore more thoroughly the microeconomic foundations for setting priorities among human resource projects within a few specific countries.

Estimates of Private Returns to Human Capital in Africa

Education, child nutrition proxied by adult height, adult health-nutrition proxied by height-to-weight (Body Mass Index), and labor mobility are all critical factors in achieving recent sustained growth in factor productivity (Kuznets, 1966; Fogel, 1994). To compare the contribution of these four human capital inputs, an expanded wage function is estimated from Living Standard Measurement Surveys collected in Côte d'Ivoire and Ghana. As noted in Section 2, these human capital inputs may also be valued as a consumer good and thus acquired by persons who are innately more able and productive and possibly come from families that have greater economic opportunities. These sources of bias could lead to

overestimates of the productive effects of human capital inputs on wages. On the other hand, if the human capital inputs are themselves measured with error, as we expect in survey data, this measurement error would tend to bias estimates of the human capital-input effects on wages downward, or toward zero. A large human capital literature has concluded that the upward biases from simultaneous feedbacks and omitted variables, such as ability and family status, are roughly offset by the downward biases due to errors in measurement. How these two sources of bias balance out precisely is an empirical question that needs to be addressed in each new environment and with each new source of data (Griliches, 1977; Lam and Schoeni, 1993). The most common way to correct for these sources of bias in estimating the wage equation is to use suitable instrumental variables, such as the X discussed in Section 2.

It is also widely observed that anthropometric indicators of nutrition and health status, such as height and BMI, education, and mobility are all positively correlated with each other across individuals in a society. Therefore, when estimating a wage function that is conditioned only on education, one may expect that if a greater variety of human capital inputs have a positive effect on wages, then the omission of any one will lead to an upward bias in the estimated wage effects of those inputs that are included in the wage function. Because economists have generally only included education and postschool years of experience in estimating wage functions in low income labor markets, such as in Africa (Schultz, 1988), it is likely that returns to education are overstated because health, nutritional status, and mobility are not simultaneously considered. If health limitations on adult productivity are more serious in Africa than elsewhere, this source of overstating returns to education might be of particular concern in the African context.

Table 4 reports the coefficients estimated simultaneously on these four human capital inputs in the wage equation, controlling also for 10 regions of birth, 8-10 ethnic groups, five age dummies, and the season of interview to capture seasonal cycles in agricultural wages (Schultz, 1996). In order to predict variation in the human capital inputs demanded by individuals and their families, as described in Figures 1 and 2, the X variables (Figures 1 and 2) include the years of education of the individual's parents, and whether they worked in agriculture, the local relative price of foods, the distance to local schools and medical facilities, and community health and sanitation infrastructure. If individuals reside in a different region from their birth place, then the average local characteristics of that region of birth are assumed relevant to their childhood investments in human capital and define the X variables used to predict the human capital inputs. Different combinations of these overidentifying instrumental variables (IV) are considered and they suggest that the IV wage equation estimates are approximately the same (Schultz, 1996).

The first finding in Table 4 is that the coefficients on years of education decrease with the inclusion of the other three human capital input variables, but only modestly, and generally by less than one-tenth. The estimates of all four human capital inputs tend to be positive and statistically significant using ordinary least squares (OLS). When the instrumental variable (IV) estimates are calculated based on the predicted levels of individual years of schooling, migration, height, and BMI, the precision of the estimates decreases as reflected in the decline in the t ratios reported beneath coefficients in parentheses in Table 4. But according to the Hausman (1978) specification test of the exogeneity of each human capital input separately, height is rejected as exogenous at the 10 percent level of confidence in three out of four gender/country samples, and BMI is rejected as exogenous in three out of four cases at the 5 percent level. Migration is never rejected as exogenous, and education is rejected at the 5 percent level in only one out of the four samples - for females in Ghana. If tested jointly, the four inputs fail to be exogenous in all four samples, and thus I report the IV estimates in Table 4 for all four inputs. It makes little difference whether OLS or IV estimates are consulted for education and migration, whereas the wage effects of health and nutrition are sensitive to the choice, and according to the specification tests the IV estimates should be consistent and are therefore preferred.

As other studies have shown (Glewwe, 1990; Schultz, 1993b; Vijverberg, 1993) the percentage wage effects associated with an average additional year of schooling are larger in Côte d'Ivoire, 7 - 11 percent for women and men, than in Ghana, 3.7 to 4.4 percent, respectively. The larger private returns to schooling in Côte d'Ivoire than Ghana can be attributed to the greater supply of educated workers in Ghana, or the greater growth in the derived demand for educated workers in Côte d'Ivoire. In the three decades before these surveys were collected the real GNP per capita increased about 70 percent in Ghana and 316 percent in Côte d'Ivoire (World Bank, 1991). Migration from birthplace is associated with the log wage being .7 to .9 larger for men and women in Côte d'Ivoire, and from .2 to .5 larger in Ghana, respectively. Cultural-political barriers to movement across tribal regions may inhibit interregional migration to a greater extent in Côte d'Ivoire than in Ghana; the concentration of high wage opportunities in the Abidjan region is responsible for larger interregional differences in wages for workers with the same observed characteristics than is the case in Ghana.

An increase in BMI (weight-to-height-squared) by one unit is associated in the IV estimates with an increase in wages of 16 to 10 percent for men and women in Côte d'Ivoire, and by 8 and 10 percent in Ghana, respectively. The association between log wages and height is stronger in Ghana than in Côte d'Ivoire, suggesting malnutrition among children is more often a binding constraint on adult height in Ghana, and indeed 36 percent of the children under age 5 were estimated to be malnourished in Ghana in 1990, whereas only 12 percent were in Côte d'Ivoire (World Bank, 1991). An increase in the IV height of one centimeter is associated with a 5.7 to 7.5 percent increase in the wages of men and women in Ghana, respectively. In Ghana men age 20-29 report an average height of 1.70 meters, or an increase of 2 centimeters over Ghanaian men age 50-65, whereas in Côte d'Ivoire young men in these surveys have a height 1.71 meters versus 1.67 in the older ages, implying a significantly faster rate of growth in height occurred in Côte d'Ivoire than in Ghana in this three decades. For women in Ghana the advance has also been slower from 1.57 to 1.58 meters for the same two age groups, whereas in Côte d'Ivoire women have increased their average height from 1.56 among those age 50-65 to 1.59 among those age 20-29. These apparently small improvements in height are consistent with larger declines in child and adult mortality in Côte d'Ivoire than Ghana over recent decades (Benefo and Schultz, 1996).

Wage gains associated with cross sectional anthropometric improvements linked to child health and nutrition may be substantially larger as of 1989 in Ghana than in Côte d'Ivoire, whereas the returns to education and mobility appear to be significantly larger in Côte d'Ivoire than in Ghana. These estimates could be used to support differing priorities for human capital investments in these neighboring countries, and these empirical findings illustrate the need for labor-market based evaluations of the actual productive returns to a variety of forms of human capital, in order to assess their productive value in a particular economy and their responsiveness to policy instruments. For example, evaluating schooling by student achievements on standardized tests may help administrators monitor and improve the quality of schools. But a final test of the economic value of what the schools add to the productivity of the labor force is better measured as the wage returns to additional schooling in the labor market. And wage returns may not parallel closely qualitative measures of test achievements. A larger supply of school-provided skills in the labor market can be expected to depress wage premia associated with those skills, and detract from the priority that would otherwise attach to investment of additional social resources in further expanding the supply of this category of skill even though test performance of school graduates did not deteriorate.

There remains a fundamental problem in factoring into such a microanalysis of wage returns the impact of macroeconomic setting. Ghana had experienced several decades of stagnation and at the time of these surveys had not yet begun to experience renewed growth. It might be expected that wage returns to education have increased subsequently in Ghana, and may have conversely declined in Côte d'Ivoire as that economy encountered a number of years of retrenchment and structural adjustment. It is not well established how these changes in the institutional setting and the cessation of growth impacts returns to human capital. In the longer run, when both economies return to more consistent growth, the smaller supply of well educated workers in Côte d'Ivoire may again contribute to raising returns to education in that economy above the level in Ghana, but one might expect the differentials to be smaller than reflected in Table 4 derived from surveys collected in the late 1980s.

Private Wage Returns to Years of Education

Household survey and census data on individual incomes and wages have documented the systematic patterns of heterogeneity of labor in countries at various stages of development. The wages of workers differ according to their sex, post-school years of experience, and most notably according to their schooling, typically summarized by their number of years completed. In addition, various qualitative dimensions of the education process and its resource intensity are sometimes found to also affect a worker's wages, but these issues are taken up in Section 7. First, consider what factors determine the returns to a constant quality of education?

The most obvious and important factor is the relative supply. If two groups of labor are imperfect substitutes for each other, then increasing the supply of one relative to the other will decrease their relative wages, holding other conditions constant. Conversely, if the relative wage does not fall as the relative supply of better educated workers increase in an economy, there must be some offsetting growth in derived demand for such skills. One possible source of such a shift in labor demand is change in the national composition of output, for some sectors employ relatively more (or less) of the better educated types of labor than the national average, and relative expansion (or decline) of these sectors would increase relative demands. When changes in sectoral composition of output and relative supplies do not together account for the change in relative wages, it is concluded that technical change is non-neutral and indeed education-biased. Research to discover what factors influence such technical change or skill-bias in demand has considered the openness of the economy to international trade, and the creation and transfer

of technology through research and development, and licensing of products and processes protected by property rights. There is no agreement yet on how to measure or evaluate the contribution of these potential determinants of the relative demand for skills. Obtaining a better understanding of the demand determinants of human resource returns is an important goal, while the consequences of changes in the supply of skills on skill returns has been repeatedly documented (Topel, 1997).⁴

It is often assumed that the marginal efficiency of human capital investments tends to decline as a society invests more to educate an ever larger fraction of each subsequent birth cohort.⁵ According to this long run equilibrium view of the process of investing in educational human capital, returns are likely to be highest in the early expansion of primary and basic secondary schooling, and then begin to decline as a substantial share of a cohort is provided with post secondary schooling, and so on. According to this equilibrium economic framework, investments in education would be extended until the marginal returns to human capital decline to the marginal returns on alternative physical capital investments. In reality, however, because the education of a generation takes many years to complete, and adult education does not appear to be a close substitute for educating youth, the supply of education may adjust more slowly than changes in demand. As a consequence, bottlenecks may emerge in providing the mix of skills demanded by the economy, and for example, returns to middle and higher education can be driven to exceptionally high levels when rapid growth suddenly stimulates the demand for such educated skills. This appears to have occurred in Brazil in the 1960s, Korea in the 1970s, and Thailand in the 1980s, to cite only a few examples (Schultz, 1988). Wage returns to college education in the United States and many other economically advanced countries increased after 1980, and this development is attributed to a skill bias in technical change (Topel, 1997). A similar increase in wage differentials favoring college educated workers is also observed in some low-income countries, notably ones that have recently reduced their barriers to international trade (Robbins, 1994).

In the two West African countries examined earlier, the private wage returns to education are estimated separately at three levels of schooling by sex in Table 5. Returns are higher at the secondary and post-secondary school levels compared with the primary level. Returns tend to now be at least as high for women as for men at the secondary and higher education levels. Because previously returns were assumed to be constant across school levels, and women were less likely than men to reach post-primary schooling, the averaged returns to education estimated for women appeared to be less than for men in Table 4. With disaggregation of schooling by level it is common to find private wage returns to schooling are slightly larger for women than for men (King and Hill, 1993; Schultz, 1993b). The first three columns on the right side of Table 5 report the returns to education estimated by ordinary least squares methods based on only wage workers. Labor earnings are thought to be reported more precisely for wage earners than for self employed, who are likely to include realized returns to business capital and neglect capital gains (Vijverberg, 1991). It is possible, however, that the proportional gains to productivity from education are less (or more) for adults in low income countries who work as self employed or in family production activities compared with those who work in a wage or salary job.

Therefore, the second set of estimates on the left side of Table 5 statistically corrects for the unrepresentativeness of the sample of wage earners. The nonrandom selection of the sample of wage earners appears to interject a small upward bias in the estimates of the returns to education, except for males in Ghana where returns increase slightly with correction for sample selection for secondary and higher education.⁶ It is now evident that returns to primary schooling in Ghana are not significantly different from zero, but returns are 8 and 14 percent for men and women at the secondary level, and 12 and 10 percent for higher education, respectively. In Côte d'Ivoire returns start at 8 to 11 percent for women and men at the primary level, and then rise to about 20 percent for both sexes at both the secondary and higher education levels. Evidently in 1985-88, there is little added scarcity of primary educated workers in Ghana to justify the further expansion of the school system at this level, but returns to secondary schooled workers suggest expansion at the secondary level would recoup private opportunity costs of attending school.

The decisions of individuals to migrate and what type of economic activity to pursue will depend in part on their educational attainment, and conversely returns to education are partially realized through flexible labor markets that facilitate these coordinated geographic and sectoral reallocations of labor (Schultz, 1988). The returns to education are often observed to be somewhat larger among wage earners than estimated for the self employed. Similarly, it is often observed that wage returns to education are larger in urban than in rural wage labor markets, providing an explanation for why better educated workers are more likely to migrate, particularly from rural to urban labor markets (Schultz, 1988). In Côte d'Ivoire, Vijverberg (1993) analyzed the range of employment opportunities faced by an educated worker, including whether to migrate to the urban sector, and whether to work as self employed or in wage employment. He is thus able within his estimated framework to decompose the returns to education for men and for women into that portion that accrues due to each of these reallocations of the time of better

educated workers to the sectors where their labor is more highly rewarded. Aggregating across sectors and estimating a "reduced form" return that does not conditioning on sector of employment provides, nonetheless, a useful estimate of the total returns to such human resources such as education, health status, and nutrition, proxied by height, BMI, or the proportion of days unable to work because of disabling illness or health limitations (Schultz and Tansel, 1993).

Another intersectoral allocation of labor occurs between the private and public sectors. Glick and Sahn (1997) evaluate the returns to men and women in Guinea from education, and how it differs between self employment, private wage sector and public wage sector, and they find public sector jobs provide a larger wage premia for educated workers, particularly for women. Van der Gaag and Vijverberg (1988) also report substantial wage differentials between public and private sector wages in Côte d'Ivoire, but after they control for education and other worker characteristics in a switching regression framework that corrects for the self selection of the worker into the sector where they are most productive, the public-private wage gap is eliminated. If the goal is to decompose that total gain from education or another form of human capital into that which arises from migration and from gaining access to particular sectors of employment, a more complete structural model of the sectoral allocation of labor is required. But estimates of this structural decomposition depend critically on additional controversial identifying restrictions, which if they are not correct could distort interpretation of the data. Policy makers seeking guidance on human resource priorities should therefore rely initially on the "reduced form" wage effects of schooling, health, and nutrition that are not conditioned on worker choices regarding whether or where to work.

Rationed Access to and Supply of Education in South Africa

Private individuals and families are assumed to invest their resources in the acquisition of human capital in part because they expect to earn attractive productive returns on their outlays. Consequently, the supply of human capital investments provided by individuals is expected to respond to wage returns, as it would to an exogenous market price for any other output. In planning public investments that seek to coordinate a broader increase in the supply of certain human capital skills to the economy, it is appropriate to ask how much the added supply will depress market returns. Only in special circumstances is it defensible, however, to presume that observed variation in individual supplies of human capital are exogenous to demands. Only with such exogenous variation in supply can the relationship be estimated between relative supplies and relative wages (or returns) that approximates the elasticity of substitution between different groups of workers.⁷ One such case is changes in the age composition of a population, which leads to there being variation in the relative size of a sequence of birth cohorts, as in the case of the baby boom in the United States from 1946 to 1956 that led to a sharp increase in the rate of growth of college graduates entering the labor force in the 1970s. Returns to college collapsed from a stable 10-12 to 7 percent by the end of the 1970s. Apartheid in South Africa was responsible for another special set of circumstances that varied educational supplies independently of demand. The government rationed access to the public school system for political purposes, providing many times the educational resources per white youth as per African youth, with intermediate levels of support given the colored and Asian groups. If the resulting variation in the supply of education by race in South Africa can be treated as exogenous to variations in aggregate demands, variation in relative supplies should depress returns and identify the extent of substitution between different education groups.

Mwabu and Schultz (1995) analyzed the 1993 South African Living Standard Survey, and estimated the private wage returns to a year of primary, secondary, and higher education for men and for women, separately for the four main racial groups: African, colored, Asian, and White. The expansion of the educational system for these racial groups has also varied over time, perhaps independently of labor market demands. Therefore, the wage earning sample between the ages of 16 and 65 is divided into three age groups to assess how educational supplies and returns covaried. The findings for the two largest racial groups, Africans (70%) and whites (14%) are summarized in Table 6. Because the public expenditures per student are many times larger for white schools than African schools, within the same school level, it might be expected that returns due to quality differences between race groups would favor whites relative to Africans (Moll, 1992). But instead, age aggregated results reported in the last column of Table 6 show higher returns at each level for Africans than whites; primary returns are 6.2 and 8.4 percent for African women and men, whereas they are -3.4 and -1.2 for whites, respectively; at the secondary school level the returns are 25 and 16 percent for African women and men, whereas they are 5.2 and 8.4 percent for whites; and finally at the higher education level, African women earn returns of 40 percent per year of additional schooling, whereas African men earn 29 percent, in contrast with the 13.9 and 15.1 returns received by white women and men, respectively. Across the three age groups, the African returns to schooling tend to be slightly larger for the younger groups with a few exceptions, suggesting that though supplies of better educated workers are increasing in some cases, demands for better educated workers must be rising faster.

Beneath the return estimates for each age group is the absolute value of the t ratio associated with the estimated, and below that the proportion of the age group that has received this level of education, specifically the average of those who completed and began each level of schooling. To take an extreme example, 42 percent of the white males age 30 to 44 enrolled for some higher education, whereas only 4 percent of the African males in this age group have received some higher education. For white women the fraction with higher education is 28 percent, whereas for African women is 7 percent. The Asian and colored groups have intermediate levels of schooling, and their rates of return are accordingly between those of the whites and Africans (not reported fully here). Plotting the returns against the supplies in Figure 3, there is a clear downward sloping relationship, despite the higher quality of the white education. The solid line represents the weighted regression of the returns against supplies for the 71 groups distinguished by age-sex-race-level of school, where the weight for each observation is the inverse of the standard error of the return estimate for that cell in the sample. The common regression line has a slope coefficient of $-.32$, even after the intercept is allowed to shift between school levels. There is a strong economic argument for South Africa to relax the rationing of educational opportunities to the nonwhites and in particular the Africans. According to the above weighted regression, if the proportion of African men who received higher education could be increased from the current 4 percent in the age group 16-29 to 8 percent, without diluting the quality of that education, the returns would decline only from 31.7 to 30.4 percent. These strikingly high wage returns to African schooling are not significantly affected when potential selection bias due to analyzing only the wage earning sample is corrected. Nor do quantile regressions confirming any tendency for returns to higher education to decrease among Africans with below average wages (residuals) (Mwabu and Schultz, 1995).

Also at the secondary school levels, all age wage returns for Africans are nearly twice as large for males as the corresponding returns for whites, 16 versus 8 percent, and 25 versus 5 percent for women. Expansion of secondary and higher education for Africans has the attraction of both increasing labor incomes and growth efficiently, while also reducing the overall racial inequality of income by investing in the less affluent racial groups. It is nonetheless likely that as racial barriers diminish in the labor market, the scarcity value of highly educated Africans will increase further, widening inequality of earnings among Africans, while narrowing inequality between Africans and whites as groups.

The Trade-Off between Quantity and Quality of Education

Public policy seeks to change both the quantity of years of schooling and the quality of that schooling. In principle, improvements at both margins should be evaluated using the same yardstick: how much does a marginal increase in public expenditures and private resources augment the present discounted value of the lifetime productivity of the student that benefits from these additional outlays? But there are relatively few analyses of how improvements in the qualitative margins of education have paid for the added cost. Also, if the quality of schooling is varied without changing the private cost of schooling, one expects that this improvement in quality will have a tendency to increase the quantity demanded by individuals and families. Often the local quality of schooling is a response itself to local parent demands for quality, even if the total costs are not always passed along to the student. If quality is viewed as an endogenous feature of local schools that responds to local demands of parents for more schooling, it will tend to be correlated positively with the error u in the demand equation (1), and it is likely to be correlated with the error v in the wage equation (2) if there are any unmeasured dimensions of quality. In this case, estimates of the educational demand or wage function will be biased with the inclusion of quality.

In cross sectional surveys and censuses, measures of quality of schooling tend to be positively related to the quantity of schooling that individuals receive. If this quality is thought of as yet another form of human capital, the omission of quality from the wage equation that includes the quantity of schooling will bias upward the estimate of the wage return to quantity. Conversely, the inclusion of a quality variable in the wage function tend to decrease the estimated wage return to quantity. But if quality of schooling is endogenous, or quality affect endogenously the quantity demanded, estimates of a more complicated structural model may be required that may deviate in either direction from the incomplete one that typically includes only quantity of schooling in the wage function.

The individuals who benefit most from quantitative extensions of the supply of schooling, or increased enrollments, may not be the same individuals who benefit most from qualitative improvements in education. Quantitative extensions in basic schooling tend to favor the poor and rural segments in the population who are often the last to be drawn into the educational system. On the other hand, the distribution of qualitative improvements in the educational system is often a political decision, and may favor the politically more powerful and well-off segments of the population. Although the low quality of education provided to the lower socioeconomic groups may be cited as a reason to raise school quality, unless there are transparent subsidies to improve only the schools in poor regions, the political economy of education may lead to the allocation of quality to those who lobby more strongly for quality

improvement. The latter are likely to be the relatively rich and well educated. Higher education in Africa benefits mostly the upper classes who can secure entry for their children by sending them to good urban preparatory schools. The subsidies and stipends to most African students in higher education only makes these transfers to the children of the rich a more clearly inequitable and possibly even inefficient use of public revenues (Psacharopoulos and Woodhall, 1985)

Deolalikar (1997) recently examined Kenyan expansions in school facilities in 1994 and found that they had the effect of increasing the enrollment of children in the poorest quintiles of the family distribution of income, but had no impact on the enrollments of children in the top quintile. On the other hand, improvements in teacher-pupil ratios, which proxies increased quality of schooling, had the reverse effect of increasing enrollment rates of children in the top quintile and actually reducing the enrollment of children in the poor quintiles. He concludes that in settings where primary enrollment is not yet universal, programs and policies that seek to expand the number of school facilities should have a higher priority than interventions that increase the teacher-pupil ratio. This study did not estimate the cost of raising the quality of education or demonstrate its effectiveness in raising the subsequent productivity of the students who benefited from the intervention.

In an analysis of the demand for school enrollment in Tanzania in 1990/91, Mason and Khandkar (1997) found the recent small declines in primary enrollment rates may be a response to the modest level of wage returns that workers with primary education receive today in Tanzania, 7 and 13 percent for males and females, respectively. Differences in primary enrollment rates are not strongly related to the small opportunity costs or direct costs associated with students attending primary schools, or for that matter to the income levels of the parents. However, at the secondary school level, when the fees for school attendance rise sharply and the opportunity costs of the time of students increase as well, only relatively rich households can afford to send their children to secondary school. A general expansion of secondary school enrollments, where returns are somewhat higher for males, 8 percent, and about the same for females, 13 percent, it is likely that enrollment growth will come from the upper quintile of the income distribution. This pattern of only the upper classes being able to send their children to secondary school will not change unless new financing arrangements are adopted that provide direct fellowships, tuition waivers, and subsidies to the poor.

As noted in a variety of studies in Africa, many children start school at a relatively late age, and this greater "age-for-their-grade" is associated with their tendency to drop out of school with fewer years completed. Mason and Khandkar (1997) find the same parental income and education variables exert a strong effect on secondary school enrollment and early starting ages in Tanzania. They do not find that a shortage of primary school facilities in the region or a longer distance to the local school is an important deterrent to early enrollment in primary schools. On the other hand, Tansel (1997) finds in both Côte d'Ivoire and Ghana that the distance to local schools has a substantial effect on enrollments and attainment, controlling for parental education and income. The distribution of benefits from expanding secondary education in Tanzania, by building more secondary schools closer to the student's home, and encouraging students to start their schooling earlier, do not seem to benefit the poorer classes in that country.

In South Africa the effects of teacher-pupil ratios are also examined by Case and Deaton (1996) as a measure of local school quality. They find them to be an important determinant of enrollments, years of schooling completed for the student's age (a proxy for school starting age), and test scores. All three of these school outcomes are also related to parent education and incomes. But after controlling for these household demand factors, Case and Deaton still find the teacher-pupil ratios are quantitatively important in explaining educational demands among Africans. They also note that expenditures in the student's household on education are greater in communities with a higher teacher-pupil ratio. They interpret this pattern to suggest that local school quality encourages a greater private allocation of resources to the educational process in the home.

Kremer and his associates (1997) evaluated the consequences when a randomly selected group of Kenyan schools were provided by a NGO with a small set of quality improvements, including added textbooks and free uniforms. The early evidence from this random experiment in providing additions to "school quality" suggest that the school receiving the added quality increased their enrollments significantly, and although class size increased sharply, the test scores of the enrolled students declined only marginally, or less than would have been expected on the basis of the relationship between class size and test performance. The authors concluded from this first round of analysis of this unusual social experiment that the assisted schools have increased their efficiency in educating students with their available resources by adding to their enrollments at relatively low marginal cost. But most of the increase in enrollment at the experimental schools came at the expense of declining enrollments from neighboring schools, not by attracting into schools additional students. If the short run increase in class size is viewed as an increase

in efficiency in the experimental schools, there is presumably a parallel decrease in class size in the neighboring schools with a concurrent loss in efficiency. Also, if the experimental schools maintain their larger enrollments for a period of time, it is expected that local teachers will seek the assignment of more teachers to their school, who will be paid by the Ministry of Education. The long run gains achieved by this experimental interventions to provide some specific quality inputs to a random group of Kenyan schools may not be readily evaluated without more information on the outcomes in the schools that are adjacent to the experimental schools, and information on how the experimental school adjust other inputs, such as teachers, over time to the reallocation of enrollments across schools. Much should be learned from the analysis of subsequent rounds of surveys of these experimentally designed interventions in the Kenyan school system. More such social experiments in local education and health programs are likely to repay their expense in improved policy strategies in Africa and elsewhere, if they are carefully designed and thoroughly evaluated.

Recent studies in Africa have suggested that improvements in school quality, proxied by smaller classes and increased availability of textbooks, etc., can increase enrollments and improve student test scores. Studies have not yet confirmed how large the effects of these qualitative improvements in schools are on the later productivity of the better educated adult workers. Nor is there yet sufficient evidence to document how high the rates of return would be for allocating additional public resources toward reducing class size versus building more schools to increase enrollments. Deolalikar's (1997) study of Kenya documents that the distributional consequences of qualitative improvements may be more concentrated among the rich than the poor, and it is not surprising that the expansion of primary schools benefits more the poor than the rich, where the rich are already sending virtually all of their children to primary school. The efficiency of qualitative investments is yet to be tested in these studies. And when qualitative interventions pass the efficiency standard along with the benefits of quantitative increases in enrollments, the distributional implications of qualitative advances in education should then be studied with utmost care.

Concluding Observations

Creating the base of information required to allocate public resources among human capital resource development programs in Africa, or elsewhere, is a daunting task that is only beginning to be fully conceptualized and rigorously implemented. Describing the policy environment and socioeconomic resources of families that lead them to demand human resources for their members is the first step. The second step is to measure how these human resources increase the productive capacity of those family members over their adult lives. A third step required for informed policy making is to know how much it costs to modify the policy environment of the family so as to foster a specific change in the accumulation of human resources. With these three pieces of information, it should be possible to estimate the efficiency with which policy interventions can add to the potential income of a population, or in other words to estimate what these human capital investments earn in the way of productive returns. But public resource allocations should not stop at evaluating the overall efficiency or returns to human capital investments. They should also go on to weigh the personal distribution of those returns or benefits. Only when we combine an understanding of who demands human capital, how much it affects the productivity of workers, what it costs the society, and who benefits, can we begin to set human resource priorities on a firm foundation.

The information base required for such decisionmaking is most readily obtained from integrated household surveys, such as the Living Standard Measurement Surveys coordinated by the World Bank, and parallel community surveys that describe the local policy environment and appraise the cost of different existing programs and interventions that affect human capital formation behavior.

Most policy research on human resources has focused on education, and it seems reasonably clear that social and private investments in basic primary and secondary schooling have unusually high returns in many African settings. But each country and each level of schooling requires separate appraisal, and although the wage returns emphasized in this paper represent a reasonable approximation for the private returns to schooling, when the opportunity costs of a student's time is the only family-born expense, social costs of the school system also need to be taken into account. When these social costs are relatively large, as often occurs with higher education, it is not uncommon for the social returns to higher education to be much lower than the private wage returns reported here (Psacharopoulos and Woodhall, 1985). The available evidence suggests that public expenditures on higher education benefit mainly the upper income classes in Africa, and this inequitable distributional outcome is made even worse in those countries where students at the best universities are provided with stipends, regardless of their family's income. This costly scheme of subsidizing higher education should be reformed before there are general expansions in higher education. The reforms might replace stipends with student loans and fellowships, but even these support mechanisms should be available only to the poor. Tuitions paid by the remaining students would begin to

provide universities with more decentralized autonomy and stronger incentives to offer programs where the demands of student are strongest.

The basic information and analytical methodologies required to evaluate the productive returns to investments in public health are only beginning to be assembled. There are strong indications that health limitations are a costly burden on the productive potential of adults in Africa (Schultz and Tansel, 1993). A third or more of the gains in labor productivity achieved in the last two hundred years in Western Europe are linked to improvements in health, nutrition, and resulting gains in adult height (Fogel, 1994). Scattered surveys indicate that advancements in nutrition are reflected in gains in adult height in Africa as they were in the previous period in Europe, and indeed life expectancy has risen more rapidly in Africa than it has in developed countries. But these recent health gains in low income countries are closely related to increases in female education, per capita income, and in Africa with urbanization. As these indicators of progress in education and development have ceased to rise in many African countries, health improvements will slow or stagnate. The region remains a laggard in those crude indicators of mortality that are reported by international agencies.

It seems likely that there are intervention strategies that could directly deliver cost-effective gains for Africa in child nutrition, child survival, and adult morbidity. But the systematic collection of information in large household surveys that parallel experimental public health delivery systems is not a commonplace occurrence in Africa today. They are urgently needed to design new programs and attract the attention of governments and the donor community. Such major social experiments with their costly evaluation apparatus should be implemented to test the most promising approaches available to the complex of tropical disease and malnutrition that continues to prevail in broad regions where the productivity of the small farmer remains stagnant and urban job opportunities are not expanding. These new modes of intervention, such as possibly the child immunization efforts, should be evaluated by the best teams of researchers that can be found, given the recognized importance of health problems in Africa. These survey evaluation efforts should be designed to measure both the variation in community program health inputs and the household economic resources and behavior that buttress the demand for health care and health related inputs. Narrow mission-oriented data collection efforts, such as the World Fertility Survey and the Demographic Health Surveys, advanced survey methodology in the 1970s and 1980s but failed to examine the important microeconomic constraints on household demographic behavior or ask how such data should be designed to advance our understanding of the consequences of local public policy. Advancements in women's education, improvements in child survival, and changing patterns of fertility are interrelated outcomes of a household that is coordinating its allocation of resources to achieve competing lifetime objectives. Although the demographic transition is beginning in Africa later than in other regions of the world, it can be expected to evolve almost as rapidly as it did in Latin America or East Asia, if community health and women's education programs are sufficiently supported.

Finally, the role of geographic mobility of labor in Africa as a human resource investment requires more systematic study than it has received. There may be large payoffs to investments that facilitate interregional migration, at least in East and West Africa. With the multitude of native languages and cultures across Africa, reducing the barriers to the movement of people within countries, and obviously across countries, must represent as much a political as economic commitment. It is not unique to Africa that powerful urban middle class groups oppose measures to facilitate rural-urban migration, for they promise to impose social costs of congestion on urban residents and increased cost of public services in the already crowded metropolitan areas. This was the predominant position of elites in Latin America in the 1960s when rural-urban migration reached a peak in that continent, and is not exceptional. The cultural heterogeneity of Africa may explain in part why mass education, that forges a common means of communication, is associated with such large percentage gains in labor productivity in Africa. Yet even when schooling and health are held constant, as illustrated in Table 4, wage gains associated with migration in Côte d'Ivoire and Ghana are substantial for both men and women. What remains largely unexplored is how cost-effective public policies might be designed to increase migration and redistribute the local costs and benefits of the migration in order to distribute more generally the gains that accrue to the society from increased labor mobility.

In conclusion, if one were to single out an economic constraint that has slowed development in Africa in recent decades, it would appear to be the low levels of health, which is most readily linked to the relatively low levels of female education in all but Southern Africa. Given the large private wage returns to schooling, the economic case for additional investments in basic primary and secondary education is unambiguous, even without the social externality associated with female education contributing to reducing mortality, fertility, and population growth. The balance of benefits over costs to public health and migration programs appears promising, but the specific design of such programs will require further study. Until there is more large-scale social experimentation to document the social and private returns to public expenditures that promote health and labor mobility, cost-effective allocations of these resources cannot

be confidently inferred from past research. With the further expansion of African school enrollments, pressure will build to improve the quality of schooling in Africa. The same standards of cost effectiveness should be applied to evaluating qualitative improvements as to enrollments, plus the challenge of finding means to deliver the benefits from higher quality schooling more equally between the poor and the rich.

Notes and References

1. In studies of agricultural household behavior it is common to use rainfall as an exogenous instrument (Z) to shock incomes. In a cross country study, Pritchett and Summers (1996) wanted to measure the effect of aggregate income (Y) on health, and they proposed using the country's terms of trade or international prices for exports and imports as their Z to shock exogenously Y, and thereby avoid the human capital productivity feedback.
2. Why would the unexplained (beneficial) time trend have reversed in these later results compared with Preston's (1975, 1980)? One possibility is that the measure of national income has changed. In Preston's study local GDP per capita was converted into dollars at prevailing foreign exchange rates, whereas I have used the more recently calculated purchasing power parity price GDP levels (Summers and Heston, 1991), that should better approximate personal welfare and consumption opportunities. That change in intercountry conversion of local currency values does not change notably these results, although because of the increased variability in intercountry incomes based on foreign exchange rates, the income elasticities diminish somewhat. Another change from Preston's early studies is the inclusion of female and male education separately, which has been justified by extensive analyses of household survey data, some of which has been done by Preston and coauthors (Mensch et al., 1985). It remains for more research to document whether the trends in mortality that are unaccounted for by observables across countries have indeed changed direction and, more important, why this development occurred.
3. Women's education has a smaller effect increasing life expectation in Africa than it does in the rest of the world, perhaps because the character of that education is less well designed to help women manage health care, or the allied conditions which complement female education in increasing survival of children and adults (e.g. modern drugs) are less readily available in Africa than they are elsewhere, reducing the effectiveness of female education as a means for improving African health.
4. In the 1950s and 1960s the evolving demand for educated workers was thought to be readily projected by manpower planning methods that relied on only a few features of the aggregate economy, such as its structure of employment and per capita income. The manpower planning approach failed to monitor empirically the labor market's signals for which skills were actually scarce and hence commanded the largest wage premia relative to the private and social costs of reproducing those skills (UNESCO, 1968). This reluctance to rely on market pricing of labor may be explained by doubts that wages reflect labor's true marginal productivity or indeed that other prices are not generally distorted from their true shadow values. The prices deduced by social planners were thought to be more accurate than those observed in low income economies. This perception led economists to prefer development planning over relying on market mediated priorities in the field of human resource development. This philosophical proclivity is observed in many English-trained economists who were influential in shaping development policies in the ex-English colonies in Africa. See Krueger (1997) for the broader ramifications of this intellectual history for international trade policy in the period after the Second World War.
5. An related, but quite different, idea is that by increasing the proportion of a birth cohort (or generation) receiving a certain level of schooling the marginal returns to that level of schooling decrease. Implicit in this idea is that there exists an independent distribution of unobserved "ability" in a cohort that complements education in terms of raising labor's productivity. Those who have this ability are more likely to be the first to obtain that schooling, and their returns are higher than those who are least likely to be drawn into that level of schooling, and only attend that level of school when it becomes nearly universal. Quantile regressions of the wage function provide a means to explore this hypothesis that the returns to schooling are higher for the higher quantiles of the distribution of residuals in the wage function, and decline with the lower quantiles (Mwabu and Schultz, 1996). This interpretation of quantile regressions of the wage function that assume wage residuals represent mainly an unmeasured form of ability have been used to describe the structure of wages in South Africa. There is no evidence among Africans that returns to education are lower for those with lower wage residuals. On the other hand, among white cohorts, among whom more than a third have received higher education compared with a few percent of Africans, returns to higher education are significantly lower for those with lower wage residuals. This suggests that in the extreme when educational investments are extended to an exceptionally large fraction of a cohort, the wage returns may be depressed. At the levels of investment in education among the nonwhite groups in South Africa, there was no evidence from the quantile regressions that returns declined in lower wage residual groups (Mwabu and Schultz, 1996). Unions, however, have a large impact on South African wages, reducing wage variation

- within the union sector, and moderating returns to schooling, while increasing the gap between the wages of union members and those received by the large majority of workers who are not union members (Schultz and Mwabu, 1997).
6. In an analysis of the South African labor market based on data collected in 1993 there did not appear to be a significant effect of sample selection bias to the wage function from estimating from only wage earners (Mwabu and Schultz, 1995). For the white sample who are largely wage earners when they are in the labor force this might not seem surprising, but for Africans, Colored and Indians who were more likely to be in self employment the selection bias remained statistically insignificant when the wage earner selection equation was identified by the inclusion of nonearned income and various types of assets. In many studies of selection bias to the wage equation it is found that the bias is more substantial for women than for men, presumably because a larger fraction of women than men are not earning wages (Schultz, 1993b). In evaluating the effect of acute disabling illness on labor productivity in Côte d'Ivoire, sample selection bias was not statistically significant (Schultz and Tansel, 1993).
 7. More specifically, the coefficient on the relative supply variable in a regression explaining the relative wage between two groups of labor can be interpreted as the inverse of the elasticity of substitution between the two groups of labor in the economy (Hammermesh, 1993; Topel, 1997). But in order to estimate the elasticity of substitution from such a regression, it must be assumed that the supply variation is exogenous to other factors that might affect the relative demands for these labor groups, and it is commonly assumed that the aggregate production function is subject to constant returns, and that there are no other factors of production that might have different degrees of substitution or complementarity with the two labor groups, such as physical capital, natural resources and land, or other forms of labor.

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