Human Capital Development in Africa: Agents, Drivers and Implications for Growth and Structural Transformation

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Abstract: This paper investigates the drivers of human capital development in Africa empirically using household-level and firm-level data, and the implications for growth and structural transformation. The study finds that though Sub-Saharan Africa lags behind all other regions in educational accessibility, there has been an upward trend in enrolments. At the household level, the key drivers of educational attainment are household income, parental education, school infrastructure and quality, and individual characteristics such as age and health status. At the firm level, the determinants of training for workers include organizational size and age, credit availability, and workforce educational status. Human capital is observed to be positively associated with growth and at the same time facilitating the transformation from dependence on agricultural sector employment to non-agricultural sector employment. The positive externalities associated with human capital calls for sustainable pro-education and pro-training policy from governments in Africa.

Keywords: human capital development, private enterprises, rural and urban households, structural transformation, growth, human development.

1. Introduction

The process of human capital development could be thought of as involving two basic economic agents- individuals or households and firms, pursuing their own self-interest, but with positive spillovers for the entire society. For individuals, educational enhancement and skill acquisition are prerequisites for success in the labour market and better quality of life. For firms, providing training to their workforce is a mechanism for improving their basic, technical and managerial skills, and in the end ensuring profitability. The externality outcomes from the human capital investment decisions and actions of households and firms bring in public policy makers or government (a third economic agent) whose goal, among others, is to improve national competitiveness, and standards of living.

Globally, the structure of production is changing. Increasingly, it is becoming knowledge intensive, and this is accompanied by a demand for high quality human capital (Kumar, 2006).

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Low levels of human capital deter technological upgrading (Goedhuys *et al.*, 2008) and adaptability to best practices in production, and with globalization occurring at a fast pace, developing high quality human capital is a corner stone in maintaining Africa's competitiveness.

Sub-Saharan Africa lags behind all regions in the global economy in terms of accessibility to education. Between 2001 and 2009, net primary enrolment ratio (expressed as percent of primary school age population) was 73.7% in Sub-Saharan Africa compared to 86.9% in South Asia; net secondary enrolment ratio was 34.4% in Sub-Saharan Africa, while in South Asia it was 53.5%; gross tertiary enrolment ratio was 5.5% in Sub-Saharan Africa and 12.8% in South Asia (UNDP, 2010). Accessibility to education (i.e., getting enrolled in schools) precedes achievements in education (measured in terms of ultimate educational endowment possessed by individuals). Therefore, from a regional educational accessibility perspective, Africa has some catching-up to do. While governments in Africa are trying to encourage schooling by providing tuition-free education at primary and in some cases at the basic level of education, it must be noted that gaining global competitiveness calls for educational attainment beyond the primary level. Linked to the issue of educational attainment is the need to ensure that Africa's workforce is productive at their work place. For the private sector to be an engine of growth, it must have what it takes to assume this role. At the core of this expected role is a well-trained workforce. The twin requirement of an educated and well-trained workforce in Africa for the realization of greater competitiveness and productiveness lead to a fundamental question, namely, what drives educational attainment and firm-level training in Africa?

This study highlights three major socio-economic development issues in Africa: the issue of stepping-up educational attainment at the household level (a key component of human capital); the lack of skills at the firm level and the effort by firms to address this issue through training provision (another human capital element); and the growth and structural transformation implications associated with human capital development.

The specific objectives of this study are as follows: (i) profile secondary educational attainment and estimate the determinants at the household level (both urban and rural Africa) from cross-country and country-specific perspectives; (ii) assess the determinants of training at the firm level; and (iii) analyze the implications of human capital development for growth and structural transformation in Africa.

In order to address the above objectives, the paper has been structured into 5 parts. Starting off with an introduction, a profile on education and training in Africa are presented in Section 2. This is followed in Section 3 by an analysis of education drivers at the household level. In Section 4 an analysis of training determinants at the firm level is presented. The implications of the analyses carried out in Sections 3 and 4 and discussed in Section 5.

2. Profile on Education and Training in Africa

Secondary level of education occupies a strategic threshold in the human capital development of any country. It marks a level of education beyond primary education and at the same time it is the springboard to higher education at the tertiary level. Compared to primary educational

attainment, individuals or households with secondary educational attainment tend to have: relatively better prospects in the labour market (employment and earnings); lower morbidity rates; better access to improved water source and sanitation facilities; and less demand for traditional fuels (firewood and charcoal). Therefore, secondary education can be considered to be "a key determinant in poverty reduction and sustainable development" (Keriga and Bujra, 2009, p27). How has Africa performed as far as educational attainment at the secondary level is concerned?
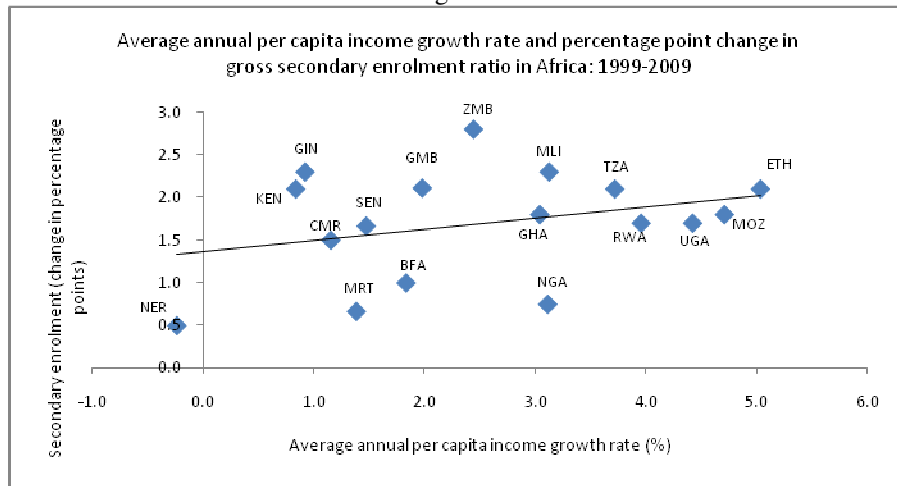
Some progress appears to have been made in secondary school attendance in Africa. Based on a total of 17 countries in Africa shown in Figure 1, the mean gross secondary school enrolment ratio increased from 17.6% in 1999 to 34.6% in 2009, while the median enrolment ratio went up from 15% to 32%. Mozambique, which in 1999 had the lowest secondary enrolment ratio of 5% reached an enrolment ratio of 23% in 2009. On the other hand, Kenya which had the highest secondary school enrolment ratio of 38% in 1999 moved farther up to 59% in 2009. The coefficient of variation decreased from 57% in 1999 to 38% in 2009, suggesting that a reduction in relative dispersion has occurred. The reduction in the coefficient of variation also suggests some sort of convergence taking place in secondary school enrolment rates.

Figure 1
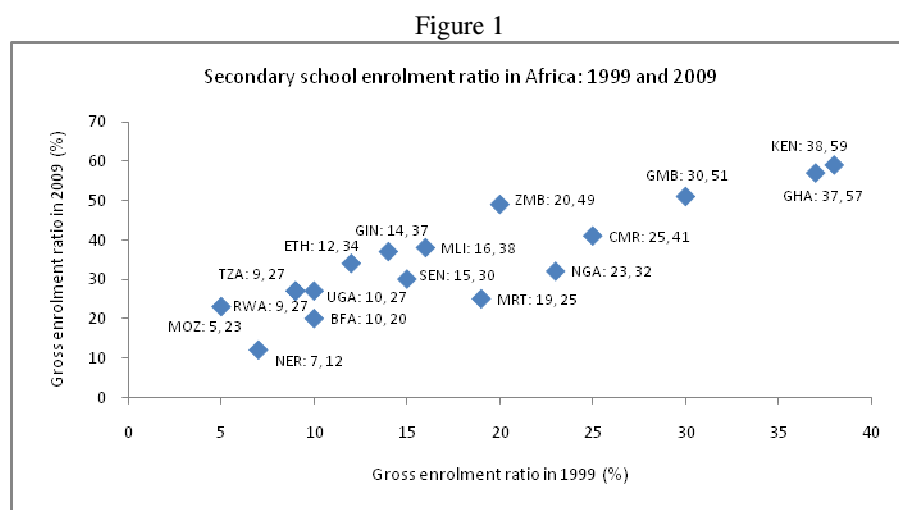
Source: Based on data from the World Bank's World Development Indicators

The increase in secondary school enrolment (and for that matter, school enrolments in general) has been associated positively with growth in per capita income (a correlation coefficient of 0.31). Between 1999 and 2009, secondary school enrolments in Africa increased annually by 1.7 percentage points on average, while per capita income grew annually at 2.5% on average (based on the sample of 17 African countries shown in Figure 2). With the exception of Niger which registered a negative average annual per capita income growth rate (of -0.2%) and the lowest increase in secondary school enrolment rates, all the other countries under consideration had positive per capita income growth rates as well as relatively better enrolment ratios at the secondary school level. To a large extent, this relationship underscores the importance of economic growth and for that matter rising incomes in enhancing school attendance, attainment and human capital development in Africa.

Figure 2

Average annual per capita income growth rate and percentage point change in gross secondary enrolment ratio in Africa: 1999-2009

Source: Author's calculations based on data from the World Bank's World Development Indicators

Tertiary enrolment ratios are generally not more than 10%. For some countries like Niger, Mozambique, Tanzania, Gambia, tertiary enrolment ratios were as low as 1% in 2009 (Figure 3). Countries with relatively lower secondary enrolment ratios (such as Mozambique and Niger) tend to have lower tertiary enrolment ratios, while Ghana with a relatively higher secondary enrolment also has a better enrolment ratio at the tertiary level. It must be pointed out that having a higher secondary enrolment ratio does not necessarily guarantee that tertiary enrolment ratio will also be high (as shown by the case of Gambia and Kenya). Nevertheless, taken together and from a statistical point of view, there appears to be a positive correlation between secondary and tertiary school enrolment ratios in Africa, with a correlation coefficient of 0.36.

Figure 3

Secondary and tertiary school enrolment ratios in Africa: 2009
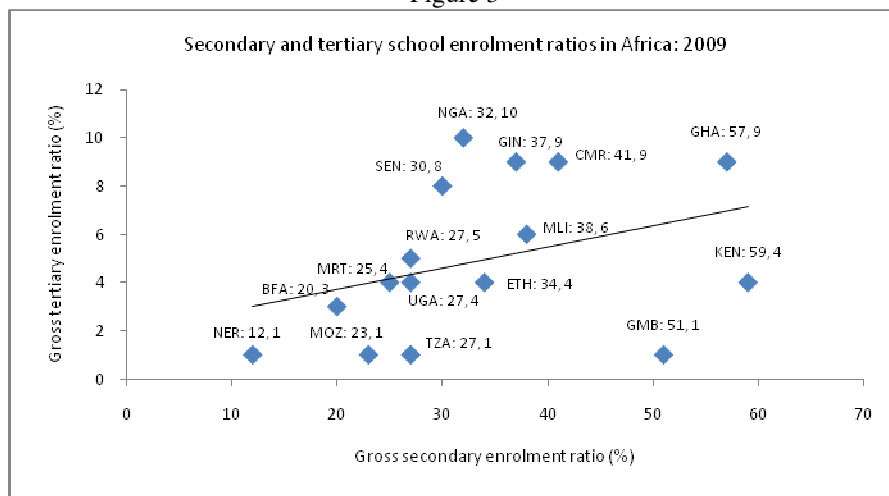
Source: Based on data from the World Bank's World Development Indicators

Another perspective on human capital accumulation can be examined by focusing on the highest level of schooling attended or completed (i.e., achievements in education). Using this indicator and a time frame covering a five-year period, there are signs of moving in the right direction as far as educational attainment in Africa is concerned. In West Africa (represented by Ghana) the

proportion of adult population (aged between 15 and 49 years) with less than secondary educational attainment has fallen from 41.4% to 35.7%; in East Africa (represented by Kenya) it has fallen from 68.4% to 62.8%; and in Southern Africa (represented by Zambia) it has fallen from 67% to 58.4%. On the other hand, the proportion of adult population who had completed a secondary school level or higher has increased from 11.6% to 18.4% in Ghana; 20.5% to 24.3% in Kenya; and 8.9% to 13.7% in Zambia (Figure 4).

Figure 4
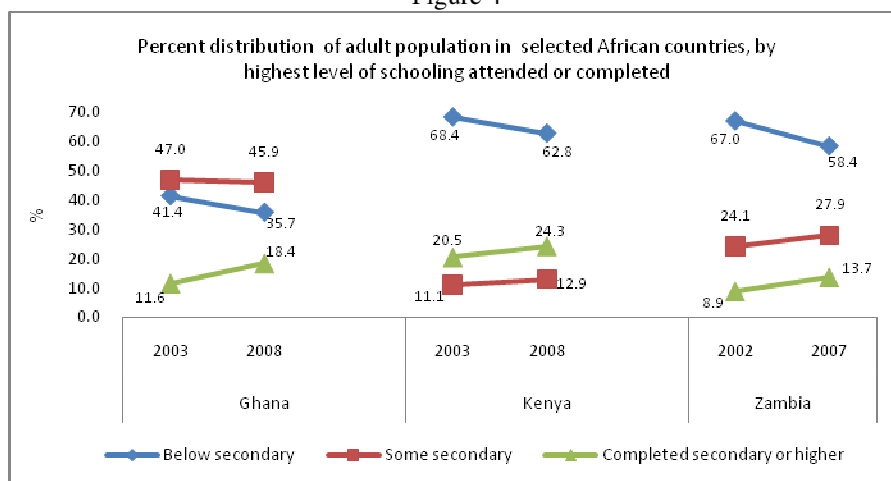
Source: Author's calculations based on data from the Ghana Demographic and Health Survey 2008 and 2003; Kenya Demographic and Health Survey 2008 and 2003; and Zambia Demographic and Health Survey 2007 and 2001-2002

Figure 5
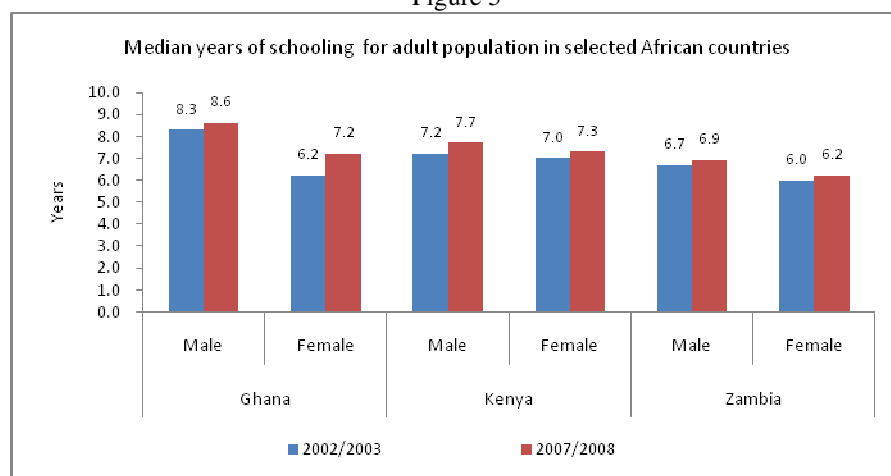
Source: Ghana Demographic and Health Survey 2008 and 2003; Kenya Demographic and Health Survey 2008 and 2003; and Zambia Demographic and Health Survey 2007 and 2001-2002

In terms of actual years of schooling there is also evidence to suggest that human capital accumulation is occurring. Generally, over the five-year period shown in Figure 5, a modest increase in the median years of schooling occurred for both males and females in Ghana, Kenya and Zambia. For males, the median years of schooling ranged between 6.7 years in Zambia to 8.3years in Ghana in 2002/2003, while in 2007/2008 these were 6.9 years and 8.6 years

respectively. In the case of females the median years of schooling in 2002/2003 was between 6 years in Zambia and 7 years in Kenya, compared to 6.2 years and 7.3 years in 2007/2008 respectively. Africa is noted for its relatively youthful age structure but another characteristic for the youth in Africa is that investment in their human capital is occurring. As a result, the median years of schooling has increased for the population (both males and females) aged between 15 and 24 years (See Appendix Table A1). This is a positive sign and further increases in years of schooling will help in the build-up of a potentially productive workforce, *ceteris paribus.*

Acemoglu and Pischke (1999) observed that although formal educational attainment is the most common indicator of human capital, on-the-job training (or training at the workplace by firms) may be at least as important in determining productivity. For firms investing in the human capital of their workers this is often seen to be a mechanism for increasing the employability of poorly educated prospective employees, improving the productivity of existing employees, and enhancing the flexibility and adaptability of all workers (Jacobs *et al.*, 1996). Against this backdrop, what has been the incidence of training by firms in Africa and to what extent is this associated with the skill endowment of workers? Figure 6 provides an answer to this question.

Using descriptive statistics to summarize training incidence by firms, we find that, an average of 30% and median of 28% of manufacturing sector firms in Africa offered formal training to their workers in 2006/2007. During this period, Senegal recorded the lowest incidence of training, with 16.3% of firms in that country offered formal training to their employees. The highest incidence of formal training by firms (i.e., 43.1%) took place in Burkina Faso. With regard to the quality of human capital employed by manufacturing sector firms in Africa, an average of 39% and median of 40% of workers employed were regarded as unskilled workers. The data shows that the lowest incidence of unskilled workers occurred in Gambia (22.3%), while the highest incidence of 59.3% was in Niger. Put together, Figure 6 shows that there is a positive correlation between the prevalence of unskilled workers in a firm and the proportion of firms offering formal training, with a correlation coefficient of 0.54.

Figure 6
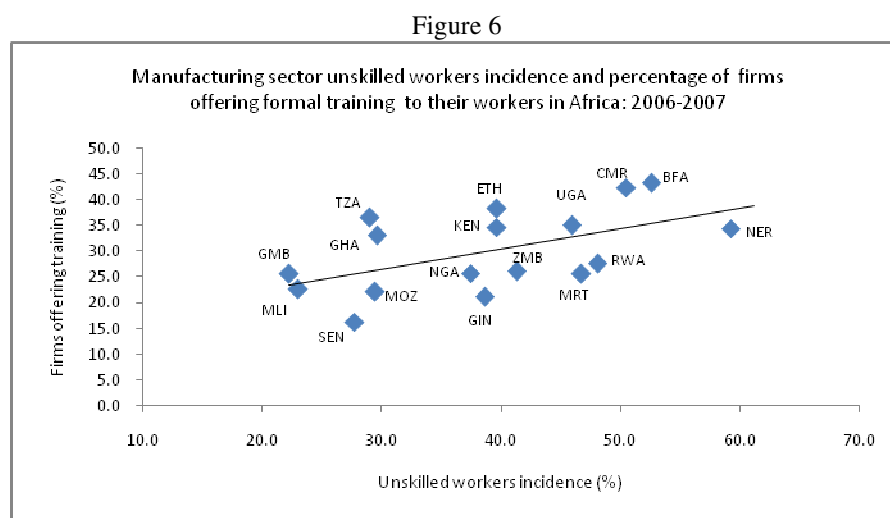
Source: World Bank's Enterprise Survey data

An important distinction that is made in the literature with regard to training is the difference between general and specific training. Though both types of training increase the marginal

productivity of the worker, general training tends to be portable to other employers, while specific training, to a large extent, could be regarded as non-portable to other employers. General training impacts the worker's production capability in all jobs by an equal amount, irrespective of the firm under consideration, while specific training impacts the worker's productivity only in the current job (Lynch and Black, 1998; Bartel and Borjas, 1977). Firms are therefore more likely to invest in specific training of their workers and the profitability of this training depends on the expected duration of the job. On average, relatively more production workers in Africa (i.e., individuals involved directly in the production process) receive formal training at their workplace, compared to non-production workers (i.e., management, professional, support, administrative, and sale employees, among others), as shown in Figure 7. Although training programs for production workers and non-production workers are likely to be made up of both general and firm-specific elements, it could be argued that, to a large extent, training for production workers is relatively more firm-specific.

In Ghana, 56% of production workers and 24.9% of non-production workers received training from the firms employing them (Figure 7). In Kenya, a higher percentage of workforce in both categories received formal training from their employers (66.6% for production workers, and 60.8% for non-production workers). In Zambia, while 70.4% of production workers received formal training from their employers, a relatively smaller percentage of non-production workers received training (27%). Thus, there is a wide variation in training incidence across countries in Africa. This could be one of the factors accounting for the differences in productivity across the continent. On average, the cost of training to firms, expressed as a share of their total sales, was 4.3%. The cost of training varied from 3.8% of total sales by firms in Mali to 5.5% of total sales by firms in Mozambique.

Figure 7
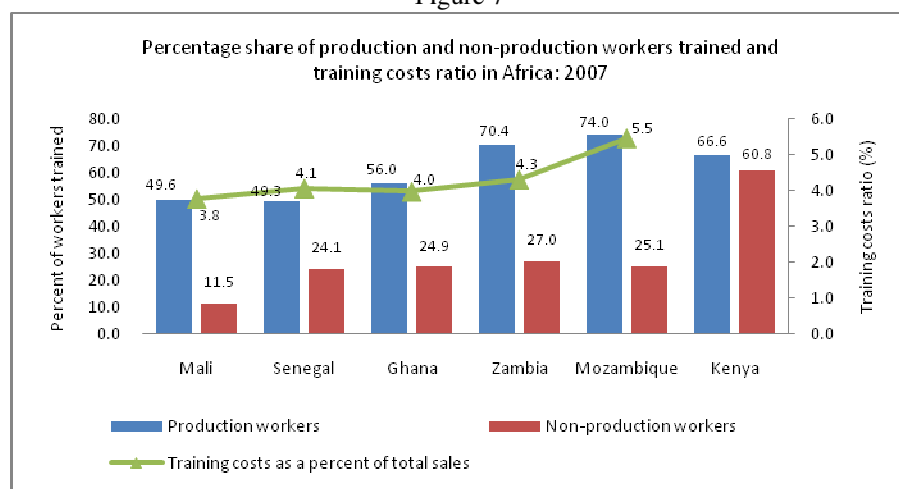
Source: Author's calculations based on The World Bank's Enterprise Survey data

Human capital accumulation is positively correlated with per capita income (often used as an economic measure of wellbeing) and life expectancy (a social indicator of wellbeing), as shown in Table 1. At the same time, an increase in the stock of human capital tends to be negatively correlated with mortality rates (another social indicator of wellbeing). These correlation results suggest that human capital development generates better human development outcomes for countries in Africa. In fact it has long been observed that education and health are joint

investments made in the same individual and that an individual is more effective in society as a producer and as a consumer by virtue of such investments (Sab and Smith, 2002).

Table 1: Correlation between education and other human development measures in Africa: 2000-2007

	Education	Per capita income	Life expectancy	Under-5 mortality rate
Education	1.00			
Per capita income	0.51	1.00		
Life expectancy	0.20	0.26	1.00	
Under-5 mortality rate	-0.53	-0.37	-0.47	1.00

Note: Secondary school enrolment is used as a proxy for educational attainment
Source: Author's calculations based on data from the World Bank's World Development Indicators

The correlation results also suggest that inequality in human capital endowment (whether in terms of gender or locality) could have adverse human development outcomes for vulnerable groups in an economy. Castello and Domenech (2002) highlight the fact that human capital disparity is equally as important as income and land inequality in explaining wealth inequality and growth. In this context, income distribution is influenced by the distribution of human capital and the better the distribution of human capital endowment, the better will be the distribution of income, all things being equal. What drives human capital development in Africa? The answer to this question is presented in two parts, based on the type of economic agent involved- households and firms. The next section starts off by examining the role of households in the build-up of the educational component of human capital in Africa and the drivers involved.

3. Drivers of Education at the Household-level

In their classic paper on family investments in human capital, Mincer and Polachek (1974) identified the family or household as a social institution with a key function of building the human capital of children. They noted that the human capital development process was a lengthy one, which was becoming even much longer due to the growing demands of technology. The authors also pointed out that the "optimal investment in human capital of any family member requires attention not only to the human and financial capacities in the family, but also to the prospective utilization of the capital which is being accumulated" (p. 77). Households do not simply investment in human capital of their members just for the sake of doing so, rather it is expected that such investments will pay off in future through an appropriate compensation in the labour market and efficient use of the human capital developed. To the extent that how much is earned in the labour market is determined by the stock of human capital accumulated by individuals, a sequence of positive net investments results in an earning power that grows over the life cycle, *ceteris paribus*. Following this expectation and linked to the African context, a pertinent question is whether households in Africa are carrying out their perceived function of building the human capital of their children and what drives this process. This section attempts to address this issue by falling on evidence from household level data across Africa.

There is no doubt that the human capital development effort by households in Africa has been far from smooth, especially in households below the poverty threshold. Katan (2006) drawing from

studies carried out by Deininger (2003) and UNICEF (2005) identified some obstacles confronting poor households in their efforts towards building the human capital of their children. Notable among these obstacles were household income, schooling costs, educational attainment of parents, school infrastructure, disability, cultural norms and the opportunity costs of attending school.

In modeling the drivers of human capital development, the methodology adopted and variables included were influenced by the nature of dataset available (type of variables), especially the dependent variable under consideration. Based on the data-set available, the first model examined was estimated by least squares method, and took the following form:

$$\ln s_j = \beta x_j + \varepsilon_j \quad (1)$$

where s_j is the net secondary school enrolment ratio for the jth household; x_j is the set of explanatory variables for the jth household, notably, household financial resource status, household structure (using age dependency ratio as proxy), urban or rural residence status, and country of residence; and ε_j is the error term.

Living Standards Measurement Survey (LSMS) data at the household level and disaggregated on the basis of household expenditure quintile at the rural and urban levels were used to estimate a regression model on secondary educational attainment in Africa. A total of 9 African countries (Ghana, Kenya, Zambia, Mozambique, Cameroon, Uganda, Ethiopia, Gambia and Burkina Faso) for which LSMS data was available between 1997 and 2003, and which were also included in the list of countries analyzed in the previous section have been put together for the cross country analysis in this section. The data was obtained from the World Bank's Africa Development Indicators 2006 Report. Due to the nature in which the data had being presented, each country had an equal split of 5 observations for rural households and 5 for urban households structured on the basis of expenditure quintiles. Thus each of the countries had a total of 10 observations for each variable. Taken together a total of 90 observations were used in the pooled model estimated, and a split of 45 observations each was used in the separate urban and rural models estimated. The average net secondary school enrolment rate for the entire sample was 25%, with urban being 35.8% and rural 14.1%. The results from the empirical estimation are presented in Table 2.

Household income status or financial resource (using household expenditure quintile groups as proxy) is a statistically significant determinant of secondary school enrolment rates. In relation to the lowest welfare quintile, belonging to a household in higher quintile groups increases the secondary enrolment rates, ceteris paribus. What this means is that the poor tend to stand the risk of having their children not enrolling in secondary schools, which in the absence of policy interventions, could create an intergenerational cycle of low human capital for this vulnerable group. The financial resource effects on school attendance for rural households are higher than in urban households.

Table 2: Regression results on determinants of secondary school enrolment in Africa

Dependent variable: Log(net secondary enrolment rate) in Africa

Estimation technique: OLS

	Pooled model		Urban model		Rural model	
	Coef	t-value	Coef	t-value	Coef	t-value
Household income status						
Lowest quintile (reference group)						
Second quintile	0.474*	3.11	0.242**	2.15	0.593*	3.36
Third quintile	0.765*	4.34	0.395**	2.43	0.900*	4.46
Fourth quintile	1.008*	4.74	0.563**	2.58	1.101*	4.40
Highest quintile	1.300*	4.71	0.732*	2.68	1.404*	3.71
Locality						
Urban (reference group)						
Rural	-1.249*	-7.73				
Household structure						
Age dependency ratio	0.299	0.69	-0.463	-1.04	0.254	0.38
Country						
Mozambique (reference group)						
Zambia	0.770*	3.86	0.391*	2.72	1.025*	4.49
Kenya	0.364***	1.78	-0.108	-0.55	0.580**	2.54
Ghana	1.366*	7.01	0.650*	4.67	1.979*	8.50
Cameroon	1.336*	6.76	0.793*	4.67	1.684*	7.13
Uganda	0.259	1.27	0.051	0.39	0.408	1.20
Ethiopia	0.072	0.37	0.498*	3.37	-0.487**	-2.03
Burkina Faso	1.039*	5.32	0.512*	3.13	1.390*	5.55
Gambia	0.267	1.37	0.156	1.05	0.248	0.99
Constant	1.975*	4.1	3.159*	5.66	0.533	0.67
F-statistic	F(14, 75)	24.97	F(13, 31)	19.38	F(13, 31)	21.1
Adj. R-squared		0.790		0.845		0.856
No. of observations	90		45		45	

Note: *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.

It is also evident from the pooled model that residing in rural areas, in relation to urban areas, tends to be negatively associated with secondary school enrolment. In fact, a major issue in the human capital development slack in Africa is the fact that there are gaps (demographic, income, infrastructure and health) between rural and urban localities. In almost all countries in Africa, over one-half of the population resides in rural areas but rural incomes are less than one-half of the national income. Empirical evidence of this situation is displayed in Figure 8. With low incomes and poverty being predominantly rural phenomena, and in addition to school infrastructure inadequacy in rural areas, educational attainment in rural areas tends to be less than desirable. Also, the problem of isolation of some rural communities can worsen school accessibility. The World Bank (2006, p. 12) observed that: "if isolation raises the costs of

obtaining education, for instance, the accumulation of human capital becomes economically infeasible".

Figure 8
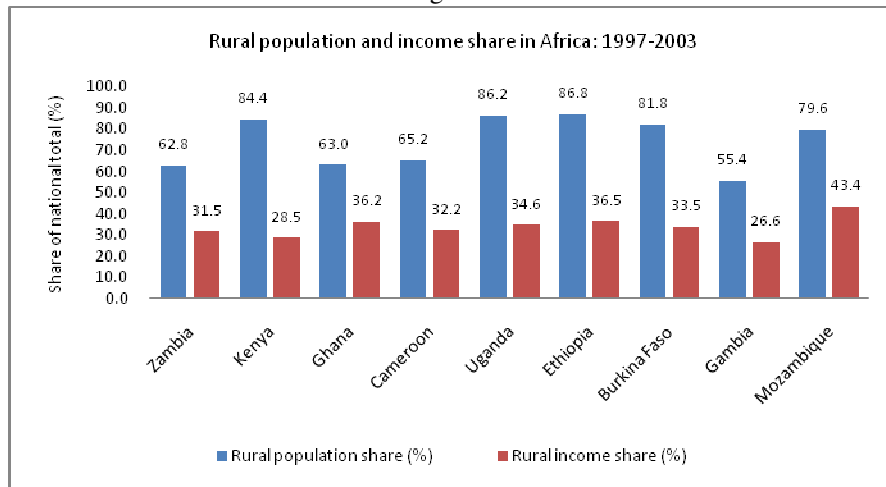
Source: Author's calculations based on data from the World Bank's Africa Development Indicators 2006

How much does it cost households to carry out their role of building the human capital of children? In order to answer this question we examined data on education share of total household expenditures in Africa in both urban and rural areas. The mean monthly expenditure share on education is displayed in Figure 9. On average, education expenditures account for 2.4% of total monthly expenditure of rural households and 4.4% of total monthly expenditures of urban households in Africa. In rural areas education expenditures range between 0.4% (in Mozambique) and 4% (in Uganda), while in urban areas it is between 1% (in Mozambique) and 8% (in Burkina Faso).

Figure 9
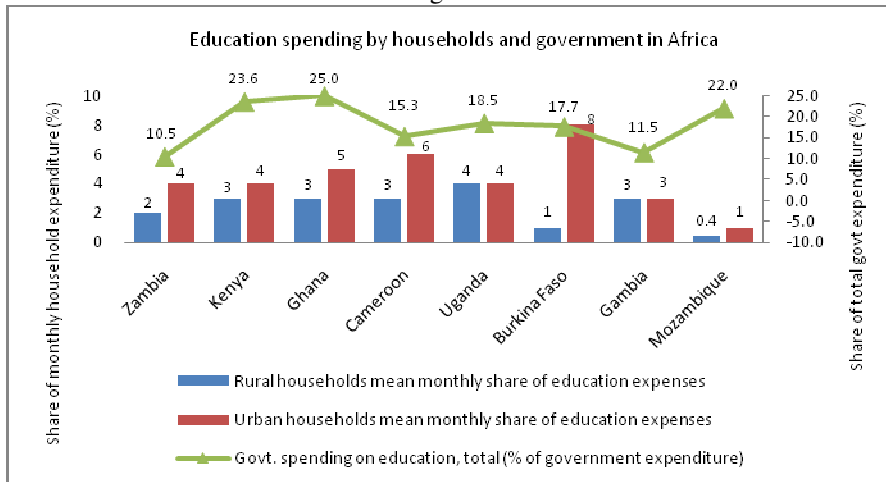
Note: Household rural and urban mean monthly share of education expenses in total monthly household expenditures are for the period 1997-2003. Government spending on education as a share of total government expenditures is for the period 2000-2008.
Sources: World Bank's World Development Indicators 2011; World Bank's Africa Development Indicators 2006; and Ghana Statistical Service (2007), Economic Survey 2001-2005, p.70.

The positive externalities associated with education have attracted government investments in education as well. An average of 18% of governments overall expenditures is allocated towards the education sector in Africa. The functional classification of government budget shows that education's share of total government budget outlays ranged between 10.5% (in Zambia) and 25% (in Ghana).

Going beyond the cross-country analysis presented, we estimated a country-specific model for Ghana in an attempt to distill other drivers of human capital development. This aspect of the analysis used data from the Ghana Statistical Service's 2003 Core Welfare Indicators (CWIQ) Survey, a nationally representative survey. The CWIQ survey covered 49,003 households obtained through a district-based probability sampling technique. The sample used in this study was made up of 59,636 individuals aged between 15 and 30 years, with 62% residing in rural areas. The focus was to identify the factors that influenced the probability of an individual completing a grade at the secondary education level or higher. The model associated with this aspect of the analysis was estimated by probit regression technique. Another aspect of the Ghana country-specific analysis was to examine years of schooling accumulated by individuals. This was estimated by ordinary least squares method. The variables representing individual characteristics (age, gender and disability status), household financial resources, parental educational attainment, and school infrastructure and quality (proximity to school, teacher and furniture availability in schools) were included in both models, and they were estimated for rural and urban localities. The results are presented in Table 3.

Before discussing the results, we wish to acknowledge upfront that the empirical literature on school outcomes identifies the importance of student intellectual ability in educational attainment (McIntosh and Munk, 2007; Lee and Burkam, 2003). Unfortunately the data-set we used did not contain any variables of student test scores and therefore this variable was excluded from our analysis. Notwithstanding the exclusion of student test scores in the models estimated, the variables included in our study are equally important and help to distil some of the key drivers of educational attainment at the household level. It is also important to note that even in studies that explicitly include student ability variables, household income and parental education have been found to be positive and significant determinants of children's schooling.

Consistent with the findings presented in Table 2, household income status (proxy for financial resources) is seen in Table 3 to be a significant determinant of years of schooling and the probability of completing a grade at the secondary school level or higher. Moving up in income status creates better opportunities for human capital development of household members. This suggests that schooling is a normal good. Higher financial resources enable households to acquire the necessary educational inputs (such as text books and tutors to provide additional teaching support for children) needed to ensure the academic success of their children. The impact of income status on educational attainment tends to be much higher in rural areas than in urban areas. This could be due to the fact that as incomes increase for rural households the urgency in getting children to help in agriculture and other labor market activities rather than in going to school is somewhat reduced. A decline in child labour incidence tends to be associated with an increase in school attendance and attainment, all things being equal. The significance of household resources in schooling has been underscored in various studies. Eloundou-Enyegue and Davanzo (2003) found that for children from families in low socio-economic status group,

tend to be disadvantaged. Compared to their counterparts from families of higher socio-economic status, children from low income families in Cameroon are on average 68% more likely to drop out from school at the junior secondary school level. Our study shows that 80% of children in the lowest income quintile in Ghana have not completed junior secondary school or higher levels beyond that, compared to 41% in the case of those in the highest income quintile.

Table 3: Regression results on predictors of human capital development in Ghana, for population aged between 15 and 30 years: 2003

	Model 1				**Model 2**			
	Dependent variable: Highest grade completed being secondary or higher (dummy variable)				Dependent variable: Log (Years of schooling)			
	Estimation technique: Probit				Estimation technique: OLS			
	Urban		**Rural**		**Urban**		**Rural**	
	Marginal impact	z-value	Marginal impact	z-value	Coef	t-value	Coef	t-value
Individual characteristics								
Age	0.344*	41.00	0.239*	39.63	0.182*	34.25	0.200*	32.84
Age squared	-0.007*	-38.51	-0.005*	-37.76	-0.004*	-30.97	-0.004*	-30.15
Has disability	-0.079*	-3.42	-0.057*	-3.94	-0.041*	-2.39	-0.083*	-4.25
Female	-0.147*	-20.52	-0.144*	-28.11	-0.063*	-14.08	-0.067*	-12.96
Household income status								
Lowest quintile (reference group)								
Second quintile	0.066*	6.45	0.076*	8.94	0.034*	4.60	0.044*	4.51
Third quintile	0.098*	9.37	0.112*	12.78	0.054*	7.37	0.055*	5.75
Fourth quintile	0.112*	10.28	0.125*	14.09	0.055*	7.37	0.066*	6.99
Highest quintile	0.117*	10.35	0.145*	16.17	0.055*	7.08	0.070*	7.38
Head/Parent's education								
Below secondary (reference group)								
Some secondary	0.081*	5.44	0.102*	8.98	0.031*	2.83	0.052*	5.34
Completed secondary	0.322*	40.61	0.341*	51.92	0.132*	20.29	0.156*	26.41
Post-secondary	0.354*	37.27	0.446*	32.87	0.286*	36.86	0.309*	33.04
School infrastructure & quality								
Lack of teachers	0.028	0.92	-0.038**	-2.35	0.013	0.77	-0.067*	-4.99
Lack of furniture	-0.119*	-3.71	-0.167*	-10.36	-0.057*	-3.23	-0.091*	-6.29
Primary school over 1 hour away	-0.118**	-2.04	-0.088*	-7.99	-0.103***	-1.71	-0.103*	-5.99
Secondary school over 1 hour away	-0.101*	-7.12	-0.117*	-21.72	-0.026**	-2.61	-0.054*	-9.09
Test statistics	LR chi2(16)	6738.3		9813.6	F statistics	390.6		346.3
R-squared		0.219		0.213		0.240		0.187
Mean for dependent variable		59.8%		31.7%		7.96 years		4.96 years

Note: *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.

Another important determinant of educational attainment is the level of education of parents. The results show that in relation to parents with primary education or none, those with some secondary educational attainment or higher tend to exert a positive impact on the depth of school attainment of their children or household members. The higher the parent's educational level, the stronger the association with children's human capital development. Again, the impact is

stronger in rural areas than in urban areas. In their study on intergenerational education mobility in South Africa, Nimubona and Vencatachellum (2007) observed a similar positive impact of parents' education on their children's education. Parents with a higher level of education have generally had better success from a socio-economic point of view. They have experienced the leverage education confers in terms of better access to formal sector jobs, earnings and better quality of life. A desire to have similar opportunities for their children tends to drive them to invest in their education.

Guryan et al (2008) in their study on parental education and parental time with children noted that higher educated parents tend to spend more time with their children. This finding was quite striking given the fact that higher educated parents also tend to spend more time working outside the home. The point to note is that parents with relatively higher education are generally in a better position to help their children with academic work, which to some extent eases the pressures from schooling on children, and to some extent encourages children to stay in school. Other studies by Olaniyan (2011) on Nigeria and Nkamleu (2009) on Cote d'Ivoire all support the positive effect parents schooling has on children's education.

The importance of school infrastructure and quality in the human capital development process is also underscored in the results presented in Table 3. Generally, if school is located far away from home, it tends to de-incentivize school goers, and this tends to lower the extent of human capital accumulation that occurs, ceteris paribus. Similarly, the lack of furniture in schools also serves as an obstacle towards higher level of school attainment, with the impact being stronger in rural areas than in urban areas. Another factor that negatively affects human capital development is the lack of teachers. However, this factor appears to be statistically significant only in rural areas, and this could be a reflection of the seriousness of the problem in rural areas.

Individual characteristics also matter in the human capital development process. An individual's age has non-linear effect of educational attainment; and being a female (relative to male) tends to be associated with lower educational attainment, an issue often underpinned by cultural norms and values rather than individual academic capabilities. The relatively low educational attainment of females is also explained by pregnancy-related reasons. An analysis of the data showed that 5.4% of urban females aged between 15 and 24 years not currently attending school was due to pregnancy. In rural areas this was 9.8%. An additional 2.8% of female youth in urban areas and 4.7% in rural areas attributed their non-schooling status to getting married. The issue of females opting out of school for pregnancy and marriage-related reasons is common in Africa. In their study on school drop-out in South Africa, Grant and Hallman (2008) noted that one-fourth of 20-22 year old females had dropped out of school as a result of getting pregnant. This finding suggests the importance of reproductive health education in schools and awareness creation on the short-run and long-run socio-economic implications of youth pregnancy.

Students with a health disability such as functional limitation, learning disability and medical conditions (relative to not having a health disability) tend to have a setback in schooling. Such disabilities tend to be negatively associated with educational attainment, all other factors being held constant. This finding is consistent with the study by Boyle et al (2007) and the World Health Organization and World Bank (2011). Using household data on Malawi, Namibia, Zambia and Zimbabwe, the World Health Organization and World Bank found that between

24% and 39% of children with disability had never attended school. Our study shows that 33% of Ghanaian children with disabilities have never attended school. Though different types of disabilities tend to be associated with different schooling outcomes, the disadvantaged situation of children with disabilities compared to their peers without disability call for timely interventions to address this.

Having examined the drivers of the educational component of human capital at the household level, we turn now to firms and their role in training and skills provision (another component of human capital). One of the novelties of this study is the analysis of drivers of formal training provision by firms in general and SMEs and large firms in particular. Though there is much literature on developed countries, not much work has been done on determinants of firm training of workers in Africa, to the best of our knowledge.

4. Drivers of Training at the Firm-level

Training at the workplace of private sector firms differs from other forms of human capital investment such as education and government training. At the workplace the decision to train involves two economic agents, namely, the individual worker and the firm. As Lynch (1994, p.3) points out: "these two agents may differ greatly in their levels of risk aversion, time horizons, information about the labour market, access to capital markets and preferences". Consequently, the decision to build up human capital through training investments is not obvious. Firms may be unwilling to invest in the training of their employees if problems of "poaching" or "cherry-picking" are pervasive (Lynch and Black, 1998). These problems are attributable to free-riding tendencies which are associated with the practices of other firms hiring away employees who have been trained by their competitors. In this regard, if either employee turnover is high or if the very act of training spurs the process of employee turnover or both, then human capital investments by firms may be cut back. This could, from a national perspective, have an adverse effect on human capital development, with dire consequences for productivity, growth, structural transformation and human development.

Organizational size tends to influence the decision to invest in training. Generally, large firms are more likely to provide formal training to their employees (Knoke and Kalleberg, 1994). Large firms can enjoy economies of scale in training provision. This is often not so in the case of small and medium-sized firms (SMEs). A major implication of the economies of scale in training provision is that large firms tend to incur relatively lower training costs per employee compared to SMEs by virtue of the fact that "they can spread fixed costs for training over a large group of employees" (Salas-Velasco, 2007, p. 235). Harris (1999) observes that larger establishments tend to have greater costs of monitoring employees, which encourages them to provide more training to improve productivity and to lower worker turnover.

The external environment facing firms also influences the incentive to train. In particular the availability of credit or financial flows especially on favourable terms tends to create opportunities for firms in dealing with critical contingencies. The internal environment of the firm (in terms of its practices and workers capabilities as reflected in their skills-endowment and educational attainment) also has repercussions on training provision. How do these and other factors influence firm training in Africa?

A probit model is used to determine the drivers of human capital development at the firm level. Data for this aspect of study was drawn from the World Bank's Private Enterprise Survey conducted in 2007. Cross-country evidence based on 6 African countries (Ghana, Senegal, Mali, Kenya, Zambia and Mozambique) is presented. In all, the sample was made up of 2,845 firms, 90.4% of which were small and medium-sized firms, and 9.6% large-sized firms. Descriptive statistics for the sample of firms are presented in appendix Table A3.

The following probit model was estimated:

$$y^*_i = x_i\beta + \varepsilon_i, \quad i = 1, \ldots, n \qquad (2)$$
$$y_i = 1 \text{ if } y^*_i > 0$$
$$y_i = 0 \text{ if otherwise}$$
$$\varepsilon \approx N(0, 1)$$

where: y_i, the formal training provision status of the firm, is a binary response indicator of the ith firm determined by the underlying latent variable y^*_i; x_i is a vector of explanatory variables (organizational size and age, internal characteristics, external environment, industrial sector of operation and country of location), the β coefficients quantify the impact of the explanatory variables, and ε_i is the error term. The set of variables representing organizational size and age in our empirical model on incidence of training provision by firms includes: dummy variables for three different firms sizes, namely, small, medium, and large-sized firms; the age of firms (represented by the years of existence); and whether the firm under consideration has part of a multi-establishment (i.e., whether the firm has a parent firm). The internal characteristics of the firm is represented by three variables- information technology appropriateness (in this case the use of e-mail by the firm in its communications with clients and suppliers serves as a proxy), pursuit of financial accountability (by undergoing annual financial audit), and proportion of the firm's workforce that are considered to be inadequately educated. Regarding the external environment of the firm, it is represented by two variables- credit constraints confronting the firm, and the informal practices of competitors considered to be an obstacle to operations. The industrial sector of operation has five dummy variables representing food production, garment, other manufacturing, retail and other services.

The findings displayed in Table 4 show that medium and large sized-firms were more likely to provide training to their workers, compared to small-sized firms. This is consistent with previous studies by Salas-Velasco (2007), Lynch and Black (1998), Jacobs *et al* (1996), and Knoke and Kalleberg (1994). In Model 4 of Table 4, it is evident that the marginal impact of large-sized firm's probability in offering training to workers is 3.6times higher than the impact from medium-sized firms (0.233 vs. 0.064).

The longer the years of existence, the more likely the firm provides training to its workers. Growing old comes with experience but at the same time it comes with production challenges. Firms have to catch up with new technologies, obsolete methods of production will have to be replaced by current and better methods of production and skills of workers will have to be upgraded for them to be adaptable to the changes occurring at the workplace. Therefore to stay competitive, as firms existence gets prolonged there is a tendency for them to provide training programs to their employees. Furthermore, growth of firms occurs over time and this brings with it more financial resources and the possibility of enjoying some form of economies of scale in training provision.

Firms that attempt to use best practices in information and communications technology, and undergo annual financial audit as part of maintaining financial soundness and accountability (in relation to those who do not), are more likely to provide training to their workers. Firms that perceive their workers to be inadequately educated and therefore unable to function effectively at the workplace tend to provide more training programs than those employers who share a contrary view. In this regard, though firms pursue their own self-interest in providing training to their inadequately educated workforce, they are indirectly helping these workers break-up a potentially vicious cycle of low human capital accumulation. This benefits the firm, the worker and society at large.

Table 4: Formal training drivers in firms in Africa, irrespective of size: 2007

Dependent variable: Training incidence at the work place

Estimation method: Probit

	Model 1		Model 2		Model 3		Model 4	
	Marginal impact	z-value	Marginal impact	z-value	Marginal impact	z-value	Marginal impact	z-value
Organizational size and age								
Medium-sized firm	0.150*	7.04	0.072*	3.36	0.071*	3.30	0.064*	2.91
Large-sized firm	0.372*	10.93	0.246*	7.10	0.241*	6.94	0.233*	6.60
Firm's age (years)	0.002**	2.47	0.001**	2.12	0.001**	2.04	0.001**	2.21
Has a parent firm	0.139*	5.02	0.104*	3.81	0.102*	3.75	0.103*	3.80
Internal characteristics								
Uses ICT (email)			0.133*	6.96	0.132*	6.93	0.126*	6.49
Undergoes annual financial audit			0.104*	5.43	0.102*	5.29	0.100*	5.18
Inadequately educated workforce			0.061*	3.70	0.067*	3.93	0.065*	3.82
External environment								
Credit constraints					-0.036***	-1.91	-0.038**	-2.01
Informal practices of competitors					-0.005	-0.30	-0.004	-0.23
Industry of operation								
Food							-0.062**	-2.35
Garment							-0.080*	-2.92
Other manufacturing							-0.066*	-2.62
Retail							-0.105*	-4.09
Country of location								
Ghana	0.152*	5.04	0.154*	4.99	0.161*	5.12	0.149*	4.72
Zambia	-0.013	-0.45	-0.053***	-1.94	-0.056**	-2.01	-0.058**	-2.13
Senegal	0.002	0.06	0.001	0.04	0.002	0.08	-0.017	-0.58
Kenya	0.071**	2.28	0.001	0.03	0.006	0.20	0.005	0.17
Mali	0.049	1.64	0.069**	2.26	0.071**	2.31	0.065**	2.10
LR Chi-square		298.7		415.9		419.7		437.5
Pseudo R-squared		0.095		0.133		0.134		0.140
No. of observations		2845		2845		2845		2845

Note: *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.

Firms identifying credit constraints as a major obstacle confronting their operations are associated with a lower incidence of training, compared to those firms without credit constraints. Generally, small and medium-sized firms tend to be more saddled with credit constraints and without government policy intervention to ease the credit constraint, not only will the credit constraint affect the growth and performance of firms but it will adversely affect the efforts of firms in skills-formation and development.

Though the informal practices of competitors such as "poaching" serve as a disincentive to training, it appears to be statistically insignificant. Employers in the food products, garment, other manufacturing and retail sectors were less likely than those in the other service sectors to provide training to their workforce.

Table 5: Training drivers in SMEs and large-sized firms in Africa: 2007

Dependent variable: Training incidence at the workplace

Estimation method: Probit

| | Small and medium-sized firms | | Large-sized firms | |
	Marginal impact	z-value	Marginal impact	z-value
Organizational size and age				
Firm's age (years)	0.001**	1.95	0.004**	2.03
Has a parent firm	0.100*	3.46	0.166**	2.21
Internal characteristics				
Uses ICT (email)	0.130*	7.06	0.220**	2.11
Undergoes annual financial audit	0.100*	5.46	0.237***	1.86
Inadequately educated workforce	0.054*	3.22	0.172**	2.43
External environment				
Credit constraints	-0.034***	-1.82	-0.102	-1.47
Informal practices of competitors	-0.003	-0.18	-0.052	-0.73
Industry of operation				
Food	-0.062**	-2.49	0.103	0.71
Garment	-0.067**	-2.59	-0.137	-0.77
Other manufacturing	-0.059**	-2.45	0.022	0.15
Retail	-0.102*	-4.32	-0.341	-1.51
Country of location				
Ghana	0.127*	4.18	0.100	0.67
Zambia	-0.048***	-1.77	-0.255**	-1.98
Senegal	-0.033	-1.20	0.057	0.35
Kenya	0.008	0.27	-0.106	-0.81
Mali	0.049***	1.70	0.017	0.07
LR Chi-square		242.6		45.4
Pseudo R-squared		0.093		0.122
No. of observations		2572		273
Observed probability		0.205		0.571

Note: *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.

Table 5 splits the sample into two groups: SMEs and large-sized firms and presents the results from estimating the drivers of training of workers at the firm level. The findings show that about 57% of large-sized firms provide training to their workers, compared to 21% in the case of SMEs. Variables representing the organization's size and age and internal characteristics all turn out to be statistically significant determinants of training for both SMEs and large-sized firms. In terms of the external environment, credit constraint emerges as being negatively associated with the probability of providing training to workers, but it is only statistically significant in the SMEs model. In other words, credit constraints seem to matter more for SMEs in Africa, as far as building the skills of their workers is concerned. This is an issue that policy-makers would have to address in order to ensure that SMEs stay competitive and survive in a highly globalized environment. What are the implications of human capital development for growth and structural transformation in Africa? This is addressed in the next section.

5. Implications for Growth and Structural Transformation

The empirical analysis carried out in the previous sections show that, at the household level, the key drivers of educational attainment are household income, parental education, school infrastructure, and individual characteristics such as age and health status. At the firm level, the determinants of training for workers include organizational size and age, credit availability, and workforce educational status. From a trend perspective, it was found that the quality of Africa's human capital appears to be improving.

The implications of human capital development for growth in Africa can be identified through the existing literature on growth and economic development. Drawing from the works of Mankiw *et al* (1992), Lucas (1988), Romer (1990), and Benhabib and Spiegel (1994), Kumar (2006) identifies four channels through which economic growth may be influenced by the human capital endowment of a country.

The first channel takes into consideration the fact that human capital is an input in the production function and therefore increases in this input tends to be associated with an increase in output, ceteris paribus. The second channel recognizes the generation of positive externalities from the development or accumulation of human capital. This in essence leads to endogenous growth. A third channel revolves around the extent of innovativeness that is associated with human capital accumulation. In this regard, improvement in human capital paves the way for greater innovation through the process of research and development. A fourth channel through which human capital development could influence growth performance is predicated on the observation of a possible correlation between human capital accumulation and physical capital investment. For Africa, the transmission mechanisms of human capital accumulation imply that government policy of realizing growth can be facilitated through the accumulation of human capital in addition to other growth-enhancing factors such as good governance and functional institutions. The observation of a trend towards rising enrolment and completion rates in secondary schools in Africa, and investments by firms in the training of workers imply the possibility for growth (at both the micro and macro levels) via the channels mentioned earlier on.[2]

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[2] The effects of international migration associated with human capital development in Africa have not been examined explicitly in this paper. It is, however, an important issue which has growth implications. Suffice to

Growth is associated with rising incomes and this empowers families or households to investment in the human capital of their children. Rising incomes from growth, also allows for demand for goods and services which in turn encourages firms to invest (both in physical and human capital), maintain jobs, produce and add to the growth process. A sort of virtuous cycle could therefore be set in motion, one that ultimately leads to better human development outcomes. However, it must be pointed out that pervasive inequality between urban and rural areas could create a situation where the human capital-induced growth may skew the benefits to urban areas. Government policy intervention is therefore needed to ensure that rural areas catch up in the human capital accumulation effort.

Moving from low to high levels of educational attainment calls for meeting the challenges associated with all levels of education and in particular ensuring that much progress is made at the lower levels of education and lower levels of living (as seen in rural areas) in order to facilitate the upward movement. The role of government in developing, implementing and monitoring "pro-education policy" strategically and sustainably is pivotal. Government investments in education augment the investments by households in the human capital of their members. The Overseas Development Institute (2011) points out that, smart policies for ensuring educational progress from lower to higher levels, and for that matter improving human capital include addressing both demand and supply constraints to education. "Successful education reforms have involved training teachers and constructing new schools, but also policies to reduce financial barriers and encourage school participation, such as scholarships, school feeding programs and elimination of school fees" (ODI, 2011; p.8).

Figure 10
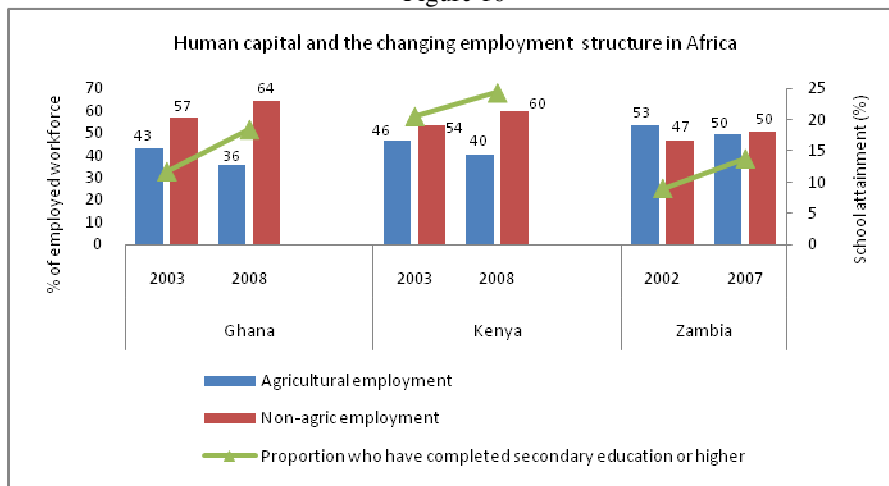
Source: Ghana Demographic and Health Survey 2008 and 2003; Kenya Demographic and Health Survey 2008 and 2003; and Zambia Demographic and Health Survey 2007 and 2001-2002

Apart from the growth implications, there are also structural transformation implications of human capital development in Africa. The productivity improvements that are associated with higher educational attainment are not confined to the manufacturing industry and services sectors

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mention here that international migration has both positive and negative elements associated with it, and the "brain drain" issue often cited can potentially be harnessed into "brain gain" through appropriate government policy initiatives. This is an area that can be explored in an in-depth manner in future studies.

alone but also tend occur in agriculture. Education and the knowledge it comes with allows for better use of agricultural resources and adoption of productivity enhancement technologies. This helps in reducing the number of people needed in agricultural production, and often allows for a transfer of some of the labour force to non-agricultural sectors. This has been part of the structural transformation that has occurred in industrialized countries. There seems to be signs of this structural transformation taking place in Africa (though in its very rudimentary form, as shown in Figure 10).

With a youthful population structure in Africa, and with accessibility to schooling rising (as evidenced by the rising school enrolment ratios at all levels) it is possible for education policy-makers to introduce "green curriculum" to educational institutions. Knowledge of, and skills development in energy efficiency, reduction in carbon footprints, and utilization and management of natural capital (arable land, forests, ecosystems) among others, will put Africa's next generation of human resources – workers, managers of firms and entrepreneurs on a "green-awareness path". This will allow for environmental-consciousness among the youth and hopefully motivate them to adopt environmental-friendly practices in future that will foster green growth and sustainable development, where best practices in green technology and management are used pervasively. This will usher in another dimension to the structural transformation process much needed in Africa. The willingness and ability of policy makers in Africa to move this agenda forward will be vital for the structural transformation process and outcomes.

Appendix

Appendix Table A1: Educational attainment in Africa by gender and age group

	Ghana median years of schooling				Kenya median years of schooling				Zambia median years of schooling			
	Male		**Female**		**Male**		**Female**		**Male**		**Female**	
Age group	2003	2008	2003	2008	2003	2008	2003	2008	2002	2007	2002	2007
15-19	7.1	7.3	6.9	7.3	6.4	7.2	6.7	7.2	6.0	6.9	6.0	6.7
20-24	8.4	8.8	8.0	8.2	7.8	8.6	7.5	7.6	7.5	7.7	6.2	6.4
25-29	8.5	8.5	5.8	8.2	7.5	8.0	7.4	7.5	6.8	7.0	6.1	6.3
30-34	9.0	8.6	5.1	6.0	7.9	7.8	7.3	7.4	6.9	6.9	6.1	5.9
35-39	9.0	8.9	4.2	5.6	8.0	9.1	6.4	7.3	6.9	6.7	5.5	5.8
40-44	9.3	9.3	5.4	5.3	6.8	7.6	5.9	6.7	6.7	6.8	5.6	5.9
45-49	9.1	9.2	3.4	4.6	6.5	6.9	3.9	6.0	7.6	6.8	3.7	5.3

	5-year difference in median years of schooling					
	Ghana: 2008 minus 2003		**Kenya: 2008 minus 2003**		**Zambia: 2007 minus 2002**	
Age group	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
15-19	0.2	0.4	0.8	0.5	0.9	0.7
20-24	0.4	0.2	0.8	0.1	0.2	0.2
25-29	0.0	2.4	0.5	0.1	0.2	0.2
30-34	-0.4	0.9	-0.1	0.1	0.0	-0.2
35-39	-0.1	1.4	1.1	0.9	-0.2	0.3
40-44	0.0	-0.1	0.8	0.8	0.1	0.3
45-49	0.1	1.2	0.4	2.1	-0.8	1.6
% of age groups with increase in years of schooling	*71.4%*	*85.7%*	*85.7%*	*100%*	*71.4%*	*85.7%*

Source: Ghana Demographic and Health Survey 2008 and 2003; Kenya Demographic and Health Survey 2008 and 2003; and Zambia Demographic and Health Survey 2007 and 2001-2002

Appendix Table A2: Descriptive statistics for sample (aged 15-30 years) used in determining the drivers of educational attainment in Ghana

	Urban sample		Rural sample	
	Mean	Std Dev	Mean	Std Dev
Years of schooling	7.930	4.075	4.960	4.259
Completed a grade at secondary or higher	0.598	0.490	0.317	0.465
Individual characteristics				
Age	21.780	4.731	21.854	4.940
Has disability	0.024	0.155	0.029	0.168
Female	0.528	0.499	0.515	0.500
Household income status				
Second quintile	0.207	0.405	0.203	0.402
Third quintile	0.193	0.395	0.186	0.389
Fourth quintile	0.179	0.383	0.184	0.388
Highest quintile	0.172	0.378	0.194	0.395
Household Head/parent's education				
Some secondary	0.052	0.222	0.055	0.228
Completed secondary	0.325	0.468	0.237	0.425
Post-secondary	0.131	0.337	0.043	0.203
School infrastructure				
Lack of teachers	0.014	0.117	0.034	0.181
Lack of furniture	0.015	0.122	0.030	0.170
Primary school over 1 hour away	0.004	0.065	0.068	0.252
Secondary school over 1 hour away	0.072	0.259	0.430	0.495
No. of observations	22,800		36,836	

Source: Based on Ghana Statistical Service's 2003 CWIQ survey micro level data.

Appendix Table A3: Descriptive statistics for sample on firms used in determining training drivers in Africa

	Pooled sample		SMEs		Large-sized firms	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Training incidence	0.240	0.427	0.205	0.403	0.571	0.496
Organizational size and age						
Firm's age (years)	14.301	12.475	13.311	11.453	23.630	17.048
Firm has parent	0.106	0.308	0.089	0.285	0.267	0.443
Internal characteristics						
Firm uses email in business communication	0.399	0.490	0.349	0.477	0.872	0.335
Firm undergoes annual financial audit	0.471	0.499	0.428	0.495	0.875	0.331
Inadequately educated workforce	0.418	0.493	0.408	0.492	0.516	0.501
External environment						
Credit constraints incidence	0.731	0.444	0.743	0.437	0.619	0.487
Problems with informal practices of competitors	0.700	0.458	0.705	0.456	0.659	0.475
Industry of operation						
Food	0.199	0.400	0.185	0.388	0.337	0.474
Garment	0.170	0.376	0.178	0.382	0.103	0.304
Other manufacturing	0.295	0.456	0.276	0.447	0.473	0.500
Retail	0.194	0.395	0.211	0.408	0.029	0.169
Country of location						
Ghana	0.173	0.379	0.180	0.384	0.114	0.318
Zambia	0.170	0.375	0.163	0.369	0.238	0.427
Senegal	0.178	0.382	0.188	0.391	0.081	0.273
Kenya	0.139	0.346	0.107	0.310	0.440	0.497
Mali	0.172	0.378	0.188	0.391	0.022	0.147
No. of observations	2845		2572		273	

Source: Based on The World Bank's 2007 Enterprise Survey micro datasets.

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