Education and Economic Development in Africa[1]

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August 17, 2010

[1]Paper prepared for the 4th African Economic Conference, October 27-29, 2010, Tunis, TUNISIA. I thank but not implicate John Karikari and Elizabeth Asiedu for helpful comments and David Klinowski and Nathan Moore for outstanding research assistance.

Abstract

This paper uses panel data from two new data sets on educational attainment to investigate the effects of education on several development outcomes in African countries. I find that education has a positive and significant impact on these development outcomes. I also find that different levels of education affects development outcomes differently; for some development outcomes, primary and secondary education may be more important than tertiary education while for some development outcomes, such as income growth rate, tertiary education may be more important. The results of this paper have implications for development policy in African countries.

KEY WORDS: HIGHER EDUCATION, ECONOMIC DEVELOPMENT, AFRICA, PANEL DATA

JEL: O, O1, O24, O5

1 Introduction

> "If you plan for a year, plant a seed. If for ten years, plant a tree. If for a hundred years, teach the people. When you sow a seed once, you will reap an single harvest. When you teach the people, you will reap a hundred harvests".
>
> 7th Century BC Chinese philosopher Guan Zhong.

Modern theory of economic growth stresses the principal role of human capital, especially education and health. However, the relationship is not limited to income growth rates. The relationship between education and economic development has long been recognized in the development literature. On the one hand, education is seen as a product of the development process that is worthy of pursuit by itself (note that education is the MDG # 2). On the other hand, education is considered a crucial input into the development process. It is considered an input to economic growth, health outcomes, institutional development, and possibly trade, among others. Although education is considered important in the development literature, there have been few empirical studies to measure its importance in the development process in African countries. The few empirical studies on the relationship between education and development have focused almost exclusively on the effects of education on income growth to the exclusion of other aspects of development. The second issue is that it is not clear which level of education is appropriate for development in the context of low income countries and whether all development outcomes are equally affected by all levels of education. While the World Bank and other international development organizations argue for a focus on primary education, some researchers suggest that it is higher education that is relevant for long term development. For African countries, this debate has hardly began.

Educational attainment in Africa is low by all standards and lags behind educational attainment in the rest of the world. Figure 1 shows the average level of educational attainment of the adult population (25 years and older) in Africa and other parts of the world for 2005.[1] In 2005, only 18, 9, and 1.5 percent of the adult population in Africa had completed primary, secondary, and tertiary education respectively; the average years of schooling at all levels stood at 4.7 while the average years of tertiary education stood at 0.08 years. While the educational attainment in Africa is low in absolute terms, it seems even lower when compared with to educational attainment in the rest of the world. For example, the proportion of the adult population that has completed tertiary

education were 4.9, 4.5, and 3.9 the African ratio in the world, East Asia and the Pacific Less Developed Countries (LDCs) respectively. Using other measures educational attainment, Africa's absolute and relative educational attainment is low as figure 1 shows.

Even though educational attainment in Africa is low, it has grown rapidly since 1960. For example between 1960 and 2005, the proportion of the adult population that has completed tertiary education, average years of schooling at all levels and the average years of tertiary education increased by 464, 408, and 400 percent respectively in Africa. With the exception of East Asia and the Pacific, the growth rate of Africa's educational attainment was the fastest in the world during the period. Although educational attainment in Africa has grown relatively fast, the gap between educational attainment in Africa and other parts of the world has widened. For example, while the proportion of the adult population that has tertiary education increased by 490% between 1960 and 2005, the ratio of tertiary educated adults in world relative to the ratio in Africa increased from 3.5 times to 4.6 times during the same period. To what extent will this increasing education gap result in an increased development gap? It all depends on the degree to which education influences development outcomes; an issue I investigate in this paper.

This paper uses a new panel data on educational attainment in African countries over the 1960-2008 period to investigate the effects of education on a number of development outcomes. Specifically, I investigate the effects of educational attainment on economic growth, a range of health outcomes (MDG # 4 & 6), political stability, and the participation of women in national politics. I also investigate the level of education that is most important for particular aspects of development in Africa. I do so by estimating a growth (other development outcomes) equation in which education is an added regressor. I disaggregate education into primary, secondary, and tertiary education, thus allowing me to investigate the effects of *different levels* of education on different development outcomes. Investigating the effects of education on a range of development outcomes provides a broader perspective on the effects of education on development than has hitherto been attempted. I also use a second data set on education attainment to estimate the development outcome equations as part of my robustness test.

Education is correlated with several social development outcomes; among these are health, fertility choices, the education of children, the ability to develop, learn or adapt new technologies to local environment, and build institutions and a sense of nationhood. This reduces the probability of civil conflicts hence political stability in a country. Because educated people are, on the average,

quicker to train and adopt new technologies, they tend to be the innovators in a country. One of the United Nations' Development Program's (UNDP) measure of development of nations is gender equity (MDG # 3). There is no better visible manifestation of gender equity in national life than the level of women's participation in national politics. Yet this aspect of development has not received serious attention in the economic development literature. Education, especially tertiary education, is more likely to break down traditional barriers and therefore make it possible to increase women's participation in national politics.

I have chosen to focus on Africa for a number of reasons. First, the region has one of the lowest rates of education attainment, especially higher education, in the developing world. Africa is also one of the least developed as defined by several indicators—income, human development, health, gender equity, political stability, among others n the world. The combination of low levels of education and development suggests that the marginal effect of a change in education is likely to be high. Second, although the region is less developed, it is going through rapid change and it may be interesting to investigate what role education plays in this process. Finally, African policy makers are pursuing a range of policies, including increased investment in education, as a means of accelerating development. In addition to knowing the general effects of education on development, it may be necessary for policy makers to know which levels of education are relevant for a particular development outcome. In spite of the role education plays in the development process, research on the role of education in African development seem to be limited to the income growth effects of education. This paper attempts to broaden the discussion.

This paper makes some contributions to the literature on the relationship between education and economic development. Unlike other studies that focus exclusively on the growth effects of education or the impact of education on health outcome, this is the only paper I am aware of that studies the effects of education on a wide variety of development outcomes, including political stability and gender issues in African countries. The focus on a wider range of development outcomes provides a broader view of the link between education and development than is normally the case in the economics literature. The focus on several outcomes also lead to a marriage of the subjects studied by economists and many other social scientists, such as political scientists, sociologists, and anthropologists. Second, the use of two new data sets on educational attainment that are generally believed to be of high quality for this study is unique to this study. Finally, I use modern statistical methods that are appropriate for the studies of the various development outcomes.

The results of this paper can be briefly summarized as follows: I find that conditional on other variables, education has significant positive effects on several aspects of development—income growth, health outcomes, political stability, and women's participation in national politics. I find that the effects of education on development outcomes is not linear; different levels of education affects development outcomes differently. The effect of tertiary education on income growth and regional integration in Africa is much larger than the effects of lower levels of education; on the other hand, lower levels of education have stronger impacts on preventive health than tertiary education. Finally, I find that education decreases the probability and intensity of armed conflicts in the African region, all things equal. The results of this paper has implications for education and development policies in Africa.

The rest of the paper is organized as follows: Section 2 briefly reviews the literature on the relationship between education and development, especially as it relates to African countries, section 3 introduces the equation(s) to be estimated, section 4 discusses the data and estimation methods, while section 5 presents and discusses the statistical results. Section 6 concludes the paper.

2 Previous Studies

Because I investigate the effects of education on several development outcomes, it will be impossible to provide an appropriate review of the relevant literature,hence I do not present the usual literature review. I therefore mention a few of the relevant papers in this section. Most studies on the effects of education on development have used cross-country data and focused on the growth effects of education (Barro: 1999, Romer: 1990, Atardi and Sala-i-Martin: 2003, Fakuse: 2010, Nelson and Phelps: 2006, Gyimah-Brempong *et al*: 2006, Ciccone and Papaionnou: 2009, Mamoon and Murshed: 2009, among others). Others use time series data (e.g. de la Croix *et al*: 2008) or cross-state data within a country (Baldwin and Borrelli: 2008) to investigate the effects of education on income growth. These authors generally find education to have a positive and significant effect on income growth rate. The growth effect comes through several channels; among which are the ability to create and absorb new technologies, improve health increased savings and investments (especially in human capital), and the externalities effects of education (Groweic: 2010).

Recent studies on the relationship between education and income have relied on new and improved data sets that cover more countries and dynamic panel or instrumental variables estimators.

Toya *et al* (2010) finds a positive relationship between education and income growth in the world. The positive and significant relationship remained unchanged whether education was measured as years of education completed at all levels or years of secondary education completed. Barro and Lee (2010) finds that education as measured by years of schooling completed by the adult population has a significant growth impact, all things equal. Similarly, Cohen and Soto (2007) investigates the effects of education on income growth and find that both initial years of schooling and change in years of schooling have significant positive impact on income growth in the world.

After a long period of championing "education for all" (i.e. emphasizing primary education to the possible neglect of tertiary education), the World Bank published a 2008 Report, *Accelerating Catch Up: Tertiary Education for Growth in Africa* advocating increasing rapid increases in the *quantity* and *quality* of tertiary education in as African as a mechanism for accelerating income growth and poverty reduction in an increasingly knowledge based globalized economy. Similarly, Martinez *et al* (2010), and Kamara *et al* (2007) emphasize increased tertiary education, especially, the production of scientific, technical, and entrepreneurial skills, as a way to accelerate growth in Africa. However, few of these studies conduct detailed empirical analysis to support their arguments. This paper attempts to provide empirical support for the arguments made in these papers.

Several authors have investigated the effects of education on health outcomes and have generally found that education tends to have positive effects on health outcomes (Silles: 2008, Gilleskie and Harrison: 1999, Glick *et al*: 2009, Cutler *et al*: 2006, Kabubo-Mariara *et al*: 2009, and Gyimah-Brempong and Wilson: 2004 among others). This happens either because educated people have better information about health alternatives or they make better health decisions, given the alternatives available to them. For example, Glick *et al* (2009) find that educated people are less likely to be misinformed about HIV in Madagascar, while Gilleskie and Harrison (1999) argue that educated people are able to choose better health inputs which in turn increases their health outcomes than those with lower levels of education. In addition to better information, because education increases earnings, educated people have incentives to invest in their health in order to increase their life long earnings. Although a few studies on the relationship between education and health have used data from African countries, the overwhelming preponderance of research on the relationship between education and health have used data from the developed and other parts of the developing worlds.

The general focus of these studies has been on the educational effects on income growth or the health effects of education but not on either political stability, female participation in political participation of women generally. The closest study that has looked at the effects of education and economic opportunity on political stability is the work of Collier and Hoef

None of these studies mentioned above also combine a study of the effects of education on growth, health, political stability and female participation in politics in one paper. Most of these studies use cross country data thus ignoring the longitudinal aspect of education's impact on development. Finally, non of these studies disaggregate education to the various levels of education. Yet, for policy purposes, it may be important to investigate the effects of education on several dimensions of development on one study. I try to fill the gaps in the literature in this study.

3 Model

There are several ways through which education can affect development outcomes. For example education can increase economic growth through: (i) increases in the productivity of existing resources (especially labor), (ii) create and (or adopt) and rapidly diffuse new technologies, (iii) improve health and increase the supply of labor. (iv) Because increased education increases labor income and increases health (life expectancy), this provides incentives to increase investment in education and health, further increasing economic growth. In addition, education improves the quality and efficiency of institutions, thus leading to higher rates of development. Some researchers argue that education reduces the potential for ethnic conflict because of the inter-ethnic friendship developed by political leaders during school days. Because this study deals with several development outcomes, I only discuss the effects of education on outcomes at a very general level and in a limited way. However, it is unlikely that all levels of education contribute equally to these development outcomes. For example, it is unlikely that primary education plays the same role in bonding national leaders, hence provide political stability, as tertiary education does. It is therefore important that I disaggregate education by levels.

I begin with a simple idea that a development outcome i in period t depends on current inputs of human and physical capital, and technology. Development outcomes are also likely to be influenced by institutional, policy, and political/security environments. Formally, I specify the development

outcome equation as:

$$y_{ijt} = f(H_{kjt}, \mathbf{X}) \qquad f_1 > 0 \tag{1}$$

where y_{ijt} is development outcome i in country j in period t, H_{ijt} is education human capital level k of country j in period t, $\mathbf{X}$ is a vector of other inputs and environmental factors that are likely to affect development outcome i. I assume that education level j will have a positive effect on the development outcomes of interest in this paper. It is possible that different levels of education may have different impacts on various development outcomes. As a result of this possibility, I measure education as consisting of three levels—primary (*primary*), secondary (*secondary*), and tertiary (*tertiary*). I note that not all variables in the $\mathbf{X}$ vector will enter every development outcome equation in the study, and while the $\mathbf{X}$ vector will contain endogenous and predetermined variables in some equations the $\mathbf{X}$ vector in other equations will consist of exogenous variables only. The different elements of $\mathbf{X}$ in the different outcomes equations will also affect the estimation method used for each development outcome equation.

Equation (1) is written at a general level. To estimate it, I must indicate the mechanisms through which education affects these outcomes, provide a specific functional form as well as define the variables contained in the $\mathbf{X}$ vector. Because economic theory does not provide guidance as to specific functional forms for most of the outcome equations, I specify a linear (in coefficients) functional form for these outcomes equations. It is possible that education does not have a linear effect on development outcomes; the effects may be discontinuous at different levels of education. For example, Gyimah-Brempong *et al* (2006) and Self and Grabowsky (2004) find that the effects of education on income growth is discontinuous with tertiary education having a larger impact on growth than primary or secondary education. To account for this possibility, I specify H in a discontinuous form—primary, secondary, and tertiary. Finally, because the regressors in $\mathbf{X}$ for each outcomes equation differ and because there are several of such outcomes equations that I estimate in this study, I do not define specific variables in $\mathbf{X}$ for the outcome equations. Instead I will present these variables for some of the equations in the results section.[3]

I assume that in addition to a vector of control variables, human capital affect these development outcomes. I assume that human capital and education are related in the following way. $H_i = \Theta(S_i)$, where S_i is educational level, and $i = primary, \quad secondary, \quad and \quad tertiary$. I assume that human capital is linearly related to education. I therefore write the development outcome equation

I estimate as:

$$y_{ijt} = \alpha_0 + \alpha_1 primary + \alpha_2 secondary + \alpha_3 tertiary + \mathbf{X}\beta + \varepsilon \quad (2)$$

where *primary, secondary*, and *tertiary* are primary, secondary, and tertiary education respectively, ε is a stochastic error term, α_i and β are coefficients to be estimated, and $\mathbf{X}$ is as defined in the text above. My interest is in the sign and statistical significance of *primary*, *secondary* and *tertiary* in the various development outcomes I investigate. I expect the coefficient of *primary, secondary*, and *tertiary* to be different from each other. As indicated above, the control variables in $\mathbf{X}$ differ for each outcome equation I estimate. If the effects of education on development outcomes is the same at all levels of education, then there will be efficiency losses in estimation when education is disaggregated. I therefore test to see if there are differences in the effects of different levels of education on development outcomes in my estimation.

4 Data and Estimation Method

4.1 Data

There are several dependent variables and regressors in this study. I briefly describe their measurements and sources in this sub-section. The outcome variables I investigate are the growth rate of real per capita income ($\dot{y}$) measured as the annual growth rate of per capita real GDP, political stability ($polstab$), and the participation of women in national politics which I measure as the proportion of national parliamentarians who are women ($womenparliament$). In addition to these outcome variables, I investigate a number of health outcome variables that include life expectancy at birth ($lifeexpt$), under five mortality rate ($u5mort$), the proportion of adult tuberculosis cured using dots ($TBcure$), the prevalence of HIV/AIDs ($hivaidsprev$), immunization against measles ($immunemeasls$), and the proportion of children inoculated against tetanus and DPT($1yrdpt$). I measure $polstab$ by the index of political stability as presented in Kaufmann *et al* (2009). $u5mort5$ is measured as the number of children per 10,000 who die before their fifth birthday. $TBcure$, $immunemeasls$, $1yrdpt$, and $hivaidsprev$ are measured as the proportion of the population (children in age group) who are cured of TB using DOTS (immunized against various diseases).

Other explanatory variables in the paper are per capita income ($income$), investment (k), government consumption ($govcon$), population growth rate ($popgro$), foreign aid (aid), post conflict sit-

uation (*postconflict*), health expenditure/GDP ratio (*healthexp*), and two measures of governance—rule of law (*rulelaw*) and the government effectiveness (*goveffect*). Income is the real per capita GDP with 2000 purchasing power parity (PPP) as the base, *govcon* is the ratio of government consumption expenditures to GDP, (*popgro*) is the annual growth rate of a country's population while *aid* is measured the net aid disbursement/GDP ratio. We follow earlier researchers and measure k as the gross domestic fixed investment/GDP ratio in a country. *healthexp* is measured as the ratio of all health expenditures to a nation's GDP, *urbanpop* is the proportion of the country's population that lives in urban areas. I measure post conflict as a dummy variable that takes the value of unity if a country is emerging from conflict, zero otherwise.

The variable of interest in this paper is education. There are several ways to measure education: while some authors measure it as the enrollment ratios (Barro: 1997) others measure it as education expenditure/GDP ratio (Appiah and McMahon: 2002). Neither of these measures of education measure the stock of education human capital that is used for production, hence development outcomes. As Solow (2003) points out, enrollment and expenditure ratios are inputs into the production of educational human capital; they are not additions to the stock of human capital itself. I therefore follow Barro and Lee (2010) and measure education as the proportion of the adult population (25 years and older) that has completed a certain level (*primary, secondary, tertiary*) of education in a country. proportion of the adult population that has attained a certain level of education is likely to include the proportion that has attained the next level of education. For example, the proportion of the population that has completed *secondary* include those who have gone on to complete *tertiary* education. Therefore, in estimation, I net out the higher level of education from the lower level of education. For example, in estimation, I measure *secondary* as $secondary = lsc - lhc$, thus making sure that *secondary* does not include *tertiary* as well. I treated *primary* in a similar fashion while I measure *tertiary* as Barro/Lee's *lhc*. The correlation between *primary* and *lpc* and *secondary* and *lsc* are 0.76 and 0.98 respectively; the correlation between *primary* and *secondary*, *secondary* and *tertiary*, and *tertiary* and *primary* are 0.26, 0.45, and -0.13 respectively. These correlations are significant at $\alpha = .05$ or better.

For robustness tests, I alternatively measure education as the average number of years of education completed at *all levels* by the adult population (Barro/Lee's *years*) as well as average level of years of schooling at each level of education attained by the adult population (*yr-sch-...* Finally, I uses Soto's (2007) educational data set to estimate the equations as additional robustness check

on my results. I treated these other measures similarly as I treated the other measures of education as discussed above in estimation. In addition to education and other variables mentioned above, I included other variables in **X** vector as control variables or as instruments. These include being landlocked and student/teacher ratios.

Data for this study comes from several sources. Data on education were obtained from Barro and Lee (2010), *Barro-Lee Educational Attainment Dataset*, on line version at www.barrolee.com. This data set extends the 2000 Barro-Lee data set to 2010. Barro and Lee (2010) show that there is a high correlation between the new series and the old (2000) data with a correlation coefficient of 0.98. Income, its growth rate, investment, and other socioeconomic variables were obtained from the World Bank's *World Development Indicators, 2010* (on-line version). The health outcomes data (*u5tmort, TBcure, hivaidsprev, immunemeasls, and 1yrdpt*) as well as the share of health expenditure financed from external sources were obtained from The World Health Organization, *WHO Statistical Services*, various years. Data for post conflict were obtained from the files of PRIO. I obtained the *aidgni* data from OECD Development Assistance Committee (DAC), 2009 on line version at http://www.oecd.org/dac/stats/dcrannex, 2009 while data for *rulelaw* and *bureau* were obtained from International Country Risk Guide (ICRG), *Political Risk Points by Components*, ICRG, 2009.

The data are from 1960 to 2010 but the sample period differ according to the outcome being investigated. For example, the income growth equation covers all years of the study, the health outcomes data are from 1990 to 2008. As is usually done in the literature, I use five year averages instead of annual data in order to reduce the noise created by very short term variation in the variables. Second, because of lack of observations for some years for some variables, the sample sizes differ according to which development outcome is being analyzed. Generally, the sample size varies from 178 for the *womenparliament* equation to 440 observations for the $\dot{y}$ equation.[4] The data covers 52 countries in Africa over the sample period.[5] Because observations are not available for every year, the samples are unbalanced panels.

Summary Statistics of the sample data are presented in table 1. Generally, the data reveals that health outcomes in African countries are relatively low and highly variable, income growth rate low, while political instability is high. The general impression one gets from the data is that development in Africa in general is very low. In general, the level of educational attainment, especially tertiary education, in African countries during the sample period was relatively low. In addition to its

low level, educational attainment in the region was also highly variable both across countries and through time. Although educational attainment in the region is relatively low, it grew relatively fast during the sample period.

4.2 Estimation Methods

I estimate several development outcomes in this study and one estimator may not be appropriate for all outcomes. Therefore, I use an eclectic set of estimators to estimate the outcomes in the model. The growth and health outcomes I estimate have lagged dependent as well as endogenous regressors. It is well known that in the presence of dynamics, neither the fixed effects (FE) nor the random effects (RE) estimator produces consistent estimates. For the income growth and health outcome equations, I use the dynamic panel data (DPD) estimator proposed by Arellano and Bond (Arellano and Bond: 1991) because the equations contain lagged dependent as well as endogenous regressors. The DPD estimator is a GMM estimator that produces consistent estimates in the presence of dynamics and endogenous regressors. Because I consider education as endogenous in most of the outcome equations, I instrument for the different levels of educational attainment in estimating these equations.

The DPD estimator consistently estimates dynamic panel data equations and has been used in several recent empirical growth research that uses panel data. However when the series are persistent, as these variables are likely to be, lagged levels of endogenous and predetermined regressors tend to be weakly correlated to their subsequent first differences, thus leading to biased estimates on account of weak instruments. Blundell and Bond (1998) have introduced the "systems DPD" estimator to correct this problem. The "systems estimator" adds a levels equation with lagged values of first differences of endogenous and predetermined regressors as instruments to the difference equation and jointly estimate the two equations as a system. I test for the exogeneity of all regressors as well as the appropriateness of the instrument vector.

In addition to the DPD estimator, I use an instrumental variable general method of moments (GMM) estimator as well as a Hausman-Taylor type estimator to estimate the growth equation as robustness checks. The DPD, GMM-IV, and Hausman-Taylor estimators estimate one equation at a time. It is possible that joint estimation of the growth equation and other endogenous regressors will improve efficiency in estimation. I therefore use a seemingly unrelated regression (SUR) estimation method to estimate the growth equation as another form of robustness check.[6]

5 Results

5.1 Initial Results

The estimates are presented in tables 2-4. Table 2 presents the estimates for the income growth equation, table 3 presents the estimates for the various health outcomes equations, while table 4 presents the estimates for women's participation in national politics and political stability. In general, the equations I estimate fits the data reasonably well as indicated by the regression statistics as well as the signs on the coefficient estimates.

5.1.1 Education and Income Growth

Table 2 presents the estimates of the effects of different levels of education on income growth rate of per capita income in Africa. I present the estimates from three different estimators to ensure that my results are not dependent on the estimator I use. Columns 3 presents the estimates from the Arellano and Bond two-step DPD estimator, column 4 presents the estimates from a GMM-IV estimator, while column 5 presents the estimates from a Seemingly Unrelated Regressions (SUR) estimator. I present FE estimates in column 2 for the purposes of comparison. Regression statistics suggest that the growth equation fits the data reasonably well and the coefficient estimates have the expected signs. I reject the null hypothesis that all coefficient estimates are jointly equal to zero, that there is second-order serially correlated error terms, and the Hansen J test results suggest an appropriate vector. The Hausman statistics lead me to reject the null hypothesis that all regressors are exogenous, hence the FE estimator is not an appropriate estimator for the growth equations. I also note that because of the inclusion of lagged endogenous regressor, the FE estimates may be inconsistent. Further discussion of the results will therefore not include the FE estimates.

The coefficients of the education variables—*primary, secondary*, and *tertiary* are positive and significantly different from zero at $\alpha = .05$ or better in the DPD, GMM-IV, and SUR estimates. The coefficients range from 0.0186 for *primary* to 1.03 for *tertiary* depending on the estimator being considered. A likelihood ratio test to test the null hypothesis that *primary, secondary*, and *tertiary* are jointly equal to zero produce a χ^2 statistic of 12.86 11.21, and 13.41 for the DPD, GMM-IV, and SUR estimates. With 3 degrees of freedom, I reject the null that education has no significant effects on income growth. The positive and significant coefficient estimates on *primary, secondary* and *tertiary* suggest that all levels of education have significantly positive impacts on

income growth rate in Africa, all things equal. This result is consistent with prior expectations and are generally consistent with the results obtained by research that finds positive and significant relationship between education and income growth. Although the estimates from the different estimators differ in magnitude, the pattern is similar across all estimators: the coefficient estimate of *tertiary* is larger in absolute magnitude than those of *secondary* and *primary* and the estimate of *secondary* is large than that of *primary* in all columns in table 2.

The magnitude of the coefficients on *primary, secondary* and *tertiary* may suggest that different levels of education have different effects on income growth with *tertiary* having the most effect. Elasticities of growth with respect to *primary, secondary* and *tertiary*, calculated at the means of the variables, are 0.254, 0.347, and 0.782 for *primary, secondary*, and *tertiary* using the DPD estimates.[7] In general, I can conclude that education has a positive and significant impact on the growth of real GDP in Africa. Moreover, my estimates indicate that the growth impact of tertiary education is much higher than lower levels of education, all things equal. If the coefficients of *primary, secondary*, and *tertiary* are the same, then there is a loss of efficiency in breaking education into various levels. I therefore test to see if the coefficient estimates of the three levels of education are equal. The likelihood ratio test to test the equality of the coefficients of all levels of education produced a χ^2 statistic of 28.59. This is well into the rejection region so I reject the null hypothesis of equality of the coefficients of different levels of education. The test result suggests that not disaggregating education into various levels will lead to biased estimates of the coefficient of education.

The coefficient estimates of other variables in the income growth rate are of the expected signs and are generally statistically significant at conventional levels. In particular the coefficients of *xgrow, invest, goveffect* and *aid* are positive and significantly different from zero while those of *aidsq, govcon* and y_0 are are negative and significant. The signs and statistical significance on the control variables in the growth equation suggests that the education measures are not acting as proxies for some omitted variables in the growth equation. My result that *primary, secondary* and *tertiary* have significant growth impact in Africa is consistent with research that finds that education positively affects economic growth (Jamison *et al*: 2007, Gyimah-Brempong *et al*: 2006, Atardi and Sala-i-Martin: 2003, Baldwin and Borrelli: 2008, and de la Croix *et al*: 2008, among others).

Although I instrument for the possible endogeneity of educational attainment at all levels as

well as investment and export growth rates in the DPD and GMM-IV estimates, these estimators are based on single equation estimation methods. It is possible that this approach could influence the estimates presented in columns 3 and 4 in table 2. A true "systems estimator" may be required. To investigate this possibility, I used a SUR estimator to jointly estimate the growth, education attainment and export growth equations. The SUR estimates for the growth equation are presented in column 5 of table 2. Regression statistics suggest a good fit to the data, the coefficient estimates are of the expected signs, and most of the estimates are significantly different from zero at conventional levels. Similar to the estimates presented in columns 3 and 4, the coefficients of *primary, secondary*, and *tertiary* are positive and significant at $\alpha = .10$ or better. More important, the coefficient of *tertiary* is, at least, four times as large as those of *primary* or *secondary*. The estimates in columns 3-5 suggest that my results that education generally has a positive and significant impact on income growth and that higher education has larger growth impact than primary and secondary education do not depend on the estimator I use to estimate the model.

5.1.2 Education and Health Outcomes

Estimates of the effects of education on health are presented in Panel A of table 3. Column 2 presents the estimates for the *lifeexp* equation, column 3 the estimates of the under 5 mortality rate (*u5mort*), column 4, the estimates of successful treatment of tuberculosis using DOTS (*TBcure*), column 5 presents the estimates of HIV/AIDS prevalence (*hivpreval*), column 6 presents the estimates for the proportion of children immunized against measles (*immunemeasls*), while column 7 present the proportion of one year olds who have undergone a complete inoculated against dpt (*1yrdpt*). The coefficients of *primary, secondary* and *tertiary* are negative in the *infantmort* equation but the coefficient of *tertiary* is insignificant at conventional levels. This may suggest that primary and secondary education may be important for reducing infant mortality while tertiary education may have no significant impact. An alternative interpretation of the coefficients is that once one has achieved secondary education, additional education has no impact on infant mortality. A χ^2 test of equality of the coefficients of *primary, secondary*, and *tertiary* rejects the null of equality at $\alpha = .05$.

The coefficients of *primary, secondary* and *tertiary* in columns 2-7 of table 3 are generally significant at conventional levels and of the expected signs. The coefficients of *primary* and *secondary* are negative and significant in the *u5mort* equation, positive and significant in the *immunemeals*

equation, and positive in the *1yrdpt* equation although only that of *primary* is significant in that equation. The coefficient of *secondary* is positive and significant in the *TBcure* equations. These estimates are consistent with expectations. The coefficients of *primary* and *secondary* are insignificant in the *lifeexpt* equation and *primary* and *secondary* have insignificant coefficients in *TBcure* and *1yrdpt* equations respectively. Contrary to expectations, the coefficients of *primary* and *secondary* are positive and significant in the *hivaidsprev* equation, suggesting that there is a positive correlation between HIV/AIDS prevalence and primary and secondary education in African countries. The coefficient of *tertiary* is positive and significant in the *lifexpt* and *TBcure* equations while is it negative and significant in the *hivaidsprev* equation. It is, however, not significant in the *u5mort, immunemeasls* and *1yrdpt* equations at any level of confidence.

The conclusion I draw from these coefficient estimates is that education generally has positive and significant health benefits, hence improves the health dimension of human development. However, the estimates also suggest that different levels of education have differential impacts on different aspects of health outcomes. For example, primary and secondary education seem to have stronger impacts on preventive health programs, such as immunization and infant mortality reduction. On the other hand, life expectancy at birth and curative health outcomes, such the cure rate of tuberculosis, are highly correlated with tertiary education than with primary and secondary education. Similarly, while HIV/AIDS prevalence rates is positively correlated with low levels of education (*primary* and *secondary*), it has a large negative correlation with tertiary education, all things equal. Perhaps, what is needed for preventive health is primary and secondary education while tertiary level of education is required for curative health and long live expectancy.

The results are consistent with the results of studies that find a positive and significant relationship between education and health outcomes (Berchenall: 2007, Groot and van den Brink: 2007, Gyimah-Brempong and Wilson: 2004, Nelson and Phelps: 2006, Glick *et al*: 2009, Silles: 2008, Cutler *et al*: 2006, Gilleskie and Harrison: 1998, and Kabubo-Mariara *et al*: 2008. among others). However, not all levels of education significantly affect health outcomes. While primary and secondary education are important determinants of inoculation against diseases and reducing infant mortality, tertiary education has no significant impact on these outcomes. On the other hand, tertiary education has a significant impact on the cure rate of tuberculosis while primary and secondary education does not. These results suggest that lower levels of education may be more relevant for preventive health while tertiary education may be more relevant for curative

health, conditional on one contracting a disease. My results differ from those of earlier research in this regard. The implication is that policy makers may target health interventions differently to different levels of education, depending on whether they are interested in prevention or cure.

Coefficient estimates of the control variables are generally of the expected signs and significantly different from zero at conventional levels. In particular, the coefficient estimates of per capita income and its growth rate as well as health expenditure/GDP ratio all significantly are correlated with better health outcomes. Given that health expenditures have the desired health outcomes, African governments may want to increase their expenditures on health in addition to the indirect health effect of education investments. Not surprisingly, the coefficient estimate of *goveffect* suggests that government effectiveness is important in achieving the desired health outcomes, all things equal. This is not surprising given that an efficient government can deliver better health services given the health budget as well as communicate health information much better than an inefficient government. A possible lesson from this estimate is that institutions matter for effective health outcomes, a conclusion that is consistent with studies that conclude that institutions matter for economic growth.

5.1.3 Women in Politics and Political Stability

Table 4 presents the estimates for the women in politics and political stability (*polstab*). Column 2 presents the estimates for the *womenparliament* while *polstab* estimates are presented in column 3. Regressions statistics indicate that the model fits the data reasonably well. The coefficients of *primary* and *tertiary* are positive and significantly different from zero at = .01 while that of *secondary*is insignificant at any reasonable confidence level. I reject the null hypothesis that *primary, secondary*, and *tertiary* have no significant effect on the participation of women in politics in African countries. The estimates suggest that education generally have a significant and positive effect on the participation of women in politics in African countries. The magnitudes of the coefficients of the primary and secondary follow the patterns of these coefficients in the $\dot{y}$ equation; the correlation is higher for *tertiary* than for other levels of education in this equation, suggesting that the relationship between education and participation in politics by women increases with the level of education in a country, all things equal.

I am not able to identify the mechanism through which this effect takes place. However, I may speculate that the result is being carried by the fact that education allows people to accept new

ideas, the notion that resources (including leadership resources) should be allocated to maximize social efficiency, as well as break down traditional barriers. This makes it possible for educated societies to accept the leadership role for women and for women to demand leadership roles in their societies. It is also possible that there is a different underlying process other than education that is determining the participation of women in national politics. As to why secondary education has no significant effect on women in parliament while primary and tertiary education do, it may be due to the nature of the Barro/Lee data. Indeed I find that secondary education has a positive and significant effect on women participation in parliament when I use the Soto education data reported below.

The coefficient estimates of other variables in this equation have the expected coefficients and significantly different from zero at conventional levels. In particular, the coefficients of per capita income, the lagged growth rate of per capita income growth rate, government consumption, and urbanization have positive and significant coefficient estimates. These variables are in some way, indices of development so one can argue that my results can be interpreted to mean that women participation in politics increases with the levels of development. An interesting result is the strong and highly significant coefficient on the *postconflict* dummy variable. This coefficient estimate indicates that women in post-conflict countries tend to participate in national politics than their non-conflict countries. It is possible that women's political leadership roles emerge during conflicts when most of the men are fighting wars and this carries on to post-conflict periods.

Estimates of the *polstab* equation are presented in column 3 of table 4. Similar to the women in parliament equation, the regression statistics of the *polstab* equation indicate a reasonably good fit. I reject the null hypothesis that all slope coefficients are jointly equal to zero at any reasonable level of significance. Coefficient estimates in this equation are of the expected signs and are generally significant at reasonable levels. The coefficient of tertiary education is positive and significant at $\alpha =$ 05 or better suggestion that higher educational attainment is correlated with political stability in African countries, all things equal. On the other hand, the coefficients of *primary* and *secondary* are insignificant at any reasonable confidence level, suggesting that lower levels of education attainment are not correlated with political stability. The coefficients of lag income growth rate, current level of per capita income, government effectiveness, and the level of urbanization are significantly correlated with political stability in African countries, all things equal.

5.2 Robustness Tests

The results presented above are based on measuring education as the proportion of the adult (25 years and above) population that has completed a given level of education. It is possible that this measure of education drives my results. I investigate this possibility using the average number of years of particular level of educational attainment by the adult population (Barro and Lee's $yrs-sch$ as my measure of education. The coefficient estimates for *primary, secondary* and *tertiary* are 2.9920, 0.6754, and 37.3547 respectively.[8] These coefficient estimates are significantly different from zero at $\alpha = .01$ or better. The coefficient estimates of the control variables in these equations are similar to their counterparts in table 2. In addition to years of school completed at different levels of education, I used the average years of all levels of educational attainment (Barro/Lee's $yr - sch$) as an alternative measure of education in estimating the equations. The coefficient of *yr-sch* in the growth equation is 0.6607 and it is significant at $\alpha = .01$. These exercises suggest that my results do not depend on the measurement of education I use.

The second set of robustness test I conduct is to change the specifications of the equation I estimate. In the growth equation for example, I alternatively deleted the quadratic term of *aidgni*, added a dummy variable for being landlocked, and replaced *goveffect* by bureaucratic quality *bureau*. In the health outcomes equations, I alternatively excluded *govcon*, *popgro* and *aidgni* from the equations. These specifications did not *qualitatively* change the coefficients of *primary, secondary*, and *tertiary* or the coefficient estimates of the control variables in those equations. Moreover, these specification changes did not change the order of the rankings of the development effects of the various levels of education. In the *womenparliament* and *polstab* equations, I alternatively excluded *healthaid* and *urbanpop*, added an interaction term between *postconflict* and *goveffect* but these specifications did not change my results *qualitatively*. I conclude from these exercises that my results are robust to the measure of education and model specification.

The education data I use in this study is the Barro/Lee Educational Attainment 2010 data set. There is a possibility that my results are crucially dependent on this data set. Soto (Cohen and Soto: 2007) has produced a cross country panel data set on educational attainment that are similar to the Barro/Lee data set. Soto presents 10 year averages of educational attainment, as opposed to Barro/Lee's 5 year averages, for most countries in the world for the 1960 to 2010 period. Although the two data sets are broadly similar, there are a few differences. For example, Barro/Lee data

starts from 1950 while Soto's data starts from 1960. There are also slight differences in the number of countries covered in these data sets. For example while Soto presents data for Nigeria, Barro/Lee does not. I used the Soto data set to estimate the development outcome equations as an additional robustness check in my study. To be consistent with the Barro/Lee data, I used the proportion of the population 25 years and older that has completed a given level of education as my measure of education. Similar to Barro/Lee's *yr-sch* variable, the Soto data set has a variable that measures the average number of years of schooling completed by the adult population defined to be 25 years and above (*ty25*). I use this variable as an alternative measure of education in this section of the paper.

The coefficient estimates of *primary, secondary*, and *tertiary* in the outcome equations are presented in table 5.[9] Panel A presents the estimates for the health outcome equations while panel B presents the estimates for the political development and growth equations. Regression statistics indicate a good fit to the data to all outcome equations. The coefficients of *primary, secondary* and *tertiary* in the health outcome equations are as expected and most of them are significantly different from zero at conventional levels. The signs and statistical significance are similar to their counterparts in table 3. Moreover, the order of the magnitudes of *primary, secondary*, and *tertiary* are similar to their counterparts in table: significant coefficients in table 3 are also significant in table 5. The estimates suggest that in general, education has positive and significant effect on health outcome. Furthermore, higher education is positively correlated with life expectancy and curative medicine while preventive health is positively correlated with lower levels of education.

The coefficients of *tertiary* is positive and significant in the income growth, *womenparliament*, and *polstab* equations is positive and significant at $\alpha = .05$ or better, suggesting that higher education has a positive and significant impacts on income growth, women's participation in politics and political stability. The coefficients of *primary* and *secondary* are *qualitatively* similar to their counterparts in tables 2 and 4. Also, the estimates suggest that the growth impact of higher education is higher than the growth effect of secondary and primary education. The estimates of *ty25* is as expected and significant in all outcome equations. In all outcome equations, χ^2 test rejects the null hypothesis that the coefficients of *primary, secondary* and *tertiary* are equal and therefore can be represented by one measure of education. The exercise in this section indicates the results presented in the paper above is not dependent on the education data I used to estimate the equation.

My results are generally consistent with the results of research that finds that education has significant positive impacts on many development outcomes, including income growth, health outcomes and political stability. My results are however, different from those of earlier researchers in another respect: I find that the effect of education on development varies by level of education and by the type of development outcome being investigated. In general, I find that tertiary education has a greater impact on most development outcomes than lower levels of education in African countries. The results of this paper have research and development policy implications. From a research point of view, the results suggests that researchers who investigate the effects of education on development may have to disaggregate education attainment into different levels of attainment, else there may be the risk of biased and possibly inefficient estimates of the effects of education on development.

Most research on the relationship between education and development has focused on the direct growth effects of education. To the extent that education also affect some of the variables that explain income growth (e.g. health, institutions), my results suggest that researchers who investigate the growth effect of education should look at the issue from a general equilibrium framework rather than the usual partial equilibrium framework. In this regard, the results are similar in spirit to Bleakley (2010) who finds that health is both human capital as well as an *input* into the production of other types of human capital, hence the aggregate effects of health may be different from the macro effect. The conclusion that education generally have a significant impact on development outcomes in Africa suggests that policy makers should invest in more education for the citizens of their countries. This is especially the case in Africa where levels of educational attainment is very low. Besides the broader general effect of education on development outcomes, the finding that higher education generally has a greater effect on development outcomes suggest that African policy makers should invest more in higher education than they currently do.

6 Conclusion

This paper uses panel data to investigate the effects of education on several development outcomes—income growth, health, female participation in politics, and political stability—in Africa. Controlling for a number of covariates, I find that educational attainment has significantly positive impacts on all development outcomes in Africa, all things equal. In addition, I find that the effects of ed-

ucation on development outcomes differ according to the level of education—primary, secondary, or tertiary. Generally, higher levels of education tend to have larger development impacts than lower levels of education. There are some exceptions to this generalization: for preventive health, lower levels of education tend to be more important than higher levels of education while higher levels of education are more significant for curative health and longer life expectancy. My results are robust to model specification, data sources, and measurement of education. The results are consistent with the results of research that finds that education has significant impacts on several development outcomes.

The results, however, should be viewed with caution. First, my study covers a relatively short period—1960 to 2010. It is not clear to what extent the results are generalizable to other parts of the developing world as a whole and over a very long period of time. Second, because of data constraints, I am not able to investigate the effects of education on poverty and inequality, two important development outcomes, in Africa. Third, the data does not allow me to adjust for the *quality* of education; perhaps educational quality, rather attainment, as I use in this study, may be more relevant to development. Fourth, this paper does not adjust for employment of educated people in Africa. If educated people are unemployed or are engaged in non-productive rent-seeking activities, the development impact of educations will not be maximized (Al-Samarrai and Bennell: 2007, Rogers: 2008). Finally, I measured development outcomes using several different outcomes. It may be necessary to use a summary measure of development outcomes as the dependent variable rather than relying on several variables.[10] Perhaps, using a Principal Components analysis to create a composite index of development from the many development outcomes I used may be a good idea, an idea I intend to pursue later.

Notwithstanding the caveats above, my results have policy and research implications. My finding that different levels of education have differential effects on development outcomes have research implications; researchers need to disaggregate education into the various levels. Failure to do so may lead to biased estimates of the effects of education on development outcomes. My results also have policy implications. The most obvious is that increasing the quality and quantity of education will lead to improved development outcomes in Africa. African policy makers may therefore do well to increase investment in education as a mechanism for speeding up the development process in the region.

My results that various development outcomes are affected differently by *primary, secondary*,

and *tertiary* education has policy implications. It implies that policy makers may have to tailor different policies to different levels of education. For example, if policy makers are interested in preventive health, the policy lever may be to increase primary and secondary education; if the policy interest in regional integration, then an emphasis on tertiary education may be the right way to go. The point is that while a broader emphasis on all levels of education is important for development in Africa, it may be necessary to focus on particular levels of education for specific development outcomes.

Although not investigated here, one of the ways through which education affects development outcomes is its externalities effect.[11] In addition to African governments investing in all levels of education, there may be second round effects of education, such as through education of children, health benefits that boosts productivity in the long run. In addition, there could be regional and scale effects of education that have not been explored in this paper. For example, one possible way education in an African country may affect development in the African region is through spatial spillover to other countries in a sub-region.

7 Notes

1. The figure is based on data from Barro and Lee (2010).

2. For example the UNDP's *Human Development Index (HDI)* includes a gender equity index.

3. Variables that enter various equations are presented in tables 2-4 and in the discussion of the results.

4. The sample size differ according to the availability of data for variables that enter a given equation.

5. The countries in the sample are Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Democratic Republic of Congo, Congo republic, Cote d'Ivoire, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Lesotho, Liberia, Madagascar, Morocco, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, and Zimbabwe. All nominal values were were converted to 2000 PPP values. The sample used for this study are dictated by the availability of the requisite data.

6. Because of the large number of equations for the health and other outcomes, I do not present the results using other estimators. Estimates not reported here indicate that my results do change if I use alternative estimators for the health and other equations.

7. Elasticities calculated from the other estimates produced similar rankings of the growth effects of *primary, secondary* and *tertiary.*

8. I do not present the full estimates for these equations and other equations for space considerations. The estimates of these equations using the alternative measures of education produce *qualitatively* similar results as those in tables 2-4.

9. I only present the coefficient estimates for the education variables but not the estimates for all the other regressors for space consideration. The estimates of the control variables are *qualitatively* similar to their counterparts of those presented in tables 2-4.

10. One could use the UNPDP's *HDI* as a possible measure of general development.

11. See, for example, Romer (1990).

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Table 1: **Summary Statistics of Sample Data**

Variable	Mean*	Standard Dev.	Minimum	Maximum
$\dot{y}$ (%)	1.1969	6.9767	-15.045	12.1325
income (PPP_{2000}	2719.65	3758.11	150.81	31,308.95
$lifeexp$ (years)	52.16	8.17	26.41	72.33
$xgrow$	5.4814	18.1995	-61.0633	76.713
$TBcure$ (%)	71.0296	14.1670	11.52	100.00
$u5mort$ (per 1000)	144.41	70.81	11.92	373.9
k (%)	20.1289	10.153	0.1240	98.5773
$conflict$ (%)	0.2214	0.4660	0.00	2.00
$popgro$ (%)	2.5739	1.2849	-8.2714	10.9203
$aidgni$ (%)	10.4884	11.1017	0.0088	71.7069
$1yrdpt$ (%)	61.7117	26.3756	1.00	99.00
$immunemeasl$ (%)	62.5401	22.9674	1.00	99.00
$womenparliament$ (%)	12.0835	8.5204	0.00	56.30
$hivaidsprev$	4.9815	6.5832	0.10	28.90
$govcon$	16.1112	7.4712	2.2875	69.5428
$healthexp$	5.7641	2.3459	1.5682	15.1867
$urbanpop$	28.29	16.89	13.29	56.58
lpc	9.0921	8.1706	0.2131	50.0110
$primary$	4.5605	5.7789	0.00	49.3764
lsc	4.5304	5.8863	0.00	33.2976
$secondary$	3.6098	4.2068	0.00	27.8793
$tertiary$	0.9206	1.2692	0.0	10.5066
$polstab$	-0.5962	0.9616	-3.2769	1.1449
$goveffect$	-0.6928	0.6209	-2.5000	0.9507
$years$	1.2937	0.9547	0.06	4.32
Max N	440			

* these are unweighted averages.

Table 2: **Estimates of Growth Equation**

Variable	**Coefficient Estimates**			
	FE	**DPD**	**GMM**	**SUR**
primary	0.0262**	0.0668**	0.0186**	0.0209*
	(1.98)	(2.02)	(2.05)	(1.74)
secondary	0.0431*	0.1151**	0.1522**	0.0589*
	(1.68)	(2.45)	(2.22)	(1.65)
tertiary	0.2176***	1.0354***	0.2893***	0.2214***
	(2.92)	(3.66)	(3.21)	(2.99)
y_0	-0.1276**	-0.2573***	-0.2148***	0.1447
	(3.12)	(8.37)	(4.76)	(1.46)
xgrow	0.0467***	0.1206***	0.0825***	0.1620***
	(3.87)	(9.73)	(4.49)	(6.93)
k	0.0218**	0.0522**	0.0236**	0.0394**
	(2.21)	(2.38)	(2.13)	(2.43)
aid	0.2864***	0.1302***	0.3156***	0.0786***
	(2.89)	(5.69)	(3.00)	(2.77)
aidsq	-0.0081***	-0.0029***	-0.0052***	-0.0023**
	(4.23)	(6.51)	(2.92)	(1.70)
goveffct	0.3876***	0.5839***	0.4682**	0.5286***
	(3.89)	(3.87)	(2.68)	(4.15)
govcon	-0.0879***	-0.3246***	-0.0896**	-0.1986***
	(3.98)	(7.22)	(2.97)	(3.28)
N	440			
$\mathbf{R}^2$				0.57
F				28.83
ρ	0.5687		0.8987	
χ^2	211.98	870.81	111.36	189.268
2nd ord. ser. cor.		-0.3184	-0.87	
Hansen J test		15.62 [16]	12.89 [13]	
C statistic		5.28 [6]	3.38 [5]	
Hausman m		89.58 [8]	53.42 [8]	52.21 [8]
K-Paap rk Wald			21.599	
First stage $\mathbf{R}^2$			0.46	

Dependent Variable: Per Capita Income Growth Rate

+ absolute value of "t" "z" statistics in parentheses. * 2-tail significance at $\alpha = 0.10$
** 2-tail significance at $\alpha = 0.05$ *** 2 tail significance at $\alpha = 0.01$

Table 3: **Education and Health Outcomes**

Variable	**Coefficient Estimates**					
	lifeexpt	*u5mort*	*TBcure*	*hivaidsprev*	*immunemeasls*	*1yrdpt*
primary	-0.0344	-0.6728***	-0.0229	0.0739**	0.1633**	0.1288**
	(1.35)	(4.01)	(0.52)	(2.57)	(1.99)	(2.48)
secondary	0.0794	-3.3782***	0.3709*	0.6674***	1.8779***	0.2478
	(0.49)	(3.39)	(1.69)	(3.40)	(2.83)	(1.44)
tertiary	0.9383***	3.7399	0.7866**	-3.5799***	-2.1064	0.1132
	(2.92)	(1.12)	(2.23)	(4.83)	(1.51)	(0.19)
healthexp	0.1226**	-9.3367**	-0.3582	0.8714**	0.1827**	1.2458**
	(2.12)	(2.57)	(0.63)	(2.30)	(1.72)	(2.32)
gdpgrowlag	0.0467***		0.0825***		0.2762**	1.6423***
	(3.87)		(4.49)	(3.11)	(2.01)	(4.76)
lgdpcap	2.4572**	-10.3051**	0.0236**	3.3901	2.4002**	6.0753**
	(2.28)	(2.01)	(2.13)	(1.49)	(2.08)	(2.53)
govcon	-0.0292	-3.4285***	0.0153**	-0.2729*	0.7322**	
	(0.59)	(3.30)	(3.00)	(1.61)	(1.78)	
aidgni	0.4471***	0.2802	0.2187***	-0.3312		
	(3.72)	(1.51)	(2.92)	(1.14)		
$goveffct$	0.2899***	-0.8239**	0.4682**	-0.2118**	0.0695**	0.3195
	(2.98)	(1.74)	(2.68)	(2.22)	(1.87)	(1.08)
healthaid	-0.0696**	-0.0115**	-0.0896**	0.0044	0.0012	0.4188***
	(1.97)	(2.31)	(2.97)	(1.13)	(0.49)	(4.07)
popgrow		0.0236**			0.1452**	
		(2.43)			(2.02)	
urbanpop	0.0125**			0.2143		
	(1.88)			(1.43)		
N	440					
F	86.66	68.61	0.8987	85.76	28.98	38.05
$\mathbf{R}^2$	0.56	0.58	0.59	0.62	0.49	0.58
Klien-Paap LM	15.17	14.46	-0.87	16.21	13.30	16.49
Hansen J test	15.89	15.62	18.63	21.32	5.11	13.72
C statistic	6.29 [5]	5.28 [6]	3.38 [5]	5.89 [5]		6.15
Hausman m	68.13 [10]	89.58 [8]	53.42 [8]	70.21 [10]		
K-Paap rk Wald	15.22	15.56	21.599	13.56		19.21
First stage $\mathbf{R}^2$	0.44	0.31	0.46	0.41	0.49	0.57

+ absolute value of "t" "z" statistics in parentheses. * 2-tail significance at $\alpha = 0.10$
** 2-tail significance at $\alpha = 0.05$ *** 2 tail significance at $\alpha = 0.01$

Table 4: **Women in Parliament and Political Stability**

Variable	**Coefficient**	**Estimates**
	Womenparliament	**Polstab**
primary	0.1149***	0-.0004
	(3.28)	(0.21)
secondary	-0.2311	-0.0070
	(1.01)	(1.26)
tertiary	0.3803***	0.0397**
	(2.86)	(2.26)
gdpcapgrlag $(\dot{y}_{t-1})$	0.0764**	0.0168**
	(2.06)	(2.11)
lgdpcap	6.9313**	0.3071***
	(1.72)	(3.16)
govcon	0.2134**	
	(1.98)	
$postconflict$	3.8976***	
	(3.12)	
$goveffect$	1.2176***	1.0282***
	(3.21)	(10.09)
aidgni	1.1461***	
	(3.61)	
healthaid	0.4471***	
	(3.72)	
urbanpop	0.0146***	0.0028**
	(2.78)	(1.97)
N	440	
F	25.87	41.77
R^2	0.42	0.54
Klien-Paap LM	15.34	40.03
Hansen J	9.86	6.71
Hausman m	49.42	62.89
K-Paap rk Wald	16.65	58.49
First stage $\mathbf{R}^2$	0.49	0.56

* 2-tail significance at $\alpha = 0.10$ ** 2-tail significance at $\alpha = 0.05$
*** 2 tail significance at $\alpha = 0.01$

Table 5: **Education and Development Outcomes: Soto Data**

Variable	**Coefficient**		**Estimates**			
	PANEL A:	**HEALTH**	**OUTCOMES**			
	lifeexpt	*u5mort*	*TBcure*	*hivaidsprev*	*immunemeasls*	*1yrdpt*
primary	-0.6979	-0.5123***	0.6987	0.0098*	0.0998**	0.3167**
	(1.59)	(3.43)	(1.52)	(1.67)	(2.11)	(1.98)
secondary	-0.2101	-2.6529***	0.2176**	0.4531**	0.9088**	0.4365
	(0.95)	(4.11)	(1.89)	(2.19)	(2.47)	(1.46)
tertiary	1.2025***	12.4398	0.6549***	-2.4316***	1.6654	0.0912
	(3.52)	(0.98)	(2.98)	(3.83)	(0.99)	(1.27)
*ty*25	-0.0696**	-0.0115**	0.2152**	0.0044	0.0012	0.4188***
	(1.97)	(2.31)	(2.22)	(1.13)	(0.49)	(4.07)
	PANEL B:	**OTHER**	**&**	**OUTCOMES**		
	gdpgrow		*Womeninparlia*		*polstab*	
primary	0.9730		0.0236**		0.4002	
	(1.27)		(2.13)		(1.08)	
secondary	-0.7879		0.0153**		0.1322*	
	(0.61)		(3.00)		(1.68)	
tertiary	0.7841***		0.5665.***		0.4012**)	
	(2.92)		(3.08)		(2.91)	
*ty*25	0.7538***		4.8975***		0.3152**	
	(2.93)		(4.28)		(2.11)	