Post-Secondary Schooling Quality and Manufacturing Capacity in Africa

Research · August 2015

DOI: 10.13140/RG.2.1.4464.1125

1 author:

Oluyomi Ola-David
Covenant University Ota Ogun State, Nigeria
32 PUBLICATIONS **104** CITATIONS

Post-Secondary Schooling Quality and Manufacturing Capacity in Africa

ADEWOLE, MUSILIU ADEOLU[1]

Department of Administration
Elizade University
Ondo State, Nigeria.
&

OLA-DAVID, OLUYOMI AYOYINKA[2]

Department of Economics and Development Studies
School of Social Sciences
College of Business & Social Sciences
Covenant University, Nigeria

ABSTRACT

Quality investment in post-secondary schooling could facilitate structural transformation of African economies presently dominated by small-scale agricultural activities. To probe the causal relationship between human capitalquality and manufacturing capacity, we build a new database of schooling quality. The country-level average test score of students in the GMAT examinations between 1984 and 2006 is used as the main measure of post-secondary schooling quality. Our OLS results suggest a strong and positive relationship between schooling quality and manufacturingcapacity. Our results are robust to the addition of a fairly large number of relevant variables, corrections for influential observations and check for self-selection related biases. Furthermore, we use 2SLS technique to correct for possible endogeneity, omitted variable bias and measurement error of the schooling quality indicator.Our instrument passed the tests of exogeneity, although the maximum likelihood technique is used due to weak instrument problem.

Key words: Africa, Schooling Quality, Manufacturing Capacity

JEL Codes: I I0 I2 I23 I25

[1] Corresponding author: musiliu.adewole@elizadeuniversity.edu.ng
[2] olu.oladavid@covenantuniversity.edu.ng

1.0 Introduction

Nearly two decades of sustained economic growth in Africa has not produced any significant effect on the structure of African economies (Aryeetey & Nelipher, 2012). The structural transformation required to reduce poverty and create massive jobs mostly occurs as economies move from low-productivity agriculture to high productivity manufacturing. African countries have not witnessed an increased growth in the volume of manufacturing value added as a percentage of GDP from 1995 to 2005 (Aryeetey & Nelipher, 2012). Unfortunately, this trend persists against the backdrop of sustained economic growth in Africa, which started in the latter half of the 1990s. To turn this situation around, one policy action advocated by development experts is the need to pay less attention to regulatory reforms, but focus more on upgrading their physical and human capital infrastructure (Page, 2012).While suggested policy approaches raise a number of questions, the relevant question for this study is whether quality human capital investment is causally related to manufacturing capacity in Africa? If our interest is narrowed down, basically, to higher education, the issue will be whether differences in post-secondary schooling quality across Africa also explain the variation in manufacturing performance? As a first step, this study investigates the impact of post-secondary school quality on manufacturing capacity in Africa.

From a number of theoretical (Nelson and Phelps, 1966; Lucas, 1988; Romer, 1990) as well as historical accounts of developed economies (Goldin, 1998, 1999a, 1999b, 2001), rapid economic development have been partly linked to massive investment in human capital. Much of this investment has been in formal schooling. Growth and development occur as accumulation of human capital accelerates the adoption of new and better technologies (Nelson and Phelps, 1966), augment worker's productivity (Lucas, 1988) and allow the spread of new ideas as rapidly as possible (Romer, 1990). At some other end, Oded and Moav (2006) have linked the demise of class structure in European societies to massive investment in schooling capital. Higher income to a critical mass of the educated middle class will lead to better economic performance (Easterly, 2008). In the thinking of Rajan and Zingales (2006), the initial distribution of educational opportunities across groups in society could accelerate or inhibit economic development. Formal schooling also facilitates interaction with others and increases the benefits of involvement in civic activities, leading to the emergence and sustenance of democracy (Glaeser, Ponzetto and Shleifer, 2007).

Given the direct and indirect benefits of schooling, we are supposed to find incontrovertible evidences linking high economic growth to investment in human capital. However, empirical evidence has produced mixed results. While some report significant link between human capital investment and economic growth, other empirical studies produced insignificant linkage.[3]At the other extreme, other studies reported significantly negative relationship between human capital and growth. This has led to what Lopez, Thomas and Wang (2000) called the 'education-growth puzzle'. What is even more curious is that a large number of studies using micro-data have reported substantial private returns to schooling investment (see the reviews in Psacharopoulos, 1994; Psacharopoulos and Patrinos, 2004).

In getting around the schooling-growth puzzle, researchers have proposed a number of approaches that border on different alternative specifications of the growth-human capital relationship. Some use instrumental variables to account for the endogeneity of schooling capital, while others have proposed alternative ways of measuring human capital. In accounting for the puzzle, Rogers (2008) found positive and significant relationship between schooling capital and growth after accounting for the unproductive use to which quality human capital can be employed. The Rogers' study, in fact, corrected for corruption, brain drain and black market premium. Judson (1998) found that the schooling and growth relationship is not strong in countries with poor allocation of education budget.[4]

[3] Studies on the relationship between health as a form of human capital and growth have produced no clear cut consensus either (see Acemoglu and Johnson 2007, 2009; Acemoglu, Johnson and Robinson, 2003; and Bloom, Canning and Gunther, 2009).

[4] A theoretical model along this line has been developed by Rancharan (2004).

A number of other studies (Cook, 2002; Robertson, Skidmore and Toya, 2008; Appleton, Atherton and Bleaney, 2009), which corrected for schooling endogeneity and measurement error, have found positive and significant relationship between schooling and growth. Those studies, which criticized the use of quantity of schooling, (popular Barro-Lee dataset) have proposed alternative ways of measuring schooling attainment. Lynn and Vanhanen (2002) built a new database of Intelligence Quotient (IQ) capability of 81 countries. This database used by Weede and Kampf (2002) and Jones and Schneider (2006) to establish a positive and significant relationship between schooling capital and growth. Before these two previous studies, Hanushek, and Kim (1995), Hanushek and Kimko (2000), had proposed the use of schooling quality as a better measure of schooling capital. This measure of schooling quality is predicated on the fact that a year of schooling in a developing country is not the same as a year of schooling in a developed country. Though the use of several measures of schooling quality such as expenditure per child, class size, teacher-student ratio and teacher's remuneration has become widespread, Hanushek and co-researchers favoured the use of cognitive tests as a true proxy of schooling capital. The use of schooling quality in Hanushek's works has produced significant relationship between schooling and growth (see a recent review by Hanushek and Woessmann, 2008).

If recent improvements in econometric techniques and data quality are indicating positive and significant causal impact of human capital oneconomic performance, it is not clear what the relationship between human capital quality and manufacturing capacity in an African setting is. As it is, it is still difficult to say what the relationship between human capital quality and GDP per capita is for African countries because Hanushek and Kimko (2000) data on schooling quality have few observations on African countries. Economic growth, even if sustained for over a decade, as is the case in many African countries since 1995, is not necessarily beneficial to all. As a measure of post-secondary schooling quality indicator, we use the country level test scores in Graduate Management Aptitude Test (GMAT).

In doing this kind of study, we are confronted by the identification problems that confound causal estimates. One, schooling quality does not just affect manufacturing capacity; it may in turn be affected by it. More industrialised societies can afford better schools, just as better schooling is likely to foster greater manufacturing capacity. Second, countries with high-quality schooling are different in many observed and unobserved ways from countries with low-quality schooling. For instance, countries with high-quality schooling might also have better economic and political institutions. Richer countries with better schools can afford better institutions that can restrain political elite's choice of policies and foster the provision of increased public goods. Both colonial and legal characteristics of countries may also matter in determining manufacturing capacity. Control variables such as financial development, corruption, black market premium in the foreign exchange market, and geographic variables might have independent effects on manufacturing outcomes. For a sample of African countries with pronounced presence of Christian missionaries in nineteenth century Africa, the omission of a variable measuring the magnitude of missionary presence could bias the estimate of schooling quality (Woodberry, 2012). The indicator of schooling quality, average performance of students in GMAT examinations,[5] is also subject to measurement error. This is likely to bias the estimate of schooling quality downward. In addition, our schooling quality indicator as constructed is subject to self-selection problems because it is generated from non-random test scores of those who were selected to participate in GMAT examinations.

OLS regressions indicate that post-secondary schooling quality has positive and significant impact on manufacturing capacity. The result holds when we add few or large number of control variables. Our result is robust to various tests of influential observations. To provide more convincing evidence indicating that our OLS results are not driven byomitted variables or influenced by measurement error and self-selection related bias, 2SLS is used as additional identification strategy. 2SLS estimates are not significantly different from OLS estimates. We use maximum likelihood 2SLS because our instruments fail to pass the test of relevance though they do pass the tests of exogeneity.

[5] Both indicators are used in separate regressions to avoid potential bias from multicollinearity.

Thus, this study improves on previous literature in number of ways. First, we construct new data on human capital quality for cross-sectional study of African countries. Second, we provide empirical evidence on the relationship between human capital quality and manufacturing capacity in Africa. Third, we extend the debate on the relationship between education and economic performance (GDP Per Capita) to that between post-secondary education quality and manufacturing capacity in Africa, using both OLS and 2SLS techniques. To the best of our knowledge, this is the first study exploring this kind of relationship in a cross-country setting for African countries.

More specifically, this study draws on the insights of previous studies in building a new database of schooling quality. This allows us re-investigate the relationship between schooling quality and inclusive growth in a sample of African countries. Our measure of schooling quality uses the test scores of students in GMAT examinations. We determine empirically the extent to which manufacturing capacity among African countries could be explained by the quality of post-secondary schooling capital. A new database is required because the schooling quality datasets of Barro and Lee (2001) and that of Hanushek and Kim (1995) and Hanushek and Kimko, (2000) contain few African countries. Even for a study covering Africa and other continents of the world, the schooling quality datasets did not exceed 55 countries, limiting the opportunity to control for a large number of other confounding factors. The problem with the existing data on schooling qualityis that it captures cognitive ability at the lower level of education (Hanushek and Woessmann, 2008), ignoring the fact that schooling quality differences across countries may be several magnitudes bigger at the secondary and post-secondary level.[6] Yet, skills required in a technology-intensive world are acquired at the tertiary level of education. By controlling for important factors such as corruption, black market premium in the foreign exchange market, institutional quality, geographical variables, budget allocation in education, and the occupational mix of graduates produced at the tertiary level, we are able to determine that a positive and significant relationship exists between post-secondary schooling quality and manufacturing performance.

In section two, we provide a description of the GMAT data used in constructing our indicator of post-secondary schooling quality and briefly mentioned other data engaged in this study. We provide the baseline econometric model in section three and present OLS results, which contain limited number of control variables. We demonstrate that results are not driven by influential outliers, omission of important variables and self-selection bias of GMAT test scores. Section four presents the results of 2SLS regressions, reporting results of associated tests of instrument relevance and exogeneity. We summarize our results in section five and provide fitting conclusions.

2.0 Human Capital Quality Indicator: GMAT Data

GMAT, the Graduate Management Admissions Test is a creation of the Graduate Management Admissions Council. It is a 3½ hour standardized test used to measure the abilities of an applicant attempting to undertake higher education in the field of business or management in order to enable graduate schools make admission decisions. Nine business schools that decided they needed to develop a special test to evaluate and admit the best students for their programmes created the exam in 1953.

In 2008, more than 250,000 prospective business students took the GMAT exam in more than 90 countries. The reach and stature of this computer-adaptive exam reflects its ability to help quality schools find the students around the world who are the best match for their programmes and for the demands of the marketplace. The process of continually reviewing and revising the exam is a rigorous one. An international panel thoroughly studyeach potential new question before it is pilot-tested with candidates who represent the diversity of the GMAT test-taking pool. Questions are carefully screened to ensure they are cultural bias-free (GMAC, 2009).

[6] In the 2009 ranking of Universities globally, only the University of Cape Town, South Africa, made the list of top 200 Universities in the world.

The Graduate Management Admission Council (GMAC) is responsible for determining what skills to be measured by the GMAT and how this is to be measured. It coordinates the development of test questions, administration of the test and the reporting of the test scores. GMAT has been put to use for over five decades and has been repeatedly studied, tested, modified and updated to ensure its effectiveness at predicting the first year or midway through a graduate management programme. The exam is usually conducted under standard conditions in over *150* countries with high-level security installations that ensure the scores are comparable across all applicants. GMAT has been found extremely valuable in predicting performance in graduate level management programmes. Its reality has been justified over time.

The global acceptability of the GMAT has also eliminated the need of various tests for each school, region or country. The GMAT measures three broad areas of abilities viz. analytical writing assessment, quantitative ability and verbal ability. Graduate admission screening is sometimes done working with the candidate's undergraduate GPA (Grade Point Average) in conjunction with their GMAT score. However, admission is also influenced by other subjective factors such as relevant experience, recommendation letters, application essays and reports of personal interviewers. About two-thirds of the graduate schools in the world require the GMAT scores for admission. In cases where GMAT scores are not required, the scores help to assess the applicant's qualifications. Put differently, the GMAT scores is used as an indicator of academic ability.

The verbal section of the GMAT examines sentence correction, reading comprehension and critical reasoning. The quantitative section tests problem solving and data sufficiency skills while the essay section tests the ability of the candidate to do an analysis of arguments and issues. Some innovations in testing cognitive abilities, listening and leadership skills and accounting for the increase and diversity of cultures and languages involved are anticipated. Basically, the GMAT is an admission requirement in most United States of America, Canadian and European business schools. Basically, GMAT does not test any specific knowledge in business or other subjects. It however tests mental intelligence and the ability to make sound decision under pressure. The essence of the GMAT as a vital element in the evaluation of applicants by several schools is that it aids the comparison of applicants from diverse backgrounds based on a common numeric scale.

In summary, the GMAT measures basic verbal, mathematical and analytical writing skills that the individual has developed in their education and work experience. Once taken, the GMAT scores are valid for five years. The test takers are diverse from numerous geographic locations of the world, cultures, backgrounds and varied work and academic experience. Aggregate scores for post-secondary human capital obtained from GMAT may introduce selection bias into the coefficient of human capital quality. This is because the data are not generated from a random population of students. To ensure results are not biased because of self-selection, we check the correlation between country GMAT scores and scores generated randomly from a global sample of countries participating in the *Programme for International Student Assessment* (PISA) international test. Second, we use the 2SLS technique to formally confront the problems of endogeneity, measurement error and omitted variables.

Most data are drawn from World Bank WDI, some from UNESCO, and data supplied in published articles. We provide a detailed description of all variables used in this study, including the data in the appendix. Table 1.0 shows the descriptive statistics of covariates used in regressions with largest number of variables. Appendix 1 provides comprehensive description of variables and various data sources.

Table 1.0: Descriptive Statistics

Variables	Mean	Std. Dev	Min	Max
Manufacturing (% of GDP)	10.22	6.692	1.031	35.182
Average GMAT Score	405.707	32.857	345.333	511.45
Enrolment Ratio (Science/Humanities)	2.4464	0.8356	0.6167	5.0773
Trade Openness	78.6894	52.2812	7.4524	290.7872
Investment (% of GDP)	14.0175	26.5098	1.5084	190.2189
GDP Per Capita	2537.349	2806.56	492.1436	13421.38
Black Market Premium (1960-65)	17.2641	21.99103	-0.5428	85.47601
British Legal Origin Dummy	0.6538	0.48039	0	1.0000
Political Institution	0.1980	0.1974	0	0.6068
GFI Corruption (2004)	303.9463	622.1328	0	3373.5
Ethnic Fractionalization	0.64284	0.23476	0.0394	0.9302
Landlocked dummy	0.1666667	0.3761774	0	1

3.0 Econometric Model and OLS Results

3.1 Econometric Model and Initial OLS Results

We present econometric models that allow us to determine the impact of human capital quality on country level manufacturing capacity. The first equation (1) is for cross-country cross-sectional regressions.

$$\boldsymbol{GDP_{MAN} = \beta_1 + \beta_2 HC_{Qua} + X + e_i}(1)$$

GDP_{MAN} is manufacturing output as a percentage of GDP. HC_{Qua} is the schooling quality indicator measured by the test score performance of students' GMAT examinations. The students are tested for verbal, mathematical and analytical writing skills developed during school and while working. We use the aggregate country average for year 1984 to 2006 to account for lag effects of educational quality on manufacturing**. X** is a vector of control variables which includes private investment as a fraction of GDP, openness measured as sum of imports and exports as a fraction of GDP, GDP as an indicator of market size, public consumption as a fraction of GDP measuring government size, and black market premium which measures the relative attractiveness of alternative economic activities outside manufacturing. These covariates are frequently used in standard growth regressions (see Durlauf, Johnson, & Temple, 2005 for extensive literature review).

While we run regressions with essentially limited number of relevant variables because we have a maximum of 52 observations, we still include other explanatory variables to minimize bias due to omitted variables.The variables included historic factors such as intensity of slavery, pre-colonial state capacity, colonial influence, legal origin, ethnic diversity/polarisation, foreign aid, financial development, institutional quality, quantitative measure of corruption, natural resource endowments, agricultural endowments, cost of doing business, public sector investment in roads, electricity and water and geographic variables such as terrain ruggedness andlandlocked dummy. Since we cannot control for all variables which affect manufacturing capacity, we can at least attempt to reduce potential bias from unobserved variables. The term "e" represents the error term as usual.

Column 1 of Table 2.0 reports the result of univariate regression of manufacturing capacity variable on post-secondary schooling quality indicator. A unit increase in post-secondary schooling quality increases manufacturing capacity by 0.108 percentage point. This implies that a percentage point increase in schooling quality increases manufacturing capacity by 0.44 percentage point. The coefficient is statistically significant at 1 percent. The adjusted R^2 indicates that schooling quality variation alone account for more than a quarter variation in manufacturing capacity. To appreciate the economic significance of the schooling quality estimate, we compare Liberia, a country at the bottom 10 percentile, with Mauritius, a country at the top 5 percentile of schooling quality spectrum. If we assume that there are no omitted variables potentially likely to confound our school coefficient, the increase in schooling quality aggregate score from 346.15 for Liberia to 511.45 (the estimate for Mauritius), a 47.8 percentage increase, should lead to about 21 percentage point increase in manufacturing capacity.

Though a large number of variables measuring economic policy and institutional quality have been used in many growth regressions, a large number of them are not consistently statistically significant across specifications that control for some conditioning variables (Levine and Renelt, 1992). Levine and Renelt's study, using extreme-bounds analysis of Leamer (1983), find the coefficient estimates of private investment as fraction of GDP to be robust across several specifications of the growth model. In the same vein, we include the variable in the OLS regression reported in column 2. This is in addition to the schooling quality variable used in the regression reported in column 1 of Table 2.0. From column 2, the schooling quality variable is still statistically significant after controlling for private investment. In fact, the private investment coefficient estimate turned out to be insignificantly different from zero. This is in line with Easterly's (2001) cross-sectional study of African countries, which finds that private investment has no significant impact on economic performance of African countries.

In column 3, we show the regression result that controls only for trade openness, which has also been found to be significant in many growth studies. Aside, openness could facilitate the transfer of modern technology that accelerates the growth of manufacturing capacity. It could also be an avenue for the radical increase in manufacturing exports, making the manufacturing components of GDP to rise even faster. As seen in column 3, the schooling quality variable is still significant, while trade openness is not significantly different from zero.

To explain the significant cross-country variation in industrialisation driven by manufacturing activities, Murphy *et al*.'s (1989) model emphasises the place of minimum scale economies required to push economy into self-sustaining industrialisation process. In the absence of significant domestic market size and relatively costless international trade, firms may not make enough to find adopting increasing returns to scale technologies profitable. This could stallthe process of industrialisation (Murphy *et al.*, 1989). Thus, domestic market size must be central to manufacturing performance. We introduce real GDP variable as a proxy of market size, and as usual, in addition to schooling quality variable; the results are reported in column 4. Schooling quality indicator remains significant.

Table 2.0: Cross-Sectional OLS Regression Results

Row	1	2	3	4	5	6	7	8	9	10	11
Sch_Quality	0.1081** (0.0252)	0.1084* (0.01476)	0.1050* (0.0166)	0.1045* (0.0186)	0.1061* (0.0166)	0.1103* (0.017)	0.1147* (0.0141)	0.1058* (0.0188)	0.0738* (0.0242)	0.1152* (0.0193)	omitted
Inv/GDP (%)		-0.0133 (0.0167)								yes	0.1856*** (0.0935)
Openness			0.0172 (0.0213)							yes	-0.0317 (0.0244)
GDP				0.0002 (0.0004)						yes	-0.0001 (0.0009)
Black-Market					-0.0049 (0.0277)					yes	0.089715 (0.070)
Public Consumption						-8.14e-11 (9.53e-11)				yes	
Ratio 8:10							0.5054 (0.9332)			yes	0.3108 (1.262)
ratio of sec-pri								0.3418*** (0.1841)		no	no
Ratio of art-to-science									0.0982 (0.8844)	no	no
F-Statistics	54.67	29.56	27.02	43.85	20.39	----	34.20	17.19	4.91	9.43	1.02
Obs.	52	52	52	52	36	49	43	39	25	31	31
R-squared	0.2695	0.2722	0.2872	0.2790	0.3596	0.2541	0.3158	0.2462	0.1538	0.4621	0.1261

Note: In parentheses are robust standard errors. *Significant at 1 percent, ** Significant at 5 percent, ***Significant at 10 percent.

Rogers (2008) argues that schooling capital and manufacturing capacity could be affected by the activities educated manpower are drawn into. This is related to the argument that the reward structure does not just determine the course of study for prospective students but the activities which the students are engaged in when they leave school. If activities they are involved in are personally and socially productive, economic performance is better. If personally rewarding activities do not just impede growth but places considerable negative externality on productive activities (Acemoglu, 1995), economic outcome will be dismal. Thus, correcting our schooling quality coefficients for upward bias due to directly unproductive activities into which educated individuals are drawn will be necessary. We therefore add black market premium variable, an important socially unproductive activity into which obtained schooling quality can be drawn. This variable also captures the distortionary effects of public policies on economic performance in general, and more specifically, manufacturing performance. To capture fiscal policy effects on manufacturing performance, we adopt the approach of Barro (1991) and Easterly (1993) by adding public consumption as a percentage of GDP to our specification. Column 5 reports the results after adding indicators of black market premium and schooling quality, and column 6 reports the results after including both public consumption and schooling quality measures to our specification. The coefficients of schooling quality are still statistically significant in column 5 and 6.

Some literature (Baumol, 1990; Murphy, Shleifer and Vishny 1991; Acemoglu, 1995, Acemoglu and Verdier 1998) has provided both theoretical models and empirical evidence that the allocation of talent matters in explaining variation in cross-country economic performance. The empirical study of Murphy *et al.* (1989) states that country level economic performance is to a large extent determined by the production of engineers relative to lawyers. Positive growth is associated with higher engineer-lawyer ratio. The underlying assumption is that lawyers are more likely to be involved in rent-seeking while engineers are likely to be engaged in productive activities. The reward structure of society, which is a product of its institutional quality, determines the talent allocation process. In our study, we use the UNESCO data on country enrolment of students[7] for different categories of courses to determine its talent allocation pattern. We use the ratio of students enrolment in science and technology courses to those enrolled in arts and humanities. If past studies would be any guide, then higher ratio should lead to greater manufacturing capacity. Accounting for the (mis)allocation of educational talents has no significant impact on schooling quality coefficient as shown in column 7.

In many poor countries of Africa and many other countries of the developing world, political elites wield disproportionately large influence on policy outcome. Thus, policy outcomes would be different if political and economic inequality were reduced considerably. Notably, one area of influence is the volume of resources allocated to human capital development. Beyond that, the fraction of resources devoted to each level of schooling is frequently motivated by political expediency rather than economic efficiency. The argument is that higher education benefits a disproportionately smaller proportion of school population relative to lower levels of schooling which involve a larger fraction of the school population. Thus, resource misallocation among the levels of schooling impedes manufacturing growth. Ratio of government expenditure on post-secondary and government expenditure on basic education is used to measure the extent of resource misallocation. Similarly, the ratio of secondary to primary school enrolment is also used to measure the potential effect of educational resource allocation on manufacturing performance. Columns 8 and 9 report results after variables measuring resource allocation between tertiary and basic, and between secondary and basic education are introduced into our specification. In column 10, we run multivariate regression that, in addition to the schooling quality variable, includes only variables that increase the explanatory power of our model. In column 10 post-secondary schooling quality variable remains statistically significant. To determine the overall explanatory power of our schooling quality indicator in this specification; we drop the schooling quality in column 11. By comparing the coefficients of determination of regressions reported in columns 10 and 11, we estimate that overall post-secondary schooling quality

[7]Available in 2013 WDI.

variation can explain about 33.6 (drops to 0.4621 from 12.61 percent when post-secondary schooling variable is omitted) percentage of the variation in manufacturing capacity among African countries.

3.2 Specification Tests: Accounting for Influential Observations

For all cross-country regressions with limited number of observations, the presence of few influential observations might introduce bias in regression estimates. Figure 1 illustrates that a few outliers might exist. For instance, a sample of African countries might produce biased results with North African countries included in the sample. Similar bias can arise from the presence of countries such as South Africa and manufacturing giants such as Mauritius and Swaziland, which are relatively large economies. Thus, regressions in column 1 to 5 of Table 3.0 omit observations from Algeria, Egypt, Libya, Morocco and Tunisia and in column 6 we omit the five observations from North Africa. The coefficients of schooling quality remain statistically significant when we omit on a country by country basis or when all North African countries are omitted. Omitting Mauritius, South Africa and Swaziland, which appear as outliers in figure 2, has no effect on schooling quality variable as reported in columns 7 to 9. Using the natural logarithm of schooling quality in place of aggregate score used in previous regressions, which appears slightly skewed to the right, there is no impact on our coefficient of schooling quality either.

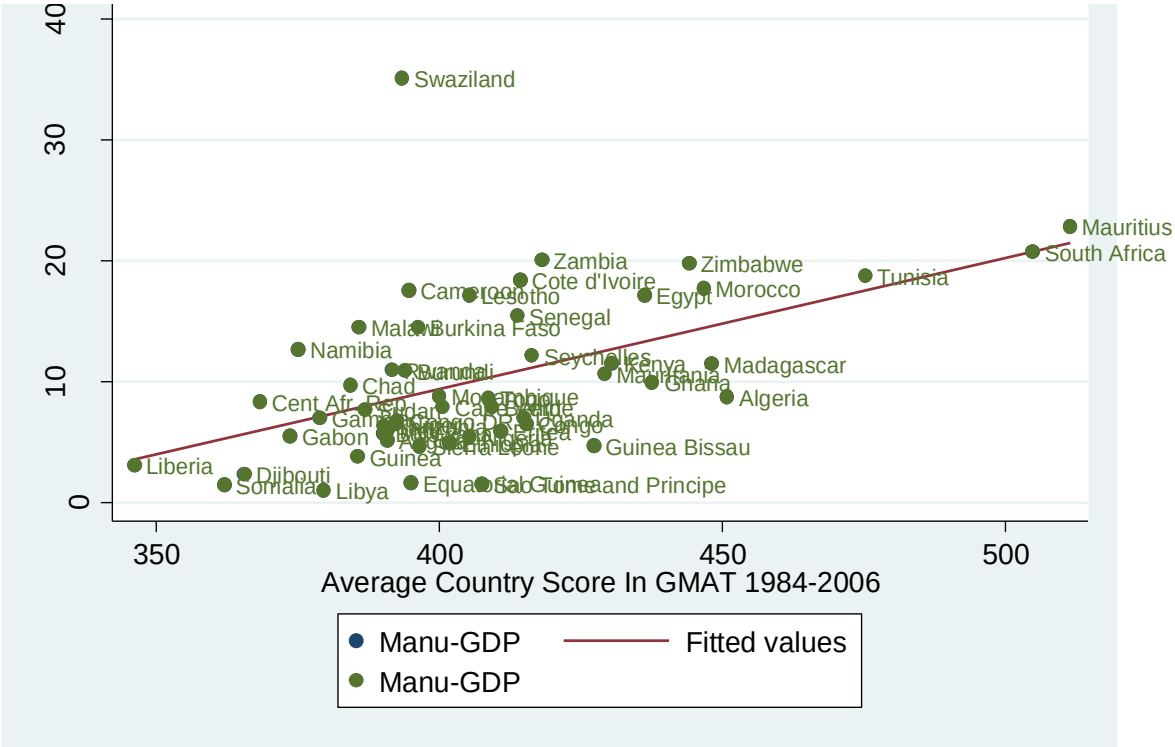

Figure 1: Manufacturing Capacity & Tertiary Schooling Quality

We use a more scientific method suggested by Belsley, Kuh and Welsch (1980). Their method depends on estimating what is called leverage values for each observation in the data, and then using the estimated leverage values in obtaining the DFITS statistic formula suggested by

Table 3.0: Dependent Variable Manufacturing as % of GDP

Row	(1) Omit Algeria	(2) Omit Egypt	(3) Omit Libya	(4) Omit Morocco	(5) Omit Tunisia	(6) Omit North-Africa	(7) Omit Mauritius	(8) Omit South Africa	(9) Omit Swaziland	(10) Log. Man. Cap	(11) DFBETA.	(12) LAD.
Gmat	0.1152* (0.0194)	0.1152* (0.0194)	0.0858** (0.0371)	0.1152* (0.0194)	0.1145* (0.0204)	0.1104*(0.025)	0.1152* (0.0194)	0.1033* (0.0267)	0.1152* (0.0194)	48.19*(8.615)	0.0997*(0.0371)*	0.1413** (0.0577)
Other Controls	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
F-Statistics	9.43	9.43	13.49	9.43	6.46	10.16	9.43	5.87	9.43	8.63	13.75	
R-squared	0.4621	0.4621	0.4307	0.4621	0.4256	0.6075	0.4621	0.4077	0.4621	0.4586	0.7245	0.2962
Obs.	31	31	30	31	30	20	31	30	31	31	17	31

Notes: In parentheses are robust standard errors. *Significant at 1 percent, ** Significant at 5 percent, ***Significant at 10 percent.

Welsch and Kuh (1977).[8] Running regression without outliers identified with DFITS does not have any effect on schooling quality measure (column 11). Finally, we ran regressions using the Least Absolute Deviation (LAD) estimation technique, which is robust to influential outliers; this is shown in column 12. The schooling quality measure is significant.

3.3 Specification Tests: Omitted Variable Bias

In this subsection, we try to account for additional historic and contemporary factors, which impact on current manufacturing capacity, and whose omission might lead to bias in the coefficient of manufacturing.While controlling for a large number of covariates, we keep a parsimonious specification by adding one variable at a time.To facilitate comparison with other results, we reproduce the results obtained in column 10 Table 2 in column 1 Table 4.0. From columns 2-11, we add one variable at a time to covariates such a private investment, openness, GDP, black market premium and public consumption, all of which added to the explanatory power of our previous specifications.

We recognize that it is also important to account for the impact of 400 years of slavery on current attempt at industrialization in many countries of Africa, which through a number of mechanisms might have adverse impact on economic performance of African countries. The slave exports during 400 years of Trans-Atlantic, Trans-Saharan, Indian Ocean and Red Sea trades through forced expulsions and sudden change in demographic configuration of the African landscape continue to have adverse consequences today (Nunn, 2008). Nunn's study finds that countries which exported more slaves during the 400-year period have worse economic performance indicators today. If the more densely populated and developed locations of Africa suffered more from slave trade, there is a logical connection slave intensity and contemporary capacity. Skilled manpower and basic population threshold may be required to transform the structure of African economies from basically agricultural activities into manufacturing, and support large-scale industrialization. In fact, the study by Obikili (2012) shows that locations in Nigeria and Ghana more severely affected by slavery record worse current educational achievement measured in terms of literacy rate. Whatley and Gillezeau (2011) show that African countries that exported more slaves are equally more ethnically diverse today. To test the impact of slavery of slave trade on current manufacturing capacity, we use the country level slave export data of Nunn (2008).Accounting for the impact of slavery on manufacturing capacity does not change the statistical significance on our coefficient of schooling quality (column 2 Table 4.0).

Starting with Burkett, Humbert and Putterman (1999), Bockstette, Chanda and Putterman (2002) and Gennaioli and Rainer (2007), a growing number of studies attribute contemporary economic performance across countries to state capacity before industrialization or colonialism. Rather than seeing disparity in economic performance as basically the results of the quality of colonial institution, the argument offered by this set of studies is that colonial governments barely adapted to existing local institutions at the time of initial contact. The quality of these institutions depends to a large extent on state capacity to broadcast power across the national boundary. Thus, it is the strength of pre-colonial state capacity to exercise the monopoly of violence right over a large territory that determines current capacity of many African countries to undertake modernization programmes (Gennaioli and Rainer, 2007). In Burkett *et al.* (1999), societies that are closer to the high-population density agriculture-driven continuum, characterized by big states, taxation and specialized trade have established practices that are more supportive of industrialization than societies closer to the low-population density 'hunter gatherer' spectrum.

[8]Belsley, Kuh and Welsch (1980) suggest a cut off absolute value of the DFITS statistic exceeding $2\sqrt{k/N}$, as indicating influential or extreme values driving the ultimate estimates obtained. k is the number of variables and N is the number of observations.

To incorporate the potential effects of pre-colonial state capacity on current manufacturing capacity of African countries in our specification, we adopt the state centralization indicator of Gennaioli and Rainer (2007) as measure of pre-colonial state capacity. This index is constructed from Murdock (1967) Ethnographic Atlas, which provides broad description of 60 social, economic, technological and political characteristics of 1270 ethnic groups across the world. The state centralization is taken from Murdock's Jurisdictional Hierarchy variable, which shows the complexity of governance structure across many societies. For this variable, 0 is assigned to ethnic groups 'lacking any form of centralized political organization', 1 to those with petty chiefdom, 2 for large 'paramount chiefdoms/small states' and 3 and 4 to large and very large states.

We adopt Gennaioli and Rainer (2007) approach, regarding groups with 2, 3, and 4 as being centralized, and are assigned 1, otherwise zero. Furthermore, we use their construction of country level indicator of state centralization on the basis of the fraction of the country's current population belonging to the centralized groups. Historic pre-colonial state capacity has no impact on current manufacturing capacity, and post-secondary schooling quality remains significant at 1 percent. (column 3 Table 4.0).

The vast differences in the strategies of colonial government of different African countries have been linked with the significant variation in the economic performance of different countries. La Porta *et al* (1999) argues that differences in cross-country economic development have a strong colonial origin. Similarly, Bertocchi and Canova (2002) find that identity of the colonial metropolitan government and the extent to which it penetrated the host economy can explain differential performance of African economies.This study suggests that British colonies appear to have comparatively better institutions than French colonies. We introduce British and Spanish dummy variables to account for their probable impact onmanufacturing capacity. Coefficient reported in column 4, Table 4.0 indicates that schooling quality is still significant at 1 percent.

A fully efficient legal system must insulate law enforcers from been attacked or bribed by parties to any case. Different legal systems offer different degree of protection to investors. To construct the legal origin variable, we assigned the value of 1 to countries under British rule and under the influence of common law for the period of colonial and after, while other countries were assigned the value of 0.[9] Introducing the legal origin variable had no effect on the economic and statistical significance of the schooling quality variable (see columns 5 and 6 of Table 4.0).

[9] Countries which had Scandinavian and German-styled legal systems are regarded as civil-law countries as done by Acemoglu and Johnson (2005). This is in line with the seminal papers (La Porta *et al.*, 1997, 1998). Only La Porta (1999) cited in reference espousing legal origin theory.

Table 4.0: Tests of Omitted Variable Bias

Row	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**
Sch_Q	0.1152* (0.0193)	0.1173* (0.0183)	0.1016* (0.05)	0.1184* (0.0192)	0.1140* (0.02)	0.1153* (0.0202)	0.1163* (0.0233)	0.1164* (0.0206)	0.1216* (0.0187)	0.1328*(0.0236)	0.1120* (0.0184)
Other controls	yes	Yes		yes	Yes	yes	yes	Yes	Yes	yes	Yes
Slavery		-0.4231 (0.3733)									
Precolonial			-1.719 (3.159)								
Colonial Origin				0.554 (1.8156)							
Colonial Origin (Spanish)					0.6653 (1.9167)						
Legal Origin (British)						-0.6233 (1.8556)					
Institution (pol)							0.6519 (4.849)				
Institution (eco)								1.964 (1.166)			
corruption									0.0013*** (0.0007)		
Biz. Cost										0061007 .0179303	
Financial devpt											-0.0915* (0.0257)
F-Statistics	9.43	8.94	3.08	7.04	7.04	7.04	8.88	10.02	9.38	12.90	8.93
Obs.	31	31	23	31	31	31	23	23	31	30	27
R-squared	0.4621	0.4908	**0.3394**	**0.4479**	**0.4479**	**0.4569**	**0.4439**	0.5192	**0.4588**	**0.4695**	0.5510

In parentheses are robust standard errors. *Significant at 1 percent, ** Significant at 5 percent, ***Significant at 10 percent.

In the last twenty years, researchers in the social sciences have explored the role of institutions in driving economic development. In fact, a substantial part of the variation in the economic performance within and across borders could be explained by differences in the quality of institutions. Acemoglu *et al*. (2005) identify institutions as the fundamental cause of long run growth performance. For instance, the economic institutions that protect individual property rights and political institutions that restrict the arbitrary exercise of powers can significantly influence individual decisions to invest in physical and human capital, to use growth-promoting technological innovations and to what end to deploy her talent and skills. Some kinds of investment and scale of investment may be more sensitive to the quality of institutions than others. Small scale agricultural investment may be less sensitive to the quality of political and economic institutions because the economic costs of expropriating their resources may be extremely high relative to larger scale manufacturing. Thus, we incorporate into our specification, measures of political and economic institutions as in Acemoglu and Johnson (2005) to determine the extent to which these institutions affect manufacturing. We use constraint against executive measure as a proxy of political institution. This measure is constructed by Witold Henisz of the University of Pennsylvania. We also use Heritage Foundation's protection against property right measure as a proxy of the quality of economic institution. As seen in columns 7 and 8 Table 4.0, schooling quality remain significant at 1 percent.

In case the measures of political and economic institutionsintroduced previously do not conceptually capture the role of institution properly, in column 9 we introduced the indicator of large-scale corruption in Africa. However, instead of resorting to the use of different kinds of proxies, which are conceptually unsuitable for measuring corruption and institutional quality (Glaeser *et al.*, 2004), we instead use quantitative corruption data recently assembled by Global Financial Integrity for African countries for the period 1984 to 1989. The data captures substantial financial resources, which are illegally accumulated and transferred out of developing economies. Adewole (2011) argued that the return of these illicit funds could be an important source of development finance for both private and public sectors in developing economies such as Nigeria. Furthermore, we posit that large-scale corruption denies the public sector tax revenues required to finance public infrastructure needed to support large-scale manufacturing. Introducing this crude proxy of corruption in the regression reported in column 9, we find that schooling quality remains significant at 1 percent.

If political and economic institutions introduced into previous specifications in addition to the corruption variable are not the relevant factors affecting manufacturing capacity, thenregulatory quality, which differs from one country to another, might have significant effect. For instance, the World Bank Cost of Doing Business index shows that it takes about 176 days to open a new business in Togo and just about three days in New Zealand. Broadly, business activities related to starting a business, obtaining licenses, employing workers, registering business' property, accessing business credit, enforcing contract agreements, protecting investors, paying taxes, carrying out cross-border trade, and shutting down businesses are comparatively more cumbersome in some countries than others. The implication is that most forms of productive business activities are costlier in some countries than in others. Therefore, we incorporate World Bank (2007) cost of doing business ranking, which includes 10 different costs associated with doing business, into our specification. As seen in column 10, the schooling quality variable remains significant.

Similarly, a bulk of the literature asserts that strong and positive relationship exists between financial system and economic development. A functional financial system, through its financial institutions, contributes to rapid economic development. In fact, financial institutions through the operations of banks, insurance firms, stock markets, bond markets and derivative markets can exert a first-order effects on economic performance of countries, accelerate economic development and considerably reduce poverty (Beck and Levine, 2003; Levine, 2005). According to Čihák, Demirgüç-Kunt, Feyen and Levine (2012*)*, the banks, by assisting to identify credit-worthy borrowers with promising projects and mobilizing savings from numerous households to invest in lucrative projects, help resource allocation required to promote economic growth and development. Furthermore, the ability of the financial system to monitor the use of borrowed funds, putting borrowers' management under intense

scrutiny limit agency losses associated with the abuse of borrowed funds and ensures better corporate governance culture across the firms. Equally, the existence of equity, bond, and derivative markets diversify risks, which in turn encourages investment in high-yield projects. Functional financial system, by lowering the costs of transactions, boosts trade and stimulates specialization. Firm and industrial expansions will require the services of functional financial system (Demirguc-Kunt and Maksimovic, 1999; Rajan and Zingales, 1998).

A well-developed financial system can support manufacturing activities better by extending business credit to them. Thus, the variation in the financial system may be able to explain variations in manufacturing capacity across African countries better than schooling quality can. Thus, we introduce domestic credit as percentage of GDP between 1980 and 2005 into the specification whose results are reported in column 11 of Table 4.0. Post-secondary schooling quality is still significant at 1 percent after accounting for the level of financial development.

The seminal study of Sachs and Warner (1995) indicates that natural resource endowments can have pernicious effects on long run growth performance. These endowments of nature lead to heightened growth costly rent-seeking, corruption, increasing fertility through rapid rise in commodity prices, crippling institutions that fast-track economic development, increasing the risks of civil war and shrinking the volume of manufacturing tradables as a result of the artificial rise in real exchange rate (Lane and Tornell, 1996; Mauro, 1995; Torvik, 2001; Collier and Hoeffler, 2002; Isham *et al.*, 2003). The effects of resource endowments on economic performance can be more severe when point natural resources, such as crude oil and diamond, are involved. Though there is little empirical support for the Dutch disease phenomenon in the literature of resource curse (Aunty, 2001; Bulte *et al*, 2004), we nevertheless attempt to control for the potential confounding effects of crude oil and diamond on manufacturing capacity in our specifications. Column 2 of Table 5 shows that schooling quality remains significant after introducing a dummy for big oil producer into our specification.

If Dutch disease is not operating through natural resource endowments, it might be working through the channel of foreign aid. Foreign aid dependence can artificially raise the value of domestic currencies, making manufacturing tradables less competitive in the international markets.This will have adverse consequences for domestic manufacturing capacity. To account for this possibility, we add net aid as fraction of GDP between 1984 and 2006 to the regression reported in column 3. As shown in column 3 of Table 5.0, schooling quality coefficient is barely affected.

Aside point resources, the works of Engermann and Sokoloff (1997), Sokoloff and Engerman (2000), Engermann *et al.* (2002), Khan and Sokoloff (2004), Engermann and Sokoloff (2005) and Sokoloff and Zolt, (2005) have shown how historic natural resource endowments, by shaping initial inequality profile of different countries, may also have subsequent knock on effects on economic development, particularly manufacturing capacity. The suitability of soils of Latin American countries for the cultivation of large-scale sugar plantation, which uses slave labour, created structural inequality, which has adverse effects on institutions, human capital development, and much more importantly industrialization. The North American environment, which is supportive of wheat cultivation grown on small family farms, led to small initial inequality, creating an environment that facilitated the emergence of middle class households, stable democratic polity, universal adult suffrage, mass education, and rapid industrialization among other things. To clarify the role of these agricultural endowments on contemporary capacity, we use wheat-sugar ratio as constructed by Easterly (2007). For the wheat-sugar ratio, he used FAO data measuring the fraction of a country's cultivable land suitable for planting different kinds of crops based on time invariant factors such as soil, rainfall, temperature and elevation. We also introduce a resource inequality indicator to check if the effects of endowment on manufacturing capacity are operating through inequality.Notably, schooling quality indicator remains significant at 1 percent as indicated in column 4 of Table 5.

A wide range of studies, starting with Easterly and Levine (1997),[10] have associated ethnic and linguistic diversity with numerous adverse economic development outcomes. The more ethnically or racially divided countries or sub-national units have poorer public policies, more significant under provision of public goods, lower public expenditure on education, higher public employment, poorer public sector service delivery, weaker ability to enforce collective action, more likely to mismanage foreign aids, greater level of corruption, more unstable political system, lesser level of state building capacity and higher public consumption. In fact, more diverse societies are less likely to react appropriately to external trade shocks because redistributive implications of public policies required to effectively tackle the shocks are more salient in societies with greater degree of ethnic diversity. By the same stretch of imagination, public policies required to foster manufacturing might be severely affected by ethnic differences. Thus, what accounts for variation in manufacturing capacity in African countries may be more of ethnic diversity than differences in the quality of higher education.

[10]See Alesina and La Farrara, 2005 for comprehensive review of the literature.

Table 5: Further Tests of Omitted Variable Bias

Row	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Sch_Q	0.1152* (0.0193)	0.1401* (0.0164)	0.1122* (0.0177)	0.1012** (0.0414)	0.1094* (0.0183)	0.08613** (0.0383)	0.1091* (0.022)	0.1065* (0.0175)	0.1237* (0.0177)	0.1272* (0.0218)	0.122*(0.0237)	0.114** (0.0506)	0.117* (0.0292)
Other controls	yes	yes		yes	yes	yes	Yes	yes	yes	yes	yes	yes	yes
Resource curse(Oil)		-0.0611** (0.0232)											yes
Foreign aid			3.63e-09*** (2.15e-09)										Yes
Major crops				5.309 (14.99)									No
Ethnic diversity					-6.01 (3.86)								No
Ethnic polarization						0.4166 (4.261)							No
Foreign edu.							-1467. 1 (913.26)						No
Terrain rugggedness								1.128* (0.371)					No
Landlock									2.665 (1.6433)				No
Infra (road)										-0.0335 (0.0391)			Yes
Infra (water)											-0.0596 (0.0507)		No
Infra (electricity)												-0.0324 (0.0351)	Yes
F-Statistics	9.43	15.18	12.96	7.75	8.51	14.62	6.81	13.30	11.27	9.33	7.09	7.49	9.67
Obs.	31	31	31	20	31	28	28	23	31	31	31	23	26
R-squared	0.4621	0.5608	0.5377	0.5787	0.4980	**0.4288**	**0.4565**	0.4935	0.5031	0.4785	0.4892	0.5623	0.5132

Notes: In parentheses are robust standard errors. *Significant at 1 percent, ** Significant at 5 percent, ***Significant at 10 percent. Other controls for column 13 include post-secondary schooling quality, trade openness and black market premium.

To account for the possibility that ethnic diversity might impede manufacturing performance either through the under-provision of public goods or the formulation of poor policies, we include the same measure of ethnic fractionalization index adopted by Easterly and Levine (1997), which measures the probability that two randomly selected persons from a given population belong to different ethnic groups. Within our economic framework, we accommodate the alternative argument that what may be important for economic development may be the presence of two major ethnic groups in a population, rather than the multiplicity of ethnic groups, many of which might be politically relevant in the contest for resources (Montalvo and Reynal-Querol, 2005). Therefore, we use the ethnic polarization index of Montalvo and Reynal-Querol (2005) to absorb the effect of ethnic polarization on manufacturing capacity. Columns 5 and 6 reports results after including variables of ethnic fractionalization and ethnic polarization into our specification. Adding ethnic fractionalization barely affects the coefficient of schooling quality, though ethnic polarization causes modest decline in its estimate.The schooling quality coefficient is significant at 1 percent for regression reported in column 5 and at 5 percent for regression in shown in column 6.Observably, ethnic polarization may be irrelevant because its addition lessened the coefficient of determination**.**

While a number of African countries became politically independent, starting from 1960, colonial influence on former colonies continued for much longer. This came not just because post-independence elites did not have any incentive to change the institutions they inherited from colonial government, but also because these metropolitan powers continued to supply higher education for a large number of those who constitute political elites in former colonies. In a recent study, Spilimbergo (2009) found that foreign-educated individuals have positive impact on the quality of democracy in their home country if they study in democratic countries. This relationship might extend to economic performance in manufacturing sector, with foreign-educated students in more industrialized countries more likely to initiate and support policies that promote industrialization. To measure this kind of effect of foreign education on domestic manufacturing capacity, we estimate the average percentage of students who acquired foreign education relative to the total number with higher degrees during 1970-2005 period using Spilimbergo's (2009) data.As seen in column 7, introducing this variable has no perceptible influence on schooling quality and has no significant impact on manufacturing.

Terrain ruggedness has a number of consequences. Very irregular terrains are expensive to cultivate and lands are prone to erosion (Food and Agriculture Organization, 1993). Building and transportation costs are prohibitive in highly irregular topography (Nogales, Archondo-Callao, and Bhandari, 2002; Allen, Bourke, and Gibson (2005). Thus, laws, and specifically anti-corruption laws could be more difficult in countries with very rugged terrains. Detecting corruption might be expensive andenforcinganti-corruption laws incountries with larger landmass might be costlier.The terrain ruggedness indicator used is that devised by Riley, DeGloria and Elliot (1999) and used recently by Nunn and Puga (2012). Countries and districts with highly irregular terrains are likely to receive fewer supplies of school facilities for learning and are likely to be more difficult to reach for prospective students. Rugged terrains increase the cost of school attendance, because students and teachers have to travel long distances through rough terrains to reach their schools. Consequently, input into cognitive skill acquisition on the part of teachers and students yield less attractive returns, partly due to physical exertion of travelling through long and ruggedness terrains. Thus, schooling quality will be lower compared with countries and districts with less irregular terrains. Institutions required to enforce high quality school service delivery are likely to be weaker in countries and districts with highly rugged terrains. Thus, country level ruggedness index of Nunn and Puga (2012) is introduced in the regression reported in column 8. While ruggedness has positive impact on manufacturing capacity, been significant at 1 percent, it barely has any effect on the coefficient of schooling quality. The coefficient is still significant at 1 percent.

Countries with huge manufacturing activities must have among many other things, geographic features that facilitate international trade that brings in raw materials required in her factories and allows the export of finished manufactured goods. In this respect, countries which are landlocked suffer a major disadvantage. Landlocked countries, that are more distant to the coasts, are also more

dependent on the benevolence of neighboring countries to secure entry into the international shipping markets (Faye, Mcarthur, Sachs and Snow, 2004). Their geographic remoteness increases the costs of trade, minimizes the gains from specialization and the application of modern technologies (Faye, *et al*., 2004). To absorb the potential effect of isolation on manufacturing capacity due to landlockness, we introduce a land dummy into the specification reported in column 9. The coefficient of schooling quality remains significant at 1 percent.

Public investments in physical infrastructure provide incentives to private investors to establish industries and help in achieving success in the exports of manufactures. The role of infrastructure in raising productivity, reducing transaction costs and accelerating economic growth has been well established in the literature (Gramlich, 1994; Lynde and Richmond, 1993;). It equally spurs investment in complementary human capital investments. It encourages specialisation in production (Bougheas, Demetriades and Mamuneas, 2000) and balanced growth across all sectors. It boosts international trade by reducing transport costs (Bougheas, Demetriades and Morgenroth 1999). Infrastructural deficiencies raise the costs of production, making firms lack competitiveness in both domestic and international markets. Even more important is the fact that physical infrastructure does not only accelerate growth but reduces economic inequality (Calderson and Serven, 2005). We constructed three measures of physical infrastructure that accelerate the growth of manufacturing capacity. These include paved roads as percent of total roads, percentage of persons with access to safe water and the percentage of population with access to electricity. Columns 10 to 12 reports results of regressions after each of the measures of physical infrastructure were included one after the other. Schooling quality remains significant.

4.0 Two Stage Least Squares (2SLS) Method and Results

The first alternative technique to the OLS method is the 2SLS identification strategy. Thistechnique is capable of producing estimates which are relatively unbiased and consistent when explanatory variables are measured with error and are endogenous to the model been estimated. It is also useful to note that omitted variable and reverse causality will make obtaining unbiased impossible from OLS regressions. Our human capital indicators are subject to measurement error and human capital quality is a choice variable for policymakers and various stakeholders to make. As long as chosen instruments are strong and exogenous, unbiased and consistent estimates can be recovered from the estimated model. To determine the impact of human capital quality on indicators of manufacturing, we use country level distance to the equator, determined by using the absolute value of a country's latitude divided by 90, mean country temperature and distance to the coast dummy (countries within 100km of the coast are assigned 1, otherwise zero) to instrument for aggregate country level post-secondary schooling quality indicators.

Similarly, distance to the equator could matter for quality of schooling capital. Areas further away from the equator tend to have better schools than countries closer because they are nearer high quality schools in the temperature countries of Europe; figure 2 depicts this relationship. Notably, there are other channels through which tropical and temperate environment could affect schooling attainment and quality beyond the mechanism previously explained. Drawing extensively from Kamarck (1976), Ram (1999) shows that a country's tropicality affect schooling life expectancy (SLE)[11] through (a) the degree of heat and humidity, (b) human health hazards associated with disease environment, and (c) human capital productivity and the incentive to acquire human vis-à-vis non-human capital. Thus, if these exogenous components of geography affect schooling quality, there is an important justification for the use of a geographic factor as an instrument for schooling. It could be that some of the direct impact of geography on growth that repeatedly features in the works of Sachs and co-researchers

[11]SLE is defined by UNESCO (1995, pp.95-96) as 'the total number of years of schooling which the child can expect to receive in the future, assuming that the probability of his or her being enrolled in school at any particular future age is equal to the current enrolment ratio for that age'

(Gallup *et al.*, 1998; Mellinger *et al.*, 2000; Gallup and Sachs, 2001; McArthur and Sachs, 2001)[12] could come via the channel of schooling. The same argument applies to Acemoglu *et al*. (2001). Thus, both strands of literature could be exaggerating the impact of geography and institutions on growth because of the failure to account for the mediating role of schooling. The study of Glaeser *et al*. (2004) is instructive in this case.

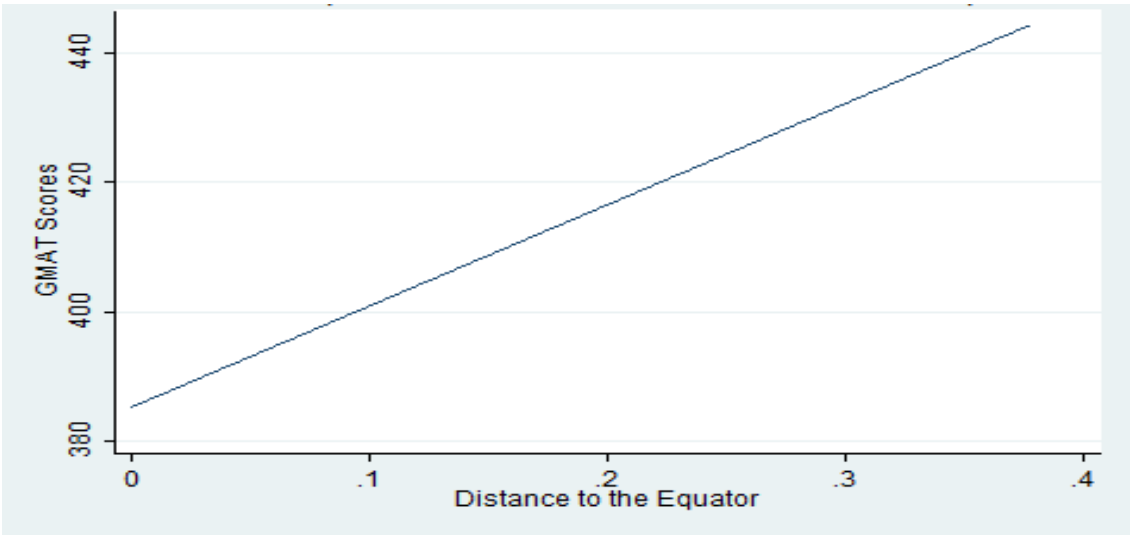

Figure 2: Relationship between GMAT Scores & Distance to the Equator

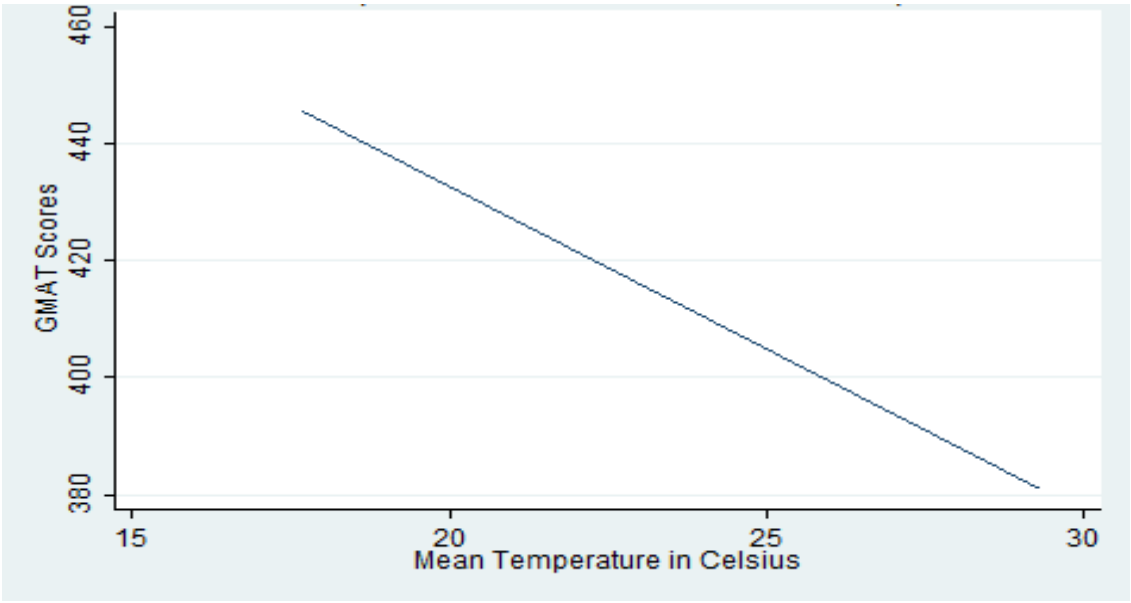

Figure 3: Relationship between GMAT Scores & Mean Temperature

Finally, there is a reason to believe that the quality of learning in the tropics with high degree of heat and humidity might be poorer relative to the temperature. Excessive heat makes the learning environment less conducive. In a general way, tropical environment, with its excessive heat, could

[12] The impact of tropicality on income (Ram 1997) could be exaggerated for the same because of failure to account for schooling.

stifle labour productivity. In a seminal study by Lee (1957), it is noted that absence of good health does affect a person's attitude toward work, initiative, creativity, learning ability, energy, and capacity for heavy or sustained work or thought. In fact Leesingled out the loss of mental initiative as the most important result of being exposed to a tropical environment. In 1970 Neville Billington's study (as reported by Kamarck 1976), produced some results concerning human output under a range of temperatures. One important conclusion from the study is that for different type of jobs, there exists a temperature threshold for optimal performance. Figure 3 captures the relationship between country level temperature and performance in GMAT exams among African countries.

Vast economic activities are concentrated in temperate and coastal zones of the world. The Wealth of Nations book by Adam Smith not only admits the place of geography in explaining the spatial concentration of business activities, but argues that the absence of sea routes could limit the size and scope of market activities. While temperate areas closer to the coast constitute considerably smaller proportion of the global landmass, it nevertheless accounts for a disproportionately greater share of world output (Mellinger, Sachs and Gallup, 2000). Because business activities in countries closer to the coast are skill-intensive in nature, schooling quality, particularly at the higher education level, are likely to be comparatively higher. This suggests that distance to the coast, measured as an indicator variable with 1 assigned countries located within 100km^2 coastline, should serve as a good instrument for the post-secondary schooling quality variable.It is visible from figure 4 that African countries closer to the coast also do better in GMAT examinations than countries further away.

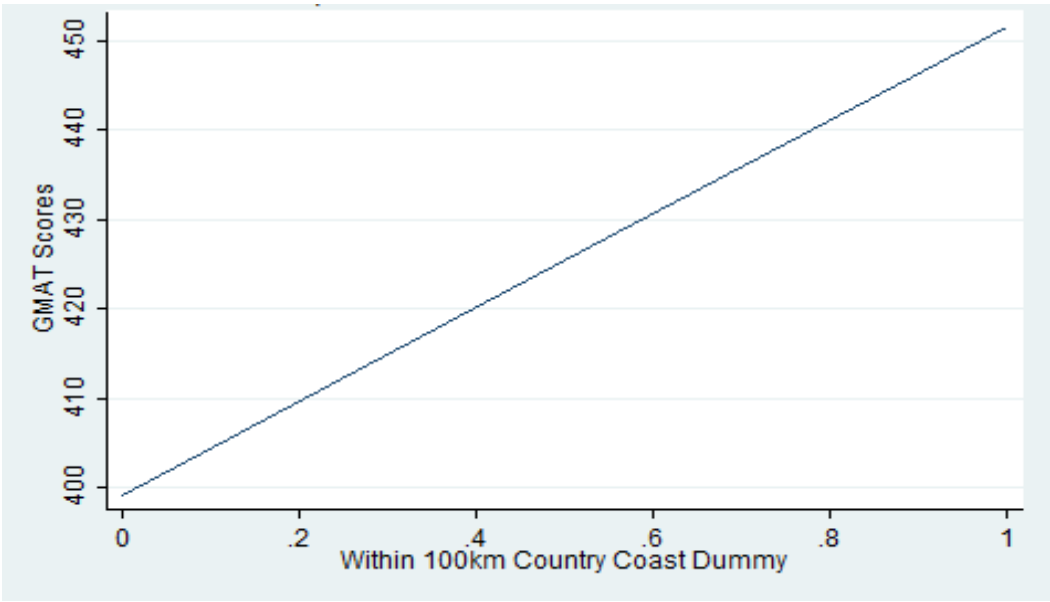

Figure 4: Relationship between GMAT Scores & Distance to the Coast

Determining the strength of instruments is very important because weak or moderately weak instruments can produce 2SLS estimates with large asymptotic bias, which are inconsistent. Since our instruments must be strong, we test the relevance using three approaches. First, we check the statistical significance of our instruments in all first-stage regressions. Statistically insignificant estimates suggest that our instruments are weak. Second, we use the rule of thumb suggestion offered by Stock (2010), which asserts that F-statistic greater than 10 suggests strong instruments. F-Statistics are generally below the safety benchmark value of 10, again suggesting the presence of weak instruments. To prevent 2SLS estimates from been biased and inconsistent when instruments are weak, we use the Moreira's (2003) maximum likelihood technique which is capable of producing valid and fully efficient estimates, whether or not instruments are strong or weak or irrelevant.

Apart from the fact that our instrument must be strong, it must also be valid. Therefore, we subject our instrument to some validity tests. The first approach examines the extent to which the mild violation of perfect orthogonality between chosen instruments and the error term will undermine confidence in our estimates. This is because a moderate correlation between our instruments and the error term can make IV or 2SLS estimates to inconsistent. In a reduced form equation, we check whether each of the instruments is significantly correlated with manufacturing capacity after all covariates used in previous regressions including post-secondary school quality variable. Our results indicate that none of these instruments is significantly correlated with manufacturing capacity. Second, we run reduced form regressions that, in addition to other relevant covariates, include all instruments but excludingschooling quality indicator. The instruments are statistically significant at 5 percent, indicating that school quality indicator is the channel through which the instruments affect manufacturing capacity.

Starting with the baseline controls used in column 10 of Table 2 for regression reported in column 1 Table 6 Panel A, a unit increase in GMAT scores increasesmanufacturing capacity by 0.128 percent point.The estimate is statistically significant at 1 percent. The corresponding OLS estimate shown in column 10 Table 2.0 is 0.1152. Thus, 2SLS estimate is not significantly different from OLS estimate. This could be because the biases due to endogeneity, measurement and omitted variables have offsetting effects on one another. To keep our model parsimonious and avoid bad controls, while still accounting for a large number of variables that might be correlated with any of the instruments or might be correlated with manufacturing capacity, we added each variable one after the other.

We introduce British legal origin dummy (column 5), political institution (column 6), corruption (column 7), ethnic fractionalization (column 2 Panel B), foreign education (column 4 Panel B) and landlocked dummy, which marginally affected the schooling quality coefficient, still leaving it statistically significant. Introducing covariates such as slave exports, costs of business regulation, crude oil dummy, ethnic polarization, percentage of total road that is paved and percentage of population with access to electricity tends to dramatically increase or decrease the coefficient of schooling quality. We suspect that multicollinearity might be responsible. Thus, our final estimation excluded these variables. Similarly, we exclude pre-colonial state capacity, which render schooling quality coefficient insignificant, changing the expected sign from positive to negative. Introducing British colonial origin dummy, protection against property rights violation variable, domestic credit as a percentage of GDP, indicator of agricultural endowments, terrain ruggedness and percentage of the country's population with access to drinking water have sharp but less dramatic impact on the coefficient estimates of schooling quality, though these estimates remain significant at 5 percent in most cases.For regressions reported in Panels A and B of Table 6, only pre-colonial, ethnic polarization and landlocked dummy variables render schooling quality coefficients insignificant due to multicollinearity. The regression implemented and reported in column 10 Table 6 has, in addition to baseline controls used in column 10 Table 2, variables such as legal origin, political institution, corruption, ethnic fractionalization and landlocked dummy. The reported estimate is 0.1040, slightly lower than the regression estimate reported in column 1 Table 6 (0.128).Regression reported in column 11 uses World Development Indicators (WDI) tertiary school enrolment data, a quantity based indicator of post-secondary schooling attainment, in place of the quality based indicator used in all previous regressions.The coefficient of tertiary schooling enrolment is statistically insignificant. This probably supports the argument of Hanushek and Woessmann (2008) that quality indicators of schooling are better than quantity indicators.

Table 6: Maximum Likelihood 2SLS Results

Panel A											
Row	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**
Sch_Q	0.1280* (0.0503)	0.1524* (0.0534)	-0.0963(0.2471)	0.1407* (0.0464)	0.1275** (0.0507)	0.1137** (0.0553)	0.0767*** (0.0444)	0.1274* (0.0493)	0.2847** (0.1379)	0.0998* (0.0346)	0.1913* (0.0629)
Baseline controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Added Var.	None	**Slavery**	**Precolonial**	**Colonial Origin**	**Legal Origin (British)**	**Institution (pol)**	**Institution (eco)**	**corruption**	**Biz. Cost**	***Financial devpt***	Crude oil
F-Statistics	2.34	2.01	1.28	2.67	1.97	2.14	2.09	2.04	2.02	5.50	2.22
R^2	0.4989	0.4868	0.1856	0.4839	0.4994	**0.5066**	0.5580	0.4995	0.1956	0.5735	0.4896
Obs.	27	27	20	27	27	26	22	27	26	23	27
Overid (AR)	0.5478	0.3011	**0.7043**	**0.4803**	**0.5267**	**0.4812**	**0.7906**	0.5476	**0.5368**	**0.0844**	0.5105
Panel B											
Row	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**
Sch_Q	0.0713*** (0.0374)	0.1229** (0.0507)	0.3112 (0.3368)	0.1132* (0.0387)	0.0894 (0.0704)	0.1325* (0.0456)	0.1867** (0.0781)	0.1452*(0.051)	0.0375 (0.0751)	0.1040** (0.0413)	-194.61 (354.54)
Other controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Added Var	**Agric. endowment**	**Ethnic diversity**	**Ethnic polarization**	**Foreign education**	**Terrain ruggedness**	**landlock**	**road**	**water**	**electricity**		
F-Statistics	4.34	1.98	2.26	4.60	2.03	2.20	2.05	1.98	6.60	6.61	0.92
R^2	0.7013	0.5060	----	0.4941	0.5218	0.5525	0.4309	0.5190	0.5324	0.5781	0.4678
Obs.	16	31	24	24	27	27	27	27	20	23	23
Overid (AR)	0.4621	0.5955	**0.9426**	**0.4093**	**0.6069**	**0.9630**	**0.7473**	0.7367	**0.9116**	**0.9326**	0.3611

Other controls for column 13 include post-secondary schooling quality, openness and black market premium. Panel B columns 10and 11 has in addition to the baseline control variables covariates of legal origin, political institution, corruption, ethnic fractionalization, foreign and landlocked dummy. Column 11 uses WDI tertiary school enrolment data.

Coefficients of all instruments are insignificantly different from zero when schooling quality indicator is added to the econometric specification, and are significant at 5 percent when schooling quality indicator is excluded. This suggests that instruments affect manufacturing capacity through their effects on schooling quality indicator. Finally, we exploit the fact that econometric specifications have three instruments for the schooling quality indicator to implement over-identification test, an important test of instrument exogeneity. Hansen test of over-identifying restriction is implemented. Reported regressions indicate that instruments are exogenous. Schooling quality variable remains statistically significant after controlling for a number of variables introduced in Tables 4 and 5.

5. Summary and Conclusion

High quality human capital investment plays a key role in facilitating economic transformation and development. To probe the causal relationship between human capital quality and transition to large-scale manufacturing businesses, we build a new database of human capital quality of post-secondary schooling quality. The average score of students in the GMAT examinations between 1984 and 2006 is used as the main measure of post-secondary schooling quality. Our OLS results suggest a strong and positive relationship between schooling quality and economic growth. Our results are robust to the addition of a fairly large number of relevant variables, corrections for influential observations and check for self-selection related biases. To further correct for possible endogeneity, omitted variable bias and measurement error of the schooling quality indicator, we use 2SLS technique, using distance from the equator, distance to the coast dummy and average country level temperature to instrument for post-secondary schooling quality. 2SLS estimates are positive and not significantly different from OLS estimates. Our instrument passed the tests of exogeneity though the maximum likelihood 2SLS technique is used due to weak instrument problem.

The introduction of multiparty democracy in Africa has provided electoral incentive for political leaders in power or those aspiring to secure political power to promise the provision of massbasic education.With significant donor support from developed countries and multilateral agencies such as the World Bank, and massive financial resources from resource booms, basic education has expanded dramatically across the continents in the last one decade. The results from this study suggest that equal amount of attention needs to be paid to the delivery of high quality post-secondary education. This is key to the transformation of African economies, which in spite of sustained growth of nearly two decades in Africa is yet to transit to large-scale manufacturing activities, which holds greater promise of poverty reduction and accelerated economic development.

ACKNOWLEDGMENTS

We are extremely grateful to Professor Chris Udry (Yale University) for reading through this study twice and giving us useful comments. We are indebted to Dr. Evans Osabuohien and Efobi Echenna for reading through the previous version of this paper, generously offering us their useful comments. The editorial assistance of Miss Olarinde Omolola is acknowledged. We take exclusive responsibility for all errors in this study

REFERENCES

Acemoglu, D. (1995). Reward Structures and the Allocation of Talent. *European Economic Review, 39*(1), 17-33.

Acemoglu, D., & Johnson, S. (2005). Unbundling Institutions. *Journal of Political Economy, 113*(5), 949-995.

Acemoglu, D., & Johnson, S. (2007). Disease and Development: The Effect of Life Expectancy on Economic Growth. *Journal of Political Economy, 115*(6), 925-985.

Acemoglu, D., & Johnson, S. (2009). Disease and Development: A Reply to Bloom, Canning and Fink. *Unpublished Mimeo, MIT*.

Acemoglu, D., & Verdier, T. (1998). Property Rights, Corruption and the Allocation of Talent: A General Equilibrium Approach. *Economic Journal, 108*(450), 1381-1403.

Acemoglu, D., Johnson, S., & Robinson, J. (2003). Disease and Development in Historical Perspective. *Journal of the European Economic Association, April–May 2003 1(2–3)*, 397– 405.

Acemoglu, D., Johnson, S., & Robinson, J. A. (2001). The Colonial Origins of Comparative Development: An Empirical Investigation. *American Economic Review, 91*(5), 1369–1401.

Acemoglu, D., Johnson, S., & Robinson, J. A. (2005). The Rise of Europe: Atlantic Trade, Institutional Change and Economic Growth . *American Economic Review, 95*(3), 546–579.

Adewole, M. A. (2011). Innovative Source of Development Finance for Africa: The Return of Stolen Funds. *Shorlisted Entry for 2010 Global Develpment Network Research Medal Competition*.

Aghion, P., & Howitt, P. (1998). *Endogenous Growth Theory.* MA: MIT Press.

Alesina, A., & Ferrara, E. (2005). Ethnic Diversity and Economic Performance. *Journal of Economic Literature, 43*(3), 762-800.

Allen, B., Bourke, M., & Gibson, J. (2005). Poor Rural Places in Papua New Guinea. *Asia Pacific Viewpoint, 46*(2), 201-217.

Appleton, S., Atherton, P., & Bleaney, M. (2008). International School Test Scores and Economic Growth.

Aryeetey, E., & Nelipher, M. (2012). Industrialisation for Structural Transformation in Africa: Appropriate Roles for the State. *Journal of African Economies, 21*(2), 55-85.

Atherton, P., Appleton, S., & Bleaney, M. (2013). International School Test Scores And Economic Growth. *Bulletin of Economic Research, Wiley Blackwell, 65*(1), 82-90.

Aunty, R. M. (2001). Resource Abundance and Economic Development. *Oxford University Press for UNU/WIDER, Oxford*, xiii+340.

Barro, R. J. (1991). Economic Growth in a Cross Section of Countries. *Quarterly Journal of Economics, 106*(2), 407-444.

Barro, R. J., & Lee, J.-W. (2001). International Data on Educational Attainment: Updates and Implications. *Oxford Economic Papers, 53*(3), 541–563.

Baumol, W. J. (1990). Entrepreneurship: Productive, Unproductive, and Destructive. *Journal of Political Economy, 98*(5), 893-921.

Beck, T., & Levine, R. (2003). Legal Institutions and Financial Development. *NBER Working Papers 10126, National Bureau of Economic Research, Inc*.

Behrman, J. R., & Birdsall, N. (2008). Quality of Schooling: Quantity Alone is Misleading. *American Economic Review, 73*(5), 928–946.

Belsley, D. A., Kuh, E., & Welsch, R. E. (1980). *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity.* New York: John Wiley and Sons.

Benavot, A., & Riddle, P. (1988). The Expansion of Primary Education, 1870. 1940: Trends and Issues. *Sociology of Education, 66*(3), 191-120.

Benhabib, J., & Spiegel, M. (1994). The Role of Human Capital in Economic Development: Evidence from Aggregate Cross-Country Data. *Journal of Monetary Economics, 34*(2), 143-174.

Benhabib, J., & Spiegel, M. M. (2005). Human Capital and Technology Diffusion. In P. Aghion, & S. N. Durlauf (Eds.), *Handbook of Economic Growth* (pp. 935-966). Amsterdam: NorthHolland.

Bertocchi, G., & Canova, F. (2002). Did Colonization Matter for Growth? An Empirical Exploration into the Historical Causes of Africa's Underdevelopment. *European Economic Review, 46*(10), 1851-1871.

Bils, M., & Klenow, P. J. (2000). Does Schooling Cause Growth? . *American Economic Review*.

Bishop, J. (1992). The Impact of Academic Competencies of Wages, Unemployment, and Job Performance. *Carnegie-Rochester Conference Series on Public Policy, 37*, 127-194.

Bishop, J. H. (1989). Is the Test Score Decline Responsible for the Productivity Growth Decline? *American Economic Review, 79*(1), 178–197.

Blackburn, M. L., & Neumark, D. (1993). Omitted-ability Bias and the Increase in the Return to Schooling. *Journal of Labor Economics, 11*(3), 521-544.

Blackburn, M. L., & Neumark, D. (1995). Are OLS estimates of the Return to Schooling Biased Downward? Another Look. *Review of Economics and Statistics, 77*(2), 217-230.

Bleakley, H. (2007). Disease and Development: Evidence from Hookworm Eradication in the American South. *Quarterly Journal of Economics, 122*(1), 73-117.

Bloom, D. E., Canning, D., & Günther, F. (2014). Disease and Development Revisited. *Forthcoming in Journal of Political Economy*.

Bockstette, V., Chanda, A., & Putterman, L. (2002). States and Markets: The Advantage of an Early Start. *Journal of Economic Growth, 7*(4), 347-369.

Bougheas, S., Demetriades, P. O., & Mamuneas, T. P. (2000). Infrastructure, Specialization and Economic Growth. *Canadian Journal of Economics, 33*(2), 506-522.

Bougheas, S., Demetriades, P. O., & Morgenroth, W. L. (1999). Infrastructure, Transport Costs and Trade. *Journal of International Economics, 47*, 169-189.

Bulte, E. H., Damania, R., & Deacon, R. T. (2004). Resource Abundance, Poverty and Development. *Working Papers 04-03, Agricultural and Development Economics Division of the Food and Agriculture Organization of the United Nations (FAO - ESA)*.

Burkett, J. P., Humblet, C., & Putterman, L. (1999). Preindustrial and Postwar Economic Development: Is There a Link? *Economic Development and Cultural Change, 47*(3), 471-495.

Calderson, C., & Serven, L. (2005). The Effects of Infrastructure Development on Growth and Income Distribution. *Unpublished mimeo*.

Cihak, M., Demirguc-Kunt, A., Feyen, E., & Levine, R. (2012). Benchmarking Financial Systems Around the World. *Policy Research Working Paper Series 6175, The World Bank*.

Collier, P., & Hoeffler, A. (1998). On Economic Causes of Civil War. *Oxford Economic Papers, 50*(4), 563–573.

Collier, P., & Hoeffler, A. (2002). AID, Policy and Peace: Reducing the Risks of Civil Conflict. *Defence and Peace Economics, 13*(6), 435-450.

Conley, T. G., Hansen, C. B., & Rossi, P. E. (2012). Plausibly Exogenous. *Review of Economics and Statistics, 94*(1), 260-272.

Cook, D. (2002). Education and Growth: Instrumental Variable Estimates. *Unpublished Mimeo, Department of Economics, Hong Kong University of Science and Technology*.

Demirguc-Kunt, A., & Maksimovic, V. (1999). Institutions, Financial Markets, and Firm Debt Maturity. *Journal of Financial Economics, 54*(3), 295-336.

Dennis, J. S., Beach, H. P., & Fahs, C. H. (1911). *World Atlas of Christian Missions.* New York: Student Volunteer Movement for Foreign Missions.

Devarajan, S., Easterly, W. R., & Pack, H. (2003). Low Investment Is Not the Constraint on African Development. *Economic Development and Cultural Change, 51*(3), 547-571.

Djankov, S., La Porta, R., Lopez-De-Silanes, F., & Shleifer, A. (2002). The Regulation of Entry. *Quarterly Journal of Economics, 117*, 1-37.

Durlauf, S. N., Johnson, & Temple. (2005). Growth Econometrics. In P. Aghion, & S. N. Durlauf (Eds.), *Handbook of Economic Growth* (pp. 935-966). Amsterdam: NorthHolland.

Easterly, W. (1993). How Much Do Distortions Affect Growth? *Journal of Monetary Economics, 32*(2), 187-212.

Easterly, W. (2001). The Middle Class Consensus and Economic Development. *Journal of Economic Growth, 6*(4), 317-335.

Easterly, W. (2007). Inequality Does Cause Underdevelopment: Insights from a New Instrument. *Journal of Development Economics, 84*, 755–776.

Easterly, W. (2008). Can the West Save Africa? *NBER Working Papers 14363, National Bureau of Economic Research, Inc*.

Easterly, W., & Levine, R. (1997). Africa's Growth Tragedy: Policies and Ethnic Divisions. *Quarterly Journal of Economics, 112*(4), 1203-1250.

Engerman, S. L., & Sokoloff, K. L. (1997). Factor Endowments, Institutions, and Differential Paths of Growth Among New World Economies: A View from Economic Historians of the United States. In S. Harber (Ed.), *How Latin America Fell Behind* (pp. 260-304). Stanford CA: Stanford University Press.

Engerman, S. L., & Sokoloff, K. L. (2005). The Evolution of Suffrage Institutions in the Americas. *Journal of Economic History, 65*(4), 891–921.

Engerman, S. L., Mariscal, E. V., & Sokoloff, K. L. (2002). The Evolution of Schooling Institutions in the Americas, 1800–1925. *Working Paper, University of California, Los Angeles*.

Esfahani, H. S., & Ramı´rez, M. R. (2003). Institutions, Infrastructure and Economic Growth. *Journal of Development Economics, 70*, 443– 477.

Faye, M., McArthur, J. W., Sachs, J. D., & Snow, T. (2004). The Challenges Facing Landlocked Developing Economies. *Journal of Human Development, 5*(1), 31-68.
Fearon, J. D., & Laitin, D. (2003). Ethnicity, Insurgency, and Civil War. *American Political Science Review, 97*(1), 75-90.
Food and Agriculture Organization. (1993). *Guidelines for Land-Use Planning.* Rome: Food and Agriculture Organization of the United Nations.
Frankel, J., & Romer, D. (1999). Does Trade Cause Growth? *American Economic Review, 89*(3), 379-399.
Frankema, E. (2012). The Origins of Formal Education in Sub-Saharan Africa: Was British Rule More Benign? *European Review of Economic History, 16*(4), 335-355.
Gallego, F. A. (2010). Historical Origins of Schooling: The Role of Democracy and Political Decentralization. *Review of Economics and Statistics, 92*(2), 228-243.
Gallego, F. A., & Woodberry, R. D. (2010). Christian Missionaries and Education in Former African Colonies: How Competition Mattered. *Journal of African Economies, 19*(3), 294-329.
Gallup, J. L., & Sachs, J. D. (2000). The Economic Burden of Malaria. *American Journal of Tropical and Hygiene, 64*(1, 2), 85-96.
Gallup, J. L., & Sachs, J. D. (2001). The Economic Burden of Malaria. *The Supplement to The American Journal of Tropical Medicine and Hygiene, 64*(1&2, January/February).
Gallup, J. L., Sachs, J. D., & Mellinger, A. D. (1998). *Geography and Economic Development. Annual World Bank Conference on Development Economics.* Washington DC: The World Bank.
Gennaioli, N., & Rainer, I. (2007). The Modern Impact of Precolonial Centralization in Africa. *Journal of Economic Growth, 12*(3), 185-234.
GFI. (2008). Illicit Outflows from Africa: Hidden Resource for Development. *Global Financial Integrity (GFI) Report*.
Glaeser, E., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2004). Do Institutions Cause Growth? *Journal of Economic Growth, 9*(3), 271-303.
Glaeser, E., Ponzetto, G., & Shleifer, A. (2007). Why Does Democracy Need Education? *Journal of Economic Growth, 12*(2), 77-99.
GMAC. (2009). Graduate Management Admission Council GMAT Mimeo.
Goldin, C. (1998). America's Graduation from High School: The Evolution and Spread of Secondary Schooling in the Twentieth Century. *Journal of Economic History, 8*, 345-374.
Goldin, C. (1999a). The Shaping of Higher Education: The Formative Years in the United States, 1890 to 1940. *Journal of Economic Perspectives, 13*, 37-62.
Goldin, C. (1999b). Human Capital and Social Capital: The Rise of Secondary Schooling in America, 1910 to 1940. *Journal of Interdisciplinary History, XXIX*, 683-723.
Goldin, C. (2001). The Human-Capital Century and American Leadership: Virtues of the Past. *Journal of Economic History, 61*(2), 263-292.
Gramlich, E. M. (1994). Infrastructure Investment: A Review Essay. *Journal of Economic Literature*.
Grigg, D. B. (1970). *The Harsh Lands: A Study in Agricultural Development.* New York: St. Martin's.
Grogger, J. T., & Eide, E. (1993). Changes in College Skills and the Rise in the College Wage Premium. *Journal of Human Resources, 30*(2), 280-310.
Gutema, P., & Mekonnen, B. (2004). Does Schooling Promote Economic Growth. *African Development Review*, 385-398.
Hanushek, E. (1997). Assessing the Effects of School Resources on Student Performance: An Update. *Educational Evaluationand Policy Analysis, 19*, 141–164.
Hanushek, E. A., & Kim, D. (1995). Schooling, Labor Force Quality, and Economic Growth. *National Bureau of Economic Research Working Paper 5399*.
Hanushek, E. A., & Kimko, D. D. (2000). Schooling, Labor-Force Quality, and the Growth of Nations. *American Economic Review, 90*(5), 1184–1208.
Hanushek, E. A., & Woessmann, L. (2007). The Role of School Skills in Economic Development. *Journal of Economic Literature, 46*(3), 607-668.
Hanushek, E. N., & Woessmann, L. (2009). Do Schools Lead to More Growth? Cognitive Skills, Economic Outcomes and Causation. *NBER Working Paper 14633*.
Hanushek, E. N., & Woessmann, L. (2009). Schooling, Cognitive Skills and the Latin American Growth Puzzle. *NBER Working Paper 15066*.
Hanushek, E., & Woessmann, L. (2007). The Role of School Improvement in Economic Development. *NBER Working Paper 12832*.
Hanushek, E., & Woessmann, L. (2008). The Role of Cognitive Skills in Economic Development. *Journal of Economic Literature, 46*(3), 607-668.
Homer-Dixon, T. F. (1999). *The Environment, Scarcity and Violence.* Princeton: Princeton University Press.

Isham, J., Woolcock, M., Pritchett, L., & Busby, G. (2003). The Varieties of Resource Experience: How Natural Resource Export Structures Affect the Political Economy of Economic Growth. *Middlebury College Working Paper Series 0308, Middlebury College Department of Economics*.

Jones, G., & Schneider, W. J. (2006). Intelligence, Human Capital and Economic Growth. *Journal of Economic Growth, 11*, 71-93.

Jovanovic, B., Lach, S., & Lavy, V. (1992). Growth and Human Capital's Role as an Investment in Cost Reduction. *Mimeo, June*.

Judson, R. (1998). Economic Growth and Investment in Education: How Allocation Matters. *Journal of Economic Growth, 11*, 71-93.

Kamarck, A. M. (1976). *The Tropics and Economic Development.* Baltimore, MD: John Hopkins University Press.

Klapper, L., Luc, L., & Raghuram, R. (2006). Entry Regulation as a Barrier to Entrepreneurship. *Journal of Financial Economics*(82), 591-629.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. (1999). Quality of Government. *Journal of Law, Economics and Organization, 15*(1), 222-279.

Lane, P. R., & Tornell, A. (1996). Power, Growth and the Voracity Effect. *Journal of Economic Growth, 1*(2), 213-241.

Lange, F., & Topel, R. (2006). The Social Value of Education and Human Capital. In E. A. Hanushek, & F. Welch (Eds.), *Handbook of the Economics of Education, Volume 1* (pp. 459–509). Amsterdam and Oxford: Elsevier, North-Holland.

Lau, L. J., Dean, T. J., & Louat, F. F. (1991). Education and Productivity in Developing Countries: An Aggregate Production Function Approach. *Policy Research Working Paper 612. Office of the Vice President, Development Economics, World Bank, Washington D.C*.

Leamer, E. E. (1983). Let's Take the Con Out of Econometrics. *American Economic Review, 73*(1), 31-43.

Lee, D. H. (1957). *Climate and Economic Development in the Tropics.* New York: Harper.

Levine, R. (2005). Finance and Growth: Theory and Evidence, Chapter 12. In P. Aghion, & S. Durlauf (Eds.), *Handbook of Economic Growth, Volume 1* (pp. 865-934). Elsevier.

Levine, R., & Renelt, D. (1992). A Sensitivity Analysis of Cross-Country Growth Regressions. *American Economic Review, 82*(4), 942-963.

Lewis, W. A. (1955). *The Theory of Economic Growth.* Homewood, Illinois: Irwin.

Lopez, R., Thomas, V., & Wang, Y. (2000). Addressing the Education Puzzle: The Distribution of Education and Economic Reforms. *Unpublished Mimeo, University of Maryland, Department of Economics*.

Lorentzen, P., McMillan, J., & Wacziarg, R. (2008). Death and Development. *Journal of Economic Growth, 13*(2), 81-124.

Lucas, R. (1988). On the Mechanics of Economic Development. *Journal of Monetary Economics, 22*, 3–42.

Lynde, C., & Richmond, J. (1993). Public Capital and Long-Run Costs in UK Manufacturing. *Economic Journal, 103*, 880-893.

Lynn, R., & Vanhanen, T. (2002). *IQ and The Wealth of Nations.* Westport, CT: Praeger.

Mauro, P. (1995). Corruption and Growth. *Quarterly Journal of Economics, 110*(3), 681-712.

McArthur, J. W., & Sachs, J. (2001). Institutions and Geography: Comments on Acemoglu, Johnson and Robinson. *NBER Working Paper w8114*.

Mellinger, A. D., Sachs, J. D., & Gallup, J. L. (2000). Climate, Coastal Proximity and Development. In G. L. Clark, M. P. Feldman, & M. S. Gertler (Eds.), *Oxford Handbook of Economic Geography.* New York: Oxford University Press.

Miguel, E., & Kremer, M. (2004). Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities. *Econometrica, 72*, 159-217.

Montalvo, J. G., & Reynal-Querol, M. (2005). Ethnic Diversity and Economic Development. *Journal of Development Economics, 76*, 293-323.

Moreira, M. J. (2003). A Conditional Likelihood Ratio Test for Structural Models. *Econometrica, 71*(4), 1027-1048.

Murdock, G. P. (1967). *Ethnographic Atlas.* Pittsburgh: University of Pittsburgh Press.

Murnane, R. J., Willett, J. B., & Levy, F. (1995). The Growing Importance of Cognitive Skills in Wage Determination. *Review of Economics and Statistics, 77*(2), 251-266.

Murnane, R. J., Willett, J. B., Braatz, M. J., & Duhaldeborde, Y. (2001). Do different Dimensions of Male High School Students' Skills Predict Labor Market Success a Decade Later? Evidence from the NLSY. *Economics of Education Review, 20*(4), 311-320.

Murnane, R. J., Willett, J. B., Duhaldeborde, Y., & Tyler, J. H. (2000). How Important are the Cognitive Skills of Teenagers in Predicting Subsequent Earnings? *Journal of Policy Analysis and Management, 19*(4), 547-568.

Murphy, K. M., Shleifer, A., & Vishny, R. W. (1989). Industrialization and the Big Push. *Journal of Political Economy, 97*(5), 1003-1026.

Murphy, K. M., Shleifer, A., & Vishny, R. W. (1991). The Allocation of Talent: Implications for Growth. *Quarterly Journal of Economics, 106*(2), 503-530.

Neal, D. A., & Johnson, W. R. (1996). The Role of Pre-Market Factors in Black-White Differences. *Journal of Political Economy, 104*(5), 869-895.

Nelson, R., & Phelps, E. (1966). Investment in Humans, Technological Diffusion and Economic Growth. *American Economic Association Papers and Proceedings, 56*, 69–75.

Nogales, A., Archondo-Callao, R., & Bhandari, A. (2002). *Road Cost Knowledge System.* Washington, DC: World Bank.

Nunn, N. (2007). Historical legacies: A Model Linking Africa's Past to its Current Underdevelopment. *Journal of Development Economics, 83*(1), 157-175.

Nunn, N. (2008). The Long-Term Effects of Africa's Slave Trades. *Quarterly Journal of Economics, 123*(1), 139-176.

Nunn, N., & Puga, D. (2012). Ruggedness: The Blessing of Bad Geography in Africa. *Review of Economics and Statistics, 94*(1), 20-36.

Obikili, N. (2012). The Impact of Slave Trade on Literacy in Africa: Evidence from the Colonial Era. *Department of Economics, State University of New York at Binghanton Working Paper*.

Oded, & Moav. (2006). Das Human-Capital: A Theory of the Demise of the Class Structure. *Review of Economic Studies, 73*, 85-117.

O'Neill, J. (1990). The Role of Human Capital in Earnings Differences Between Black and White Men. *Journal of Economic Perspectives, 4*(4), 25-46.

Page, J. (2012). Can Africa Industrialise? *Journal of African Economies, 21*(2), 86-125.

Pritchett, L. (2001). Where Has All the Education Gone? *World Bank Economic Review, 15*(3), 367–391.

Pritchett, L. (2006). Does Learning to Add Up Add Up? The Returns to Schooling in Aggregate Data. In E. A. Hanushek, & F. Welch (Eds.), *Handbook of the Economics of Education, Volume 1* (pp. 635–695). Amsterdam and Oxford: Elsevier, North-Holland.

Psacharopoulos, G. (1994). Returns to Investment in Education: A Global Update. *World Development, 22*(9), 1325–1343.

Psacharopoulos, G., & Patrinos, H. A. (2004). Returns to Investment in Education: A Further Update. *Education Economics, 12*(2), 111–134.

Rajan, R. G., & Zingales, L. (1998). The Governance of the New Enterprise. *CRSP Working Papers 487. Center for Research in Security Prices, Graduate School of Business, University of Chicago*.

Rajan, R. G., & Zingales, L. (2006). The Persistence of Underdevelopment: Institutions, Human Capital, or Constituencies? . *NBER Working Paper 12093*.

Raleigh, C., & Urdal, H. (2007). Climate Change, Environmental Degradation and Armed Conflict. *Political Geography, 26*(6), 674-694.

Ram, R. (1997). Tropics and Economic Development: An Empirical Investigation. *World Development, 25*(9), 1443-1452.

Ram, R. (1999). Tropics, Income and School Life Expectancy: An Inter-Country Study. *Economics of Education Review*, 253-258.

Rancharan, R. (2004). Higher or Basic Education? The Composition of Human Capital and Economic Development. *IMF Staff Papers, 51*(2), 309-326.

Riley, S., DeGloria, S., & Elliot, R. (1999). A Terrain Ruggedness Index that Quantifies Topographic Heterogeneity. *International Journal of Sciences, 5*(1-4), 23-27.

Robertson, R., Skidmore, M., & Toya, H. (2008). A Re-evaluation of the Effect of Human Capital Accumulation on Economic Growth: Using Natural Disasters as an Instrument. *Working Paper 05-08, University of Wisconsin-Whitewater, Department of Economics*.

Rogers, L. M. (2008). Directly Unproductive Schooling: How Country Characteristics Affect the Impact of Schooling on Growth. *Journal of Development Economics, 52*, 356-385.

Romer, P. M. (1990). Endogenous Technological Change. *Journal of Political Economy, 98*, 71–102.

Sachs, J. D. (2000). Tropical Underdevelopment. *Prepared for Economic History Association Annual Meeting, September 2000 and CID Working Paper No. 57, December 2000 Available at http://www.cid.harvard.edu/cidwp/057.htm*.

Sachs, J. D., & Malaney, P. (2002). The Economic and Social Burden of Malaria. *Nature Insight, 415*(6872).

Sachs, J. D., & Warner, A. M. (1995). Natural Resource Abundance and Economic Growth. *NBER Working Paper No. 5398*.

Sachs, J. D., & Warner, A. M. (1999). The Big Push, Natural Resource Booms and Growth. *Journal of Development Economics, 59*, 43–76.

Sachs, J. D., & Warner, A. M. (2001). The Curse of Natural Resources. *European Economic Review, 45*, 827–838.

Schultz, T. P., & Tansel, A. (1997). Wage and Labor Supply Effects of Illness in Cote d'Ivoire and Ghana: Instrumental Variable Estimates for Days Disabled. *Journal of Development Economics, 53*(2), 251-286.

Seebens, H., & Peter, W. (2005). The Impact of Increased School Enrolment on Economic Growth in Tanzania. *African Development Review*, 274-300.

Sokoloff, K. L., & Engerman, S. L. (2000). History Lessons: Institutions, Factor Endowments, and Paths of Development in the New World. *Journal of Economic Perspectives, 14*(3), 217-232.

Sokoloff, K. L., & Zolt, E. M. (2005). Inequality and the Evolution of Institutions of Taxation: Evidence from the Economic History of the Americas. *Paper Presented at NBER Workshop on Political Economy, November*.

Spilimbergo, A. (2009). Democracy and Foreign Education. *American Economic Review, 99*(1), 528-543.

Stock, J. (2010). The Other Transformation in Econometric Practice: Robust Tools for Inference. *Journal of Economic Perspectives, 24*(2), 83-94.

Strulik, H. (2008). Geography, Health and the Pace of Demo-Economic Development. *Journal of Development Economics, 86*, 61-7.

Temple, J. (2001). Growth Effects of Education and Social Capital in the OECD Countries. *OECD Economic Studies*, 57-101.

Torvik, R. (2001). Learning by Doing and the Dutch Disease. *European Economic Review, 45*, 285–306.

Weede, E., & Kampf, S. (2002). The Impact of Intelligence and Institutional Improvements on Economic Growth. *Kyklos, 55*(3), 361-380.

Welsch, R. E., & Kuh, E. (1977). Linear Regression Diagnostics. *Technical Report 923-77, Sloan School of Management, Massachusetts Institute of Technology*.

Whatley, W., & Gillezeau, R. (2011). The Impact of the Transatlantic Slave Trade on Ethnic Stratification in Africa. *American Economic Review, 101*(3), 571-576.

Wilson, K. (2002). The Effects of School Quality on Income. *Economics of Education Review, 21*, 579–588.

Woodberry, R. (2012). The Missionary Roots of Liberal Democracy. *American Political Science Review, 106*(02), 244-274.

World Bank . (2007). *Doing Business Report, 2007*. Washington D. C.: World Bank.

World Bank. (2013). *World Development Indicators, 2013*. Washington DC, US: World Bank.

Zorina, K. B., & Sokoloff, K. L. (2004). Institutions and Technological Innovation During the Early Economic Growth: Evidence from the Great Inventors of the United States, 1790-1930. *NBER Working Papers 10966, National Bureau of Economic Research*.

Appendix 1

Variable Description & Data Sources

Variables	***Variable Description***	***Data Source***
Sch_Quality	aggregate country average for year 1984 to 2006	*GMAT*
Inv/GDP (%)	*Investment as percentage of GDP (1990 to 2005)*	*Penn-World 8.1pwt*
Openness	Openness measured as sum of imports and exports as fraction of GDP (1995 to 2006).	*Penn-World 8.1pwt*
GDP	*Real Gross Domestic Product* (1995 to 2006)	*8.1pwt*
Black-Market	Black market premium	*Rogers (2008)*
Public Consumption	Adding public consumption as a percentage of GDP to our specification	
Ratio 8:10	Ratio of government expenditure on post-secondary and government expenditure on basic education.	*UNESCO*
ratio of sec-pri	The ratio of secondary to primary school enrolment	*UNESCO Judson(2001)*
Ratio of art-to-science	Ratio of students enrollment in science and technology courses to those enrolled in arts and humanities	*UNESCO*
Slavery	*Natural logarithm of Slave Exports (1400-1900)*	*Nunn (2008)*
Precolonial	*Pre-colonial State Capacity. 1 assigned to ethnicities with well-developed state and zero to others. Precolonial state capacity index is constructed by summing up values assigned to ethnicities currently with the present post-colonial states (0-1)*	*Gennaioili& Rainer (2007)*
Colonial Origin (British)	*This is British colonial dummy. 1 is assigned to former British colonies, otherwise zero.*	*Nunn &Puga (2011)*
Colonial Origin (Spanish)	*This is* Spanish *colonial dummy. 1 is assigned to former British colonies, otherwise zero.*	*Nunn &Puga (2011)*
Legal Origin (British)	*This is British legal origin in dummy. 1 is assigned to former British colonies with British legal system, otherwise zero.*	*Nunn &Puga (2011)*
Institution (pol)	*Constraints on Executive that measures the extent to which individual policy maker preference does not determine public policy. It ranges from 0 to 1, higher values implying greater constraint.(data averaged over 1970-2005 period).*	*WitoldHenisz*political constraint index (polcon) dataset
Institution (eco)	This variable assumes values from 0-10 where 0 implies 'no judicial independence', 'no trusted legal framework exists', 'no protection of intellectual property', 'military interference in rule of law', and 'no integrity of the legal system' and 10 means 'high judicial independence', 'trusted legal framework exists', 'protection of intellectual property', 'no military interference in rule of law', and 'integrity of the legal system'. Originally from Fraser Institute http://www.freetheworld.com/datasets_efw.html	*Quality of Government Database Gothenburg University.*
Biz. Cost	*2000-2005 World Bank cost of doing business ranking.*	*World Bank WDI (2013)*
Financial devpt	*1995-2005 Domestic Credit as a fraction of the GDP.*	*World Bank WDI (2013)*
Resource curse(Oil)	*Big oil producer dummy. 1 is allotted to countries producing and exporting oil, otherwise zero.*	*Woodberry (2012) dataset*
Foreign aid	*1995-2005 Foreign aid as percentage of GDP*	*World Bank WDI (2013)*
Major crops	*Ratio of country's land suitability for growing sugarcane relative to wheat as inequality indicator.*	*Easterly(2007) dataset contained in article.*
Ethnic diversity	*The probability that two randomly chosen persons from a given population belong to different ethnic groups.*	*Easterly and Levine (1997)*
Ethnic	*The bimodal distribution of two major ethnic groups.*	*Rey*

polarization		
Foreign edu.	*1970-2000 percentage of the post-secondary students studying abroad*	*Spilimbergo (2009) dataset (AEA Webpage)*
Enrol-t	*1970-2000 tertiary enrolment rates.*	*Spilimbergo (2009) dataset (AEA Webpage)*
Terrain rugggedness	*Terrain ruggedness index which the regularity or otherwise of different terrains.*	*Nunn and Puga (2011)*
Landlock	*Value 1 is assigned to land lock countries, otherwise zero.*	*Woodberry (2012)*
Infra (road)	*Roads, paved (% of total roads) Average 1990 -2006*	*World Bank WDI (2013*
Infra (water)	*Improved water source (% of population with access) Average 1990 -2006*	*World Bank WDI (2013*
Infra (electricity)	*Access to electricity (% of population) Average 2009-2010*	*World Bank WDI (2013)*
aid	*Net official development assistance and official aid received (constant 2011 US$) Average 1984 -2006 as percentage of foreign aid.*	*World Bank WDI (2013)*
Govt con exp	*General government final consumption expenditure (constant 2005 US$) Average 1984 -2006*	*World Bank WDI (2013)*
Manu/GDP	*Manufacturing, value added (% of GDP) Average 1984 - 2006*	*World Bank WDI (2013)*
Current gdp	*Gross Domestic Product at current US$ (Average 1984 -2006)*	*World Bank WDI (2013)*
corruption	*Total illicit outflows as a percentage of total trade monetary volume (Average 1984 - 1989).*	Global Financial Integrity (2008)
Distance to the Equator	*Distance to the equator divided by 90.*	*Acemoglu et al (2001)*
Mean country Temperature	*Average country temperature (1970-2000)*	*Acemoglu et al (2001)*
100 km distance to the coast	*All countries within 100km distance to the coast are assigned 1, otherwise zero.*	*Acemoglu et al (2001)*