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Geography, Institutions, and Compared Development in Africa

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GEOGRAPHY, INSTITUTIONS, AND COMPARED DEVELOPMENT IN AFRICA

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ABSTRACT

Recent years have seen a significant improvement in the economic performance of some African countries. The resulting increased dispersion in income levels across Africa, combined with the pertinence of detecting regional role models renders an intra-African analysis more attractive. In this paper I estimate the respective contribution of institutions, geography, and policies in determining income levels in sub-Saharan Africa. I find that income per capita in this region can be explained to a large extent with a few variables: quality of economic institutions, trade, population density in the 19th century, investment, mineral resources, and a dummy variable for small island nations. Contrary to other regions in the world, some policy variables remain significant after controlling for institutions in Africa. Measures of geography (climate, disease ecology, rainfall) have no direct effect on income levels once institutional quality is controlled for.

1. INTRODUCTION AND HISTORICAL OVERVIEW

The poor economic performance of sub-Saharan Africa (SSA) since the 1970's has received considerable attention in recent literature on economic development. Most growth regressions employed in literature use a near-global sample of countries and impose the same specification for all regions save for the inclusion of regional dummies as level or interaction effects (Paul Collier and Jan Willem Gunning, 1999a). These regional dummies (in this case an Africa dummy) are at times statistically significant and negative: although African slow growth can be explained to some extent with a few variables measuring environment and institutions, the Africa dummy remained often significant. This clearly suggests a hitherto not captured element specific to African countries. Accordingly, scholars examined alternative specifications with the purpose to eliminate the importance of the Africa dummy[1]. However, this debate has not, as yet, reached conclusive results and the factors behind the Africa dummy (usually negative) remain elusive in much of the current research. Collier and Gunning (1999a) provide an alternative explanation: it is possible that the persistence of a significant Africa dummy in the regressions is attributable to inadequate proxies for the main impediments to growth (high risk, inadequate social capital, and inadequate infrastructure), which are particularly severe problems in Africa.

One limitation of this identification strategy consists of considering sub-Saharan Africa as a homogeneous block of countries with under-performing economies. In reality, disparities in income levels within Africa are vast and recent years have seen a significant improvement in the economic performance of the continent[2]. A few African countries have started to grow very fast, while others descended into social and economic chaos. The result is

[1] For example, **Sachs and Warner** (1997) find a significant "tropics" variable thereby causing the Africa dummy to become insignificant.
[2] See table A3.

greater dispersion among countries. For that reason, an intra-African analysis is today more pertinent than it could possibly have been fifteen years ago.
In this paper, I will review previously proposed growth determinants in a sample restricted to African countries that allows for investigating possible heterogeneity in explanatory factors. Idiosyncratic risk, particular to Africa and not replicated in other developing regions, is best identified in a sample restricted to Africa. Additionally, the detection of regional role models might induce significant demonstration effects in the rest of the continent. Within-continent models may be important because the information is both closer to hand and more evidently pertinent (Collier and Gunning, 1999b).

Several recent cross-country analyses of economic growth, although not always specifically targeted at African countries, present conclusions that help explain Africa's poor economic performance. There are essentially two different views for explaining different development outcomes in the long run: geography and institutions. Both groups are here considered in a broad sense. Accordingly, the geography strand includes location, climate, ecology, and even specific precipitation/rainfall variables, while the institutions view is regarded as including explanations coming from literature on such diverse topics as economic and political institutions, policies, relative inequality and even armed conflicts.

Sachs and Warner (1997) refer to the importance of poor economic policies in Africa (particularly the lack of openness to international markets) and add geographical factors such as tropical climate and lack of access to seaports as having also contributed to Africa's slow growth. Sachs (2001) sums up the numerous ways in which physical geography might have contributed to the income gap between tropical and temperate regions. This essay discusses the importance of production technologies in the tropics lagging behind temperate zone technology in the critical areas of agriculture and health, and the

difficulty in mobilizing energy resources in tropical economies. A subsequent paper (Sachs, 2003) shows that geographical and ecological variables (in this case malaria transmission) have a direct effect on income levels even after controlling for institutional quality.

A general decline in rainfall in sub-Saharan Africa in the latter half of the 20th century has also received some attention in the literature. Barrios et al. (2003) explore this avenue empirically in an economic growth framework and find that this decline of rainfall can be imputed with between 13% and 36% of the income gap of Africa relative to other developing countries.

The explanations advanced by the institutions view are necessarily heterogeneous due to broad definition of institutions herein considered.

Mauro (1995) finds that corruption lowers investment, thereby lowering economic growth (an index of ethnolinguistic fractionalization, henceforth ELF, is used as an instrument for corruption). ELF is highly correlated with corruption and other institutional variables and the author assumes that ELF is exogenous to economic variables. A related finding is that corrupt, unstable governments invest less on education: it is possible that education expenditure provides less corruption opportunities (Mauro, 1993).

A different strand of the literature links ELF to poor growth and public goods outcomes. Easterly and Levine (1997) report that ethnic diversity helps explain cross-country differences in public policies, political stability, and other economic indicators. The authors argue that Africa's low growth record is associated with low schooling, political instability, underdeveloped financial systems, distorted foreign exchange markets, high government deficits, and insufficient markets. ELF is suggested to help explain a significant part of Africa's poor performance in these proximate causes for economic growth. More recently, Alesina and La Ferrara (2004) contributed considerably to the flourishing ELF literature. Apart from resolving problems involved with correctly measuring ELF, they find evidence that ELF has more

negative effects at lower levels of income, and less negative effects in democracies. This negative effect is partly channelled through public goods, as social planners tend to choose smaller provision of public goods in the presence of a larger number of ethnic groups.

Elbadawi and Sambanis (2000) argue that ELF is less responsible for Africa's civil wars than previously assumed. They find that political instability in Africa is mostly due to high levels of poverty (reducing the opportunity cost of rebel labour), failed political institutions (ethnic groups might not feel adequately represented at national level), and economic dependence on natural resources (increasing the incentive for loot-seeking). Interestingly, the authors suggest that ELF and natural resource dependence might work as threshold variables: up to a point natural resources add to the incentive for loot-seeking, passing this point provide sufficient resources for the government to set up capable security forces and to buy support. The same reasoning holds for the ELF variable, as it is easier to start and support rebellions in polarized societies (with ELF indices around 0.5) than in highly fragmented societies (with ELF indices closer to 1) where it is certainly easier for the government to divide them[3].

This argument has remarkable implications since polarized societies are much more frequent in the Americas than in Africa. Typically, Latin American societies are polarized into two main ethnic groups: Europeans/Africans in Brazil and the Caribbean, and Europeans/Amerindians in much of remaining Latin America. In comparison, African societies tend to be much more fragmented into numerous "tribes" with a median ELF index of 0.71 for sub-Saharan Africa.

Barro (1999) and Easterly (2000) discuss the effects of relative income inequality on economic growth. Barro (1999) finds that higher inequality tends to retard growth in poor countries. Among the advanced explanations for this causality, credit-market imperfections (the poor have limited access to

[3] See figure 1.1.

credit) and socio-political unrest (disruptive activities in general cause uncertainty and non-productive efforts such as criminal activities and defensive efforts) seem particularly pertinent for a study on African economic performance. A related line of research is found in Easterly (2000). He finds econometric evidence that supports the Engerman and Sokoloff (1997) thesis that tropical commodity exporters are more unequal than other societies, and concludes that a high share of income for the middle classes and relatively low ethnic polarization distinguishes economic success stories from failures.

Finally, some authors prefer to emphasize institutions as an encompassing framework instead of focusing on more specific institutional factors (e.g. corruption). It is impossible to be exhaustive when referring to research on the link between institutions and economic development, so here I refer two recent papers that add to this subject: Acemoglu et al. (2004) argue that factor endowments may have affected growth outcomes indirectly through institutions, as colonial powers set up different sets of institutions according to local characteristics regarding climate and disease environment. According to their thesis, institutions that encourage economic growth emerge when political institutions allocate power to groups with interests in broad-based property rights enforcement, when they create constraints on power-holders, and when there are relatively few rents to be captured by those who hold the political power.

Levine (2005) also focuses on the importance of secure property rights and presents two different views that help explain why property rights differ greatly among different countries: legal traditions and factor endowments. He concludes that the law view and the endowments hypothesis are not contradictory and that indeed both are statistically significant when used simultaneously.

Perhaps the most comprehensive review of Africa's problems is available in Collier and Gunning (1999b) and Collier and Gunning (1999a). The authors

go over the existing literature and identify four factors as being particularly important: the lack of openness to international trade; a high-risk environment; a low level of social capital; and poor infrastructure.

It is in this framework that the present paper proposes to add to the research on African development. Contrary to popular belief, income differences among African nations are not smaller than in other continents and this provides the starting point for this paper. To my knowledge, this is the first time that econometric analysis is conducted with a sample that is deliberately restricted to sub-Saharan African countries in order to identify the specific degrees of influence that explanatory factors have in this region.

For that purpose, the paper is structured as follows. The next section discusses African economic performance in space and time. Section 3 presents the data and descriptive statistics. The results of my level regression analysis are given in section 4 and section 5 concludes.

2. ECONOMIC PERFORMANCE IN AFRICA

Prior to 1885 the colonization of Africa by European powers had been nearly impossible. In the early 19th century, European presence in the African mainland was restricted to the Capeland (Dutch/British); Bathurst, Freetown, and Accra (British); Senegambia (French); and Angola and Mozambique (Portuguese). With the exception of Capeland, this European presence was confined to coastal bases or narrow coastal strips. The reasons for Africa's immunity to European overseas power projection were primarily geographical (very high European mortality rates owing to tropical diseases) and demographic (the demographic imbalance favouring native populations could not be offset with the military technology of the day). Improved disease control and new military technology (magazine rifles, maxim gun) changed

the power balance dramatically in the latter half of the 19th century and led to the partition of much of Africa in the Congress of Berlin (1884-5).

African agriculture had developed very slowly in the centuries running up to the 19th century. This is mostly due to low-yielding crops and relative absence of mammals suitable for domestication in SSA. As big and domesticated mammals are important for food production and animal traction, their inexistence in SSA resulted in larger reliance on human slavery for transport duties on the continent. Tropical Africa formed a formidable barrier to the propagation of crops and livestock from Europe/Asia into more temperate regions of Southern Africa. Diamond (1997) presents an excellent overview of the geographical factors that impeded faster agricultural productivity growth in pre-20th century Africa. Subsequent European colonization gradually removed some of the constraints that African agriculture had previously faced. This is particularly the case of new livestock and crops, but also the monopolization of violence by the colonial state resulting in widespread pacification across SSA.

Thus, the experience of previous centuries in Africa seems to be of limited relevance for explaining present day differences in economic performance among African nations (Collier and Gunning, 1999b). This situation contrasts with the history of the western hemisphere, where massive demographic shifts from the 16th century onwards shaped the American nations of today and explain to a large extent differential economic performance in the Americas[4].

The earliest available estimates on income levels in sub-Saharan Africa come from Maddison (2003). His estimates for 1950 GDP per capita in Africa show a coefficient of correlation of 0.43 with 2003 data on income levels for the same countries. Therefore, present-day differences economic performance are to a large extent the result of developments in the 20th century, with the first half of the century (colonization) carrying less weight than the latter half

[4] See for example **Engerman and Sokoloff** (1997).

(post-independence) in explaining current economic performance. Dispersion of income levels in African countries has increased markedly since 1950.

The wealthiest countries in Africa in 1950 were southern African (South Africa, Namibia), small island nations (Mauritius, Seychelles), or otherwise oil producing with a relatively small population (Gabon)[5]. This trend persists to the present: in 2003, the countries with highest per capita income levels were situated in Southern Africa (South Africa, Botswana, Namibia, Swaziland), small island states (Mauritius, Seychelles, Cape Verde), or combined significant oil production with low population (Equatorial Guinea, Gabon).

Less obvious are the common denominators for Africa's poorest nations in 1950: Botswana, Lesotho, Guinea, Guinea-Bissau, Burundi, Malawi, and Ethiopia (including Eritrea). No clear trend is visible as these countries differ widely in size, location and colonizing entity. Regarding income levels in 2003, two new and post-colonial explanatory factors for poor economic performance emerge: armed conflicts and poor policies. Among the seven poorest countries, five were particularly affected by wars of different nature: Ethiopia, Guinea-Bissau, Democratic Republic of the Congo (henceforth DR Congo), Burundi, and Sierra Leone. The two remaining countries, Tanzania and Malawi, although generally peaceful, are well known for persistently poor economic policies (poor macroeconomic environment, socialism, etc.[6]).

Individually, Botswana's extraordinary performance in the period 1950-1990 with an average annual increase in GDP per capita of 10% should be highlighted. Unparalleled are the growth rates in Equatorial Guinea over the 1996-2004 period (with an average annual growth rate in GDP per capita of 39.3%). Equatorial Guinea's growth rates are a direct result of coupling significant oil revenues with a relatively small population. Other countries that did particularly well include Swaziland (9.3% per annum) and Guinea-Bissau

[5] See table A3.
[6] See for example **Collier and Gunning** (1999a).

(8.9%) in the period to 1973, and the small island nations of Cape Verde (7.8%) and Mauritius (5.5%) during the 1970's and 1980's. Since 1996 the highest growth rates in sub-Saharan Africa were observed for Equatorial Guinea, Mozambique (6.4% per annum), and Chad (5.7%). The latter recently joined the restricted group of oil producing African countries, while Mozambique is converging to pre-1973 levels of income following two dismal decades characterized by civil war and poor economic policies.

African economic performance was generally much more encouraging up to the early 1970's. Indeed, only four countries registered a decline in income levels during the 1950-1973 period: Niger (-0.4% per annum), Chad (-0.4%), Sudan (-0.2%), and Benin (-0.1%). These countries are situated in, or in the vicinity of, the Sahel region. At first glance, this seems to support the rainfall hypothesis, as the Sahel region was the worst hit by the generalized lack of rainfall in the second half of the 20th century. However, a more careful examination shows that rainfall started to decline only in the 1970's and was more pronounced in the western Sahel region (Mauritania, Senegal, The Gambia) than in these particular countries[7]. All four countries had more precipitation in the period 1950-1970 than in the previous half century, in accordance with the wider African trend of particularly high levels of precipitation in the 1950's and 1960's. Consequently, the relative and absolute economic decline of these four countries preceded the climatic change.

The two decades starting in the mid-1970's witnessed a completely different outlook as economic regress became much more widespread. Income levels fell in 29 out of 47 African countries in our sample. Of all countries, the most dramatic drops were observed for Angola (-2.9% per annum), Mozambique (-2.4%), and former Zaire (-2.2%). As a result, by 1990 the GDP per capita for Angola was about half of its 1973 level. Although African growth rates have recovered in recent years, the economic decline persisted for some African

[7] For data on precipitation levels, see **Barrios et al.** (2003).

countries. The worst hit countries in 1996-2004 are: Guinea-Bissau (-4.8% per annum), Zimbabwe (-3.7%), and DR Congo (-3.3%).

What do these countries have in common? It is manifest that these countries suffered from poor economic policies (almost all), civil war (Angola, Mozambique, DR Congo), and/or persistent political instability with a strong negative impact on economic activity (Guinea-Bissau). Additionally, some of these countries lost most of their European or Asian populations, which until then had contributed considerably to their relative prosperity (Angola, Mozambique, Zimbabwe).

Table A4 offers a different perspective on economic performance in Africa. Panel A presents aggregate data for African sub-regions, whereas panel B clusters the countries in accordance with the nationality of the colonizer. This exercise might be useful as it permits some insight into the "horserace" between natural endowments and legal origin. Several authors conducted research on the relative merits of the law view and the endowments hypothesis for explaining development in the long run[8].

Panel A shows that only two groups of African countries stand out from the crowd: Southern Africa and the small island nations. The latter exhibit higher income levels than the rest of the continent and the gap has been increasing steadily since the 1970's. This group combines countries that successfully invested in service industries (Mauritius, Seychelles, Cape Verde) with oil producing countries (particularly Equatorial Guinea). So far and from this group, only São Tomé and Príncipe and the Comoro islands have failed to follow this path.

Southern Africa had in the period 1950-90 income levels that approximately doubled the African average. The 2003 data, from a different source, shows an even wider income gap. Although South Africa carries much weight in explaining this regional difference, it is by no means the only country in the

[8] For a recent paper on this subject, see **Levine (**2005).

region with a GDP per capita significantly above average African income levels. Indeed, at any moment since 1950 most Southern African countries had income levels above the median African GDP per capita. The 1950 data show that Southern African relative prosperity had been mostly confined to South Africa and Namibia, and to a lesser extent to Angola and Mozambique, yet this region includes several small countries that achieved very high growth rates over sustained periods (Botswana, Swaziland, Lesotho). In fact, by 2003 only landlocked Zambia and Malawi were relatively poor by African standards.

As for the rest of the continent, the narrow range is remarkable, with income levels in 2003 ranging from 1051$ in Eastern Africa to 1258$ in Western Africa. It is worth mentioning that the Sahel Region as a whole is the only one to escape the general trend of declining income levels in the 1973-90 period. This is the more surprising considering that this region was the worst hit by the relative drought of the 1970's and 1980's. In fact, this region was the worst performing in the period 1950-73 characterized by abundant rainfall. Conversely, Eastern Africa has been persistently the poorest part of Africa. One possible explanation here advanced is that this region combines unusually low natural resource endowments with large populations.

It is impossible to dissociate SSA's economic fortunes from those of its most populous country, Nigeria. The broader African trends are replicated and even amplified in Nigeria: fast growth in the period to 1973, economic regression in the 1970's and 1980's, and moderate growth since. As a result, Nigerian GDP per capita fell below the median African income level in 2003. However, it should be noted that the 2003 estimates use a different source, and as such are not directly comparable to the historical statistics as estimates from different origins vary considerably. This note of caution is particularly pertinent in the case of estimates for African countries.

Panel B shows the same countries in the same periods, but now grouped according to the identity of the colonizer. The control group "Other" includes countries that were never colonized (Liberia, Ethiopia, Eritrea), countries that were the single SSA colony of a European power (Equatorial Guinea was a Spanish colony), and countries where the identity of the colonizer is not obvious (South Africa, Somalia, Namibia, Cameroon). This control group, strongly influenced by South Africa's economy, is by far the most prosperous. The gap in income levels is clearly evident with the 2003 data, although the historical data exhibits a much more mitigated disparity, particularly before 1990.

Remarkable is the similarity between English and French speaking countries. Throughout all the second half of the 20th century, the difference in GDP per capita between these two groups of countries never reached 10%. By 2003, both groups of countries diverged by less than 1% in their income levels.

The Portuguese speaking countries exhibit relatively high levels of income since 1950. The exception is the period 1973-90 when civil war, poor policies, and the exodus of European populations caused strong economic contraction in Angola and Mozambique. This result does not necessarily mean that Portuguese colonial authorities were more competent than others at promoting economic growth. Rather, it is likely the result of the bulk of Portuguese colonization in Africa being situated in economically more viable Southern Africa (94% of Portuguese speaking African populations are concentrated in Angola and Mozambique).

Former Belgian colonies are persistently poorer than other African countries. However, with only three countries in this group it is difficult to reach substantive conclusions and the relatively benign economic outlook of present-day Rwanda confirms that having been colonized by Belgium was not necessarily a curse.

This survey suggests that there is little evidence that the entity of the colonizer, or for that matter the origin of the legal system, significantly

impacts the economic performance of African nations. On the other hand, it is possible that others forces (geographical factors, location, disease ecology) mask the role played by colonial administrations. Consequently, the entity of the colonizer will be included as control variables in section four.

On the whole, the picture that emerges is that in the period to 1950 location was important. Only small islands and coastal Southern Africa exhibit systematically higher income levels. Landlocked Southern African countries (Malawi, Zambia) were comparatively poorer. In the second half of the 20th century peace (or the lack thereof) and policies became increasingly important, as these could not be assured any longer by the colonial state.

3. THE DATA AND DESCRIPTIVE STATISTICS

Appendix A contains the data on the variables used in this paper. Table A1 presents the complete list of variables used, together with their respective definitions and sources, while the descriptive statistics for the same variables can be seen in table A2.

Tables A3 to A7 present new data specifically constructed for this paper. Tables A3 and A4, already discussed in the previous section, present data on GDP per head for countries presented individually or grouped according to geographical or historical attributes. Although it is normal that GDP estimates from different sources vary, nowhere are the discrepancies more felt than in SSA. This is particularly notorious for Guinea and Congo, to name just two examples. Most alternative GDP data (IMF, 2001 data from Maddison (2003), 2000 data from the World Penn Tables) show that Congo has relatively high levels of income for African standards. On the contrary, the IMF and Maddison (2003) coincide in considering Guinea relatively poor whilst the Human Development Report 2005 and the World Penn Tables advance

estimates that are well above the African median country. These discrepancies point to considerable error in the variable for GDP estimates.

Table A5 presents data on rainfall levels from Barrios et al. (2003). This time series data on the average annual rainfall for 289 states, islands, and territories is taken from (IPCC Intergovernmental Panel on Climate Change, 2001). Shown is the variation in precipitation in the decades since 1950, with all precipitation levels being compared to average rainfall levels in the period 1900-1949. The data is obtained by calculating the variation for individual countries and subsequently computing the regional averages. The relatively "wet" decades of 1950 to 1970 are clearly visible in the first two columns. The climatic outlook altered significantly in the 1970's for the Sahel Region and Western Africa. These two regions suffered from considerably lower levels of rainfall in most of the 1970-1998 period. This general decline of rainfall is more recent in Southern Africa and simply inexistent in Central and Eastern Africa. The regression analysis uses the estimates obtained for the 1970-1998 period, visible in the last column.

Considering the importance of armed conflicts for explaining Africa's poor economic performance, an updated variable that measures these conflicts is clearly needed. Unfortunately, even the recent literature presents data on length and intensity of conflicts that refers to the late 1990's at best. For example, Murdoch and Sandler (2002) present time varying (quinquennial) data on the number of years of civil wars for the 1955-1990 period. This data is not appropriate for level regressions that have GDP per capita in 2003 as the response variable. Accordingly, table A6 presents a new effort at measuring the number of years of armed conflicts between 1990 and 2003. Low-intensity conflicts, or regionally limited conflicts, without significant nationwide economic impact were not included (Ghana, Kenya, Mali, Namibia, and Nigeria). The first column presents the countries considered in Collier and Gunning (1999a) to have had civil wars in the 1990's (prior to 1998). The

second column presents estimates based on information from Kinder and Hilgemann (2003), while the third column presents estimates based on information from the Peace Pledge Union. Naturally, different authors might characterize the very same conflict using different criteria and thus reach different conclusions. Therefore, when these two sources differ the mean was adopted as estimate for the length of the conflict. According to these new estimates, the countries that are most affected by recent armed conflicts are: Sudan, Angola, Sierra Leone, Niger, and Liberia.

Finally, table A7 presents estimates on the fraction of the population that is European or from European descent. Several authors find that these populations might have impacted economic development (Acemoglu et al., 2001; Vaz Silva, 2005). Additionally, table A4 shows that Southern Africa has substantially higher income levels than other African regions. It is possible that this difference might be partially explained with more significant European settlements in this region. In order to examine this hypothesis, European settlements is included as additional control variable. Following the methodology and reasoning adopted in Vaz Silva (2004), the highest fraction of the population from European descent was adopted as opposed to the fraction on a particular moment in time. This approach seems reasonable since it allows for a more accurate measurement of the impact European settlements had on institutions and economic performance. Even if European populations left the ex-colony, it is likely that their presence had some long-lasting effects in the country.

On the whole, European settlements are far less common in Africa than in the western hemisphere. Only six African countries had at any point in time European minorities that composed at least 5% of the total population: South Africa (22%), Mauritius (17%), Angola (9%), Zimbabwe (7%), Namibia (6%), and São Tomé and Príncipe (5%). These countries are either island

nations or situated in more temperate Southern Africa, and have been relatively prosperous for African standards since 1950.

4. ECONOMETRIC ANALYSIS

4.1 Explaining institutional development in Africa

Before we turn to level regression analysis with income levels as the dependent variable, it is important to explore the determinants of institutional development in Africa. Apart from its intrinsic interest, this scrutiny might be useful insofar as it allows the identification of viable instruments for institutional quality, which can be used in subsequent instrumental variable (IV) regression analysis.

The estimates from this analysis are reported in appendix B. Table B1 shows in panel A the independent variables related to the settlement hypothesis first proposed by Acemoglu et al. (2001). The underlying assumption is that in places where the disease ecology was benign, Europeans established settlement colonies with growth inducing institutions such as secure property rights (e.g. South Africa). Conversely, where the disease environment was less favourable, Europeans would set up an "extractive state" whose institutional framework was primarily designed for the conservation of power in the hands of a small colonial elite. Column (1) uses the original Log European settler mortality variable (henceforth ESM), while the remaining equations test the alternative measures proposed in Vaz Silva (2004).

All variables have coefficients with the expected sign, but the ESM variable is not statistically significant. In addition, the climate variable shown in equation (4), although marginally significant, bears little explanatory power. The best fits are obtained with the land variable in column (2) and with the disease variable in column (3).

Panel B examines the importance of colonial origin or geographic location for institutional development. Column (1) reports the coefficients of the colonial dummies, and it is visible that all are statistically insignificant. Whatever the reasons for better or worse governance across Africa, the entity of the colonizer does not seem to matter. Column (2) adds dummy variables for the two economically more successful regions in Africa. The results suggest that Southern African countries have indeed better institutions and the magnitude of the coefficient (0.48) corresponds to almost one standard deviation in the institutions variable. It is possible to argue that location influenced the institutional development in the colonies. In order to examine this hypothesis, column (3) adds the location dummies as control variables to the original specification in equation (1). As a result, the coefficients for the colonial origin dummies move in the expected direction: the French and the Belgian colonial dummies improve slightly, while the British and the Portuguese colonial dummies fall somewhat. This is certainly due to the fact that Britain and Portugal shared Southern Africa between them, whereas Belgian and French colonies were situated in more tropical (and poorer) parts of Africa. However, all colonial dummies remain statistically insignificant at the same time as the Southern Africa remains significant even after controlling for colonial origin.

Panel A in table B2 examines other explanatory factors that are often referred in literature on institutions and growth. The two measures of ELF included in columns (1) and (2) are not found to be statistically significant determinants of institutional quality. Column (3) shows that the impact of armed conflicts on institutions is large, negative, and significant (-0.07 per year of conflict). Oil exports and mineral exports have different impacts on institutions: the effect of major oil exports on institutional development is large and adverse, but mineral exports do not seem to affect national institutions significantly. Column (4) also shows that landlocked countries do not suffer from

considerably worse governance than their coastal counterparts, once natural resources are controlled for. If being landlocked affects economic performance, as often suggested in literature, its effects must run through different channels of causation (e.g. difficulty of trade).

Finally, panel B in table B2 puts it all together as all variables previously found to be significant determinants of institutional quality are included in the same specification. The land, oil, and war variables remain significant with the anticipated signs and cause the Southern Africa dummy to disappear. The inclusion of the disease variable, as in column (2) adds little to the equation obtained in column (1).

These results seem to confirm the "natural resource curse" since oil exporting African countries have significantly worse institutions. These estimates suggest that vast oil resources alone are responsible for Nigeria's institutions poor ranking (-1.1). Were it not for oil, Nigeria could expect to see its governance improve to African average (approximately to the level of Rwanda –0.64). War also affects economic institutions adversely, the estimated impact being large and negative. The long civil war in Sudan explains this country's poor institutions (-1.25). Excluding the impact of war, Sudan could expect to have institutions more on the level of Ethiopia's (-0.55), recently very popular with western aid donors. Perhaps more surprising is the large and positive coefficient of the land variable. This last result suggests that sparsely populated African countries developed better institutions than densely populated ones. Nevertheless, the next section will show that the land variable has direct effects on income levels even after controlling for institutions. This finding casts some doubts on the direction of causality and the underlying theory.

4.2 Explaining economic development in Africa

The next step is to examine determinants of economic development in SSA. For that purpose, the ordinary least squares regressions in tables C1 and C2 have the following specification:

$$(1) \quad \log y_i = \alpha + \beta_1 Ins_i + \beta_2 Landlock_i + \chi_i' \gamma + \varepsilon_i,$$

where y_i is income per capita in country i in 2003, Ins_i is the measure of institutional development, $Landlock_i$ is the dummy variable for landlocked location, χ_i is a vector of other covariates, and ε_i is a random error term. This design permits the scrutiny of variables that might plausibly be correlated with economic outcomes once institutional quality and geographic location are controlled for. Although geographic location is here proxied by landlocked status, other geography variables will be considered as potential determinants of economic performance. Landlocked location is often found to have a negative impact on economic development through higher transaction costs and this effect is exacerbated in Africa, as this continent has a particularly high proportion of landlocked countries. Adam Smith noted this negative effect on commerce and communication as early as 1776.

Panel A in table C1 presents additional geography- and demography-related controls. Column (2) shows that the land variable remains significant and positive after controlling for institutions. While this result eliminates one possible instrument for institutional quality in subsequent IV regressions, it also opens new questions as it not entirely clear why more land available per inhabitant in 1850 should have a direct impact on economic performance today. One possible explanation is that this variable, being positively correlated to present-day population densities, is capturing the effect of overall population size or population density on income levels. Column (3) reports that population size is indeed negatively correlated to income levels in

SSA and its coefficient is significant at the 5% level. Population density, reported in equation (4) is not statistically significant. These results reflect the fact that African GDP are to a large extent determined by the extraction of natural resources. Increased population merely depresses the overhead wealth created by these activities without the creation of "endogenous" growth. Additionally, it might be easier to measure correctly an increased population than to measure the new economic activities created by these larger populations as these are in Africa often employed outside the formal economy (e.g. subsistence farming). The statistical effect is to increase the denominator in the GDP per capita calculus without the corresponding increase in the numerator.

Columns (5) to (7) present three other geography-related variables. Although all have the "correct" sign, none of these variables is significant at the 10% level once institutions and landlocked location are controlled for. Several recent papers reach the conclusion that geography has little or no direct effect on income as its role operates predominantly or exclusively through the choice of institutions (Acemoglu et al., 2001; Easterly and Levine, 2002; Rodrik et al., 2002). On the other hand, Sachs (2003) maintains that malaria transmission, itself strongly affected by ecological conditions, has a direct effect on the level of per capita income even after controlling for institutional quality.

Perhaps more surprising is the negligible impact that reduced rainfall in Africa had on income levels. However, caution is advised as the methodology used in Barrios et al. (2003) diverges substantially from the methodology used in this paper: they use an economic growth framework versus level regression analysis here, a different set of control variables, and different data sources for GDP per capita. It is important to note that the equations in *Dry Times in Africa* do not include institutions as control variable and that the data for income levels comes from the World Penn Tables (6.1) instead of Maddison

(2003). The differences in estimates for GDP per capita are very pronounced for some African countries.

Panel B shows the same basic specification with new covariates. According to equation (1), European settlements had a significant and positive direct impact on income. Nevertheless, it is important to examine this hypothesis with additional controls, as Europeans settled in the most temperate parts of the African continent and the direction of causality cannot be established with this equation alone. Column (2) reports the coefficients of the colonial entity dummies. Although the institutions variable remains significant, the colonial dummies are statistically insignificant suggesting that the origin of the colonizer does not have a direct impact on levels of income (through infrastructure for example). The results in table B1 had already shown that the origin of the colonizer is not strongly related to institutional quality in African countries.

Table C2 replicates the model specification seen in table C1 with new regressors. The first two columns show that oil and mineral exporting are both statistically significant at the 5% level and have the predicted (positive) sign. Conversely, columns (3) and (4) demonstrate that ELF does not have a linear relationship with income once institutions are controlled for (regardless of which measure of ELF we use). Column (5) adds regional dummies for the two regions that exhibit the best economic performance in Africa. Both coefficients are statistically and quantitatively relevant. This last result suggests that the relative prosperity of these regions cannot be explained uniquely with better institutions, but that other forces might be at play. Remarkable is equation (6): the coefficient on war is negative and large (4 log points or 4% per year of armed conflict) but is not significant at the 10% significance level after taking the effects of institutions and landlocked location into account. It is possible that the usually devastating effect of armed conflicts on economic activity is here incorrectly measured (error in the

variable) or that the institutions variable already incorporates the effects of armed conflicts. Interestingly, the inclusion of the war variable in this equation causes the institutions variable to be not significant at the 10% level. On the plus side, this result allows us to explore the war variable as instrument for institutions in subsequent IV regressions, as this variable is statistically related to institutional quality and does not seem to be related to income otherwise than through its effect on institutions.

Finally, panel B in table C2 adds the policy variables trade (as a percentage of GDP), investments (idem), schooling, and log illiteracy rates. All of them are significant at the 5% or 1% significance levels and have the anticipated signs.

Table C3 brings all this together in more inclusive ordinary least squares regressions. The identification strategy here proposed is to include a large number of regressors and to test successively for the exclusion of not relevant determinants. For that purpose, we include in the basic specification all controls found to be significant in tables C1 and C2. The exception is the European settlements variable since the coefficient of this variable was not longer significant after controlling for small island or Southern African location (not shown). Both regional dummies remained significant at the 10% or 5% significance level in this regression. Since most Europeans settled in Southern Africa, the Europeans variable was effectively capturing the effect of other forces that cause this part of Africa to have higher incomes. European populations outside of temperate Southern Africa had little or no impact on national levels of income.

Column (1) reports the coefficients in the most inclusive model specification. The independent variables in this equation explain 80% of the variability in income levels across SSA and only institutions, the mineral dummy, and the small island dummy are significant (at the 5% level). Remarkably, the southern Africa dummy has now the "wrong" sign and is insignificant

suggesting that this positive regional effect can be sufficiently explained with the remaining independent variables.

Replacing the land variable with log population (as in the second column) adds nothing to the model. The R-squared drops somewhat and only two determinants remain significant.

Column (3) repeats equation (1) with the exclusion of the Southern Africa dummy. The F-test for excluded variables does not reject the null hypothesis and the overall cost to the model is negligible. Considering the high correlation between schooling and illiteracy rates, it might be irrelevant to include both proxies of human capital in the same specification. Accordingly, equation (4) excludes log illiteracy rates from the model. Again, the F-test does not reject the null hypothesis and the R-squared remains virtually unchanged at 0.79.

Column (5) excludes the oil-exporting dummy with very similar results and column (6) tests the exclusion of the land variable. However, the F-test for this last exclusion easily rejects the null hypothesis and the R-squared now falls more markedly to 0.71. It seems that the land variable, although individually insignificant, carries considerable joint explanatory power within this specification.

Equation (7) tests instead the exclusion of the schooling variable, and in this case the null hypothesis is not rejected while the cost to the R-squared is much more mitigated. Hence, the specification in column (7) will serve as our basic regression in the IV regression analysis.

Table C4 reports the instrumental variable estimates. For ease of comparison the original OLS estimates are shown in column (1). Column (2) presents the estimates obtained with war as instrument for our measure of institutions. The coefficient of institutions increases slightly to 0.73 suggesting that the attenuation bias due to measurement error more than offsets reverse causality and omitted variables biases. The other coefficients of interest are not

significantly affected by instrumenting for institutions. Using log European settler mortality rates as instrument for institutions as in column (3) clearly affects the precision of the estimates. All our explanatory variables have now p-values above 0.1 and the sample size drops to 25 observations. Column (4) basically reproduces equation (2) with the only difference that trade is now instrumented by landlocked status. The coefficient of trade doubles but once again the precision of the estimates is visibly affected.

In table C5, I show the 36 African countries for which no data is missing, along with actual levels of income and their predicted income levels from the regressions. The results are that the restricted OLS regression (with six independent variables) presents very similar estimates to the ones obtained with the unrestricted OLS regression (nine independent variables): the median deviation from observed values (median y-ŷ) increases moderately from 21.4 to 22.8 and the difference for the average deviation is even smaller (34.1 versus 34.0). The benefit of IV regression analysis in this particular case is not obvious, as the estimates do not differ significantly from the OLS estimates. The last column presents estimates for the IV regression with instruments for institutions and trade, even if this regression presents the largest departure to the actual values for GDP per capita. Overall, the best estimates are obtained with OLS or IV with only institutions being treated as endogenous.

The predicted GDP per capita levels are particularly accurate for Sierra Leone, the Central African Republic, Senegal, DR Congo, and Burkina Faso. It is important to note that this group of countries includes three countries that are located in arid or semi-arid areas (Central African Republic, Senegal, Burkina Faso), yet their levels of income are correctly predicted without accounting for reduced rainfall. This provides further evidence for the small importance of precipitation levels for explaining income in Africa. On the other hand, deviations are particularly large for South Africa, Gabon, Guinea, Congo,

Zambia, Madagascar, Tanzania, and Malawi. South Africa and Gabon are atypical countries for Africa: South Africa is singular owing to its heavy reliance on white taxpayers and Gabon combines large oil wealth with a relatively small population (inadequately proxied by the oil dummy). As for Guinea and Congo, the problem seems to lie in the measurement of their GDP per capita. The predicted income for Guinea ranges from 900$ to 1000$ (actual value is 2097$), while the fitted values for Congo (1400-2000) overestimate the observed GDP per capita of 965$.

It is possible that the predicted levels of income are closer to the real levels for these two countries than is suggested by the "real" values of GDP per capita used in the Human Development Report, considering the substantial discrepancies in the measurement of GDP from different sources.

As for the remaining four countries (Zambia, Malawi, Tanzania, and Madagascar), the predicted values systematically overestimate the actual income levels. Here the main culprit seems to be the institutions variable. All four countries are credited with relatively good institutions in the reports of survey institutes and international organizations, although these do not translate into higher growth rates. One possibility is that responses on the quality of governance in these four countries overrate the "true" quality of economic institutions in these countries.

5. CONCLUDING REMARKS

In this paper I argue that differences in income per capita across African countries can be explained to a large extent with a few variables: quality of economic institutions, trade, population density in the 19th century, investment, mineral resources, and a dummy variable for small island nations.

One striking difference to other regions in the world is the significance of policies (trade, investment) for level regressions with income per capita as the

dependent variable. Illiteracy rates and schooling are also statistically and quantitatively significant in some of the regressions.

Rodrik et al. (2002) argue that policies should be viewed as a flow variable, in contrast to institutions, which is a stock variable. Accordingly, institutions are the cumulative outcome of past policy actions and their relative quality already contains all the relevant information about the impact of policies. They conclude that policy variables should be employed in growth regressions and measures of institutional quality should be used in level regressions. This argument works well with worldwide samples but in this paper we saw that some policy variables remain significant in an African sample even after controlling for institutions. History is likely to be responsible for this finding: whereas the societal and economic structure of American nations was largely shaped prior to the 19th century, the economic performance of African regions remained remarkably levelled until the end of the colonization period (coastal Southern Africa is here the exception). Policy actions started to diverge more markedly once colonial administrations withdrew and their outcomes influence present income levels in Africa. It seems likely that in the case of Africa more time is required until measures of institutional quality fully reflect past policy actions.

Equally surprising is the importance of the land availability variable for explaining levels of income in SSA. This variable is statistically related to present population density but bears more explanatory power than the latter. To some extent, this reflects the findings in Acemoglu et al. (2002). Although at present population density and income are negatively correlated in Africa, high population densities around the equator suggest that in the past these regions had higher levels of agricultural productivity. European presence reversed this trend as their crops, livestock, and technology proved more suitable to temperate regions further away from the equator. Part of this causality also flows via institutions, as these low population density regions attracted more European settlers (Acemoglu et al., 2001).

Finally, we see the importance of institutional quality for economic performance in the long run confirmed. The estimated magnitude of the coefficient on the institutions variable (around 0.7) is very similar to the estimated impact of better governance on economic performance found for the western hemisphere using the same measure of institutional quality (Vaz Silva, 2005). This means that, if Nigeria could improve its institutional framework by one standard deviation (to approximately the level of Gabon), then its level of income would rise over time to 1560$ (an increase of more than 50%). The same can be said of Kenya: a one standard deviation improvement in institutional quality (to the level of Senegal or Ghana) could cause its GDP per capita to rise by 50% to 1540$.

In this paper we also identified a new instrument for institutions. Our measure for armed conflicts is negatively related to the quality of economic institutions but does not seem to affect income levels otherwise than through institutions. However, the case for IV regression analysis applied to an African sample is not evident as the coefficient on institutions changes little with instrumentation (from 0.67 to 0.73).

One final word of caution is necessary in this context. It is never easy to estimate correctly levels of economic or institutional development, and the more so for African countries. Estimates vary substantially depending on the source we adopt, and causing the adopted proxies for Africa's growth constraints to be at times deficient. The poor data quality for African countries ultimately bears the risk that the effects of some of Africa's idiosyncratic difficulties are not captured in regression analysis.

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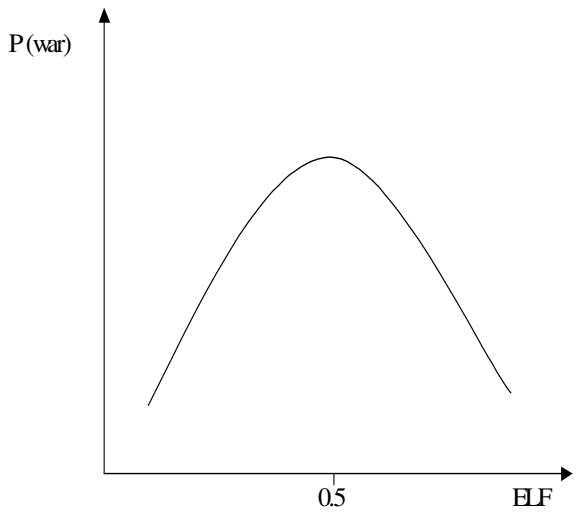
Figure 1.1: ELF and support for rebellions



Notes: $0 \leq P(War) \leq 1$; $0 \leq ELF \leq 1$

Appendix A: Data

Table A1 **Definitions and Sources of Country Level Variables**

Variable	Definition and Source
Log GDP per capita (PPP) in 2003	Natural logarithm of GDP per capita in USD (PPP) in 2003. Source: Human Development Report 2005.
Institutions	Average of four aggregate indicators (Government Effectiveness, Regulatory Quality, Rule of Law, Control of Corruption) over the 1996-2004 period. Source: Aggregate Governance Indicators 1996-2004 (World Bank).
Population of European descent	See table A7 for data construction and sources.
Availabity of land	The data for this variable (LA) is a direct result of the division of total land area considered by FAO to be suitable for agricultural use by the estimated population around 1850. It is essentially a measure of population density with the difference that total land area is corrected for desert areas unsuitable for agriculture. Source: Vaz Silva (2004).
Disease environment	This variable reflects data on incidence rates from the tropical diseases malaria, yellow fever and dengue. For all three diseases shown, the numbers correspond to the fraction of the population living in areas with the respective disease in 1950. Source: Vaz Silva (2004).
Climate	The estimates correspond to the fraction of land area that is situated within a particular type of the Koeppen-Geiger climate zones. In this case, only temperate zones were considered (C,D, and H-type). Source: Vaz Silva (2004).
Log European settler mortality rate	Natural logarithm of the estimates for mortality rates European settlers could face overseas during the 19th century. Source: Acemoglu et al. (2001).
Trade	This variable measures trade as a percentage of the GDP in 2000. Source: World Penn Tables.
Log Adult illiteracy rate in 2003	Natural logarithm of the percentage of the population aged 15 and above that is illiterate. Source: Human Development Report 2005.
Dummy for former French colony	This variable is equal to one if the country is exclusively a former French colony and zero otherwise.
Dummy for former British colony	This variable is equal to one if the country is exclusively a former British colony and zero otherwise.
Dummy for former Portuguese colony	This variable is equal to one if the country is a former Portuguese colony and zero otherwise.
Dummy for former Belgian colony	This variable is equal to one if the country is a former Belgian colony and zero otherwise.
Dummy for oil exporting	This variable is equal to one if the country is a significant oil producer. This is the case of Angola, Cameroon, Chad, Congo, Equatorial Guinea, Gabon, and Nigeria.
Investment	This variable measures investment as a percentage of the GDP in the 1997-2004 period. Source: IMF.
Schooling	This variable shows estimates for the combined gross enrolment ratio for primary, secundary, and tertiary education in 2002/03. Source: Human Development Report 2005.
Dummy for mineral exports	This variable is equal to 1 if the country's mineral exports exceed 1.5% of the GDP. The data refers to 1995 or the closest year with available data. Source: World Bank.
Average Ethnolinguistic fractionalization	AVELF is a composite indicator that results from the average of 5 different measures of ethnic and linguistic fractionalization. Source: Easterly and Levine (1997).
Ethnolinguistic fractionalization in 1960	ELF60 is an index of ethnolinguistic fractionalization in 1960. It measures the probability that two randomly selected people from a given country will not belong to the same ethnolinguistic group. Source: Taylor and Hudson (1972).
Dummy for small island nation	This variable is equal to 1 if the country is a small island nation and zero otherwise.
Dummy for Southern Africa	This variable is equal to 1 if the country is situated in Southern Africa and zero otherwise.
Landlocked	This variable is 1 if the country is landlocked and zero otherwise.
War	See table A6 for data construction and sources.
Rain	This variable shows the variation in average rainfall in 1970-98 relative to average rainfall in the period 1900-49. Source: Barrios et al. (2003).
Log Population	Natural logarithm of the total population. Source: Maddison (2003).
Log Population density	Natural logarithm of the population density.

Appendix A: Data

Table A2 **Descriptive Statistics**

Variable	Observations	Mean	Standard Deviation	Median	Minimum	Maximum
Log GDP per capita (PPP) in 2003	46	7.48	0.89	7.29	6.31	9.89
Institutions	48	-0.62	0.57	-0.58	-2.04	0.73
Population of European descent	48	0.01	0.04	0.00	0.00	0.22
Availability of land	40	0.28	0.57	0.09	0.01	2.77
Disease environment	43	0.77	0.31	0.97	0.00	1.06
Climate	43	0.16	0.29	0.00	0.00	1
European settler mortality rate	27	505.74	650.1	280	15.5	2940
Trade	46	77.52	36.3	64.5	28	165
Adult illiteracy rate in 2003	46	40.28	20.59	35.3	8.1	87.2
Dummy for former French colony	48	0.33	0.48	0	0	1
Dummy for former British colony	48	0.33	0.48	0	0	1
Dummy for former Portuguese colony	48	0.1	0.31	0	0	1
Dummy for former Belgian colony	48	0.06	0.24	0	0	1
Dummy for oil exporting	48	0.15	0.36	0	0	1
Investment	42	20.69	10.41	19.26	7.6	68.31
Schooling	46	50.35	16.37	47.5	21	85
Dummy for mineral exports	48	0.19	0.39	0	0	1
Average Ethnolinguistic fractionalization	47	0.61	0.29	0.73	0	1
Ethnolinguistic fractionalization in 1960	37	0.64	0.25	0.71	0.04	0.9
Dummy for small island nation	48	0.13	0.33	0	0	1
Dummy for Southern Africa	48	0.21	0.41	0	0	1
Landlocked	48	0.33	0.48	0	0	1
War	48	2.79	3.99	0	0	14
Rain	47	-3.88	8.47	-2.7	-24.2	10.2
Population (in thousand)	48	14592.56	22932.25	7917.5	80	133882
Population density	48	73.59	108.49	35.8	2.32	650.54

Appendix A: Data

Table A4 **Income levels in Sub-Saharan Africa**

Panel A	1950			1973			1990			2003		
Set of countries	Population	GDP	GDP per capita	Population	GDP	GDP per capita	Population	GDP	GDP per capita	Population	GDP	GDP per capita
Sahel	17085	10992	643	27021	20656	764	41286	32304	782	60160	72887	1212
Western Africa	48869	38528	788	85362	115200	1350	141925	158991	1120	203223	251523	1258
Central Africa	25703	16449	640	41789	39803	952	67882	56195	828	94237	101990	1082
Eastern Africa	56324	33223	590	98771	76216	772	162919	116508	715	227690	230964	1051
Southern Africa	34084	52090	1528	59279	154065	2599	90433	207144	2291	112072	569933	5085
Small island states	1079	1573	1458	1802	4127	2290	2412	9484	3932	3021	28013	9273
Total Africa	**183144**	**152855**	**835**	**314024**	**410067**	**1306**	**506857**	**580626**	**1146**	**700403**	**1255310**	**1792**
Median			**716**			**1151**			**974**			**1235**

Panel B	1950			1973			1990			2003		
Entity of colonizer	Population	GDP	GDP per capita	Population	GDP	GDP per capita	Population	GDP	GDP per capita	Population	GDP	GDP per capita
Britain	77251	55626	720	140605	157733	1122	238890	240670	1007	333313	442830	1329
France	32377	24895	769	53179	56677	1066	85170	81167	953	123151	162221	1317
Belgium	18371	9916	540	30825	24162	784	50216	29926	596	70531	53321	756
Portugal	11147	11696	1049	17097	30489	1783	22162	22697	1024	30194	48092	1593
Other	43998	50722	1153	72318	141006	1950	110419	206166	1867	143214	548846	4162
Total Africa	**183144**	**152855**	**835**	**314024**	**410067**	**1306**	**506857**	**580626**	**1146**	**700403**	**1255310**	**1792**
Median			**769**			**1122**			**1007**			**1329**

Sources: Human Development Report 2005 for 2003 GDP per capita data.

Maddison (2003) for historical statistics and Population 2003 data.

Population shown is combined population for the region and GDP/GDP per capita shown is aggregate GDP/GDP per capita for the region.

No data is available for Somalia 2003 GDP and Liberia 2003 GDP.

Sahel: Gambia, Mauritania, Senegal, Chad, Burkina Faso, Mali, Niger.

Western Africa: Ghana, Guinea, Togo, Côte d'Ivoire, Benin, Nigeria, Guinea-Bissau, Sierra Leone, Liberia.

Central Africa: Gabon, Cameroon, Rwanda, Central African Republic, Congo, DR Congo, Burundi.

Eastern Africa: Djibouti, Sudan, Uganda, Kenya, Eritrea, Madagascar, Ethiopia, Tanzania, Somalia.

Southern Africa: South Africa, Botswana, Namibia, Swaziland, Lesotho, Zimbabwe, Angola, Mozambique, Zambia, Malawi.

Small island states: Equatorial Guinea, Mauritius, Seychelles, Cape Verde, Comoro Islands, São Tomé and Príncipe.

British colonies: Mauritius, Botswana, Seychelles, Swaziland, Lesotho, Zimbabwe, Nigeria, Sierra Leone, Zambia, Malawi, Ghana, Sudan, Uganda, Kenya, Tanzania, The Gambia.

French colonies: Central African Republic, Guinea, Togo, Côte d'Ivoire, Benin, Gabon, Djibouti, Congo, Comoro Islands, Madagascar, Mauritania, Senegal, Chad, Burkina Faso, Mali, Niger.

Belgian colonies: Rwanda, Democratic Republic Congo, Burundi.

Portuguese colonies: Cape Verde, Guinea-Bissau, São Tomé and Príncipe, Angola, Mozambique.

Other: Equatorial Guinea, South Africa, Somalia, Namibia, Cameroon, Liberia, Ethiopia, Eritrea.

Appendix A: Data

Table A5 Regional variation in rainfall

Set of countries	1950's	1960's	1970's	1980's	1990's	1970-1998
Small island states	4.0%	0.0%	-5.3%	-3.2%	-3.2%	-3.9%
Southern Africa	5.7%	0.1%	10.4%	-3.6%	-6.3%	0.2%
Central Africa	4.5%	7.3%	3.2%	-0.5%	2.5%	1.7%
Western Africa	7.0%	3.9%	-6.3%	-11.5%	-7.9%	-8.6%
Eastern Africa	2.5%	10.4%	0.0%	1.4%	6.2%	2.5%
Sahel	15.5%	3.8%	-15.3%	-20.4%	-14.0%	-16.6%
Total Africa	**6.6%**	**4.2%**	**-2.2%**	**-6.3%**	**-3.8%**	**-4.1%**

Source: Barrios et al. (2003).

Data shown is unweighted average variation in rainfall for constituent countries in the decade(s), and shows decadal average relative to the 1900-1949 average rainfall.

Sahel: Gambia, Mauritania, Senegal, Chad, Burkina Faso, Mali, Niger.

Western Africa: Ghana, Guinea, Togo, Côte d'Ivoire, Benin, Nigeria, Guinea-Bissau, Sierra Leone, Liberia.

Central Africa: Gabon, Cameroon, Rwanda, Central African Republic, Congo, DR Congo, Burundi.

Eastern Africa: Djibouti, Sudan, Uganda, Kenya, Eritrea, Madagascar, Ethiopia, Tanzania, Somalia.

Southern Africa: South Africa, Botswana, Namibia, Swaziland, Lesotho, Zimbabwe, Angola, Mozambique, Zambia, Malawi.

Small island states: Equatorial Guinea, Mauritius, Seychelles, Cape Verde, Comoro Islands, São Tomé and Príncipe.

Appendix A: Data

Table A6 **Wars and armed conflicts 1990-2003**

Country	C&G 99	Atlas	PPU	Adopted	Notes
Angola	x	1975-2002	1975-2002	13	Civil war, power struggle for natural resources
Benin				0	
Botswana				0	
Burkina Faso				0	
Burundi	x	1994	1988-	8	Ethnic conflict
Cameroon				0	
Cape Verde				0	
Central African Republic		1996-97		2	Rebellion
Chad			1990-95	6	Civil war and factional struggles
Comoro Islands				0	
Congo		1997	1993-95, 1997-	6	Ethnic violence and aftermath 1993-95, 1997- ; civil war 1997
Côte d'Ivoire			2002	2	Civil war and aftermath 2002-
Djibouti		1991-94	1991	3	Civil war 1991-94
Equatorial Guinea				0	
Eritrea		1968-91, 1998-99	1998-2002	5	War 1968-91, interstate war 1998-99
Ethiopia		1968-91, 1998-99	1998-2002	5	War 1968-91, interstate war 1998-99
Gabon				0	
Gambia				0	
Ghana			1994	0	Ethnic disputes
Guinea				0	
Guinea Bissau			1998-1999	2	Civil war and aftermath
Kenya			1990-	0	Ethnic violence
Lesotho				0	
Liberia	x	1990-96	1990-96, 2000-	9	Civil war 1990-96, rebel insurgency and cross-border conflicts 2000-
Madagascar				1	Country divided in 2002
Malawi				0	
Mali			1990-95	0	Regional civil war
Mauritania				0	
Mauritius				0	
Mozambique		1976-1992	1981-1992	3	Civil war
Namibia		1999		0	Caprivi strip separatists (1999)
Niger		1992-97	1991-	10	Regional civil war
Nigeria			1997-	0	Recurrent ethnic, religious and political conflicts
Rwanda	x	1992-94	1992, 1994-95	3	Ethnic conflict and aftermath
São Tomé and Príncipe				0	
Senegal		1992-95	1960-2001	8	Separatist conflict
Seychelles				0	
Sierra Leone	x	1991-2001	1991-2001	11	Civil war and aftermath
Somalia	x	1992, 1997	1988-	8	Civil war and factional struggles
South Africa			1983-1994	0	Political violence
Sudan	x	1983-	1984-	14	Civil war
Swaziland				0	
Tanzania				0	
Togo		1990	1991	1	Unrest
Uganda		1995-96	1990-	8	Rebel/Ethnic violence
Dem. Rep. Congo		1998-	1998-	6	Civil war
Zambia				0	
Zimbabwe				0	

Sources: Collier and Gunning (1999a), Kinder and Hilgemann (2003), and Peace Pledge Union.

Note: C&G 99 show countries considered by Collier and Gunning to have had civil war in the 1990's.

When different sources diverge on lenght of conflict, the average was used.

Appendix A: Data

Table A7 **European populations in Africa**

	Fraction of Population of European descent			
Country	AJR data	Other sources	Adopted	Notes
Equatorial Guinea	0.00	0.00	0.00	Less than 1000 Europeans (mostly Spanish) in 2005
Mauritius	0.17	0.02	0.17	AJR estimate for 1975. 2% in 2005
South Africa	0.22	0.1	0.22	AJR estimate for 1900. 10% in 2001
Seychelles			0.00	
Botswana		0.02	0.02	
Gabon	0.00	0.01	0.01	10700 (mostly French) in 2005
Namibia		0.04-0.08	0.06	
Cape Verde		0.01	0.01	
Swaziland		0.03	0.03	
Lesotho		0.00	0.00	Europeans, Asian, and other are 0.3%
Zimbabwe	0.07		0.07	AJR estimate for 1900
Angola	0.08	0.09	0.09	500000 Europeans in 1975. Most left in the same year
Ghana	0.00	0.00	0.00	Europeans are less than 1%
Cameroon	0.00	0.00	0.00	Europeans are less than 1%
Guinea	0.00	0.00	0.00	
Djibouti			0.03	French, Arab, Ethiopian, and Italian are 5%
Sudan	0.00	0.00	0.00	
Gambia	0.00	0.00	0.00	Non-African are 1%
Mauritania	0.00	0.00	0.00	
Comoro Islands		0.00	0.00	
Togo	0.00	0.00	0.00	Europeans and Syrian-Lebanese are less than 1%
Senegal	0.00	0.00	0.00	Europeans and Lebanese are 1%
Côte d'Ivoire	0.00	0.00	0.00	20000 Europeans before 2004
Uganda	0.00	0.00	0.00	Europeans, Asian, and Arab are 1%
Rwanda	0.00	0.00	0.00	
São Tomé and Príncipe		0.05	0.05	4000 (mostly Portuguese) in 1975
Chad	0.00	0.00	0.00	1000 Europeans (mostly French) in 2005
Burkina Faso	0.00	0.00	0.00	
Mozambique	0.03		0.03	150000 Europeans left in 1975
Benin	0.00	0.00	0.00	5500 Europeans in 2005
Central African Republic	0.00	0.00	0.00	
Nigeria	0.00	0.00	0.00	
Kenya	0.01		0.01	AJR estimate for 1900
Mali	0.00	0.00	0.00	
Congo	0.00	0.00	0.00	Europeans are less than 0.3%
Zambia	0.03		0.03	Most settlers left by end of 1960's
Eritrea			0.00	
Niger	0.00	0.00	0.00	1200 Europeans (mostly French) in 2005
Madagascar	0.00		0.00	
Ethiopia	0.00		0.00	
Guinea-Bissau	0.00		0.00	Europeans and Mulatto are less than 1%
Dem. Rep. Congo	0.01		0.01	AJR estimate for 1900
Burundi	0.00		0.00	3000 Europeans in 2005
Tanzania	0.00		0.00	Asian, Europeans, and Arab are 1%
Malawi	0.03		0.03	Most settlers left by end of 1960's
Sierra Leone	0.00		0.00	Small numbers of Europeans in 2005
Liberia	0.00		0.00	
Somalia			0.00	

Note: AJR estimates are for 1975 unless otherwise stated. Other sources relies mostly on CIA World Factbook data for present-day unless otherwise stated.

Appendix B: Institutional development in Africa

Table B1 **Determinants of institutional quality in Africa I**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A	Dependent variable is institutions							
Log European settler mortality	-0.13							
	(0.1)							
Availability of Land		0.49			0.45	0.53		0.44
		(0.06)			(0.06)	(0.05)		(0.08)
Disease environment			-0.78		-0.36		-0.94	-0.4
			(0.22)		(0.26)		(0.37)	(0.31)
Climate				0.41		0.24	-0.26	-0.07
				(0.20)		(0.27)	(0.35)	(0.27)
R-squared	0.09	0.24	0.18	0.04	0.37	0.35	0.19	0.37
Number of observations	27	40	43	43	38	38	43	38
Panel B	Dependent variable is institutions							
Dummy for Belgian colony	-0.44		-0.26					
	(0.49)		(0.46)					
Dummy for British colony	0.33		0.27					
	(0.36)		(0.33)					
Dummy for French colony	0.16		0.31					
	(0.34)		(0.31)					
Dummy for Portuguese colony	0.08		-0.09					
	(0.41)		(0.42)					
Small island state dummy		0.28	0.36					
		(0.31)	(0.37)					
Southern Africa dummy		0.48	0.52					
		(0.22)	(0.26)					
R-squared	0.12	0.12	0.23					
Number of observations	48	48	48					

Note: heteroskedastic-consistent standard errors are in parentheses.

Appendix B: Institutional development in Africa

Table B2 **Determinants of institutional quality in Africa II**

	(1)	(2)	(3)	(4)	(5)
Panel A	Dependent variable is institutions				
Average Ethnolinguistic fractionalization	-0.15				
	(0.3)				
Ethnolinguistic fractionalization in 1960		-0.05			
		(0.52)			
War			-0.07		-0.07
			(0.02)		(0.02)
Dummy for oil exporting				-0.46	-0.38
				(0.18)	(0.2)
Dummy for mineral exports				-0.02	-0.07
				(0.27)	(0.24)
Landlocked				-0.01	0.03
				(0.16)	(0.14)
R-squared	0.01	0.0005	0.27	0.08	0.33
Number of observations	47	37	48	48	48
Panel B	Dependent variable is institutions				
Availability of Land	0.42	0.44			
	(0.07)	(0.07)			
Southern Africa dummy	-0.05	-0.17			
	(0.19)	(0.19)			
Dummy for oil exporting	-0.44	-0.34			
	(0.15)	(0.14)			
War	-0.05	-0.04			
	(0.02)	(0.01)			
Disease environment		-0.35			
		(0.3)			
R-squared	0.49	0.56			
Number of observations	40	38			

Note: heteroskedastic-consistent standard errors are in parentheses.

Appendix C: Explaining economic development

Table C1 **Determinants of GDP per capita in OLS regressions**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A	Dependent variable is Log GDP per capita in 2003						
Institutions	0.72**	0.39	0.59***	0.72**	0.46	0.54	0.76**
	(0.32)	(0.43)	(0.34)	(0.31)	(0.37)	(0.39)	(0.32)
Landlocked	-0.41***	-0.53**	-0.26	-0.42***	-0.34	-0.35	-0.46**
	(0.22)	(0.22)	(0.19)	(0.23)	(0.23)	(0.25)	(0.23)
Availability of Land		0.49**					
		(0.23)					
Log Population			-0.22**				
			(0.1)				
Log Population density				-0.07			
				(0.08)			
Disease environment					-0.37		
					(0.39)		
Climate						0.2	
						(0.5)	
Rain							0.01
							(0.01)
R-squared	0.23	0.3	0.38	0.24	0.16	0.15	0.26
Number of observations	46	39	46	46	41	41	45
Panel B	Dependent variable is Log GDP per capita in 2003						
Institutions	0.59***	0.64***					
	(0.32)	(0.37)					
Landlocked	-0.37	-0.38					
	(0.22)	(0.26)					
Europeans	5.5*						
	(1.43)						
Dummy for Belgian colony		-0.58					
		(0.87)					
Dummy for British colony		-0.41					
		(0.65)					
Dummy for French colony		-0.66					
		(0.67)					
Dummy for Portuguese colony		-0.61					
		(0.74)					
R-squared	0.29	0.29					
Number of observations	46	46					

Note: heteroskedastic-consistent standard errors are in parentheses. Significance at the 1%, 5%, and 10% levels are denoted respectively by "*", "**", and "***".

Appendix C: Explaining economic development

Table C2 **Determinants of GDP per capita in OLS regressions II**

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A	Dependent variable is Log GDP per capita in 2003					
Institutions	0.96*	0.76**	0.69**	0.94*	0.5***	0.6
	(0.25)	(0.31)	(0.33)	(0.24)	(0.25)	(0.4)
Landlocked	-0.28	-0.5**	-0.5**	-0.34	-0.33***	-0.39***
	(0.21)	(0.2)	(0.24)	(0.21)	(0.17)	(0.22)
Dummy for oil exporting	0.89**					
	(0.44)					
Dummy for mineral exports		0.5**				
		(0.22)				
AVELF			-0.48			
			(0.5)			
ELF60				0.38		
				(0.41)		
Small island state dummy					1.27**	
					(0.53)	
Southern Africa dummy					0.68**	
					(0.27)	
War						-0.04
						(0.04)
R-squared	0.34	0.28	0.27	0.47	0.49	0.25
Number of observations	46	46	45	35	46	46
Panel B	Dependent variable is Log GDP per capita in 2003					
Institutions	0.65**	0.54**	0.75*	0.31		
	(0.3)	(0.26)	(0.24)	(0.35)		
Landlocked	-0.1	-0.3***	-0.31	-0.26		
	(0.22)	(0.17)	(0.21)	(0.22)		
Trade	0.01**					
	(0.004)					
Log illiteracy rate		-0.84*				
		(0.2)				
Investment			0.04**			
			(0.02)			
Schooling				0.03*		
				(0.01)		
R-squared	0.4	0.51	0.47	0.43		
Number of observations	46	46	42	46		

Note: heteroskedastic-consistent standard errors are in parentheses. Significance at the 1%, 5%, and 10% levels are denoted respectively by "*", "**", and "***".

Appendix C: Explaining economic development

Table C3 **Determinants of GDP per capita in OLS regressions III**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A	Dependent variable is Log GDP per capita in 2003						
Institutions	0.69**	0.77*	0.68**	0.63**	0.53**	0.6*	0.67*
	(0.27)	(0.24)	(0.26)	(0.25)	(0.21)	(0.2)	(0.24)
Trade	0.003	0.004	0.003	0.004	0.005**	0.007*	0.005**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Availability of land	0.15		0.12	0.18	0.17		0.19
	(0.23)		(0.2)	(0.17)	(0.17)		(0.19)
Log Population		-0.06					
		(0.08)					
Log illiteracy rate	-0.18	-0.17	-0.16				
	(0.31)	(0.28)	(0.28)				
Investment	0.03	0.01	0.03	0.02	0.03**	0.02	0.03**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)
Schooling	0.006	0.007	0.006	0.009	0.01	0.01***	
	(0.009)	(0.009)	(0.009)	(0.007)	(0.008)	(0.007)	
Dummy for oil exporting	0.28	0.49	0.31	0.32			
	(0.32)	(0.32)	(0.32)	(0.32)			
Dummy for mineral exports	0.6**	0.57**	0.56**	0.59**	0.61**	0.64*	0.66**
	(0.25)	(0.23)	(0.26)	(0.27)	(0.28)	(0.22)	(0.29)
Small island state dummy	0.9**	0.52	0.96**	1.07*	0.94**	0.58	1.06*
	(0.44)	(0.38)	(0.42)	(0.37)	(0.37)	(0.35)	(0.33)
Southern Africa dummy	-0.14	-0.03					
	(0.31)	(0.28)					
F-test for excluded variables			0.26	0.36	1.22	16.13	2.91
R-squared	0.8	0.74	0.79	0.79	0.78	0.71	0.76
Number of observations	36	42	36	36	36	42	36

Note: heteroskedastic-consistent standard errors are in parentheses. Significance at the 1%, 5%, and 10% levels are denoted respectively by "*", "**", and "***".

Appendix C: Explaining economic development

Table C4 **Determinants of GDP per capita in IV regressions**

	(1)	(2)	(3)	(4)
Panel A	Dependent variable is Log GDP per capita in 2003			
Institutions	0.67*	0.73**	0.9	0.83***
	(0.24)	(0.37)	(1.41)	(0.43)
Trade	0.005**	0.005*	0.006	0.01**
	(0.002)	(0.002)	(0.004)	(0.006)
Availability of land	0.19	0.15	0.67	0.07
	(0.19)	(0.25)	(1.93)	(0.28)
Investment	0.03**	0.03*	0.004	0.03**
	(0.01)	(0.01)	(0.01)	(0.01)
Dummy for mineral exports	0.66**	0.68**	0.81	0.71**
	(0.29)	(0.28)	(0.53)	(0.3)
Small island state dummy	1.06*	1.01**	0.92	0.68
	(0.33)	(0.43)	(2.05)	(0.54)
Estimation method	OLS	IV	IV	IV
Instruments		War	Log ESM	War
				Landlock
Number of observations	36	36	25	36

Note: heteroskedastic-consistent standard errors are in parentheses. Significance at the 1%, 5%, and 10% levels are denoted respectively by "*", "**", and "***".

Appendix C: Explaining economic development

Table C5 **Predicted values versus actual values**

Country	Actual GDP per capita in 2003	Predicted in inclusive OLS regression	Deviation in %	Predicted in restricted OLS regression	Deviation in %	Predicted in IV regression (2)	Deviation in %	Predicted in IV regression (4)	Deviation in %	Average deviation in %
Equatorial Guinea	19780	13652	-31.0	15157	-23.4	14317	-27.6	12669	-36.0	29.5
Mauritius	11287	12211	8.2	12328	9.2	12505	10.8	15200	34.7	15.7
South Africa	10346	4983	-51.8	4110	-60.3	4306	-58.4	4321	-58.2	57.2
Botswana	8714	10215	17.2	11448	31.4	11409	30.9	9618	10.4	22.5
Gabon	6397	2527	-60.5	1691	-73.6	1681	-73.7	1624	-74.6	70.6
Namibia	6180	4929	-20.2	4860	-21.4	4701	-23.9	5291	-14.4	20.0
Cape Verde	5214	6613	26.8	6324	21.3	6224	19.4	5321	2.1	17.4
Zimbabwe	2443	1588	-35.0	1330	-45.6	1284	-47.4	1257	-48.5	44.1
Angola	2344	1855	-20.9	1966	-16.1	1894	-19.2	2820	20.3	19.1
Ghana	2238	1967	-12.1	2408	7.6	2457	9.8	3558	59.0	22.1
Cameroon	2118	2376	12.2	1803	-14.9	1801	-15.0	1678	-20.8	15.7
Guinea	2097	909	-56.7	1003	-52.2	990	-52.8	927	-55.8	54.4
Gambia	1859	1476	-20.6	1789	-3.8	1803	-3.0	2448	31.7	14.8
Togo	1696	2211	30.4	2479	46.2	2491	46.9	2750	62.1	46.4
Senegal	1648	1311	-20.4	1528	-7.3	1544	-6.3	1617	-1.9	9.0
Côte d'Ivoire	1476	924	-37.4	1021	-30.8	1003	-32.0	1173	-20.5	30.2
Uganda	1457	1463	0.4	1167	-19.9	1173	-19.5	958	-34.2	18.5
Rwanda	1268	990	-21.9	886	-30.1	876	-30.9	687	-45.8	32.2
Chad	1210	1688	39.5	1621	34.0	1601	32.3	1246	3.0	27.2
Burkina Faso	1174	934	-20.4	1194	1.7	1199	2.1	1006	-14.3	9.6
Mozambique	1117	1285	15.0	1493	33.7	1486	33.0	1277	14.3	24.0
Benin	1115	1265	13.5	1296	16.2	1309	17.4	1149	3.0	12.5
Central African Republic	1089	952	-12.6	1115	2.4	1094	0.5	953	-12.5	7.0
Nigeria	1050	1507	43.5	1102	5.0	1067	1.6	1175	11.9	15.5
Kenya	1037	949	-8.5	859	-17.2	839	-19.1	813	-21.6	16.6
Mali	994	1136	14.3	1475	48.4	1476	48.5	1435	44.4	38.9
Congo	965	1808	87.4	1467	52.0	1410	46.1	1996	106.8	73.1
Zambia	877	2411	174.9	2792	218.4	2790	218.1	2773	216.2	206.9
Niger	835	581	-30.4	723	-13.4	704	-15.7	582	-30.3	22.5
Madagascar	809	1316	62.7	1242	53.5	1241	53.4	1205	48.9	54.6
Ethiopia	711	953	34.0	1080	51.9	1069	50.4	915	28.7	41.2
Guinea-Bissau	711	726	2.1	869	22.2	840	18.1	970	36.4	19.7
Dem. Rep. Congo	697	624	-10.5	735	5.5	691	-0.9	549	-21.2	9.5
Tanzania	621	1107	78.3	1068	72.0	1065	71.5	882	42.0	65.9
Malawi	605	1172	93.7	978	61.7	969	60.2	988	63.3	69.7
Sierra Leone	548	550	0.4	569	3.8	547	-0.2	498	-9.1	3.4
Equation		(3) in table C3		(1) in table C4		(2) in table C4		(4) in table C4		
Average	**2909**	**2588**	**34.0**	**2638**	**34.1**	**2607**	**33.8**	**2620**	**37.8**	
Median	**1239**	**1390**	**21.4**	**1399**	**22.8**	**1360**	**25.8**	**1252**	**31.0**	

Sources: Human Development Report 2005 for 2003 GDP per capita data. Not shown are countries for which data is missing.