Does land abundance explain African institutions?

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DOES LAND ABUNDANCE EXPLAIN AFRICAN INSTITUTIONS?

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ABSTRACT. The land abundance view of African history uses factor endowments to explain patterns of land rights and slavery before colonial rule. Population density and institutional outcomes have, however, been jointly shaped by the same geographic forcing variables. In a cross section of global societies, I find that historic land rights, slavery, and population density are each predicted by environmental features such as land quality and terrain ruggedness. I discuss whether these patterns support particular theories of land rights and slavery, and whether there is evidence for institutional persistence in the present.

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1. INTRODUCTION

In contrast to Europe and Asia, Africa was less densely populated at the beginning of the twentieth century (Herbst, 2000, p. 16). By then, slavery was widespread in Africa (Lovejoy, 2000). Land tenure on much of the continent was, and still is, characterized by group rights and overlapping claims (Bruce et al., 1994). The "land abundance" view of African history connects these facts (Austin, 2008a; Hopkins, 1973; Iliffe, 1995). From this perspective, since land was not scarce, it had no price, and rights over it were ill-defined. Because independent farmers could not be persuaded to become hired workers, coerced and household labor substituted for wage employment. In this paper, I use cross-sectional data on a sample of global societies to uncover the geographic forcing variables that have jointly determined historical land rights, slavery, and population density. Though this exercise is ultimately descriptive, it sheds light on whether existing theories of land rights and slavery, including the land abundance view, fit the facts.

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I take data on institutions from the cross-section of global societies included in Murdock's (1967) *Ethnographic Atlas*. Combining maps of these societies with multiple sources of spatial data, I examine whether geographic features can predict the patterns of land rights, slavery, and population density in this sample. To test for the persistent effects of these institutions in the present in Africa and Asia, I aggregate them to the country level using ethnic populations reported in the Soviet *Atlas Narodov Mira* (1964). Within sub-Saharan Africa, I test whether historical institutions predict the ownership of durable goods and levels of education in the present using data from the *Demographic and Health Surveys* (DHS).

I find that that ethnic groups are more likely to possess rights over land if land quality is better, they are observed later, precipitation is lower, malaria is more prevalent, terrain is more rugged, and if they are further from the equator. Slavery is more common in hotter environments, in societies that are observed earlier, where malaria is more prevalent, terrain is more rugged, further from the equator, and in locations with greater access to major rivers. Historical populations have been densest in areas of better land quality, lower precipitation, where societies are observed later, where malaria is most prevalent, where terrain is more rugged, and closer to the equator. Many of these patterns are similar when estimated solely on the sample of sub-Saharan ethnic groups.

Many of these results, however, are not robust to the inclusion of fixed effects for major ethnographic regions, which roughly approximate continents. The correlations of land rights with malaria and distance from the equator survive. The negative relationship between temperature and land rights becomes statistically robust. The correlations between slavery and temperature, date of observation, malaria, ruggedness, and distance from the equator also hold within these broad regions. The associations between population density, land quality, and distance from the equator remain robust within continents. The negative correlations of population density with elevation, distance from the coast, and ecological risk become statistically robust, as does the positive association between population density and access to a major river.

These results are consistent with models of land rights and slavery in which institutions evolve over time alongside population density. Rights exist over land where it is more scarce and more valuable, though there is only mixed evidence that access to trade was a determining factor. Slavery too evolves with time alongside population. Influential theories have used labor scarcity, workers' outside options, and the relative productivity of slaves in certain tasks to explain the institution. The results here do not offer unqualified support for any particular view.

The fraction of a nation's population that practiced slavery in the past negatively predicts GDP per capita across African countries today, but no similar relationship is visible for Asia. In DHS data, women from sub-Saharan ethnic groups that possessed rights over land own more durable goods today. Greater historical slavery predicts lower levels of education in the present, but not within countries.

I contribute to our understanding of historical institutions and to the role of geography in shaping them. Land tenure and slavery matter in the present. Rights over land shape investment incentives (Goldstein and Udry, 2008), labor-supply (Field, 2007), and violence (Andre and Platteau, 1998). Nunn (2008a) shows that those African countries that exported the most slaves are comparatively poor today. These effects are not limited to Africa. Within the Americas, legacies of slavery explain differences in income across countries and U.S. counties (Engerman and Sokoloff, 1997; Nunn, 2008b), as well as long term racial gaps in education and income (Miller, 2011; Sacerdote, 2005).

Other historical "ethnic" institutions also matter today. Pre-colonial states predict economic activity (Michalopoulos and Papaioannou, 2010), provision of public goods (Gennaioli and Rainer, 2007), and governance (Acemoglu et al., 2002a). The existence of polygamy reduces the incentives to invest in capital (Tertilt, 2005). Local institutions such as land rights and polygamy have been resilient to national policies (Bubb, 2009; Fenske, 2012a). As little is known about the origins of institutions that have not been established by Europeans, I add to our knowledge of the evolution of institutions.

Bio-geographic features such as continental orientation (Diamond, 1997), domesticable species (Olsson and Hibbs, 2005), population (Acemoglu et al., 2002b), settler mortality (Acemoglu et al., 2001), ruggedness (Nunn and Puga, 2012) and crop suitability (Engerman and Sokoloff, 1997) predict contemporary institutional differences across countries (Easterly and Levine, 2003). Though the existing literature has focused largely on the effect of geography on institutions created by Europeans, there are exceptions. Michalopoulos et al. (2010) and Michalopoulos (2011) link heterogeneity in land quality to both ethnic fragmentation and the spread of Islam. I continue this line of research by testing the geographic features that predict land rights, slavery, and population density across ethnic groups.

The remainder of this paper proceeds as follows. In Section 2, I describe my sources of data and the econometric specifications that I use. In Section 3, I report my results and discuss their robustness, though detailed robustness checks are confined to the web appendix. I also test whether these institutions predict contemporary income differences. In Section 4, I discuss the theories of land rights and slavery that are consistent with these results, including the "land abundance" view. In Section 5, I conclude.

2. Specifications and data

2.1. **Specifications.** My base sample is a cross section of 1,205 pre-industrial societies from around the world. I investigate the geographic determinants of land rights, slavery, and historic population density by estimating:

(1) $$y_{ij} = x'_{ij}\beta + \delta_j + \epsilon_{ij},$$

where y_{ij} is an outcome of interest for society i in ethnographic region j. In practice, this will be an indicator for the presence of land rights, an indicator for the presence of slavery, or the natural log of historic population density. x_{ij} is a vector of geographical controls that describe the society's historic territory. These controls will include land quality, date of observation, average annual precipitation, temperature, absolute latitude, the share of area in which malaria is prevalent, distance from the coast, elevation, presence of a major river, ruggedness, the share of area that is desert, and the coefficient of variation of rainfall over time. δ_j is a fixed effect for the major ethnographic regions: Africa (the omitted category), the circum-Mediterranean, East Eurasia (which includes the Indian subcontinent), the Insular Pacific, North America, and South America. ϵ_i is random error.

Where the outcome y_{ij} is binary, I estimate (1) using a logit. Where y_{ij} is continuous, I use ordinary least squares (OLS). I correct standard errors for spatial dependence using the method outlined by Conley (1999).[1] I allow spatial dependence up to a distance of ten decimal degrees. For each outcome of interest, I estimate (1) on the full sample with and without the fixed effects δ_j. I also estimate (1) on a "sub-Saharan Africa" sample that includes Ethiopia and the Horn and the Moslem Sudan, regions that my data source codes as Circum-Mediterranean. In the remainder of this section, I discuss my sources of data. Details of all variables and their sources are in the web appendix.

2.2. **Data on institutions.** Data on institutions are taken from Murdock's (1967) *Ethnographic Atlas*. This is a database of 1,267 societies from around the world. It contains categorical variables describing several institutional and cultural features of these societies, usually at the time of first description by Europeans. From this sample, I remove 2 duplicate observations (the Chilcotin and Tokelau), 8 societies observed before 1500 (Ancient Egypt, Aryans, Babylonia, Romans, Icelander, Uzbeg, Khmer, Hebrews), and 52 for which land quality information is missing (mostly small Pacific islands). This leaves a base sample of 1,205 societies. 801 of these have data on land rights, 1,040 on slavery.

I construct binary variables for whether land rights or slavery exist. Summary statistics are given in Table 1. For each society, I observe land rights and slavery at the same point in time. I map slavery in Figure 1. Why use this data? The principal justification is availability. This is the only source of cross-cultural information on land rights and slavery that has global scope. The only other alternative, the *Standard Cross-Cultural Sample* of Murdock and White (1969), is a derivative of the *Ethnographic Atlas*. In addition, the variables were compiled by the same author, and so are internally consistent.

The greatest concern with these data is that they may be anachronistic. They are intended to cover societies at an idealized, timeless and synchronic moment of first European description. In practice, however, many of the observations are constructed from the works of colonial anthropologists. It is clear from Figure 1, however, that most of the observations are intended to be uncontaminated by colonial rule. While colonial

[1] In particular, I use the commands xgmlt and x_ols that are posted on his website.

governments generally abolished slavery sooner or later, what is coded in the data is what anthropologists recorded as a society's "historical" institutions; there is still much slavery in Africa according to the *Ethnographic Atlas*. In so far as the date at which a society is observed is a proxy for colonial effects and the severity of measurement error, I control for it in the econometric analysis. The Atlantic slave trade, by contrast, does pre-date the observations of the African societies in these data. I discuss this possible contamination in Section 3.2.

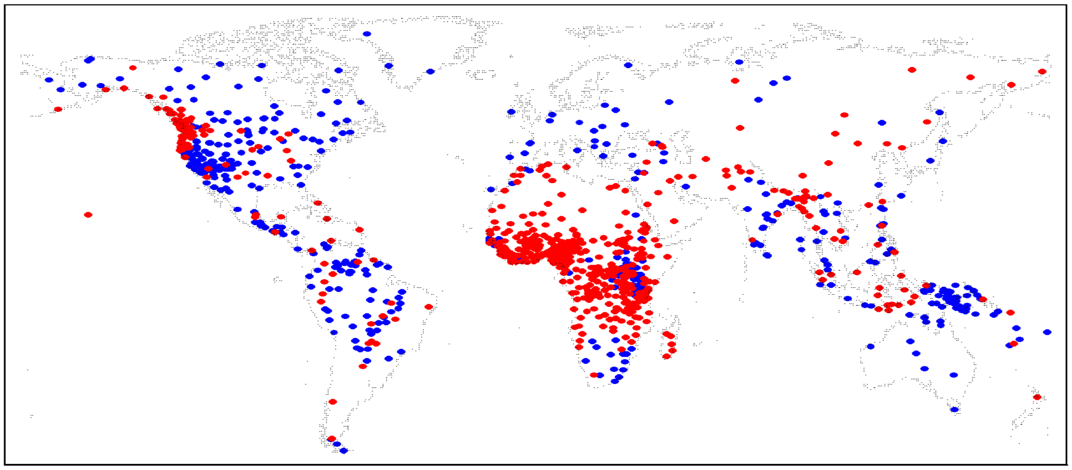
The use of Murdock's (1967) data is not unique to this paper. Baker and Jacobsen (2007b) use descriptive statistics from the *Ethnographic Atlas* to motivate a model of the gender division of labor. Gennaioli and Rainer (2007) have aggregated its data on state centralization to the country level using ethnic population numbers from the *Atlas Narodov Mira* (1964) in order to show that African countries with stronger pre-colonial states provide more public goods today. Bezemer et al. (2009) have performed a similar exercise, showing that the historical prevalence of slavery across African societies predicts lower incomes in the present. I extend these results in the present paper, showing that similar effects are not present in Asia, that historical polygamy also predicts worse outcomes in present-day Africa, and that historical institutions predict durable goods ownership and educational outcomes at the individual level within sub-Saharan Africa.

Work also exists that attempts to explain variables recorded in ethnographic sources. Whatley and Gillezeau (2011) show that coastal regions in Africa hit hardest by the slave trade are more ethnically fragmented in the present, using a map of ethnic groups from Murdock (1959). Whatley (2012) shows that these same regions have more absolutist political structures, as recorded in the *Ethnographic Atlas*. Murdock and White (1969) created the *Standard Cross-Cultural Sample* as a spin-off from the *Ethnographic Atlas*, containing a larger number of variables for a smaller sample of societies. Matthew Baker has used this and other ethnographic sources to validate models of the transition to agriculture (Baker, 2008), hunter-gatherer territoriality (Baker, 2003), land inheritance rules (Baker and Miceli, 2005), and post-marital residence patterns (Baker and Jacobsen, 2007a).

More recent treatments have combined the *Ethnographic Atlas* with spatial data on geographic characteristics. Michalopoulos and Papaioannou (2010), for example, show that economic activity measured using nighttime lights is greater in parts of Africa with more centralized states before colonial rule. Excluding other work of my own (Fenske, 2012b), the only other paper of which I am aware that has used geographic data to predict outcomes recorded in the *Ethnographic Atlas* is Alesina et al. (2011). They use the suitability of an ethnic group's territory for plough-intensive crops to predict the historic gender division of labor in agriculture, which in turn explains female labor force participation rates today.

2.3. **Population density.** In order to construct population density estimates for these societies, I first match these societies to ethnic maps. Next, I join these maps to raster

FIGURE 1. Slavery



Red circles indicate presence of slavery. Blue circles indicate absence.

data on historical population density. I begin with five ethnic maps. First, I join African societies to ethnic groups mapped by Murdock (1959). Second, I merge First Nations groups in the United States and Canada with maps from the *Handbook of North American Indians* (Heizer and Sturtevant, 1978).[2] Third, I join ethnic groups from the rest of the world to Global Mapping International's (GMI) detailed World Language Mapping System. Fourth, if no match can be found in the GMI map, I use the less detailed Geo-Referencing Ethnic Groups (GREG) map of Weidmann et al. (2010). Finally, if no match can be found in any of these, I match groups to modern administrative boundaries. For example, the Nunivak are matched to Nunivak Island.

I use the historical maps first in order to reduce migration-induced errors. The Murdock (1959) and Heizer and Sturtevant (1978) maps show ethnic groups prior to European contact. I am not aware of similar historical maps for Asia or Latin America, necessitating use of the more modern GMI and GREG maps. Of 1,267 societies, 76 are matched to a larger group of which they form a smaller part (such as the Efik to the Ibibio). 100 groups that cannot be found in any map, instead of being matched to a modern administrative boundary, are matched to polygons representing ethnic groups in the same location. For example, the Kara of Ukerewe Island do not appear in any of the ethnic maps. Because the Kerewe people occupy roughly the same territory as the Kara, the Kara are assigned the geographic characteristics of the polygon labeled "Kerewe" in the Murdock (1959) map. A full table of matches and a map of the assembled polygons are given in the web appendix.[3]

[2]These were digitized for the United States by Dippel (2010) and for Canada by myself.

[3]The *Ethnographic Atlas* gives co-ordinates for each society. All but 46 of these societies are within 500 km of the centroid of the polygon to which they are joined. Of these discrepancies, 22 are due to obvious errors in the *Ethnographic Atlas*. For example, the *Ethnographic Atlas* gives the Koreans a coordinate that

All historical population reconstructions are guesses. One book on pre-Columbian America is entitled "Numbers from Nowhere" (Henige, 1998). The principal measure I use for historical population density is from the History Database of the Global Environment (HYDE) version 3.1. This raster data on historical population covers the years 1500, 1600, and every ten years since 1700. For each ethnic group, I measure historical population density as the average of the raster points within its territory for the year of observation recorded in the *Ethnographic Atlas*.[4]

Details of these estimates are reported by Bouwman et al. (2006), Klein Goldewijk et al. (2010) and Klein Goldewijk (2005). This data source takes as its base a map of 3441 administrative units from 222 countries. Historical data are then reconstructed on this base map using Lahmeyer (2004), Helders (2000), Tobler (1995), several local studies, interpolation, and back projection. The data are reported on a five minute grid.

I plot historical population density for my base sample of ethnic groups in Figure 2. I present the percentiles of the HYDE data and the two principal alternatives, described below, in Table 1. These range from nearly zero persons per square mile for several groups in the Mato Grosso and interior Amazon, to over 3,000 persons per square mile for the Okinawans of Japan.[5]

Because historical population reconstruction is unavoidably inexact, it is important to show that the results can be obtained using alternatives to the HYDE estimates.

The alternative sources of historical population data are not in raster format, and are often recorded at a lower resolution than the observations in the *Ethnographic Atlas*. For example, one number may be given for an entire country. I adopt a simple method to estimate spatially disaggregated historic population densities for the societies in my data using these alternative sources. I begin with raster data on population density in 1995 for each of these ethnic groups and combine it with historical estimates for the broader regions within which these groups are located. Specifically, my alternative estimates take the form:

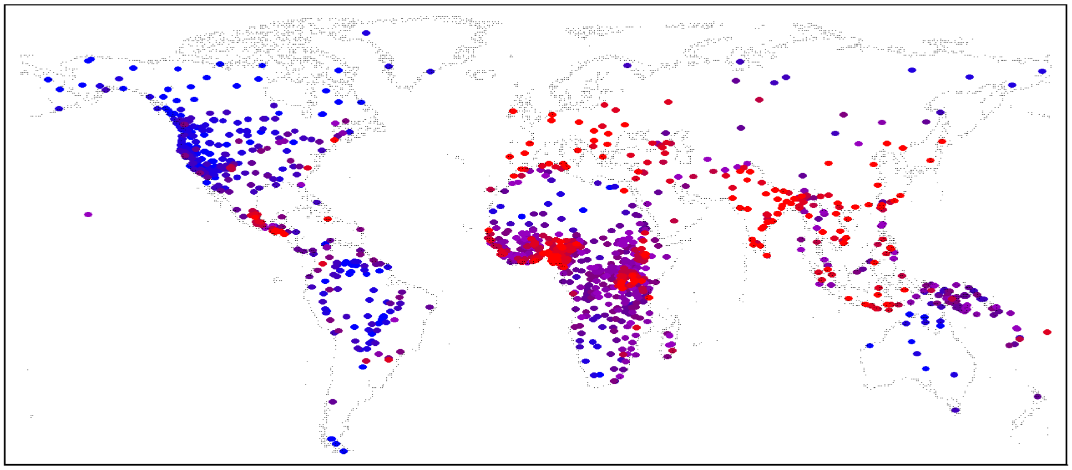
$$\text{Historical population density} = \text{Population density in 1995} \times \frac{\text{Regional density at the date of observation}}{\text{Regional density in 1995}}. \tag{2}$$

is in Tibet. 14 are groups that cover diffuse areas, making it difficult to assign them a meaningful coordinate. These include Russians and the Eastern Cree. 8 are given coordinates in the *Ethnographic Atlas* that differ from their locations in the other maps for no obvious reason. The remaining two are idiosyncratic. The GMI map divides the Botocudos into 3 polygons. Two of are in Minas Gerais, as expected, but one is in Rio Grande do Sul. Second, the polygon that represents the Diegueno in Heizer and Sturtevant (1978) is truncated at the US border.

[4]For computational reasons, I use data from each 50 year interval, imputing intermediate years exponentially.

[5]This is an over-estimate due to over-representation of Naha in the original data; administrate records give a modern density of just above 1,500 persons per square mile. Results are robust to excluding the Okinawans (see the web appendix).

FIGURE 2. Historical population density



Red circles indicate denser population. Blue circles indicate sparser population.

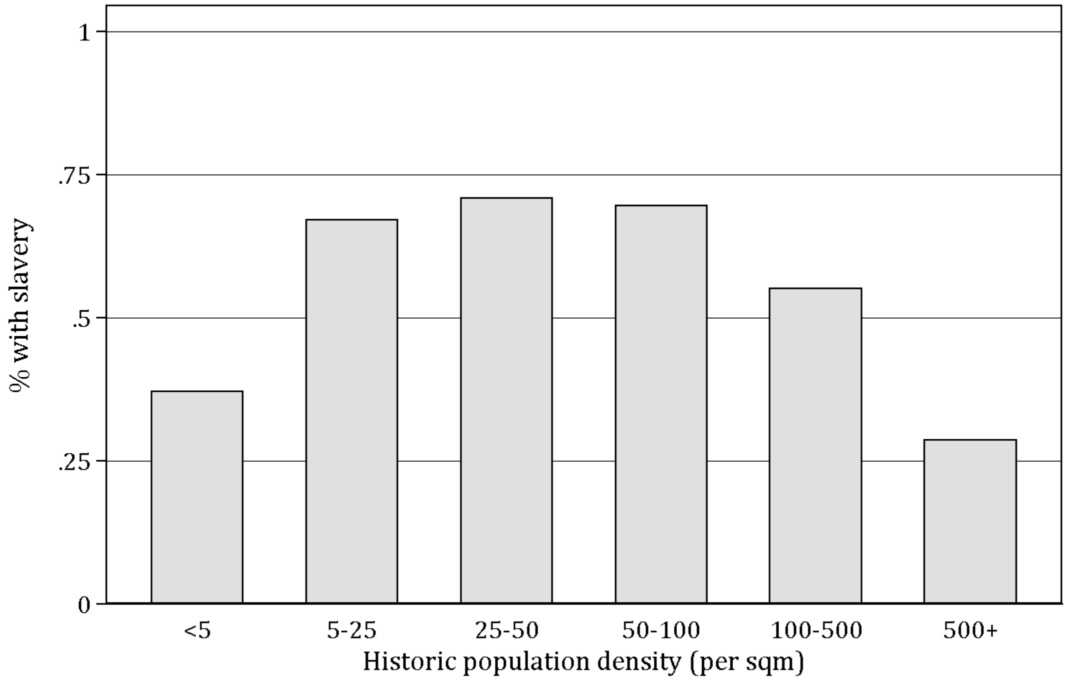
This assumes that the relative distribution of population has not changed within regions over time. If the Tamil were 1.37 times as dense as the entirety of the broad region "India" in 1995, this ratio is pushed back to 1880, the date at which they are observed. GIS data on population in 1995 is from the Food and Agriculture Organization's Global Agro-Ecological Zones project (FAO-GAEZ). I use two sources of regional estimates. The first is McEvedy and Jones (1978). There are well-known problems with these data (Austin, 2008b; Hopkins, 2009), and so I also use the ARVE Group's estimates (Krumhardt, 2010).

While only a first-order approximation, this approach is preferable to using the unweighted regional densities directly. McEvedy and Jones (1978), for example, assign a single population density to all of Canada. To treat the the Inuit and Ojibwe as equally dense would be implausible, and would introduce substantial measurement error.[6] In addition to these two main alternatives, I use the 1995 densities directly.

These data reveal a positive correlation between land rights and historic population density, and an inverse-U relationship between slavery and historic population density (see Figure 3). As I discuss in Section 4, this is consistent with certain models that make arguments similar to the land abundance view. This is not, however, dispositive. Population density and institutions are both shaped by the same geographic forcing variables. As a result, I gather data on several other geographic characteristics of these societies, and test the extent to which historic population and institutions are predicted by features of the natural environment.

[6]Ruff (2006) suggests that the Northeast had a population density at contact roughly seven times that of the Arctic. The method used here assigns the Ojibwe a historic population density of 2.20 per square mile and the Copper Eskimo a population density of 0.31 per square mile – a roughly seven-fold difference.

FIGURE 3. Slavery and historical population density



2.4. **Geographic data.** I join societies from the *Ethnographic Atlas* to several sources of geographic raster data. Sources and definitions for each variable are given in the web appendix. Each of the continuous variables are re-scaled as a standard normal variable for the regressions, so that marginal effects can be interpreted as the effect of a one standard-deviation change in the geographic variable.

The first control is land quality. To measure this, I re-scale Fischer et al.'s (2002) index of climate, soil and terrain slope constrains on rain-fed agriculture. Larger values of the re-scaled variable indicate better land. An advantage of this constraints-based measure is that it is not based on expected yields in contemporary agriculture. Crop diversity is greater today for many of the societies than at the time they are observed in the *Ethnographic Atlas*.[7] I also control for the presence of a major river, distance to the coast, elevation, the percentage of the society's territory in which malaria is endemic, precipitation, ruggedness, temperature, date of observation, absolute latitude, share desert, and the coefficient of variation of annual rainfall. This latter variable is intended as a measure of ecological risk.

2.5. **Modern outcomes.** I use two separate approaches to test whether ethnic institutions predict economic outcomes in the present day. First, I use the populations of the ethnic groups recorded in the *Atlas Narodov Mira* (1964) to aggregate these institutions

[7] I do not adjust this measure to account for the spatial distribution of population, because this approach is very sensitive to measurement error. For example, it gives implausibly high estimates of land quality in the Arctic and Sahara.

to the country level. A table of matches between the ethnic groups in the *Ethnographic Atlas* and the *Atlas Narodov Mira* (1964) is given in the web appendix. I use OLS to estimate:

$$y_i = \beta institution_i + x_i'\gamma + \epsilon_j. \tag{3}$$

Here, y_i is the natural log of PPP GDP per capita in 2005, taken from the World Development Indicators. $institution_i$ is the fraction of the pre-colonial population that possesses the institution of interest (for example, slavery). β is the coefficient of interest. x_i is a vector of controls that are commonly used by papers in the cross-country growth literature. These are: a constant, ethnic fractionalization (calculated directly from the *Atlas Narodov Mira* (1964)), absolute latitude, log land area in 1500, landlocked, island, percentage catholic, percentage muslim, log population density in 1500, colonizer dummies (from Acemoglu et al. (2002b)), and percentage malarial in 1946 (from Gallup and Sachs (2001)).

These data were supplemented for some countries using other sources, detailed in the web appendix. Summary statistics for these data are also contained in the web appendix. I estimate (3) separately for African and Asian countries. The sample includes countries for which presence or absence of the institution is known for at least half the population. Heteroskedasticity-robust standard errors are used. I do not include the Americas, because the large mestizo and overseas European populations in these regions makes it impossible to compute $institution_i$ credibly. *Ethnographic Atlas* coverage of Europe is too thin to allow $institution_i$ to be computed for most European countries.

Second, I compile data on 494,157 women from 34 sub-Saharan countries captured in the Demographic and Health Surveys. I have created this data set for a different project, and the details of these data are reported in Fenske (2012a). Using the ethnic groups reported in these data, I am able to merge these women with historical institutions from the *Ethnographic Atlas*. I use OLS to estimate:

$$y_{ijc} = \beta institution_j + x_{ijc}'\gamma + \delta_c + \epsilon_{ijc}. \tag{4}$$

Here, y_{ijc} is one of two outcomes for woman i, from ethnic group j, in country-round c. First, the DHS use factor analysis to construct a "wealth index" based on ownership of durable goods. Because this is constructed separately for each country-round, I normalize this as a standard normal variable using the mean and standard deviation for each country-round. Second, I use the woman's years of education as an outcome. $institution_{jc}$ is the presence or absence of an historical institution for the woman's ethnic group. β is the coefficient of interest. The vector of controls, x_{ijc} includes age, age squared, urban, and dummies for religion. δ_c is a country-round fixed effect. I cluster standard errors at the level of the woman's ethnic group.

3. RESULTS

In this section, I report my main results. I do not interpret these until later, in Section 4. In Section 3.1, I outline the principal geographic correlates of land rights, slavery, and historic population. In Section 3.2, I outline the robustness checks that are reported in the web appendix. In Section, 3.3, I discuss whether these institutions can predict outcomes in the present-day.

3.1. **Main results.**

3.1.1. *Land rights.* In Table 2, I report my main results concerning land rights. Land quality positively predicts land rights in both the full sample and the sub-Saharan Africa sub-sample. In the baseline, a one standard deviation increase in land quality increases the probability that land rights exist by 5 percentage points. This effect disappears, however, when fixed effects for the major ethnographic regions are included.

Precipitation has a negative and significant correlation with land rights in the baseline, but this is not significant within the sub-Saharan sample nor with major region fixed effects included. Temperature is only significantly negative within major regions. Societies that are observed later are more likely to possess land rights, though this too does not hold within regions or within sub-Saharan Africa. Malaria prevalence predicts land rights in all three specifications, though it is statistically weak within sub-Saharan Africa. Ruggedness positively predicts land rights in the baseline and within sub-Saharan Africa, though it is not statistically robust within major regions. Land rights become less common as one moves away from the equator. I find no effect of distance from the coast, elevation, the coefficient of variation of rainfall, or access to a major river in any specification.

3.1.2. *Slavery.* In Table 3, I report my main results concerning slavery. There is a positive but insignificant relationship between land quality and slavery in the global sample. This is due to the high incidence of slavery in the Pacific Northwest; if a control is added for a society's dependence on fishing, the effect of land quality becomes positive and significant, though not with fixed effects (not reported). Within sub-Saharan Africa the correlation is larger and more significant. A one standard deviation increase in land quality predicts a 5 percentage point increase the probability of slavery within sub-Saharan Africa.

The positive correlations of slavery with temperature and malarial prevalence are robust across specifications and samples. There is a negative correlation between date of observation and slavery that survives the inclusion of major region fixed effects. It is not significant within Africa. Similarly, slavery is more common in rugged areas and further from the equator, even with major-region fixed effects, though these correlations do not hold within Africa. The magnitude of the correlation between access to a major river and slavery is large across specifications (5-8 percentage points), though the standard error is also large and the estimate is not significant at conventional levels. I find no effect of precipitation, share desert, distance from the coast, elevation, or the coefficient of variation of rainfall in any specification.

3.1.3. *Population density.* In Table 4, I report my main results concerning population density. Here, coefficients can be interpreted directly as the impact of a one standard-deviation change in the right-hand-side variable. A one standard deviation increase in land quality is associated here with a large increase in population density; the effect is between 54 and 73% in the whole-world sample, and 15% in the sub-Saharan sample. Precipitation depresses population in the base sample and within Africa, though this is not robust to the inclusion of major-region fixed effects. Societies that are observed later are also more densely settled, though this correlation does not hold within major regions.

Societies further from the coast are more sparsely settled, though this is only statistically robust within major regions, and does not hold within Africa. Across specifications, there is a negative correlation between population density and elevation. In the baseline, population is most dense where malaria is most prevalent, though this is not true within major regions and is of marginal significance within Africa. Rugged societies are more densely settled, though this too is not robust within major regions. Societies further from the equator are more thickly populated. Population density is negatively correlated with the coefficient of variation of rainfall and positively associated with access to a major river, though the robustness of this correlation varies across specifications. There is no significant link between historical population density and temperature.

3.1.4. *Slavery and crop suitability.* In Table 5, I extend the main results concerning slavery. I include the suitability of the ethnic group's territory for rain-fed cultivation of the crop types reported by the FAO-GAEZ: cereals, roots/tubers, pulses, oil crops, sugar, and cotton. The magnitude and significance of the other controls do not change in any meaningful way from Table 3. Roots/tubers and oil crops enter negatively, though roots/tubers is only marginally significant in the global sample. Pulses and sugar enter positively, though these are only statistically significant with major region fixed effects, or in the African sub-sample.

3.2. **Robustness.** Because the institutions reported in the *Ethnographic Atlas* are reported roughly at the time of first European description, it is possible that African slavery in this sample is contaminated by the institutional legacies of the slave trade. I show in the web appendix that the effect of ethnicity-level Atlantic slave exports reported by Nunn and Wantchekon (2011) on indigenous African slavery is insignificant, while there does appear to be a positive correlation between Indian Ocean slave exports and slavery across African ethnic groups. If the slave trade were responsible for establishing slavery in Africa, this would be expected to bias the coefficient on distance from the coast in a negative direction, since African societies closest to the coast were hardest hit by the slave trade. If, however, I include an interaction term between "sub-Saharan Africa" and "distance to coast" Table 3, the main effect does not change, while the interaction is small and insignificant (not reported).

The measures of land rights and slavery are coarse indicators. I test in the web appendix whether alternative measures of these institutions give results consistent with Tables 2 and 3. Similarly, I use three alternative measures of historical population, attempting to re-create the results of Table 4. While many estimates move in and out of significance, most of these are small changes in magnitude. Some exceptions are worth noting. Malaria changes sign when land inheritance by children is used as a dependent variable, and distance from the coast has a much larger marginal effect when patrilineal inheritance of land is used as an outcome. With alternative measures of slavery, date of observation, temperature and malaria become insignificant and quantitatively small. Date of observation is a poor predictor of population density in the present day, and the coefficient of variation of rainfall is not a significant predictor of the alternative historical population measures.

Because land rights and slavery are missing for several observations, I show in the web appendix that the results are similar when estimated on a consistent sample for which both institutions are known. I also show that the main results do not perform well when observations are weighted by their estimated populations. Though this would be expected to correct the influence of the large number of small societies on the results, it instead only adds noise to the analysis, because this procedure multiplies any errors in estimated population densities by errors in estimated area.

Results are also broadly similar with absolute latitude excluded. Excluding high leverage observations also has little effect on the results. I show that controlling for the possible endogeneity of land quality also shows that its effect is not overstated in the baseline specification.

3.3. **Modern outcomes.** In Table 6, I report my estimates of equation (3). These are the country-level correlations between historic institutions and contemporary income. This is extends the results of Bezemer et al. (2009) and Gennaioli and Rainer (2007) to cover Asia, and to include additional institutions (land rights and polygamy) that they do not. Though state centralization and polygyny have not been discussed above, they are institutions that have been given attention by the "land abundance" view of African history and in the broader economic literature, and so they are included here.

Across institutions, the African countries that were most "advanced" before colonial rule are poorest today. Land rights, slavery, and polygamy are all negatively correlated with modern income, though statistical power becomes a problem when controlling for both geographic characteristics and colonizer identity at once. This is not simply the story of greater European settlement laid out by Acemoglu et al. (2002b). Across specifications, it is a similar set of relatively high-income countries that with low prevalence of the institutions that drive this correlation. Namibia, Equitorial Guinea, and Gabon stand out in the land rights regression; excepting Namibia, these countries also had relatively low levels of slavery, as did the relatively prosperous nations of Botswana, South Africa, Mauritius, Swaziland, and Cape Verde. Gabon and Equatorial Guinea stand out as relatively rich countries that lacked pre-colonial states.

The countries that drive the polygamy result are different; here it is mostly North African states (Algeria, Tunisia, Western Sahara) and offshore islands (Mauritius, Cape Verde) where incomes are high and polygamy is relatively uncommon. This result depends on the definition of polygamy used in the regression. In these North African states, polygamy was historically present for most of the population, though it was not the norm. If "any polygyny," rather than "usual polygyny" is used, there is no similar correlation.

The same pattern does not appear for Asia. The negative correlation between land rights and modern income does not survive geographic controls. There is a negative correlation between historical state centralization and modern income, but this is driven entirely by oil-rich gulf states – Qatar, Kuwait, Bahrain, Oman, and Saudi Arabia. Arab societies in the *Ethnographic Atlas* are generally coded as having low levels of state centralization.

In Table 7, I report my estimates of equation (4). These show the correlations between historic institutions and individual outcomes in the sub-Saharan DHS data. Women from ethnic groups that possessed land rights are wealthier today in terms of durable goods ownership. The most conservative specification suggests that land rights are associated with one third of a standard deviation increase in durable goods ownership. No similar results are found for other institutions. Women whose societies practiced slavery before colonial rule receive between 1.3 and 3.0 fewer years of education, though this result is not robust to the inclusion of country-round dummies.[8]

4. FACTS AND THEORIES

The results presented above have been descriptive, uncovering geographic variables that predict land rights, slavery, and historic population density. In this section, I discuss whether these correlations are consistent with influential theories of land rights and slavery.

4.1. **Theories of land rights.** The two most influential theories of land rights are those of Boserup (1965) and Demsetz (1967). Boserup (1965) argues that exogenous population increase is the principal driver of agricultural intensification and more permanent

[8]I have also tested whether these institutions predict whether the respondent is working, and whether her partner has a low status or high status occupation. Slavery, land rights and polygamy positively predict that a woman is working, but this correlation does not survive country fixed effects. Slavery predicts her partner has a low status occupation, though this does not hold within countries. The pattern for high status occupations is the reverse. Land rights and polygamy both negatively predict a low status occupation, but only within countries. There are no significant correlations between land rights, polygamy and high status occupations.

tenure. This is the intuition captured by the "land abundance" view of African history. Austin (2009, p. 33), for example, argues that authorities were were eager to attract more immigrants in order to subdue nature and their neighbors. Thus, strangers could generally acquire land indefinitely for token payments, while citizens were given land virtually for free (Austin, 2008a, p. 591-594). Formalizations of this theory have captured these changes as the selection of certain production technologies in response to the relative scarcity of land and labor (Hayami, 1997; Quisumbing and Otsuka, 2001), or as the profit-maximizing choice of an elite (Lagerlöf, 2009).

Demsetz (1967), by contrast, focuses on trade. He argues that land rights internalize externalities when the gains outweigh the costs. This drives enclosure of the commons in the formal treatments of Hotte et al. (2000) or Copeland and Taylor (2009), and explains the empirical results of Bogart and Richardson (2011). It is similar to the greater effort expended in defending rights over more valuable resources predicted by models of the economics of conflict (e.g. Baker (2003); Grossman and Kim (1995)).

Beyond these two influential theories, there is a literature on the enclosure of common property (e.g. Baland and Francois (2005); Baland and Platteau (2003); Grantham (1980); Lueck (1994); Netting (1976); Ostrom (1991); Runge (1986)). These works identify several benefits of common property that help explain why it survives. These include scale economies, risk pooling, exclusion and effort costs, and equity concerns.

The positive correlation of population density and land rights is congruent with the Boserup (1965) view, though it does not specify the mechanism by which land scarcity leads property rights to emerge. That better land predicts land rights is consistent with both Boserup (1965) and Demsetz (1967), since both models predict that more valuable land will be more strongly defended. The lower prevalence of land rights further from the equator is driven by the Arctic and the deserts of Australia, reinforcing this interpretation.

The positive correlation between land rights and the date of observation is congruent with an evolutionary model similar to that of Lagerlöf (2009). Counter to the Demsetz (1967) view, the two controls that best capture trade in the data – proximity to the coast and access to a major river – do not significantly predict the existence of land rights. Within Africa, coastal distance enters significantly, but with the wrong sign. The lack of a significant correlation with ecological risk and land rights is inconsistent with models suggesting that common property over land is motivated by risk pooling.

4.2. **Theories of slavery.** Several theoretical analyses of slavery and coercion exist (e.g. Barzel (1977); Bergstrom (1971); Canarella and Tomaske (1975); Findlay (1975); Genicot (2002)). Three of the most influential theories stress labor scarcity, the outside options available to workers, and the productivity of forced labor in specific tasks. Nieboer (1900) and Domar (1970) both argue that coercion is cheaper than paying a wage when labor is scarce and wages high. Proponents of the "land abundance" view of African history, such as Austin (2008a, p. 606-610), build on this argument. Lagerlöf (2009) and

Conning (2004) both provide models that formally capture this intuition. In Lagerlöf (2009), very low population densities also discourage slavery, since the opportunity cost of labor used to guard slaves is very high.

Several theories emphasize coerced workers' outside options. North and Thomas (1971), for example, hold that serfs voluntarily exchanged their labor for protection. Several models find that worse outside options for workers increase the degree of coercion in labor contracts (Beber and Blattman, 2012; Chwe, 1990).[9] Similarly, Acemoglu and Wolitzky (2011) find that labor scarcity has two effects, raising coercion through a Domar-type increase in the price of output, but also reducing coercion by improving workers' outside options.

In certain contexts, slavery may be more productive than free labor, which explains its use. For Fenoaltea (1984), this occurs where "pain incentives" are effective and detailed care is unnecessary. Fogel and Engerman (1974) link the productivity of slaves in the American south to economies of scale that could only be achieved through gang labor. Engerman and Sokoloff (1997), similarly, argue that the cultivation of crops with economies of scale is more conducive to slavery. Hanes (1996) explains the concentration of slaves in rural and domestic production by invoking the high turnover costs in these industries.

The inverse-U correlation between slavery and population density is similar to the pattern predicted by the Lagerlöf (2009) model, though this would be predicted by many possible models in which slavery emerges during an intermediate state of development. Similarly, that slavery is less likely among societies observed at later dates is congruent with a model in which slavery disappears at later stages.

The evidence on outside options is mixed. Greater temperatures indicate less hospitable environments, where escape is more difficult. Slavery is more common in these regions. By contrast, ruggedness is expected to improve the outside option of slaves by making it easier for them to flee (Nunn and Puga, 2012). Contrary to this intuition, the correlation between ruggedness and slavery is positive.

The evidence for productivity in specific tasks is also mixed. There appears to be no strong link between slavery and distance from the coast, which would suggest that trade does not matter. Access to a major river performs better, though it is not statistically robust. By contrast, the crop suitability measures in Table 5 do have predictive power. These do not, however, map neatly into any classification according to economies of scale or productivity under gang labor. Caribbean-type sugar plantations are not a feature of the indigenous societies in the data.

In sum, the broad correlations uncovered in Tables 2 and 3 are consistent with the Boserupian view of land rights. There is mixed evidence for the Demsetz view. Slavery is systematically correlated with population density in a manner consistent with some

[9] Naidu and Yuchtman (2012), by contrast, argue that British industrial workers committed to coercive contracts in order to reduce wage variation.

evolutionary models, but the geographic predictors of slavery do not offer unqualified support to any particular theory.

5. Conclusion

Bad institutions are one of the fundamental causes of African poverty, and the institutions that exist on the continent currently have been shaped by those that existed prior to colonial rule. I have addressed a theme in the economics literature – how geography affects institutions – by outlining the geographic features that predict the historical prevalence of land rights, slavery, and dense population.

Though this exercise has been mostly descriptive, these results can be used to make several points relevant to existing theories about land rights, slavery, and African history. Historical population has evolved alongside these institutions in response to underlying geographic characteristics. While institutional outcomes across broad ethnographic regions are predicted by geography, these predictions become more tenuous when looking within specific regions. Within Africa and across the world, there is stronger evidence that land rights are present where land is scarce and productive than there is of any link with trade. Though the results are suggestive of connections between slavery and labor scarcity, workers' outside options, and the relative productivity of slaves in certain tasks, they cannot distinguish any one explanation with dispositive clarity.

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Table 1

Summary statistics and percentiles of population density

	(1) Mean	(2) s.d.	(3) Min	(4) Max	(5) N	Pct.	(6) HYDE Estimate	(7) ARVE Base	(8) MJ Base
						5	0.02	0.05	0.29
Any slavery	0.54	0.50	0	1	1,040	10	0.09	0.17	0.59
Any land rights	0.74	0.44	0	1	801	15	0.26	0.28	1.21
Historic pop density	42.7	141	2.6e-07	3,627	1,205	20	0.51	0.49	1.92
Land quality	1.33	0.90	-4.0e-07	3.98	1,205	25	1.21	0.88	2.58
Date observed	1,905	53.1	1,500	1,965	1,205	30	2.39	1.96	3.79
Precipitation	1,262	855	12.6	6,164	1,205	35	3.70	3.86	5.07
Temperature	7,198	2,776	35.5	10,830	1,205	40	5.78	7.08	6.61
Absolute latitude	20.7	17.0	0.017	78.1	1,205	45	7.64	10.03	8.27
Pct. malarial	0.17	0.20	0	0.69	1,205	50	10.04	14.72	10.10
Dist. to coast	4.26	3.88	0	16.5	1,205	55	12.56	19.39	13.11
Elevation	167	9.60	141	230	1,205	60	15.78	24.39	17.33
Major river	0.28	0.45	0	1	1,205	65	20.14	32.31	22.56
Ruggedness	121,220	132,855	137	977,941	1,205	70	25.97	40.25	29.84
Share desert	0.11	0.26	0	1	1,205	75	35.17	55.00	39.13
Rainfall C.V.	0.21	0.13	0.061	1.73	1,205	80	47.25	76.05	53.36
ln (1+ Atlantic exports/area)	0.16	0.51	0	3.66	532	85	62.98	105.86	71.90
ln (1+ Indian exports/area)	0.037	0.23	0	3.33	532	90	95.85	151.97	115.18
						95	162.79	246.17	197.82

Means by major region

	Any land rights	Any slavery	Historic pop density	N
Africa	0.93	0.83	35.42	414
+ Ethiopia and the Horn + Moslem Sudan	0.93	0.84	35.51	486
+ Sahara + North Africa	0.93	0.84	35.65	526
Circum-Mediterranean	0.92	0.70	64.53	157
East Eurasia	0.83	0.54	154.27	123
Insular Pacific	0.73	0.24	41.74	119
North America	0.29	0.27	5.02	284
South America	0.27	0.27	12.21	109

Notes: Variable definitions are in the web appendix.

Table 2

Geographic correlates of land rights

	(1)			(2)			(3)		
	Full Sample						S.S. Africa		
	coef.	*s.e.*	*mfx*	*coef.*	*s.e.*	*mfx*	*coef.*	*s.e.*	*mfx*
Constant	1.406	0.183		2.049	0.454		1.190	0.524	
Land quality	0.334	0.143	0.048	0.070	0.131	0.010	0.601	0.249	0.024
Precipitation	-0.356	0.154	-0.051	0.097	0.208	0.014	-0.136	0.558	-0.005
Temperature	-0.177	0.266	-0.026	-0.629	0.291	-0.089	0.240	0.337	0.010
Date observed	0.326	0.162	0.047	0.018	0.121	0.003	-0.635	0.379	-0.026
Share desert	0.143	0.148	0.020	0.033	0.240	0.004	-0.330	0.395	-0.013
Dist. to coast	-0.163	0.160	-0.023	-0.103	0.167	-0.014	0.525	0.328	0.021
Elevation	-0.061	0.156	-0.009	-0.142	0.176	-0.020	-0.475	0.298	-0.019
Pct. malarial	1.201	0.227	0.173	0.481	0.248	0.068	0.393	0.267	0.016
Ruggedness	0.376	0.142	0.054	0.246	0.159	0.035	1.090	0.471	0.044
Absolute latitude	-0.716	0.265	-0.103	-1.045	0.353	-0.147	-2.344	0.740	-0.094
Rainfall C.V.	-0.091	0.142	-0.013	-0.178	0.146	-0.025	-0.126	0.337	-0.005
Major river	-0.173	0.243	-0.025	-0.147	0.273	-0.021	-0.236	0.495	-0.010
Circum-Mediterranean				1.321	0.921	0.136			
East Eurasia				0.072	0.728	0.010			
Insular Pacific				-1.404	0.666	-0.270			
North America				-1.939	0.838	-0.369			
South America				-2.987	0.724	-0.627			
Observations		801			801			371	

Notes: Dependent variable is any land rights. All regressions are Conley's logit, with a distance cutoff of 10 decimal degrees. "c*oef.*" is the estimated coefficient. "s.e." is the standard error adjusted for spatial dependence. "mfx" is the marginal effect. This is the effect of a one standard deviation change for continuous variables, and a one unit change for dummy variables.

Table 3

Geographic correlates of slavery

	(1)			(2)			(3)		
	Full Sample						S.S. Africa		
	coef.	*s.e.*	*mfx*	*coef.*	*s.e.*	*mfx*	*coef.*	*s.e.*	*mfx*
Constant	0.323	0.190		0.906	0.398		0.214	0.769	
Land quality	0.132	0.121	0.031	0.081	0.132	0.019	0.685	0.190	0.054
Precipitation	-0.163	0.195	-0.039	0.224	0.195	0.054	0.230	0.484	0.018
Temperature	0.928	0.268	0.221	0.766	0.232	0.184	1.689	0.486	0.132
Date observed	-0.215	0.095	-0.051	-0.350	0.110	-0.084	-0.248	0.340	-0.019
Share desert	0.040	0.168	0.009	0.032	0.147	0.008	0.445	0.381	0.035
Dist. to coast	0.140	0.127	0.033	0.164	0.127	0.039	0.033	0.215	0.003
Elevation	0.110	0.118	0.026	0.007	0.121	0.002	-0.009	0.350	-0.001
Pct. malarial	1.819	0.211	0.434	1.535	0.253	0.369	1.110	0.400	0.087
Ruggedness	0.578	0.118	0.138	0.553	0.129	0.133	0.285	0.374	0.022
Absolute latitude	0.736	0.300	0.175	0.871	0.303	0.209	-0.051	0.845	-0.004
Rainfall C.V.	0.082	0.129	0.020	0.140	0.120	0.034	-0.127	0.433	-0.010
Major river	0.350	0.197	0.082	0.303	0.209	0.072	0.779	0.498	0.053
Circum-Mediterranean				0.333	0.580	0.077			
East Eurasia				-0.530	0.646	-0.130			
Insular Pacific				-1.752	0.834	-0.404			
North America				-1.409	0.673	-0.338			
South America				-0.886	0.569	-0.218			
Observations		1040			1040			416	

Notes: Dependent variable is any slavery. All regressions are Conley's logit, with a distance cutoff of 10 decimal degrees. "*coef.*" is the estimated coefficient. "s.e." is the standard error adjusted for spatial dependence. "mfx" is the marginal effect. This is the effect of a one standard deviation change for continuous variables, and a one unit change for dummy variables.

Table 4

Geographic correlates of historic population density

	Full Sample				S.S. Africa	
	(1)		(2)		(3)	
	coef.	*s.e.*	*coef.*	*s.e.*	*coef.*	*s.e.*
Constant	1.466	0.205	2.144	0.227	1.785	0.218
Land quality	0.727	0.146	0.543	0.109	0.145	0.076
Precipitation	-0.763	0.218	-0.190	0.191	-0.327	0.200
Temperature	0.231	0.364	-0.115	0.255	0.146	0.164
Date observed	0.471	0.139	0.071	0.106	0.914	0.122
Share desert	-0.114	0.212	-0.204	0.159	-0.193	0.085
Dist. to coast	-0.328	0.205	-0.339	0.149	0.020	0.099
Elevation	-0.299	0.164	-0.276	0.135	-0.601	0.122
Pct. malarial	0.574	0.247	-0.095	0.146	0.221	0.121
Ruggedness	0.542	0.191	0.211	0.150	0.676	0.150
Absolute latitude	-0.757	0.362	-0.981	0.306	-0.999	0.244
Rainfall C.V.	-0.320	0.204	-0.331	0.160	-0.148	0.122
Major river	0.292	0.214	0.407	0.167	0.084	0.113
Circum-Mediterranean			1.205	0.352		
East Eurasia			1.559	0.381		
Insular Pacific			-1.609	0.547		
North America			-2.139	0.596		
South America			-4.036	0.780		
Observations	1205		1205		486	

Notes: The dependent variable is the natural logarithm of historic population density. All regressions are Conley's OLS, with a distance cutoff of 10 decimal degrees. "*coef.*" is the estimated coefficient. "s.e." is the standard error adjusted for spatial dependence. Because the continuous right-hand-side variables have been normalized as N(0,1), coefficients can be interpreted as the marginal effect of a one standard deviation increase.

Table 5

Geographic correlates of slavery, including crop suitabilities

	(1)			(2)			(3)		
	Full Sample						S.S. Africa		
	coef.	*s.e.*	*mfx*	*coef.*	*s.e.*	*mfx*	*coef.*	*s.e.*	*mfx*
Constant	0.311	0.183		0.951	0.407		0.245	0.864	
Land quality	0.195	0.147	0.047	0.339	0.149	0.082	0.743	0.272	0.042
Precipitation	-0.045	0.219	-0.011	0.353	0.223	0.085	0.842	0.789	0.047
Temperature	0.875	0.284	0.209	0.622	0.273	0.150	1.726	0.418	0.097
Date observed	-0.222	0.098	-0.053	-0.372	0.126	-0.090	-0.647	0.376	-0.036
Share desert	0.036	0.189	0.008	-0.044	0.161	-0.011	0.372	0.447	0.021
Dist. to coast	0.147	0.123	0.035	0.191	0.119	0.046	0.029	0.217	0.002
Elevation	0.140	0.122	0.033	0.019	0.129	0.005	0.108	0.360	0.006
Pct. malarial	1.933	0.219	0.462	1.568	0.259	0.378	1.625	0.420	0.092
Ruggedness	0.504	0.130	0.120	0.415	0.131	0.100	-0.019	0.479	-0.001
Absolute latitude	0.671	0.292	0.160	0.789	0.300	0.190	-0.346	0.939	-0.019
Rainfall C.V.	0.103	0.124	0.025	0.111	0.115	0.027	-0.322	0.488	-0.018
Major river	0.387	0.211	0.091	0.365	0.222	0.086	0.838	0.596	0.040
Wheat suitability	0.091	0.156	0.022	-0.213	0.186	-0.051	0.189	0.378	0.011
Maize suitability	0.036	0.321	0.009	0.238	0.325	0.057	0.550	0.725	0.031
Cereals suitability	0.381	0.349	0.091	0.022	0.351	0.005	-0.060	0.533	-0.003
Roots/tubers suitability	-0.549	0.305	-0.131	-0.529	0.314	-0.128	-1.679	0.549	-0.095
Pulses suitability	0.566	0.327	0.135	0.647	0.328	0.156	1.441	0.477	0.081
Oil crops suitability	-1.029	0.320	-0.246	-1.255	0.295	-0.302	-2.045	0.359	-0.115
Sugar suitability	0.265	0.189	0.063	0.528	0.205	0.127	1.034	0.485	0.058
Cotton suitability	0.315	0.297	0.075	0.378	0.302	0.091	0.515	0.528	0.029
Circum-Mediterranean				0.799	0.614	0.176			
East Eurasia				-0.858	0.671	-0.211			
Insular Pacific				-2.237	0.919	-0.483			
North America				-1.570	0.685	-0.373			
South America				-1.105	0.607	-0.269			
Observations		1040			1040			416	

Notes: Dependent variable is any slavery. All regressions are Conley's logit, with a distance cutoff of 10 decimal degrees. "*coef.*" is the estimated coefficient. "s.e." is the standard error adjusted for spatial dependence. "mfx" is the marginal effect. This is the effect of a one standard deviation change for continuous variables, and a one unit change for dummy variables.

Table 6

Historic institutions and modern GDP per capita (country-level)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Africa				Asia			
Pct. with Any land rights	-1.77**	-1.52**	-1.15	-0.83	-1.75***	-1.76***	-0.44	-0.94
	(0.715)	(0.693)	(1.066)	(1.297)	(0.319)	(0.473)	(0.860)	(0.964)
Colonial Dummies	N	Y	N	Y	N	Y	N	Y
Controls	N	N	Y	Y	N	N	Y	Y
Observations	45	45	45	45	30	30	30	30
R-squared	0.069	0.148	0.219	0.257	0.164	0.288	0.582	0.714
Pct. with Any slavery	-1.82***	-1.98***	-2.06**	-1.93	0.59	0.49	0.64	0.46
	(0.467)	(0.595)	(0.987)	(1.248)	(0.468)	(0.515)	(0.633)	(0.690)
Colonial Dummies	N	Y	N	Y	N	Y	N	Y
Controls	N	N	Y	Y	N	N	Y	Y
Observations	48	48	48	48	34	34	34	34
R-squared	0.126	0.223	0.243	0.285	0.041	0.104	0.603	0.723
Pct. with State cent.: At least 2 levels	-0.45	-0.53	-1.40*	-1.32	-1.66***	-1.56***	-1.44**	-0.96
	(0.768)	(0.677)	(0.715)	(0.906)	(0.336)	(0.395)	(0.530)	(0.911)
Colonial Dummies	N	Y	N	Y	N	Y	N	Y
Controls	N	N	Y	Y	N	N	Y	Y
Observations	46	46	46	46	34	34	34	34
R-squared	0.008	0.114	0.233	0.260	0.185	0.230	0.657	0.738
Pct. with Usual polygyny	-1.30***	-1.19**	-1.62**	-1.75*	0.55	0.71	0.03	0.71
	(0.439)	(0.450)	(0.802)	(0.989)	(0.773)	(0.741)	(0.676)	(0.669)
Colonial Dummies	N	Y	N	Y	N	Y	N	Y
Controls	N	N	Y	Y	N	N	Y	Y
Observations	49	49	49	49	34	34	34	34
R-squared	0.089	0.169	0.236	0.283	0.021	0.107	0.586	0.737

Notes: Dependent variable is ln(PPP GDP/cap), 2005. All regressions are OLS, with robust standard errors reported in parentheses. Controls are ethnic fractionalization, absolute latitude, log land area in 1500, landlocked, island, percentage catholic, percentage muslim, log population density in 1500, and percentage malarial in 1946.

Table 7

Historic institutions and individual outcomes in sub-Saharan Africa (DHS Data)

	(1)	(2)	(3)	(4)	(5)	(6)
	Dep. var: Wealth index			*Dep. var: Years of education*		
Any land rights	0.58***	0.36***	0.32***	-0.82	-0.27	1.09
	(0.108)	(0.056)	(0.113)	(1.264)	(0.487)	(0.890)
Other controls	N	Y	Y	N	Y	N
Country-round fixed effects	N	N	Y	N	N	Y
Observations	94,271	94,271	94,271	235,226	235,226	235,226
Any slavery	-0.06	0.07	-0.02	-3.03***	-1.33**	-0.38
	(0.172)	(0.110)	(0.103)	(0.713)	(0.570)	(0.434)
Other controls	N	Y	Y	N	Y	N
Country-round fixed effects	N	N	Y	N	N	Y
Observations	101,317	101,317	101,317	217,864	217,864	217,864
Any state	0.16	0.14	0.05	-1.24	-0.21	0.01
	(0.176)	(0.099)	(0.096)	(0.835)	(0.548)	(0.391)
Other controls	N	Y	Y	N	Y	N
Country-round fixed effects	N	N	Y	N	N	Y
Observations	100,966	100,966	100,966	233,930	233,930	233,930
Usual polygyny	0.05	-0.01	-0.03	0.55	-0.21	0.00
	(0.107)	(0.057)	(0.060)	(0.665)	(0.358)	(0.246)
Other controls	N	Y	Y	N	Y	N
Country-round fixed effects	N	N	Y	N	N	Y
Observations	100,940	100,940	100,940	235,263	235,263	235,263

Notes: All regressions are OLS, with standard errors clustered by ethnic group reported in parentheses. Controls are age, age squared, urban, and dummies for religion.