

DOES LAND ABUNDANCE EXPLAIN AFRICAN INSTITUTIONS?*

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The land abundance view of African history uses sparse population to explain pre-colonial land tenure and slavery. I document the geographical forcing variables that predict land rights, slavery and population density in a cross section of global societies. I discuss whether these correlations support theories of land rights and slavery, including the land abundance view. I show that pre-colonial institutions predict institutional outcomes in Africa in the present, including land transactions, polygamy and public goods. Pre-colonial institutions have effects above those of geography. The colonial reversal of fortune did not erase their influence.

In contrast to Europe and Asia, Africa was less densely populated at the beginning of the twentieth century (Herbst 2000). By then, slavery was widespread in Africa (Lovejoy, 2000). Land tenure on much of the continent was, and still is, characterised by group rights and overlapping claims (Bruce *et al.*, 1994). The ‘land abundance’ view of African history connects these facts (Hopkins, 1973; Iliffe, 1995; Austin, 2008*a*). 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 labour substituted for wage employment.

In this study, I use cross-sectional data on a sample of global societies to uncover the geographical forcing variables that have jointly determined historical land rights, slavery and population density. I then use modern survey data to show that these past institutions predict institutional outcomes in Africa today. Though these exercises are ultimately descriptive, they are carried out with three purposes in mind. First, I add to our knowledge of the relationship between geography and institutions. Second, I use these results to evaluate whether existing theories of institutions, including the land abundance view, fit the facts. Third, I use the persistent influence of these institutions to draw conclusions about the relative importance of geography and institutions, and about the colonial ‘reversal of fortune’.

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 geographical features can predict the

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patterns of land rights, slavery and population density in this sample. I test for persistent effects of these institutions within Africa. First, I use the Ghana Living Standards Study (GLSS) to investigate whether historical patterns of land rights predict differences in how plots of land are acquired in the present. Second, I use the Demographic and Health Surveys (DHS) to test for persistence in the prevalence of polygamy and for adverse effects of past slavery on the provision of public goods today.

Both land rights and slavery are correlated with the geographical features of the ethnic groups that practice them. Notably, the groups in my sample are more likely to possess rights over land if land quality is better. Within Africa, there is a positive correlation between land quality and slavery but this does not hold in the full global sample. Many of the correlates of institutions and population become insignificant when fixed effects are included for ethnographic regions that approximate continents, and the determinants of institutions within Africa differ from those in the full sample.

Influential theories of land rights emphasise population pressure and the market value of output as key determinants of property institutions. The results here suggest that rights existed historically where land was most scarce and more valuable, though there is only mixed evidence that access to trade was a determining factor. The most widely accepted theories of slavery in the literature focus on labour scarcity, workers' outside options and the productivity of slavery in specific tasks. My results suggest that slavery evolves with time alongside population. The results here do not offer unqualified support for any particular theory of slavery. In particular, the fragility of the main results when explaining intra-regional differences suggests that the causes of slavery may differ across regions, may depend on unobserved characteristics of these regions, or that intra-regional institutional spill-overs weaken the link between institutions and local geographical endowments.

In this study, I compare Ghanaian ethnic groups in which a child could inherit a parent's land with groups in which land could pass out of the nuclear family through inheritance. Where the nuclear family was strong in the past relative to the wider lineage, land is more likely to be acquired through commercial transactions today. I show that women whose ethnic groups regularly practiced polygamy before colonial rule are more likely to be in polygamous marriages today. Children born in African ethnic groups where slavery existed in the past receive fewer vaccinations today. Pre-colonial African institutions, then, continue to exert a persistent influence over and above the effects of the geographical features that have shaped them. Whatever 'reversal of fortune' may have occurred as a result of colonial rule, pre-colonial institutions that matter in the present were not entirely swept away by the process of colonisation and decolonisation.

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), labour-supply (Field, 2007) and violence (Andre and Platteau, 1998). Nunn (2008*a*) 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 US counties (Engerman and Sokoloff, 1997; Nunn, 2008*b*), as well as long-term racial gaps in education and income (Sacerdote, 2005; Miller, 2011).

Other historical ‘ethnic’ institutions also matter today. Pre-colonial states predict economic activity (Michalopoulos and Papaioannou, 2013), provision of public goods (Gennaioli and Rainer, 2007) and governance (Acemoglu *et al.*, 2002*a*). 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, 2012*a*). 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-geographical features such as continental orientation (Diamond, 1997), domesticable species (Olsson and Hibbs, 2005), population (Acemoglu *et al.*, 2002*b*), 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 (2012) link heterogeneity in land quality to both ethnic fragmentation and the spread of Islam. I continue this line of research by testing what geographical features of societies predict land rights, slavery and population density.

In Section 1, I describe my sources of data and the econometric specifications that I use. In Section 2, I report my results and discuss their robustness. Detailed robustness checks are confined to the online Technical Appendix. In Section 3, I discuss the theories of land rights and slavery that are consistent with these results, including the ‘land abundance’ view. In Section 4, I show that pre-colonial institutions in Africa have persistent effects on institutions in the present. In Section 5, I conclude.

1. Specifications and Data

1.1. Specifications

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

$$y_{ij} = \mathbf{x}'_{ij}\boldsymbol{\beta} + \delta_j + \varepsilon_{ij}, \quad (1)$$

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. \mathbf{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, the coefficient of variation of rainfall over time and a constant. 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_{ij} 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 online Technical Appendix.

1.2. *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 two duplicate observations (the Chilcotin and Tokelau), eight societies observed before 1500 (Ancient Egypt, Aryans, Babylonia, Romans, Icelander, Uzbeg, Khmer and 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 these 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 benefit of looking at pre-colonial societies is that they allow me to correlate institutions with the geographical characteristics of the societies that adopted them. Colonial institutions, by contrast, will depend both on the characteristics of colonising and colonised societies. The use of a global sample, rather than an African sample, introduces additional institutional variation and makes it possible to test whether the geographical correlates of institutions in Africa are the same as those in the rest of the world.

The greatest concern with these data is that they may be anachronistic. They are intended to cover societies at an idealised, 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 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

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

Table 1
Summary Statistics and Percentiles of Population Density

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

Means by major region			
	Any land rights	Any slavery	Historic pop density
Africa	0.93	0.83	35.42
+ Ethiopia and the Horn + Moslem Sudan	0.93	0.84	35.51
+ Sahara + North Africa	0.93	0.84	35.65
Circum-Mediterranean	0.92	0.70	64.53
East Eurasia	0.83	0.54	154.27
Insular Pacific	0.73	0.24	41.74
North America	0.29	0.27	5.02
South America	0.27	0.27	12.21

Note: Variable definitions are in the online Technical Appendix.

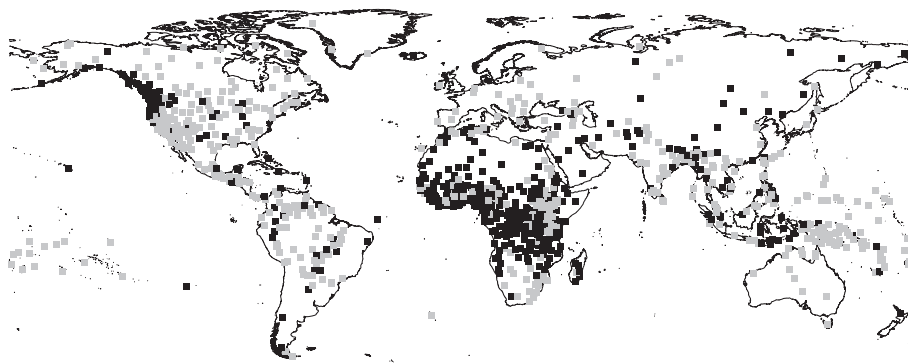


Fig. 1. Slavery

Notes. Black squares indicate presence of slavery. Grey squares indicate absence.

pre-date the observations of the African societies in these data. I discuss this possible contamination in subsection 3.2.

The use of Murdock's (1967) data is not unique to this study. Baker and Jacobsen (2007*b*) use descriptive statistics from the *Ethnographic Atlas* to motivate a model of the gender division of labour. Gennaioli and Rainer (2007) have aggregated its data on state centralisation to the country level using ethnic population numbers from Bruk and Apenchenko (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.

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. 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, 2007*a*).

More recent treatments have combined the *Ethnographic Atlas* with spatial data on geographical characteristics. Michalopoulos and Papaioannou (2013), for example, show that economic activity measured using night-time lights is greater in parts of Africa with more centralised states before colonial rule. Excluding other work of my own (Fenske, 2012*b*), the only other study of which I am aware that has used geographical 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 labour in agriculture, which in turn explains female labour force participation rates today.

1.3. *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 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 US 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). One hundred 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 geographical characteristics of the polygon labelled 'Kerewe' in the Murdock (1959) map. A full Table of matches and a map of the assembled polygons are given in the online Technical Appendix.³

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. These raster data on historical population cover the years 1500, 1600 and every 10 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 3,441 administrative units from 222 countries. Historical data are then reconstructed

² These were digitised for the US 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 a coordinate that is in Tibet. Fourteen are groups that cover diffuse areas, making it difficult to assign them a meaningful coordinate. These include Russians and the Eastern Cree. Eight 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 three polygons. Two 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.

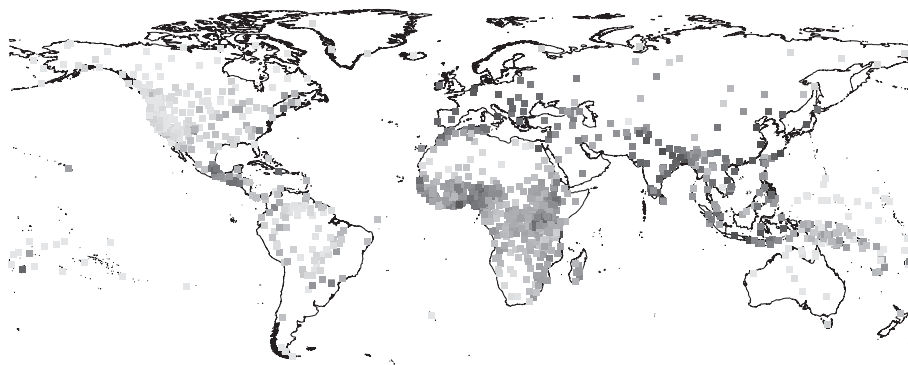


Fig. 2. *Historical Population Density*

Notes. Darker squares indicate denser population.

on this base map using Lahmeyer (2004), Helders (2000), Tobler (1995), several local studies, interpolation and back projection. The data are reported on a 5-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 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:

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

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 Organisation'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

⁵ This is an over-estimate due to over-representation of Naha in the original data; administrative records give a modern density of just above 1,500 persons per square mile. Results are similar if I exclude the Okinawans (see the online Technical Appendix).

problems with these data (Austin, 2008*b*; 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 geographical forcing variables. As a result, I gather data on several other geographical characteristics of these societies, and test the extent to which historic population and institutions are predicted by features of the natural environment.

1.4. *Geographic Data*

I join societies from the *Ethnographic Atlas* to several sources of geographical raster data. Sources and definitions for each variable are given in the online 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 geographical 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.

1.5. *Modern outcomes*

I use two separate approaches to test whether African institutions have persistent influences in the present day. First, I use plot-level data from the fifth round of the Ghana Living Standards Survey (GLSS), conducted in 2005–6. Using the ethnic groups reported in these data, I am able to merge plots with their users' historical institutions

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.

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.

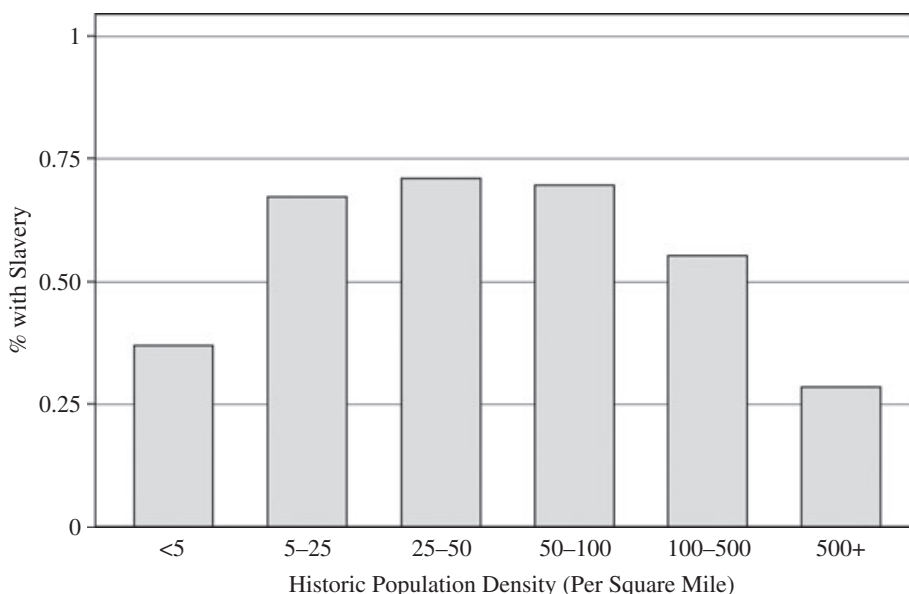


Fig. 3. *Slavery and Historical Population Density*

as recorded in the *Ethnographic Atlas*. I use OLS to estimate:

$$y_{ij} = \beta \text{institution}_j + \mathbf{x}'_{ij} \boldsymbol{\gamma} + \varepsilon_{ij}. \quad (3)$$

Here, y_{ij} is an indicator for the manner in which plot i , currently used by a member ethnic group j , was acquired. I use indicators for whether the plot has purchased, rented, sharecropped or acquired from family as outcomes. institution_j is the presence or absence of an historical institution for the plot controller's ethnic group. β is the coefficient of interest. Because all ethnic groups merged to these plots possessed rights over land in the past, I use two alternative indicators of historic land rights for institution_j . First, I record whether land inheritance is patrilineal. Second, I record whether land was inherited by children. Here, I follow Goody (1969, p. 65), who argues that:

[T]he scarcer productive resources become and the more intensively they are used, then the greater the tendency towards the retention of these resources within the basic productive and reproductive unit, which in the large majority of cases is the nuclear family.

If land is scarce, it is an important consideration in marriage. This puts emphasis on transmission of property from parents to children. Under patrilineal inheritance, land may pass from a man to his son or his brother. Under matrilineal inheritance, land necessarily passes out of the nuclear family to a man's brother or to his sister's son. I use an indicator for whether land is inherited by children as a more precise measure of the degree to which land is retained within the nuclear family.

Other controls in \mathbf{x}_{ij} are plot area, plot area squared, the gender of the plot controller, the age and age squared of the plot controller, dummies for religion,

dummies for region (roughly equivalent to a province) and ecological zone dummies. My final sample contains 8,669 plots of land. I cluster standard errors by ethnic group.

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 (2012*a*). Using the ethnic groups reported in these data, I am able to merge these women with historical institutions from the *Ethnographic Atlas*. On this sample of women, I use OLS to estimate:

$$y_{ijc} = \beta \text{institution}_j + \mathbf{x}'_{ijc} \boldsymbol{\gamma} + \delta_c + \varepsilon_{ijc}. \quad (4)$$

institution_j is the presence or absence of an historical institution for the woman's ethnic group. β is the coefficient of interest. I use past polygamy and past slavery as measures of institution_j . The first tests directly for the persistence of polygamy as an institution. The second is motivated by the fact that most slaves retained within Africa were women, and that many served as the sometimes polygamous wives of their masters (Robertson and Klein, 1983). The vector of controls, \mathbf{x}_{ijc} includes absolute latitude, malaria prevalence, suitability for rainfed agriculture, ruggedness, elevation, distance to the coast, dummies for ecological type, year of birth, year of birth squared, dummies for religion, urban, age and age squared.⁸ δ_c is a country-round fixed effect. I cluster standard errors at the level of the woman's ethnic group.

In addition, I use the DHS child recodes to collect information on the children born to these women in the five years preceding the survey. I now estimate (4) taking children as the unit of observation. The dependent variable y_{ijc} is now the number of vaccinations received. I take this as a proxy for the capacity of the state and so follow the existing literature by measuring the ability of states to provide public goods (Gennaioli and Rainer, 2007; Berger, 2008). \mathbf{x}_{ijc} contains the same controls as above, as well as the child characteristics birth date, birth order, an indicator for a multiple birth and gender.

2. Results

In this Section, I report my main results. I do not interpret these until later, in Section 3. In subsection 2.1, I outline the principal geographical correlates of land rights, slavery and historic population. In subsection 2.2, I outline the robustness checks that are reported in the online Technical Appendix.

2.1. Main results

2.1.1. 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

⁸ Year of birth and age can both be included because these are repeated cross-sections. With country-round fixed effects, the linear term is dropped due to collinearity.

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 significant within major regions. Land rights become less common as one moves away from the equator. Distance from the coast does not predict land rights in the global sample and predicts greater land rights within Africa. I find no effect of elevation, the coefficient of variation of rainfall or access to a major river in any specification.

2.1.2. *Slavery*

In Table 2, 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 in the probability of slavery within sub-Saharan Africa. I discuss this difference in more detail in Section 4.

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 with fixed effects. I find no effect of precipitation, share desert, distance from the coast, elevation or the coefficient of variation of rainfall in any specification.

2.1.3. *Population density*

In Table 2, 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 significant if I include 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 significant within major regions, and does not hold within Africa. Across

Table 2
Geographic Correlates of Historic Institutions and Population

	Any land rights			Any slavery			Log historic pop density		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Land quality	0.048** (0.019)	0.010 (0.018)	0.024*** (0.009)	0.031 (0.029)	0.019 (0.032)	0.054*** (0.018)	0.727*** (0.146)	0.543*** (0.109)	0.145* (0.076)
Precipitation	-0.051** (0.022)	0.014 (0.029)	-0.005 (0.022)	-0.039 (0.047)	0.054 (0.046)	0.018 (0.039)	-0.763*** (0.218)	-0.191 (0.191)	-0.327 (0.200)
Temperature	-0.025 (0.038)	-0.089** (0.041)	0.010 (0.013)	0.221*** (0.066)	0.184*** (0.056)	0.132*** (0.051)	0.231 (0.364)	-0.114 (0.255)	0.146 (0.164)
Date observed	0.047* (0.025)	0.003 (0.017)	-0.026* (0.015)	-0.051** (0.023)	-0.084*** (0.027)	-0.019 (0.028)	0.471*** (0.139)	0.071 (0.106)	0.914*** (0.122)
Share desert	0.020 (0.021)	0.005 (0.034)	-0.013 (0.016)	0.010 (0.040)	0.008 (0.035)	0.035 (0.031)	-0.114 (0.212)	-0.204 (0.159)	-0.193** (0.085)
Distance to coast	-0.023 (0.023)	-0.015 (0.023)	0.021* (0.012)	0.033 (0.031)	0.039 (0.031)	0.003 (0.017)	-0.328 (0.205)	-0.339** (0.149)	0.020 (0.099)
Elevation	-0.009 (0.022)	-0.020 (0.025)	-0.019 (0.012)	0.026 (0.028)	0.002 (0.029)	-0.001 (0.027)	-0.299* (0.164)	-0.276** (0.135)	-0.601*** (0.122)
Pct. malarial	0.173*** (0.031)	0.068* (0.035)	0.016 (0.011)	0.434*** (0.045)	0.368*** (0.058)	0.087*** (0.028)	0.574** (0.247)	-0.095 (0.146)	0.221* (0.121)
Ruggedness	0.054*** (0.019)	0.035 (0.022)	0.044** (0.018)	0.138*** (0.028)	0.133*** (0.030)	0.022 (0.030)	0.542*** (0.191)	0.211 (0.150)	0.676*** (0.150)
Absolute latitude	-0.103*** (0.040)	-0.147*** (0.050)	-0.094*** (0.027)	0.175** (0.072)	0.209*** (0.072)	-0.004 (0.066)	-0.757** (0.362)	-0.981*** (0.305)	-0.999*** (0.244)
Rainfall c.v.	-0.013 (0.021)	-0.025 (0.021)	-0.005 (0.014)	0.020 (0.031)	0.034 (0.029)	-0.010 (0.034)	-0.320 (0.204)	-0.331** (0.160)	-0.148 (0.122)
Major river	-0.026 (0.036)	-0.021 (0.040)	-0.010 (0.023)	0.082* (0.046)	0.072 (0.049)	0.053* (0.031)	0.292 (0.214)	0.407*** (0.167)	0.084 (0.113)
Circum-		0.136**			0.077			1.205***	
Mediterranean		(0.066)			(0.131)			(0.352)	
East Eurasia		0.010			-0.131			1.559***	
		(0.099)			(0.160)			(0.381)	

Table 2
(Continued)

	Any land rights			Any slavery		Log historic pop density			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Insular Pacific		-0.270* (0.154)			-0.404*** (0.154)			-1.609*** (0.547)	
North America		-0.369* (0.191)			-0.338** (0.151)			-2.139*** (0.596)	
South America		-0.627*** (0.125)			-0.218 (0.136)			-4.036*** (0.780)	
Observations	801	801	371	1,040	1,040	416	1,205	1,205	486
R ²		Full		Full	Full	S.S. Africa	0.440	0.590	0.919
Sample	Full		S.S. Africa	Full	Full	S.S. Africa	Full	Full	S.S. Africa

Notes. OLS, Ordinary least squares. Regressions with land rights and slavery are logit, with marginal effects reported. Regressions with population density are OLS, with coefficients reported. In both cases, these are interpretable as the effect of a one standard deviation change for continuous variables, and a one unit change for dummy variables. Each regression contains a constant (not reported). Standard errors in parentheses are adjusted using Conley's (1999) method, with a distance cut-off of 10 decimal degrees. ***Significant at 1%. **Significant at 5%. *Significant at 10%.

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 significant within major regions. Societies closer to 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 these correlations only hold within broad regions, and not within Africa. There is no significant link between historical population density and temperature.

2.1.4. *Slavery and crop suitability*

In Table 3, 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. These are: 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 2, excepting that land quality and access to a major river now have significant positive correlations with slavery within broad regions. Roots/tubers and oil crops enter negatively. Pulses and sugar enter positively, though sugar is only statistically significant with major region fixed effects, or in the African sub-sample.

2.2. *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 online 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' in Table 1, 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 online Technical Appendix whether alternative measures of these institutions give results consistent with Table 2. Similarly, I use three alternative measures of historical population, attempting to re-create the results of Table 2. 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.

Table 3
Geographical Correlates of Slavery, Including Crop Suitabilities

	Any slavery		
	(1)	(2)	(3)
Land quality	0.047 (0.035)	0.082** (0.036)	0.042** (0.018)
Precipitation	-0.011 (0.052)	0.085 (0.053)	0.047 (0.045)
Temperature	0.209*** (0.069)	0.150** (0.066)	0.097*** (0.028)
Date observed	-0.053** (0.023)	-0.090*** (0.030)	-0.036 (0.025)
Share desert	0.009 (0.045)	-0.011 (0.039)	0.021 (0.025)
Distance to coast	0.035 (0.030)	0.046 (0.029)	0.002 (0.012)
Elevation	0.033 (0.029)	0.005 (0.031)	0.006 (0.021)
Pct. malarial	0.462*** (0.047)	0.378*** (0.060)	0.092*** (0.032)
Ruggedness	0.120*** (0.031)	0.100*** (0.031)	-0.001 (0.027)
Absolute latitude	0.160** (0.069)	0.190*** (0.072)	-0.019 (0.053)
Rainfall c.v.	0.025 (0.030)	0.027 (0.028)	-0.018 (0.027)
Major river	0.090* (0.049)	0.086* (0.052)	0.040* (0.024)
Wheat suitability	0.022 (0.037)	-0.051 (0.045)	0.011 (0.022)
Maize suitability	0.009 (0.077)	0.057 (0.078)	0.031 (0.040)
Cereals suitability	0.091 (0.083)	0.005 (0.085)	-0.003 (0.030)
Roots/tubers suitability	-0.131* (0.073)	-0.128* (0.076)	-0.095** (0.044)
Pulses suitability	0.135* (0.079)	0.156* (0.080)	0.081** (0.033)
Oil crops suitability	-0.246*** (0.076)	-0.302** (0.071)	-0.115*** (0.034)
Sugar suitability	0.063 (0.045)	0.127*** (0.050)	0.058* (0.034)
Cotton suitability	0.075 (0.071)	0.091 (0.072)	0.029 (0.031)
Circum-Mediterranean		0.176 (0.122)	
East Eurasia		-0.211 (0.161)	
Insular Pacific		-0.483** (0.132)	
North America		-0.374** (0.147)	
South America		-0.269* (0.139)	
Observations	1,040	1,040	416
Sample	Full	Full	S.S. Africa

Notes. All regressions are logit, with marginal effects reported. These are interpretable as the effect of a one standard deviation change for continuous variables, and a one unit change for dummy variables. Each regression contains a constant (not reported). Standard errors in parentheses are adjusted using Conley's (1999) method, with a distance cutoff of 10 decimal degrees. ***Significant at 1%. **Significant at 5%. *Significant at 10%.

Because land rights and slavery are missing for several observations, I show in the online Technical 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 hold 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 broadly similar with absolute latitude excluded. Excluding high leverage observations also has little effect on the results. Controlling for the possible endogeneity of land quality, I show that its effect is not overstated in the baseline specification.

3. Facts and theories

The results presented above have been descriptive, uncovering geographical 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. I summarise the implications of these theories in Table 4.

3.1. *Theories of Land Rights*

The two most influential theories of land rights are those that focus on population, and those that focus on trade. Boserup (1965) argues that exogenous population increase is the principal driver of agricultural intensification and more permanent tenure. This is the intuition captured by the 'land abundance' view of African history. Austin (2009), for example, argues that authorities were eager to attract more immigrants in order to subdue nature and their neighbours. Thus, strangers could generally acquire land indefinitely for token payments, while citizens were given land virtually for free (Austin, 2008*a*). Formalisations of this theory have captured these changes as the selection of certain production technologies in response to the relative scarcity of land and labour (Hayami, 1997; Quisumbing and Otsuka, 2001), or as the profit-maximising choice of an elite (Lagerlöf, 2009).

There is a positive correlation between population density and land rights in the full sample that holds conditional on region fixed effects (not reported). Within Africa, there is still a positive correlation, though it is significant only at the 12% level (not reported). This is congruent with a population-centred view, though it does not specify the mechanism by which land scarcity leads property rights to emerge.

There is also substantial overlap between the geographical variables that predict greater population and those that predict land rights. In the global sample, these include greater land quality, less precipitation, a later date of observation, greater malaria prevalence, greater ruggedness and proximity to the equator. Conditional on region fixed effects, this pattern is less clear. Similarly, there are many variables in the sub-Saharan Africa sample that do not predict significant co-movement of population density and land rights. These include date of observation, desert, elevation and malaria. Together, these results are supportive of a population-based mechanism that explains

Table 4
Theories of Land Rights and Slavery

	Examples	Implications
Land rights		
Population-centred	Boserup (1965), Hayami (1997), Lagerlöf (2009), Quisumbing and Otsuka (2001)	Variables that predict greater population will predict land rights. In Lagerlöf, better land quality predicts land rights
Trade-centred	Demsetz (1967), Hotte <i>et al.</i> (2000), Copeland and Taylor (2009)	Variables that predict greater market values of output will predict land rights
Slavery		
Population-centred	Conning (2004), Domar (1970), Lagerlöf (2009), Nieboer (1900)	Variables that predict lower population (Nieboer) or intermediate population (Lagerlöf) will predict slavery. In Lagerlöf, better land quality predicts slavery
Outside option-centred	Acemoglu and Wolitzky (2011), Beber and Blattman (2013), Chwe (1990), North and Thomas (1971)	Variables that improve workers' outside options or that make it more difficult to coerce workers should reduce slavery
Productivity-centred	Engerman and Sokoloff (1997), Fenoaltea (1984), Fogel and Engerman (1974), Hanes (1996)	Suitability for certain crops should make slavery more likely, over and above the effect of land quality in general

patterns of land tenure across broad regions but that becomes less powerful at explaining differences within regions. This could be due, for example, to intra-regional spill-overs.

Trade-centred theories date at least as far back as Demsetz (1967). He argues that land rights internalise 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. Grossman and Kim, 1995; Baker, 2003).

That better land predicts land rights is consistent with this view, since land that can produce more valuable output will be more strongly defended. The lower prevalence of land rights further from the equator is driven by the low-productivity zones of the Arctic and Australian desert, reinforcing this interpretation. The data do not unambiguously support a trade-centred view, however. 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.

Beyond these two influential theories, there is a literature on the enclosure of common property (Netting, 1976; Grantham, 1980; Runge, 1986; Ostrom, 1991; Lueck, 1994; Baland and Platteau, 2003; Baland and Francois, 2005). 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. Many of these benefits cannot be captured by the geographic variables included here. However, the lack of a significant correlation with ecological risk and land rights in

Table 2 is inconsistent with models suggesting that common property over land is motivated by risk pooling.

3.2. *Theories of slavery*

Several theoretical analyses of slavery and coercion exist (Bergstrom, 1971; Canarella and Tomaske, 1975; Findlay, 1975; Barzel, 1977; Genicot, 2002). Three of the most influential theories stress labour scarcity, the outside options available to workers, and the productivity of forced labour in specific tasks. Nieboer (1900) and Domar (1970) both argue that coercion is cheaper than paying a wage when labour is scarce and wages high. Proponents of the 'land abundance' view of African history, such as Austin (2008*a*), 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 labour used to guard slaves is very high. Because land quality raises free wages for a given population density, his model predicts that greater land quality can lead to the use of slave labour.

The inverse-U correlation between slavery and population density in Figure 3 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. There is, however, little overlap between the variables that predict population density and those that predict slavery. Some variables predict that population density and slavery move in the same direction (ruggedness), while others predict they move in opposite directions (absolute latitude). The correlation of land quality with slavery only holds in Africa. There are many possible reasons for this. The Lagerlöf (2009) model may better apply to Africa than to other regions. Alternatively, the correlation between slavery and the measure of a society's dependence on agriculture in the *Ethnographic Atlas* is greater in the sub-Saharan sample ($\rho = 0.25$) than in the rest of the world ($\rho = 0.04$).

Several theories emphasise coerced workers' outside options. North and Thomas (1971), for example, hold that serfs voluntarily exchanged their labour for protection in an environment where a lack of markets made it difficult for payments to occur in cash or output. Several models find that worse outside options for workers increase the degree of coercion in labour contracts (Chwe, 1990; Beber and Blattman, 2013).⁹ Similarly, Acemoglu and Wolitzky (2011) find that labour 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.

The evidence on outside options is mixed. There appears to be no strong link between slavery and distance from the coast, which would suggest that markets do not matter much. Access to a major river predicts slavery, leading to the opposite conclusion. 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

⁹ Naidu and Yuchtman (2013), by contrast, argue that British industrial workers committed to coercive contracts in order to reduce wage variation.

(Nunn and Puga, 2012). Contrary to this intuition, the correlation between ruggedness and slavery is positive.

In certain contexts, slavery may be more productive than free labour. Productivity-centred views use this to explain its relative prevalence. 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 labour. 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 crop suitability measures in Table 3 do have predictive power. At face value, these suggest that the relative productivity of different agricultural systems, conditional on land quality as a whole, does predict differences in the use of slaves. These do not, however, map neatly into any classification according to economies of scale or productivity under gang labour. Caribbean-type sugar plantations are not a feature of the indigenous societies in the data.

3.3. *Summary*

The correlation of land rights with both population and its geographical predictors is supportive of a population-centred view. There is less evidence for a trade-centred view of land rights. In both cases, however, these theories better predict differences across regions than differences within regions.

The correlation of population density with slavery is similar to the specific population-centred view of Lagerlöf (2009). That land quality better predicts slavery in Africa than elsewhere supports application of this model to Africa alone. There is no strong evidence in favour of a model centred on workers' outside options. There is suggestive evidence that the relative productivity of slaves in different agricultural systems contributed to the prevalence of slavery but it is difficult to map the broad crop types recorded here into existing theories.

4. Persistence

In this Section, I show that pre-colonial institutions of land rights, slavery, polygamy and states have persistent effects on present-day institutions in sub-Saharan Africa. Though I have not focused on polygamy and states in the previous sections, they feature largely in both the literature linking African institutions to sparse population (Tambiah and Goody, 1973; Herbst 2000), and in the literature on current African development (Tertilt, 2005; Michalopoulos and Papaioannou, 2013).

4.1. *Land Rights*

In Table 5, I present estimates of (3). Pre-colonial land rights institutions predict the transactions that have been used to acquire plots of land in Ghana in the present.

Members of ethnic groups that historically practiced patrilineal inheritance and those in which children could inherit land in the past are more likely to have acquired their land through commercial transactions such as rental and sharecropping. They are less likely to have acquired land through their village or family. Individuals whose ethnic groups allowed children to inherit in the past are more likely to have bought their current plot. Together, these results tell a consistent story; ethnic groups in Ghana in which nuclear families had more control over land *vis-à-vis* lineages in the pre-colonial period display greater commercialisation of land in the present.

To account for spatial correlation at a level above the ethnic group, I also report standard errors clustered by region. These units are roughly equivalent to provinces, and there are 10 in Ghana. The significance of the results is unchanged, with one exception: ethnic groups in which children inherited land in the past are no longer significantly more likely to purchase land.

4.2. *Slavery*

In Table 5, I report estimates of (4) using slavery as a measure of pre-colonial institutions. At the individual level, there is no evidence that past slavery predicts polygamy in the present. Though there is a positive bivariate correlation that survives the inclusion of past polygamy, this does not survive the inclusion of geographical and individual controls. In the child-level regressions, however, I find that children whose ethnic groups practiced slavery in the past receive fewer vaccinations in the present. Coefficients can be compared to the standard deviation of the dependent variable, which is 3.33. Though this does not survive the inclusion of country-round fixed effects, the point estimate remains negative. Standard errors are similar when clustered by minor ethnographic region.

4.3. *Polygamy*

In Table 5, I present additional estimates of (4), using polygamy as a measure of past institutions. Here, there is clear persistence. A woman whose ethnic group regularly practiced polygamy in the past is roughly 10–14% more likely to be married polygamously today. This is robust to additional controls and country-round fixed effects.

4.4. *State Centralisation*

Though the importance of pre-colonial states for contemporary African development has been established in other contexts (Gennaioli and Rainer, 2007; Michalopoulos and Papaioannou, 2013), I find no evidence in Table 5 that the benefits of a pre-colonial state extend to the capacity of modern states to provide vaccinations to children.

4.5. *Implications for comparative development*

The persistent effects of pre-colonial institutions are relevant to at least two literatures in comparative development. First, it is not settled whether geography matters most for

Table 5
Institutional Persistence in Sub-Saharan Africa

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>Panel (a): GLSS 5</i>									
		Bought	Rented	Sharecropped	Distributed through village or family				
Patrilineal land inheritance	0.012 (0.011) [0.022]	0.073*** (0.024) [0.021]	0.124*** (0.038) [0.051]	-0.245*** (0.058) [0.058]					
Children inherit land		0.025*** (0.006) [0.022]	0.066*** (0.011) [0.014]	0.095*** (0.024) [0.038]	-0.227*** (0.074) [0.079]				
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,669	8,669	8,669	8,669	8,669	8,669	8,669	8,669	8,669
<i>Panel (b): DHS individual recodes</i>									
		Polygamous							
Usual polygyny	0.136*** (0.050) [0.048]	0.126*** (0.026) [0.017]	0.097*** (0.020) [0.020]	0.143*** (0.048) [0.060]	0.015 (0.033) [0.044]	0.040 (0.027) [0.027]	0.137*** (0.050) [0.049]	0.125*** (0.027) [0.018]	0.094*** (0.020) [0.018]
Any slavery									
Other controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Country-round	No	No	Yes	No	No	Yes	No	No	Yes
Fixed Effects									
Observations	235,408	156,108	156,108	235,372	156,556	156,556	231,460	153,978	153,978

Table 5
(Continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Total number of vaccines received									
Panel (c): DHS child recodes									
Any slavery	-1.566*** (0.411) [0.489]	-0.718** (0.327) [0.343]	-0.189 (0.272) [0.229]				-1.733*** (0.417) [0.481]	-0.816** (0.353) [0.322]	-0.262 (0.273) [0.228]
State centralisation				0.132 (0.180) [0.172]	0.075 (0.107) [0.069]	0.124 (0.079) [0.050]	0.239 (0.166) [0.146]	0.085 (0.110) [0.069]	0.150* (0.080) [0.039]
Other controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Country-round fixed effects	No	No	Yes	No	No	Yes	No	No	Yes
Observations	149,714	91,104	91,104	148,413	90,023	90,023	145,952	88,865	88,865

Notes: GLSS, Ghana Living Standards Study; DHS, Demographic and Health Surveys; OLS, Ordinary least squares. All regressions are OLS. All regressions include a constant (not reported). Other controls in the GLSS regressions include plot area, plot area squared, plot controller male, plot controller age and age squared, dummy for household member, dummies for religion, dummies for region, and ecological zone dummies. Other controls in the DHS individual recodes are absolute latitude, malaria prevalence, suitability for rainfed agriculture, ruggedness, elevation, distance to the coast, dummies for ecological type, year of birth, year of birth squared, dummies for religion, urban, age and age squared. Controls in the DHS child recodes include the same controls as in the individual recodes (which are now maternal characteristics), as well as the child characteristics birth date, birth order, multiple birth and female. Standard errors in each regression are clustered by *Ethnographic Atlas* ethnicity. In the GLSS panel, additional standard errors clustered by region are reported in brackets. In the DHS data, additional standard errors clustered by ethnographic region (e.g. Equatorial Bantu) are reported in brackets. **Significant at 1%. ***Significant at 5%. *Significant at 10%.

development through its direct effects (Sachs, 2003), through its impact on institutions (Easterly and Levine, 2003; Rodrik *et al.*, 2004), or through its influence on culture (Alesina *et al.*, 2011; Ashraf and Galor, 2011). Because the above results are conditional on geographic controls, these suggest that historical institutions exert an influence over and above the direct effects of the geographic features that have shaped them. This does not rule out a direct role for geography in shaping current institutions. Though I do not report coefficients on these, many of the geographic controls are also significant predictors of contemporary institutions, conditional on historic institutions.

Second, if indeed geography matters predominantly through institutions, the degree to which colonialism brought about a 'reversal of fortune' remains controversial (Acemoglu *et al.*, 2002*b*; Austin, 2008*b*). The results here suggest that the institutional upheaval of colonial rule could not sweep away what came before it. Though the global reversal is plainly visible, my results are consistent with other recent findings that the effects of colonial rule were heterogeneous (Banerjee and Iyer, 2005; Olsson, 2009), varied according to local conditions (Arias and Girod, 2011; Bruhn and Gallego, 2012), and that the evidence for an intra-African reversal is weaker than for a global reversal (Hopkins, 2009; Huillery, 2011).

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 geographical 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. Geographical correlates of land rights and slavery differ across regions. Notably, land quality predicts slavery in Africa, but not elsewhere. 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 labour 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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Additional Supporting Information may be found in the online version of this article:

Appendix A1. Data

Appendix A2. Polygons

Appendix A3. Other results discussed in the text but not reported there

References

- Acemoglu, D., Johnson, S. and Robinson, J. A. (2001). 'The colonial origins of comparative development: an empirical investigation', *American Economic Review*, vol. 91(5), pp. 1369–401.
- Acemoglu, D., Johnson, S. and Robinson, J.A. (2002a). 'An African success: Botswana', in (D. Rodrik, ed.), *In Search of Prosperity: Analytical Narratives on Economic Growth*, pp. 80–119. Princeton, NJ: Princeton University Press.
- Acemoglu, D., Johnson, S. and Robinson, J.A. (2002b). 'Reversal of fortune: geography and institutions in the making of the modern world income distribution', *Quarterly Journal of Economics*, vol. 117(4), pp. 1231–94.
- Acemoglu, D. and Wolitzky, A. (2011). 'The economics of labor coercion', *Econometrica*, vol. 79(2), pp. 555–600.
- Alesina, A., Giuliano, P. and Nunn, N. (2011). 'On the origins of gender roles: women and the plough', NBER Working Paper No. 17098.
- Andre, C. and Platteau, J.-P. (1998). 'Land relations under unbearable stress: Rwanda caught in the Malthusian trap', *Journal of Economic Behavior and Organization*, vol. 34(1), pp. 1–47.
- Arias, L. and Girod, D. (2011). 'Indigenous origins of colonial institutions', Working Paper, University of California San Diego.
- Ashraf, Q. and Galor, O. (2011). 'Cultural diversity, geographical isolation, and the origin of the wealth of nations', NBER Working Paper No. 17640.
- Austin, G. (2008a). 'Resources, techniques, and strategies south of the Sahara: revising the factor endowments perspective on African economic development, 1500–2001', *The Economic History Review*, vol. 61(3), pp. 587–624.
- Austin, G. (2008b). 'The "reversal of fortune" thesis and the compression of history: perspectives from African and comparative economic history', *Journal of International Development*, vol. 20(8), pp. 996–1027.
- Austin, G. (2009). 'Factor markets in Nieboer conditions: pre-colonial West Africa, c. 1500–c. 1900', *Continuity and Change*, vol. 24(01), pp. 23–53.
- Baker, M. (2008). 'A structural model of the transition to agriculture', *Journal of Economic Growth*, vol. 13(4), pp. 257–92.
- Baker, M. and Jacobsen, J. (2007a). 'A human capital-based theory of postmarital residence rules', *Journal of Law, Economics, and Organization*, vol. 23(1), pp. 208–41.
- Baker, M. and Jacobsen, J. (2007b). 'Marriage, specialization, and the gender division of labor', *Journal of Labor Economics*, vol. 25(4), pp. 763–93.
- Baker, M. and Miceli, T. (2005). 'Land inheritance rules: theory and cross-cultural analysis', *Journal of Economic Behavior & Organization*, vol. 56(1), pp. 77–102.
- Baker, M.J. (2003). 'An equilibrium conflict model of land tenure in hunter-gatherer societies', *Journal of Political Economy*, vol. 111(1), pp. 124–73.
- Baland, J.M. and Francois, P. (2005). 'Commons as insurance and the welfare impact of privatization', *Journal of Public Economics*, vol. 89(2–3), pp. 211–31.
- Baland, J.M. and Platteau, J.P. (2003). *Economics of Common Property Management Regimes*, vol. 1 of *Handbook of Environmental Economics*, pp. 127–90. Amsterdam: Elsevier.
- Banerjee, A. and Iyer, L. (2005). 'History, institutions, and economic performance: the legacy of colonial land tenure systems in India', *American Economic Review*, vol. 95(4), pp. 1190–213.
- Barzel, Y. (1977). 'An economic analysis of slavery', *Journal of Law and Economics*, vol. 20(1), pp. 87–110.
- Beber, B. and Blattman, C. (2013). 'The logic of child soldiering and coercion', *International Organization*, vol. 67(1), pp. 65–104.
- Berger, D. (2008). 'Taxes, institutions and local governance: evidence from a natural experiment in colonial Nigeria', Working Paper, New York University.
- Bergstrom, T. (1971). 'On the existence and optimality of competitive equilibrium for a slave economy', *Review of Economic Studies*, vol. 38(1), pp. 23–36.
- Bezemer, D., Bolt, J. and Lensink, R. (2009). 'Indigenous slavery in Africa's history: conditions and consequences', Paper Presented at the World Economic History Congress, Utrecht.
- Bogart, D. and Richardson, G. (2011). 'Property rights and parliament in industrializing Britain', *Journal of Law and Economics*, vol. 54(2), pp. 241–74.
- Boserup, E. (1965). *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure*. New York: Aldine.

- Bouwman, A., Kram, T. and Klein Goldewijk, K. (2006). *Integrated Modelling of Global Environmental Change: An Overview of Image 2.4*. Bilthoven: Netherlands Environmental Assessment Agency.
- Bruce, J., and Migot-Adholla, S. (1994). *Searching for Land Tenure Security in Africa*. Dubuque, IO: Kendall/Hunt Publishing Company.
- Bruhn, M. and Gallego, F. (2012). 'Good, bad, and ugly colonial activities: do they matter for economic development?', *Review of Economics and Statistics*, vol. 94(2), pp. 433–461.
- Bruk, S.I. and Apenchenko, V.S. (eds.) (1964). *Atlas Narodov Mira*. Moscow: Miklukho-Maklai Ethnological Institute at the Department of Geodesy and Cartography of the State Geological Committee of the Soviet Union.
- Bubb, R. (2009). 'States, law, and property rights in West Africa', Working Paper, Harvard University.
- Canarella, G. and Tomaske, J. (1975). 'The optimal utilization of slaves', *Journal of Economic History*, vol. 35(3), pp. 621–9.
- Chwe, M. (1990). 'Why were workers whipped? Pain in a principal-agent model', *ECONOMIC JOURNAL*, vol. 100(403), pp. 1109–121.
- Conley, T. (1999). 'GMM estimation with cross sectional dependence', *Journal of Econometrics*, vol. 92(1), pp. 1–45.
- Conning, J. (2004). 'The causes of slavery or serfdom and the roads to agrarian capitalism: Domar's hypothesis revisited', Department of Economics, Hunter College.
- Copeland, B. and Taylor, M. (2009). 'Trade, tragedy, and the commons', *American Economic Review*, vol. 99(3), pp. 725–49.
- Demsetz, H. (1967). 'Toward a theory of property rights', *American Economic Review*, vol. 57(2), pp. 347–59.
- Diamond, J.M. (1997). *Guns, Germs, and Steel: The Fates of Human Societies*. New York: W. W. Norton and Company.
- Dippel, C. (2010). 'Forced coexistence and economic development: evidence from Native American Reservations', Working Paper, University of Toronto.
- Domar, E.D. (1970). 'The causes of slavery or serfdom: a hypothesis', *Journal of Economic History*, vol. 30(1), pp. 18–32.
- Easterly, W. and Levine, R. (2003). 'Tropics, germs, and crops: how endowments influence economic development', *Journal of Monetary Economics*, vol. 50(1), pp. 3–39.
- Engerman, S.L. and Sokoloff, K.L. (1997). 'Factor endowments, institutions, and differential paths of growth among new world economies', in (S.H. Haber, ed.), *How Latin America Fell Behind. Essays on the Economic Histories of Brazil and Mexico, 1800–1914*, pp. 260–304, Stanford: Stanford University Press.
- Fenoaltea, S. (1984). 'Slavery and supervision in comparative perspective: a model', *The Journal of Economic History*, vol. 44(3), pp. 635–68.
- Fenske, J. (2012a). 'African polygamy: past and present', Working Paper, University of Oxford.
- Fenske, J. (2012b). 'Ecology, trade and states in pre-colonial Africa', *Journal of the European Economic Association*, forthcoming.
- Field, E. (2007). 'Entitled to work: urban property rights and labor supply in Peru', *Quarterly Journal of Economics*, vol. 122(4), pp. 1561–602.
- Findlay, R. (1975). 'Slavery, incentives, and manumission: a theoretical model', *Journal of Political Economy*, vol. 85(5), pp. 923–33.
- Fischer, G., Shah, M., Velthuisen, H. and Nachtergaele, F.O. (2002). *Global Agro-ecological Assessment for Agriculture in the 21st Century: Methodology and Results*. Laxenburg and Rome: International Institute for Applied Systems Analysis/Food and Agriculture Organization of the United Nations.
- Fogel, R.W. and Engerman, S.L. (1974). *Time on the Cross: The Economics of American Negro Slavery*. Boston, MA: Little, Brown and Company.
- Genicot, G. (2002). 'Bonded labor and serfdom: a paradox of voluntary choice', *Journal of Development Economics*, vol. 67(1), pp. 101–27.
- Gennaioli, N. and Rainer, I. (2007). 'The modern impact of precolonial centralization in Africa', *Journal of Economic Growth*, vol. 12(3), pp. 185–234.
- Goldstein, M. and Udry, C. (2008). 'The profits of power: land rights and agricultural investment in Ghana', *Journal of Political Economy*, vol. 116(6), pp. 981–1022.
- Goody, J. (1969). 'Inheritance, property, and marriage in Africa and Eurasia', *Sociology*, vol. 3(1), pp. 55–76.
- Grantham, G.W. (1980). 'The persistence of open-field farming in nineteenth-century France', *Journal of Economic History* vol. 40(3), pp. 515–31.
- Grossman, H.I. and Kim, M. (1995). 'Swords or plowshares? A theory of the security of claims to property', *The Journal of Political Economy*, vol. 103(6), pp. 1275–88.
- Hanes, C. (1996). 'Turnover cost and the distribution of slave labor in Anglo-America', *Journal of Economic History*, vol. 56(2), pp. 307–29.
- Hayami, Y. (1997). *Development Economics: From the Poverty to the Wealth of Nations*. Oxford: Oxford University Press.
- Heizer, R. and Sturtevant, W. (1978). *Handbook of North American Indians*. Washington, DC: Smithsonian Institution.

- Helders, S. (2000). *The World Gazetteer*. Available from <http://world-gazetteer.com>.
- Henige, D. (1998). *Numbers from Nowhere: The American Indian Contact Population Debate*, Norman, OH: University of Oklahoma Press.
- Herbst, J. (2000). *States and Power in Africa: Comparative Lessons in Authority and Control*, Princeton, NJ: Princeton University Press.
- Hopkins, A.G. (1973). *An Economic History of West Africa*, New York: Columbia University Press.
- Hopkins, A.G. (2009). 'The new economic history of Africa', *The Journal of African History*, vol. 50(02), pp. 155–77.
- Hotte, L., Long, N. and Tian, H. (2000). 'International trade with endogenous enforcement of property rights', *Journal of Development Economics*, vol. 62(1), pp. 25–54.
- Huillery, E. (2011). 'The impact of European settlement within French West Africa: did pre-colonial prosperous areas fall behind?', *Journal of African Economies*, vol. 20(2), pp. 263–311.
- Iliffe, J. (1995). *Africans: The History of a Continent*, Cambridge: Cambridge University Press.
- Klein Goldewijk, K. (2005). 'Three centuries of global population growth: a spatial referenced population (density) database for 1700–2000', *Population & Environment*, vol. 26(4), pp. 343–67.
- Klein Goldewijk, K., Beusen, A. and Janssen, P. (2010). 'Long-term dynamic modeling of global population and built-up area in a spatially explicit way: Hyde 3.1', *The Holocene*, vol. 20(4), p. 565–73.
- Krumhardt, K. (2010). 'Methodology for worldwide population estimates: 1000 BC to 1850', ARVE Technical Report no. 3.
- Lagerlöf, N.P. (2009). 'Slavery and other property rights', *Review of Economic Studies*, vol. 76(1), pp. 319–42.
- Lahmeyer, J. (2004). *Populstat Database. Growth of the Population per Country in a Historical Perspective, Including their Administrative Divisions and Principal Towns*, available from <http://www.populstat.info>.
- Lovejoy, P.E. (2000). *Transformations in Slavery: A History of Slavery in Africa*, Cambridge: Cambridge University Press.
- Lueck, D. (1994). 'Common property as an egalitarian share contract', *Journal of Economic Behavior & Organization*, vol. 25(1), pp. 93–108.
- McEvedy, C. and Jones, R. (1978). *Atlas of World Population History*, Harmondsworth: Penguin Books.
- Michalopoulos, S. (2012). 'The origins of ethnic diversity', *American Economic Review*, vol. 102(4), pp. 1508–39.
- Michalopoulos, S., Naghavi, A. and Prarolo, G. (2010). 'Trade and geography in the economic origins of Islam: theory and evidence', Fondazione Eni Enrico Mattei Working Papers.
- Michalopoulos, S. and Papaioannou, E. (2013). 'Pre-colonial ethnic institutions and contemporary African development', *Econometrica*, vol. 81(1), pp. 113–52.
- Miller, M. (2011). 'Land and racial wealth inequality', *American Economic Review*, vol. 101(3), pp. 371–6.
- Murdock, G.P. (1959). *Africa: Its Peoples and Their Culture History*, New York: McGraw-Hill.
- Murdock, G.P. (1967). *Ethnographic Atlas*, Pittsburgh, PA: University of Pittsburgh Press.
- Murdock, G. and White, D. (1969). 'Standard cross-cultural sample', *Ethnology*, vol. 8(4), pp. 329–69.
- Naidu, S. and Yuchtman, N. (2012). 'Coercive contract enforcement: law and the labor market in 19th century industrial Britain', *American Economic Review*, vol. 103(1), pp. 107–44.
- Netting, R.M. (1976). 'What alpine peasants have in common: observations on communal tenure in a Swiss village', *Human Ecology*, vol. 4(2), pp. 135–46.
- Nieboer, H.J. (1900). *Slavery as an industrial System, ethnological researches*, The Hague: M. Nijhoff.
- North, D.C. and Thomas, R.P. (1971). 'The rise and fall of the manorial system: a theoretical model', *Journal of Economic History*, vol. 31(4), pp. 777–803.
- Nunn, N. (2008a). 'The long-term effects of Africa's slave trades', *Quarterly Journal of Economics*, vol. 123(1), pp. 139–76.
- Nunn, N. (2008b). 'Slavery, inequality, and economic development in the Americas: an examination of the Engerman-Sokoloff Hypothesis', in (E. Helpman, ed.), *Institutions and Economic Performance*, pp. 148–81, Cambridge, MA: Harvard University Press.
- Nunn, N. and Puga, D. (2012). 'Ruggedness: the blessing of bad geography in Africa', *Review of Economics and Statistics*, vol. 94(1), pp. 20–36.
- Nunn, N. and Wantchekon, L. (2011). 'The slave trade and the origins of mistrust in Africa', *American Economic Review*, vol. 101(17), pp. 3221–52.
- Olsson, O. (2009). 'On the democratic legacy of colonialism', *Journal of Comparative Economics*, vol. 37(4), pp. 534–51.
- Olsson, O. and Hibbs, D. (2005). 'Biogeography and long-run economic development', *European Economic Review*, vol. 49(4), pp. 909–38.
- Ostrom, E. (1991). *Governing the Commons: The Evolution of Institutions for Collective Action*, Cambridge: Cambridge University Press.
- Quisumbing, M.A.R. and Otsuka, K. (2001). *Land, Trees, and Women: Evolution of Land Tenure Institutions in Western Ghana and Sumatra*, Washington, DC: IFPRI.
- Robertson, C.C. and Klein, M.A. (1983). 'Women's importance in African slave systems', in (C.C. Robertson, M.A. Klein, eds.), *Women and Slavery in Africa*, pp. 3–25. Madison, WI: University of Wisconsin Press.

- Rodrik, D., Subramanian, A. and Trebbi, F. (2004). 'Institutions rule: the primacy of institutions over geography and integration in economic development', *Journal of Economic Growth*, vol. 9(2), pp. 131–65.
- Ruff, C. (2006). *Population Size, Contact to Nadir. Handbook of North American Indians: Volume 3, Environment, Origins, and Population*, Washington, DC: Smithsonian Institution.
- Runge, C.F. (1986). 'Common property and collective action in economic development', *World Development*, vol. 14(5), pp. 623–35.
- Sacerdote, B. (2005). 'Slavery and the intergenerational transmission of human capital', *Review of Economics and Statistics*, vol. 87(2), pp. 217–34.
- Sachs, J. (2003). 'Institutions don't rule: direct effects of geography on per capita income', NBER Working Paper No. 9490.
- Tambiah, S.J. and Goody, J. (1973). *Bridewealth and Dowry*, Cambridge: Cambridge University Press.
- Tertilt, M. (2005). 'Polygyny, fertility, and savings', *Journal of Political Economy*, vol. 113(6), pp. 1341–71.
- Tobler, W. (1995). *The Global Demography Project: National Center for Geographic Information & Analysis (US)*, Santa Barbara, CA: National Center for Geographic Information and Analysis.
- Weidmann, N., Rød, J. and Cederman, L. (2010). 'Representing ethnic groups in space: a new dataset', *Journal of Peace Research*, vol. 47(4), pp. 491–9.
- Whatley, W. and Gillezeau, R. (2011). 'The impact of the transatlantic slave trade on ethnic stratification in Africa', *The American Economic Review*, vol. 101(3), pp. 571–6.
- Whatley, W.C. (2012). 'The Trans-Atlantic slave trade and the evolution of political authority in West Africa', in (E. Akyeampong, R. Bates, N. Nunn and J.A. Robinson, eds), *Africa's Development in Historical Perspective*, Cambridge: Cambridge University Press, forthcoming.