Environmental history

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Introduction

Question

- What is “environmental history,” and how can economists use it?

Motivation

- Environmental history provides hypotheses waiting to be modeled and tested. You can get several thesis or paper ideas by reading one book.
- There is substantial overlap between the questions asked by environmental historians and those asked by development economists, economic historians, and natural resource/ag economists... and anyone interested in long-run growth.
- Reading environmental history can make us look at these questions in new ways.

In this lecture

- I define “environmental history.”
- I outline some themes from the environmental history of Africa (the sub-field I know best).
- I describe two recent economics papers published in top journals that “look like” environmental history.
- I describe two recent papers of my own that “look like” environmental history.

What is environmental history?

- Nash (1972) *PHR*: "Environmental history would refer to the past contact of man with his total habitat." This definition casts "one of the broadest nets thrown by historians," because it goes "beyond the human dimension to embrace all life and, ultimately, the environment itself".
- Worster (1988) "Environmental history is the interaction between human cultures and the environment in the past."
- This is a "new" field within history. Nash coined the term in 1972, and The American Society for Environmental History was founded in 1975.
- Nash himself studied Americans' views towards "wilderness." The field has since spread to cover the rest of the world.

African environmental history?

- For this summary, I follow James McCann's "Green Land, Brown Land, Black Land".
- His aims: To show that African landscapes are anthropogenic. To explore how the physical world of plants, soils, climate and animals interacted with human action. To explore the history of "ideas, perceptions and prescriptions" of African cultures and colonial governments.
- I discuss two themes: Environment and state building in Africa, and (incorrect) narratives of environmental degradation.

Pre-colonial African states

Source: Wikipedia

Environment and state building in Africa

- The Sahel:
  - Between the 5th and 17th centuries, several large states emerged, including Ghana (c. 400-1250), Mali (c. 1250-1492), and Songhay (c. 1492-1591).
  - These had many common themes: central states based on tribute paid from smallholder cereal farms and revenues from trans-Saharan trade, especially in gold, slaves, cloth and leather.
  - G.E. Brooks and James Webb have studied movements in the Sahel (100-400 mm of rainfall) line over time and reached different conclusions about its relationship with states.
  - The 1000mm line marks the end of the savannah, the beginning of the woodland savannah, and importantly sleeping sickness, to which only Ndama cattle were immune.
  - Also: Sorgum and millet are drought-resistant but long-maturing and with low yields. Maize, post-1500, is the opposite.

Environment and state building in Africa

- The Sahel, cont:
  - Brooks tied activities such as cavalry raids and iron smithing to the shifts in ecological boundaries. In wetter periods, cereal farmers could expand settlements into the Sahel, pushing states closer to trans-Saharan trade routes.
  - These periods also pushed tsetse north, restraining cavalry, and hence raids to the south. Mali's expansion towards sources of gold and kola took place in dry periods, e.g. 1250-1450.
  - Djenne and Timbuktu emerged as regional hubs during what Nicholson thought was a humid period.
  - Dry conditions in the Sahel forced Tuareg camel pastoralists south, and they established control of Timbuktu in 1483. Southern enemies, such as the Mossi, could now use horses against Mali.
  - Songhay, similarly, gained from trade during the 1500-1630 wet period, but these riches also tempted the Moroccan king to conquer it.

Environment and state building in Africa

- The Sahel, cont:
  - Problems? Brooks doesn't have precise data: Nicholson gives estimates of wet and dry periods that disagree with his. He doesn't account for year-to-year changes.
  - Webb, similarly, notices increasing aridity after 1600, and uses the dynamics of zones such as the "Sahelian Cattle Zone" to interpret the region's history.
  - By 1850, the SCZ was some 250km south of where it was in 1600; pastures that nourished cattle now only supported camel herding.
  - As the desert moved south, the slave frontier did as well.
  - Point? "The physical environment of the great empire states was not a fixed canvas, but a shape-shifting stage that demanded a continuing set of adaptations of economic base and political structure."

Environment and state building in Africa

- Great Zimbabwe:
  - Peaking between 1250 and 1450, GZ was bounded between the Zambezi and Limpopo, Kalahari, and eastern coastal plain.
  - Located 1000m above sea level, GZ participated in an Indian Ocean trade network involving Swahili city states such as Kilwa, Lamu, Mombasa, and Malindi.
  - No written travelers accounts survive, though oral traditions do. Archaeology suggests that settlement and stone structures on the Zimbabwean plateau coincide with the rise of the Indian Ocean trade system, as early as the 9th century.
  - GZ was the major source of gold for the East African trade.
  - Here, the rainy season runs Nov-March; sorghum, millet and squashes could be grown, but perhaps one in five seasons suffered drought. So how did they feed themselves? Cattle – more than 98% of 15,000 bones out of one sample of 140,000 were cattle, and generally immature (so not pastoral; used for beef).
  - Unlike the areas around it, the zone is tsetse free.
  - After 1500, GZ disappears from the archaeological record. McCann suggests exhaustion of easily accessible gold or increasing moisture.

Desertification? Deforestation?

- “The Desert Doesn’t Bloom Here Anymore”
    - A 1987 documentary on *Nova*: argued that in both Burkina Faso and the American West, mismanagement had led to declining productivity; in BF this was the removal of vegetative cover and the advancing Sahara.
    - Implicit was Otterman’s thesis that removing vegetation increases reflectivity and reduces rainfall. Colonial officials too in West Africa had worried about manmade desertification.
    - The narrative of the 1984-85 Ethiopian famine was also of “land degradation in arid, semi-arid and dry sub-human areas resulting mainly from adverse human impact.”
    - ...but Nicholson estimates that rainfall in the Sahel and Soudan has dropped dramatically since the 1970s.
    - ... and Peter Lamb has shown us that ocean temperatures that move the ITCZ are much more important in determining African rainfall.
    - So, let’s re-evaluate some cases of deforestation.

Desertification? Deforestation?

- "Misreading the African landscape" in Guinea
  - A forest/savanna mosaic near Kissidougou, with islands of forest concentrated around villages.
  - From 1893 onwards, French and later independent Guinean policy assumed humans had broken down the natural vegetation, extending savanna grasslands into historically forested zones, and sough to change people's behaviors.
  - Fairhead and leach looked at aerial photos (mostly) plus some fieldwork and archival work to turn this narrative on its head.
  - In the region, settlements spring up near gallery forests and wetlands for protection from dry season fires.
  - Everyday life builds these forests: gathering thatch, reducing flammable materials, creating fire-free zones around settlements, mounding, incorporating organic matter into the soil, tethering of livestock.
  - As these forests grow, villagers use them for forest products and for planting kola, banana and coffee.

Desertification? Deforestation?

- Machakos, Kenya: Boserup or Malthus?
  - Colonial officials believed the Machakos Reserve was denuded of vegetation and at risk of massive gully erosion because of uncontrolled cultivation and herding by the local Wakamba. A desert was imminent.
  - 1990s. No desert. Mortimer, Tiffen, and Gichuki investigate using a similar approach to Fairhead and Leach.
  - c. 1900, the Wakamba cultivated in the hills and grazed in the plains, and there was no evidence of erosion, but early impressions were colored by the effects of drought and rinderpest.
  - British protection from Masaii raids allowed cultivation on lower slopes and plains
  - From 1906, the area was bounded by White farms, Crown land, and tsetse-infested bush. Several droughts followed.
  - Colonial reports noticed desiccation, but were compounding 1) the hemming in of land, 2) the first phases of occupying the lower slopes and plains, and 3) drought. Their conclusions focused on human misuse, in part because they had been reading about the American Dust Bowl.

Desertification? Deforestation?

- Machakos, Kenya: Boserup or Malthus? cont:
    - MTG, in "More people, Less erosion" use photographs to show that the situation has improved, due to farmers' conservation investments since 1960. Population growth helps market development and knowledge transmission, supporting conservation.

Desertification? Deforestation?

- Ethiopia. Earth in the balance?
  - Al Gore, in "Earth in the balance," claimed Ethiopia had gone from 40% forested to 1% forested, 1950-1990.
  - Source? A 1961 FAO document stated that 40% forest cover in 1900 had become 4% in 1960, but cites no source.
  - Possibly, the source was the author of a 1962 article claiming 37% was historically forest, based on its climatic potential for forest cover.
  - Logan's 1946 "An Introduction to the Forests of Central and Southern Ethiopia" speculated that 5% was forested in 1946.
  - The UNDP and WB in 1983 published the 40% historical forest cover figure: the Ethiopian government began quoting it.
  - The Ethiopian Relief and Rehabilitation Commission in 1985 stated that 44% was forest in 1885, 16% in 1950, and 4% in 1985. Members of the Forestry Department quoted the figures in the 1990s.

Desertification? Deforestation?

- Ethiopia. Earth in the balance? Cont:
  - But we know terracing, irrigation, contour ploughing, oxplow cultivation, elaborate crop rotation, and fertilizing with manure and hearth ashes, all date very far back in Ethiopian history.
  - Go back to the nineteenth century. Photographs, drawings, and descriptions of highland Ankober show it to be devoid of trees.
  - There are non-human reasons why trees might not be present – fire favors grass, native tree species tend to collect in well drained valleys or near natural fire breaks.
  - Trees at the time were cultivated – figs, junipers, and forested niches used for firewood over which there was royal control. People then relied on alternative fuels, especially dung, which today is seen to indicate a deforestation crisis.

Hornbeck: Overview

The Enduring Impact of the American Dust Bowl: Short- and Long-Run Adjustments to Environmental Catastrophe†

By Richard Hornbeck*

The 1930s American Dust Bowl was an environmental catastrophe that greatly eroded sections of the Plains. The Dust Bowl is estimated to have immediately, substantially, and persistently reduced agricultural land values and revenues in more-eroded counties relative to less-eroded counties. During the Depression and through at least the 1950s, there was limited relative adjustment of farmland away from activities that became relatively less productive in more-eroded areas. Agricultural adjustments recovered less than 25 percent of the initial difference in agricultural costs for more-eroded counties. The economy adjusted predominantly through large relative population declines in more-eroded counties, both during the 1930s and through the 1950s. (*JEL* N32, N52, Q15, Q18, Q54)

Hornbeck: Context

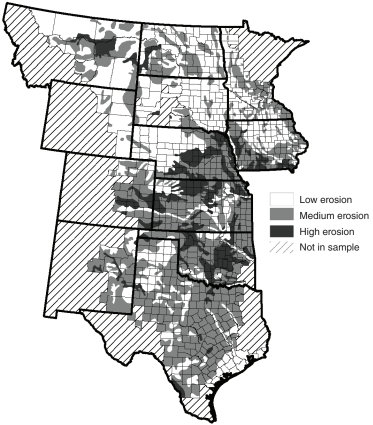


Figure 2. The 779 Main Sample Counties, Shaded by Erosion Level

Notes: Mapped erosion levels are indicated as low (less than 25 percent of topsoil lost), medium (25 percent to 75 percent of topsoil lost and may have some gullies), or high (more than 75 percent of topsoil lost and may have numerous or deep gullies). Thin lines denote 1910 county borders, corresponding to the main sample of 779 counties described in Table 1. Thick lines denote state boundaries. Crossed out areas are not in the sample.

Source: National Archives (College Park, MD), RG 114, Cartographic Records of the Soil Conservation Service, #149.

Hornbeck: Specification

IV. Empirical Framework

The empirical analysis is based on estimating average changes for more-eroded counties, relative to changes for less-eroded counties in the same state and with similar pre-1930s characteristics. Formally, outcome Y_{ct} in county c and year t is differenced from its value in 1930. This difference is regressed on the fraction of the county in medium-erosion (M_c) and high-erosion (H_c) regions, a state-by-year fixed effect (α_{st}), pre-1930s county characteristics (X_c), and an error term (ϵ_{ct}):

$$Y_{ct} - Y_{c1930} = \beta_{1t} M_c + \beta_{2t} H_c + \alpha_{st} + \theta_t X_c + \epsilon_{ct}. \tag{1}$$

Note that the effects of erosion and each county characteristic are allowed to vary in each year. The sample is balanced in each regression; i.e., every county included has data in every analyzed period.[26]

The included controls for county characteristics are the variables in panels B

Hornbeck: Results

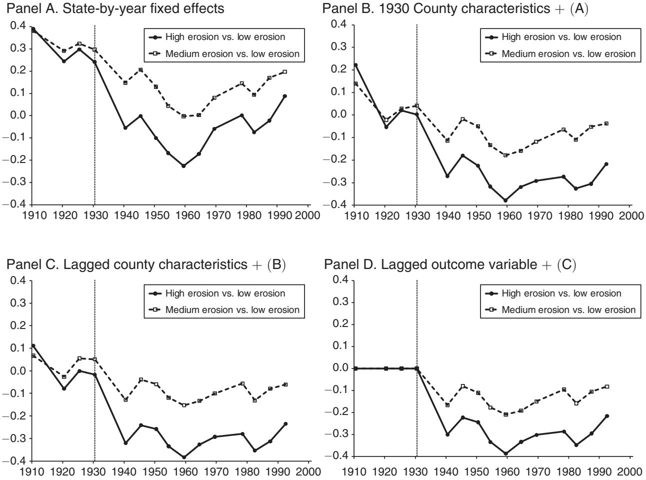


FIGURE 3. ESTIMATED DIFFERENCES IN LOG VALUE OF FARMLAND PER ACRE, BY EROSION LEVEL

Hornbeck: Results

TABLE 2—ESTIMATED CHANGES IN AGRICULTURAL LAND VALUE AND REVENUE, BY EROSION LEVEL

	Change after 1930		
	Log land value (1)	Log revenue (2)	Ratio: (1)/(2) (3)
Panel A. 1940			
High erosion versus low erosion	−0.300** (0.038)	−0.267** (0.055)	1.123** (0.184)
Medium erosion versus low erosion	−0.166** (0.030)	−0.155** (0.040)	1.069** (0.226)
High erosion versus medium erosion (calculated)	−0.134** (0.032)	−0.112* (0.051)	1.197** (0.418)
Averaged value (GLS)			1.109** (0.174)
Panel B. 1945			
High erosion versus low erosion	−0.223** (0.036)	−0.107** (0.038)	
Medium erosion versus low erosion	−0.080** (0.027)	−0.100** (0.030)	
Panel C. 1950–1954 (pooled)			
High erosion versus low erosion	−0.289** (0.041)	−0.240** (0.049)	
Medium erosion versus low erosion	−0.144** (0.032)	−0.187** (0.037)	
Panel D. 1959–1969 (pooled)			
High erosion versus low erosion	−0.340** (0.044)	−0.257** (0.058)	
Medium erosion versus low erosion	−0.183** (0.036)	−0.118** (0.042)	
Panel E. 1978–1992 (pooled)			
High erosion versus low erosion	−0.286** (0.049)	−0.297** (0.080)	
Medium erosion versus low erosion	−0.110** (0.041)	−0.034 (0.060)	
R^2	0.972	0.921	
Sample counties	779	779	

Notes: Columns 1 and 2 report estimates from equation (1) in the text, for the log value of agricultural land and buildings per acre of farmland (column 1) and the log value of agricultural revenue per acre of farmland (column 2). Column 1 corresponds to panel D of Figure 3, where the estimated coefficients are pooled across the indicated years in each panel. Column 3 reports the ratio of the estimated coefficients in panel A of columns 1 and 2. Reported in parentheses are robust standard errors clustered by county.

Hornbeck: Adjustment

TABLE 3—ESTIMATED CHANGES IN AGRICULTURAL PRODUCTION AFTER 1930, BY EROSION LEVEL

	Farmland share (1)	Log cropland productivity (2)	Log pasture productivity (3)	Land share in cropland (4)	Log wheat productivity (5)	Log hay productivity (6)	Land share in wheat (7)
Panel A. High erosion versus low erosion							
1940	−0.025	−0.390**	−0.224**	−0.000	−0.156		0.035
	(0.017)	(0.120)	(0.044)	(0.009)	(0.115)		(0.022)
1945	−0.017	−0.141	−0.116*	−0.012	−0.194**		
	(0.016)	(0.074)	(0.053)	(0.011)	(0.070)		
1950–1954	−0.037*	−0.382**	−0.116*	−0.030*	−0.230**	0.019	0.017
	(0.016)	(0.068)	(0.053)	(0.014)	(0.068)	(0.047)	(0.021)
1959–1964	−0.043**	−0.333**	−0.244**	−0.060**	−0.214**	0.089*	−0.001
	(0.016)	(0.077)	(0.074)	(0.017)	(0.075)	(0.045)	(0.022)
1969–1974	−0.013				0.021	0.143**	−0.039
	(0.015)				(0.058)	(0.044)	(0.025)
1978–1992	−0.050**				−0.011	0.210**	−0.066*
	(0.016)				(0.045)	(0.046)	(0.028)
1997					0.008	0.139*	−0.102**
					(0.056)	(0.064)	(0.032)
Panel B. Medium erosion versus low erosion							
1940	−0.019	−0.381**	−0.060	−0.003	−0.086		−0.008
	(0.013)	(0.089)	(0.038)	(0.006)	(0.085)		(0.017)
1945	0.004	−0.289**	−0.052	−0.008	−0.064		
	(0.012)	(0.062)	(0.040)	(0.007)	(0.049)		
1950–1954	−0.008	−0.313**	−0.014	−0.018	−0.181**	0.017	−0.002
	(0.013)	(0.056)	(0.041)	(0.010)	(0.065)	(0.045)	(0.020)
1959–1964	−0.025	−0.275**	0.006	−0.028*	−0.257**	0.041	−0.026
	(0.014)	(0.068)	(0.054)	(0.012)	(0.062)	(0.046)	(0.021)
1969–1974	−0.011				−0.039	−0.028	−0.070**
	(0.012)				(0.044)	(0.036)	(0.023)
1978–1992	−0.026*				−0.064*	−0.004	−0.110**
	(0.013)				(0.033)	(0.039)	(0.023)
1997					−0.066	−0.016	−0.138**
					(0.050)	(0.050)	(0.025)
R^2	0.656	0.791	0.850	0.679	0.890	0.823	0.435
Sample counties	779	779	779	779	421	421	421
Weighted by 1930 value of:	Farmland	Cropland	Pasture	(2) + (3)	Wheat	Hay	(5) + (6)

Notes: Each column reports estimates from equation (1) in the text: farmland per county acre (column 1), log crop revenue per cropland acre (column 2), log animal revenue per pasture acre (column 3), cropland per acre of cropland and pasture (column 4), log wheat output per wheat acre (column 5), log hay output per hay acre (column 6)

Hornbeck: General equilibrium

TABLE 4—ESTIMATED CHANGES IN POPULATION AND MANUFACTURING AFTER 1930, BY EROSION LEVEL

	Log population (1)	Log mfg. establishments (2)	Mfg. workers per capita (3)	Unemployment rate (4)	Log retail sales per capita (5)
Panel A. High erosion versus low erosion					
1940	−0.116**	−0.015	0.003	0.010**	−0.122**
	(0.021)	(0.069)	(0.002)	(0.003)	(0.029)
1950	−0.180**	−0.183**		−0.004	
	(0.047)	(0.067)		(0.002)	
1960	−0.267**	−0.188*	0.005		−0.066*
	(0.072)	(0.082)	(0.007)		(0.029)
1970	−0.268**	−0.104	0.006		−0.044
	(0.088)	(0.100)	(0.010)		(0.037)
1980	−0.250*	−0.041	0.013		−0.093*
	(0.101)	(0.117)	(0.013)		(0.043)
1990	−0.227*	−0.087	0.010		−0.090
	(0.114)	(0.136)	(0.012)		(0.051)
Panel B. Medium erosion versus low erosion					
1940	−0.088**	−0.100*	−0.001	0.003	−0.066**
	(0.017)	(0.047)	(0.002)	(0.002)	(0.021)
1950	−0.145**	−0.084		−0.002	
	(0.033)	(0.046)		(0.002)	
1960	−0.236**	−0.139*	0.005		0.023
	(0.054)	(0.062)	(0.005)		(0.021)
1970	−0.246**	−0.116	0.012		0.041
	(0.070)	(0.075)	(0.008)		(0.026)
1980	−0.251**	−0.036	0.018*		−0.021
	(0.082)	(0.092)	(0.009)		(0.032)
1990	−0.223*	−0.026	0.024**		−0.013
	(0.094)	(0.107)	(0.008)		(0.039)
R^2	0.654	0.637	0.612	0.866	0.998
Sample counties	779	516	287	779	758

Notes: Each column reports estimates from equation (1) in the text for the indicated outcome variable. In columns 2, 3, and 5, manufacturing and retail data are combined with population data from the nearest decade and the estimated coefficients are pooled over the following years: 1945 and 1954 for 1950; 1959 and 1964 for 1960; 1969 and 1974 for 1970; 1978 and 1982 for 1980; 1987 and 1992 for 1990. All regressions are weighted by county population in 1930. Reported in parentheses are robust standard errors clustered by county.

** Significant at the 1 percent level.

* Significant at the 5 percent level.

Chaney: Overview

Revolt on the Nile: Economic Shocks, Religion and Political Power

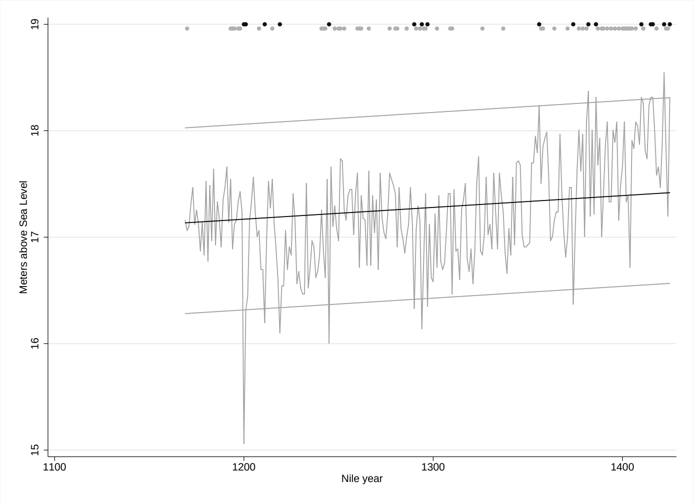
Eric Chaney*

Keywords: Political economy; Religion; Economic shocks; Social conflict; Political power

Abstract

Using centuries of Nile flood data, I document that during deviant Nile floods Egypt's highest-ranking religious authority was less likely to be replaced and relative allocations to religious structures increased. These findings are consistent with historical evidence that Nile shocks increased this authority's political influence by raising the probability he could coordinate a revolt. I find that the available data provide support for this interpretation and weigh against some of the most plausible alternatives. For example, I show that while Nile shocks increased historical references to social unrest, deviant floods did not increase a proxy for popular religiosity. Together, the results suggest an increase in the political power of religious leaders during periods of economic downturn.

Chaney: Context



Chaney: Results

Table 2: **Nile Shocks, Judge Replacement and Monument Construction**

	Dependent Variable: Judge Replaced on [t,t+1)					Standardized Monuments				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Shock	-23.75***	-24.00***	-33.50***	-30.00***	-34.33***	87.88**	86.21**	95.49*	70.32*	81.31*
	(3.95)	(4.13)	(6.78)	(5.85)	(6.97)	(43.29)	(41.39)	(54.40)	(39.71)	(42.19)
AR(10)	[0.05]	[0.09]	[0.00]	[0.93]	[0.72]	[0.01]	[0.02]	[0.00]	[0.64]	[0.45]
p-value (5 leads)				[0.20]					[0.91]	
p-value (5 lags)				[0.45]					[0.66]	
p-value (10 leads)					[0.47]					[0.88]
p-value (10 lags)					[0.00]					[0.87]
Dynasty Dummies?	No	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes
Decade Dummies?	No	No	Yes	No	No	No	No	Yes	No	No
N	257	257	257	257	257	257	257	257	257	257

Notes: the dependent variable in columns (1)-(5) is a dummy equal to one if the incumbent judge at start of Nile year t is replaced in the following year, whereas the dependent variable in columns (6)-(10) is a standardized measure of the relative allocation of new constructions to religious structures as explained in the text. In columns (1)-(5) I report 100 times the estimated coefficient. Shock is an indicator variable equal to one if the flood residual is in the upper 5% or lower 5% of the flood distribution. The row labeled AR(10) provides the p-value for the Breusch-Godfrey test with the null hypothesis of no autocorrelation up to 10 lags. The rows p-value provide the p-value for the test of the null hypothesis that the coefficients on the stated number of leads and lags of Nile shocks are jointly equal to zero. Standard errors assuming the error structure is autocorrelated up to ten lags and heteroscedastic are presented in parentheses, aside from those in columns (4),(5),(9) and (10) which are robust to heteroscedasticity. ***, **and *indicate significance at the 1%, 5% and 10% levels.

Chaney: Mechanisms

Table 3: **Possible Causal Channels**

	Prayer	Judge	Judge	Crusade	Judge	High Prices	Unrest	Sultan	Sultan	Judge
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Shock	-31.34***		-39.93***	-14.96		111.20***	85.25*	1.59		
	(11.06)		(8.45)	(27.58)		(36.21)	(49.69)	(7.53)		
Shock*Baseline		-33.50***								
		(6.76)								
Shock*Early		-7.61								
		(7.28)								
MalikiShock			-13.43**							
			(5.70)							
HanafiShock			13.06							
			(14.58)							
HanbaliShock			0.37							
			(7.33)							
(Crusade)/100					-3.97*					
					(2.05)					
Shock5									28.42*	
									(15.87)	
(High Prices)/100										-30.13**
										(12.55)
										[-56.80, -10.51]
p-value		[0.01]	[0.00]							
Estimation	OLS	OLS	SUR	OLS	OLS	OLS	OLS	OLS	OLS	IV
N	254	785	160	254	254	254	254	528	528	254
Sample	Maq.	≤ 1425	$(1265, 1425]$	Maq.	Maq.	Maq.	Maq.	Ind.	Ind.	Maq.

Notes: the dependent variable in the columns marked Judge (Sultan) is a dummy equal to one if the incumbent judge (sovereign) at the start of Nile year t is replaced in the following year. In these columns I report 100 times the estimated coefficient. The columns Prayer, Crusade, High Prices and Unrest denote the use of standardized measures of the extent to which prayer, Crusaders, high prices and unrest are mentioned in Maqrizi's chronicle as described in the text and appendix. Shock is an indicator variable equal to one if the flood residual is in the upper 5% or lower 5% of the flood distribution. Shock5 is an indicator variable equal to one if the flood residual is in the upper 2.5% or lower 2.5% of the flood distribution. The entries MalikiShock, HanafiShock and HanbaliShock provide the coefficient on the variable Shock in regression (1) estimated using SUR when head judge replacements from the Maliki, Hanafi and Hanbali schools are used as the dependent variable (the coefficient on the Shafii head judge is provided in the first row of column 3). The row p-value provides the p-value corresponding to the test that all the provided coefficients in the column are equal. In the row sample, Maq. denotes the years in the baseline sample in which the variables constructed using Maqrizi's chronicle are available ([1172,1425]) and Ind. denotes years in which Egypt was not a province of a larger dynasty prior to 1425 in both the early and baseline samples. Standard errors assuming the error structure is autocorrelated up to ten lags and heteroscedastic are presented in parentheses aside from those in column (3) where they are robust to heteroscedasticity. All regressions include decade dummies. ***, **and *indicate significance at the 1%, 5% and 10% levels.

Fenske: Overview

ECOLOGY, TRADE AND STATES IN PRE-COLONIAL AFRICA

James Fenske
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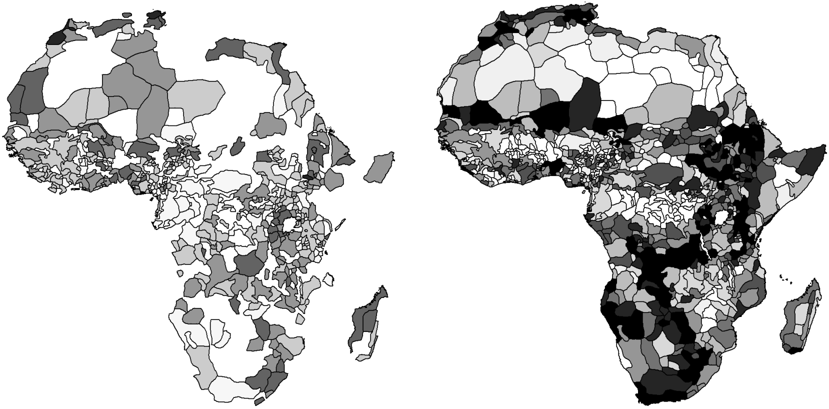
Abstract
State capacity matters for growth. I test Bates' explanation of pre-colonial African states. He argues that trade across ecological boundaries promoted states. I find that African societies in ecologically diverse environments had more centralized states. This is robust to reverse causation, omitted heterogeneity, and alternative interpretations of the link between diversity and states. The result survives including non-African societies. I test mechanisms connecting trade to states, and find that trade supported class stratification between rulers and ruled. I underscore the importance of ethnic institutions and inform our knowledge of the effects of trade on institutions. (JEL: N57, O10)

Fenske: Data



Fenske: Main result

Table 2. Ecological diversity predicts states

	(1)		(2)		(3)		(4)	
	State centralization							
	Sub-Saharan Africa						*Whole world*	
Ecological diversity	0.794***		0.484**		0.442**			
	(0.266)		(0.207)		(0.192)			
Eco. Div. (FAO)							0.446**	
							(0.184)	
Other controls	No		Yes		Yes		Yes	
UN Region FE	No		No		Yes			
Observations	440		440		440		1,077	
Pseudo R-squared	0.0111		0.0724		0.0809		0.171	
	Marginal effects							
	Continuous	*> median*	*Continuous*	*> median*	*Continuous*	*> median*	*Continuous*	*> median*
0 levels	-0.259***	-0.108***	-0.151**	-0.065***	-0.137**	-0.060***	-0.177**	-0.050
	(0.087)	(0.033)	(0.065)	(0.024)	(0.058)	(0.022)	(0.073)	(0.035)
1 level	-0.022	-0.009	-0.016	-0.007	-0.015	-0.007	0.065**	0.018
	(0.038)	(0.016)	(0.019)	(0.008)	(0.016)	(0.007)	(0.029)	(0.013)
2 levels	0.152***	0.063***	0.103**	0.045***	0.095**	0.042***	0.071**	0.020
	(0.052)	(0.019)	(0.045)	(0.016)	(0.041)	(0.015)	(0.030)	(0.014)
3 levels	0.118***	0.050***	0.062**	0.027**	0.054**	0.024***	0.035**	0.010
	(0.044)	(0.018)	(0.027)	(0.011)	(0.024)	(0.009)	(0.015)	(0.007)
4 levels	0.010	0.004	0.003	0.001	0.002	0.001	0.006**	0.002
	(0.008)	(0.003)	(0.003)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)

*** p<0.01, ** p<0.05, * p<0.1. Regressions estimated by ordered probit. Standard errors in parentheses clustered by region. Coefficient estimates where ecological diversity is replaced with an "above median" indicator are not reported. Other controls in columns (1), (2) and (3) are log area, major river, agricultural constraints, distance to coast, elevation, malaria, precipitation, ruggedness, temperature, distance to Lake Victoria, distance from the Atlantic and Indian Ocean slave trades, and dummies for crop type, unless otherwise specified. Other controls in column (4) are log area, land quality, distance from coast, elevation, malaria, rainfall, temperature, date, crop dummies, major river, ruggedness and absolute latitude.

Fenske: IV

Table 3. The main result is robust to reverse causation

	(1)	(2)	(3)	(4)
	OLS: Baseline		*IV*	
	State centralization			
Ecological diversity	0.358**	0.440**	1.998*	2.875*
	(0.147)	(0.203)	(1.124)	(1.689)
Other controls	Yes	Yes	Yes	Yes
Observations	440	370	440	370
F-statistic			48.98	7.979
	(5)	(6)	(7)	(8)
	OLS: Reduced form		*OLS: First Stage*	
	State centralization		*Ecological diversity*	
Log rainfall range	0.058**	0.136*	0.029***	0.047***
	(0.027)	(0.079)	(0.004)	(0.016)
Other controls	Yes	Yes	Yes	Yes
Observations	440	370	440	370

*** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses clustered by region. Other controls are log area, major river, agricultural constraints, distance to coast, elevation, malaria, precipitation, ruggedness, temperature, distance to Lake Victoria, distance from the Atlantic and Indian Ocean slave trades, and dummies for crop type, unless otherwise specified. The excluded instrument is the log rainfall range. In columns 3, 5, and 7, missing values of the log rainfall range are recoded to zero. In columns 2, 4, 6, and 8, these observations are excluded.

Fenske: Bonus result

Table 6. Ecological diversity is an instrument for state centralization

	(1)	(2)	(3)	(4)
	OLS	*IV*	*OLS*	*OLS*
	Light Density			
State centralization	0.279***	0.810**		0.263***
	(0.066)	(0.361)		(0.067)
Ecological diversity			0.618**	0.417
			(0.259)	(0.256)
Other controls	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Kleibergen-Paap F		12.09		
Observations	683	683	683	683

*** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses clustered by region. Other controls are distance to capital, distance to coast, distance to border, log water area, log land area, elevation, suitability for agriculture, malaria ecology, petroleum and diamonds.

Fenske and Kala: What we do

- Match gridded annual reconstructions of temperature anomalies with port-level annual data on slave exports (1730-1866).
- Show that
  1. ports exported fewer slaves in warmer years (years of lower agricultural productivity (Tan and Shibasaki, 2003; Lobell and Field, 2007)).
  2. the effect of temperature was greatest where agriculture is most sensitive to temperature.
  3. both climate trends and shocks around them can explain slave exports.
  4. historical temperature anomalies, particularly those at the peak of the slave trade, predict contemporary luminosity around ports.
- Provide a simple model in which agricultural TFP shocks reduce slave exports: we argue that higher temperatures raised the costs of harvesting slaves, due to greater costs of taxation, disorder, higher mortality, and lower productivity in supporting sectors.
- Validate this model using case studies of three influential ports: Benguela, Whydah, and Mozambique.

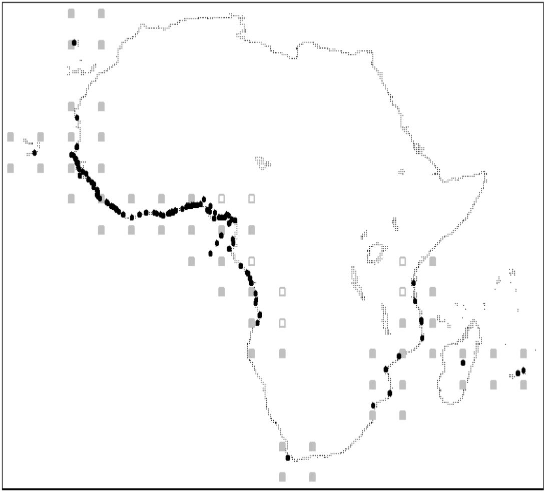
Fenske and Kala: Specification

- We estimate:

$$slaves_{i,t} = \beta temperature_{i,t} + \delta_i + \eta_t + \epsilon_{i,t}.$$

- $slaves_{i,t}$ is the number of slaves exported in year t from port i.
- $temperature_{i,t}$ is the temperature for port i in year t.
- δ_i and η_t are port and year fixed effects.
- This is estimated using a tobit.
- Standard errors are clustered by nearest climate point X year, since there are fewer climate points than ports.
- We will find $\beta < 0$.

Fenske and Kala: Data



Fenske and Kala: Main result

	(1)
Temperature	-3,052.036***
	(589.096)
Year F.E.	Y
Port F.E.	Y
Observations	18,358
Standard errors clustered by	
Year	(786.560)
Artificial square	(633.235)

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by closest climate point X year in parentheses. The dependant variable is slave exports. All regressions are tobit.

Fenske and Kala: Mechanism

	(1)
Temperature X Desert	-3,862.479**
	(1,888.139)
Temperature X Dry Savannah	-3,924.739***
	(706.096)
Temperature X Sub-humid	-2,643.011***
	(863.810)
Temperature X Moist Savannah	-1,570.826*
	(801.907)
Temperature X Humid forest	239.193
	(946.407)
Year F.E.	Y
Port F.E.	Y
Obs.	18,358

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Standard errors clustered by closest climate point X year in parentheses. The dependent variable is slave exports. All regressions are tobit.

Fenske and Kala: Robustness 1

- Heterogeneity: Port linear trends. Region quadratic trends. Include anomalies at the nearest/modal New World port. Include anomalies in shipping countries. Include prices in Africa and New World. Estimate pre-and-post 1807. Drop inactive ports. Effects are concentrated in the periods 1742-58, 1780-1790, and 1827-1845. No difference in El Nino years. Weakly significant stronger effect for larger ports.
- Measurement: Use "known" slaves. Use closest temperature point. Use slaves arriving at destination ports. Use slaves normalized by population density in 1700. Most slaves came from near the coast. "Ethnic"-level shocks.
- Level of observation: Collapse data into 1-degree by 1-degree (and 5-degree by 5-degree) boxes. Collapse to modern countries. Collapse to regions.
- Outliers: Remove influential observations. Remove the bottom 50% of ports. Remove bottom 50% of years by port. Drop each region.
- Estimation: Use OLS + Conley's OLS. Use whether port exported any slaves as outcome. First Differences. Port mean anomaly in place of fixed effects. Lag temperature as control. Include running means/variances of slave exports/temperature. Replace year F.E. with trends.

Fenske and Kala: Robustness 2

- Alternative mechanisms: Ships sink more in colder years, not less. Wind speed falls by very little. Modern temperature shocks are quite correlated over space. Shocks to interior ethnic groups give similar results. There are no heterogeneous effects for cattle-keepers or in tsetse-suitable areas.

- Lag slave exports: Include lag slaves. Instrument for lag slaves with lag difference. Port mean anomaly, year F.E., lag slave exports, and initial slave exports. OLS with Lag. Arellano-Bond.

Fenske and Kala: Bonus result

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Anomaly	0.004**	0.004**	0.065***	0.050***	0.139***	0.059**	0.166***	0.050***
	(0.002)	(0.002)	(0.022)	(0.019)	(0.050)	(0.027)	(0.045)	(0.017)
Controls	N	Y	Y	Y	Y	Y	Y	Y
Time Period	All	All	1730s	1740s	1750s	1760s	1770s	1780s
Obs.	134	134	134	134	134	134	134	134
R2	0.061	0.466	0.482	0.478	0.484	0.464	0.500	0.480
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Anomaly	0.037**	0.050**	0.019	0.036	0.044*	0.031*	0.035*	0.047*
	(0.018)	(0.023)	(0.026)	(0.033)	(0.026)	(0.018)	(0.020)	(0.028)
Controls	N	Y	Y	Y	Y	Y	Y	Y
Time Period	1790s	1800s	1810s	1820s	1830s	1840s	1850s	1860s
Obs.	134	134	134	134	134	134	134	134
Removed	0.465	0.474	0.444	0.449	0.458	0.456	0.461	0.459

Notes: ***Significant at 1%, **Significant at 5%, *Significant at 10%. Robust standard errors in parentheses. The dependent variable is luminosity. All regressions are OLS. Controls are absolute latitude, longitude, number of luminosity points, AEZ dummies, distance to the nearest port of slave demand, and average temperature over the period 1902-1980.

Conclusion

- Environmental history is a useful field for economists seeking research ideas.
- The environment matters for outcomes we care about. Often, it is measurable. Sometimes, it is exogenous. Occasionally, we can learn something about economics by researching it.