

The Origins and Long-Run Consequences of the Division of Labor

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UCSB, January 2017

Division of Labor & Comparative Development

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"The greatest improvement in the productive powers of labour, and the greater part of the skill, dexterity, and judgment with which it is any where directed, or applied, seem to have been the effects of the division of labour."

Adam Smith (1776)

Main Question

What are the deep historical determinants
and the long-run consequences
of the division of labor in pre-modern times?

A Deep Root of the Division of Labor

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- Population Diversity

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- Population Diversity
 - Diverse pool of:

A Deep Root of the Division of Labor

- Population Diversity
 - Diverse pool of:
 - Preferences

A Deep Root of the Division of Labor

- Population Diversity
 - Diverse pool of:
 - Preferences
 - Skills

A Deep Root of the Division of Labor

- Population Diversity
 - Diverse pool of:
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 - Skills
 - Knowledge

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- Population Diversity
 - Diverse pool of:
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 - Knowledge
 - Human capital

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⇒ Higher complementarities

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- with environment

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⇒ Higher complementarities

- between workers
- with environment

⇒ Higher economic specialization and division of labor

Example: Population Diversity and Specialization

Gauls around the time of Julius Caesar 100 BCE

Example: Population Diversity and Specialization

Gauls around the time of Julius Caesar 100 BCE



Example from Sample



Konso
No State
High Diversity (0.73)
High Specialization (5)



Aché
No State
Low Diversity (0.47)
Low Specialization (0)

Example from Sample



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Low Diversity (0.47)

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5 SD difference in both Diversity and Specialization

The Persistent Consequences of Division of Labor

- Division of labor in pre-modern times promoted:

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 - Productivity

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⇒ Centralized Institutions

Example from Sample (Cont.)



Konso

High Diversity (0.73)
High Specialization (5)
High Class Stratification (Wealth)
High Local Hierarchy

Aché

Low Diversity (0.47)
Low Specialization (0)
Low Class Stratification (Absent)
Low Local Hierarchy

Main Hypothesis and Findings

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- Population Diversity

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- Population Diversity
 - ⇒ Economic Specialization & Division of Labor

Main Hypothesis and Findings

- Population Diversity
 - ⇒ Economic Specialization & Division of Labor
 - ⇒ Trade

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- Population Diversity
 - ⇒ Economic Specialization & Division of Labor
 - ⇒ Trade
 - ⇒ Institutions (Statehood)

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- Economic Specialization & Division of Labor
 - ⇒ Pre-industrial Economic Development

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 - ⇒ Economic Specialization & Division of Labor
 - ⇒ Trade
 - ⇒ Institutions (Statehood)
 - ⇒ Technology
- Economic Specialization & Division of Labor
 - ⇒ Pre-industrial Economic Development
 - ⇒ Contemporary Comparative Development

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(development, conflict, public goods provision and autocracy)
 - Pre-industrial trade
(religious adherence, inter-ethnic tolerance, development)

Structure of the presentation

- 1 Introduction
- 2 Empirical Approach
- 3 Empirical Analysis
- 4 Identification Strategy
- 5 Data
- 6 Conclusions

Empirical Strategy

Exploit novel ethnic-level dataset combining data on:

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Advantage of ethnic-level analysis

- More fundamental than countries

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 - Captures intra-ethnic diversity

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Advantage of ethnic-level analysis

- More fundamental than countries
 - Captures intra-ethnic diversity
 - Excludes inter-ethnic diversity

Ethnographic Data on Specialization, Trade and Statehood

Ethnographic Measures from

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 - Writing and Records
- Statehood: Jurisdictional Hierarchy Beyond Local Community

Ethnic-level Data - Proxies of Population Diversity

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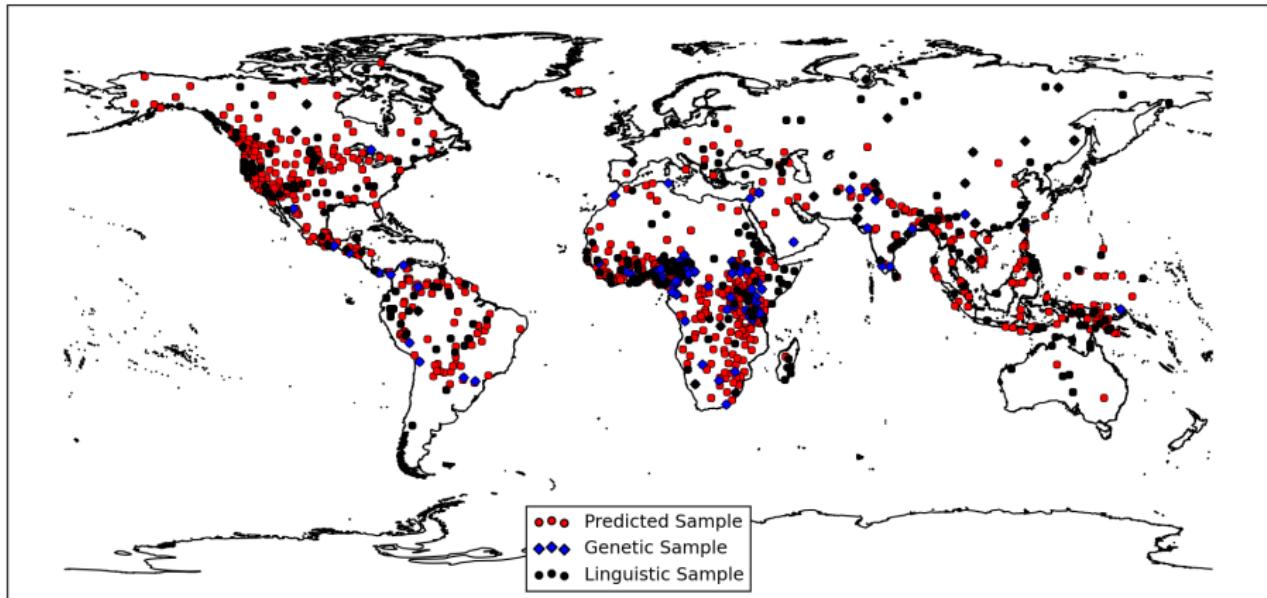
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 - Consonant and Vowel Quality Inventories, and Number of Genders
 - Potentially more affected by evolutionary processes

Samples of Ethnicities

Location of Ethnicities



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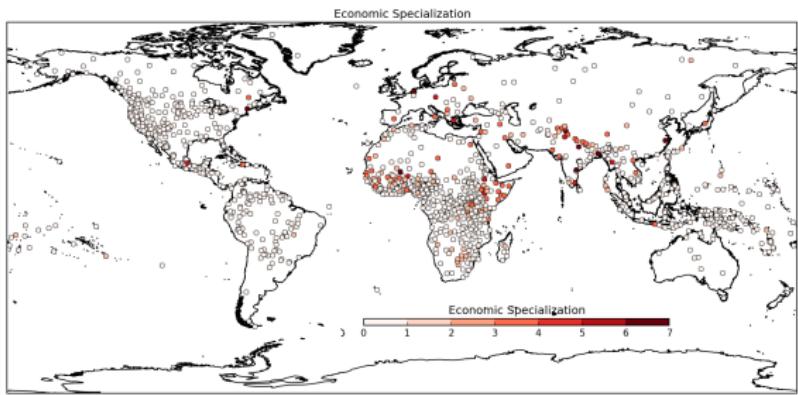
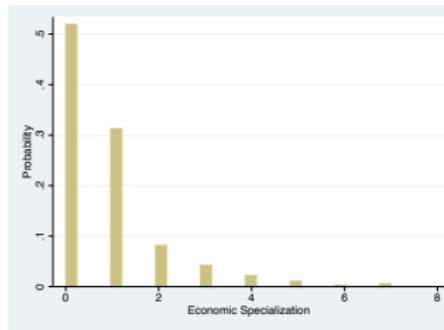
Measures of Economic Specialization

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 - 1: Activity present, but not specialized

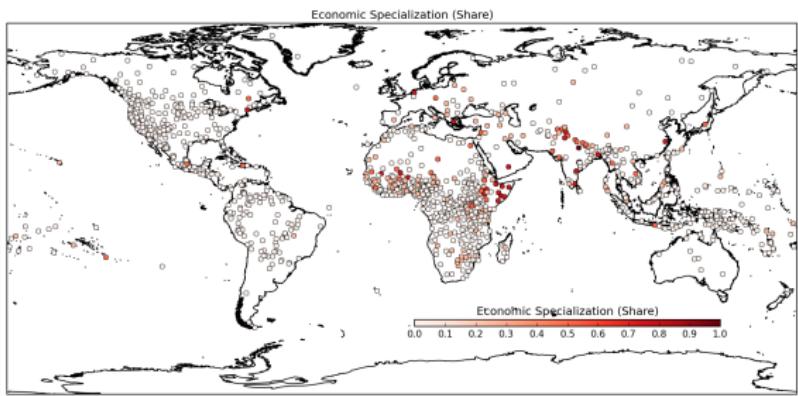
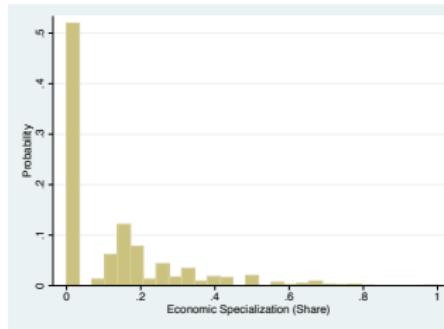
Measures of Economic Specialization

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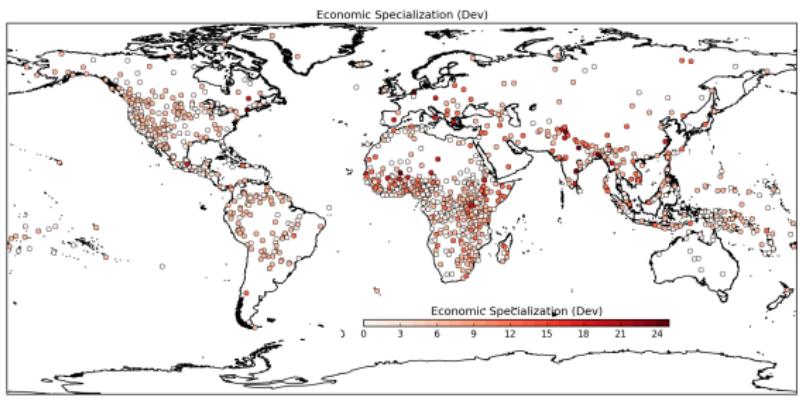
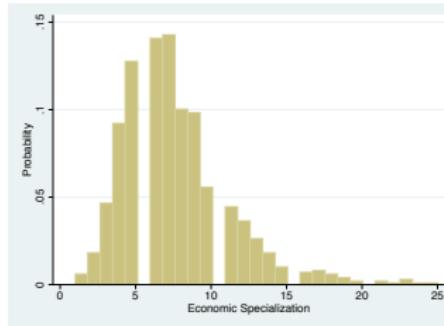
Distribution of Economic Specialization (Main)



Distribution of Economic Specialization (Share)



Distribution of Economic Specialization (Dev)



Population Diversity and Economic Specialization

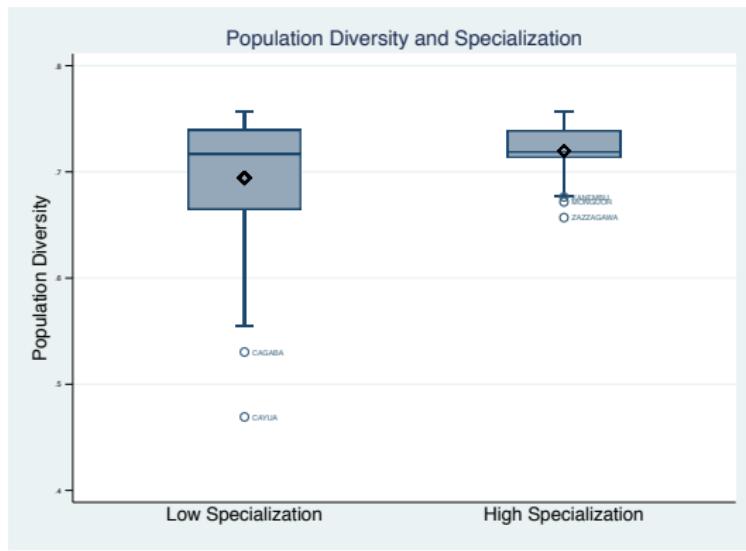
Did population diversity affect
the division of labor in pre-modern times?

Empirical Specification

$$Specialization_i = \alpha + \beta PD_i + G_i' \Gamma + X_i' \Delta + \epsilon_i$$

- $PD_i \equiv$ Population Diversity (Proxy)
- $G_i \equiv$ Main geographical controls
- $X_i \equiv$ Additional controls

Population Diversity and Economic Specialization

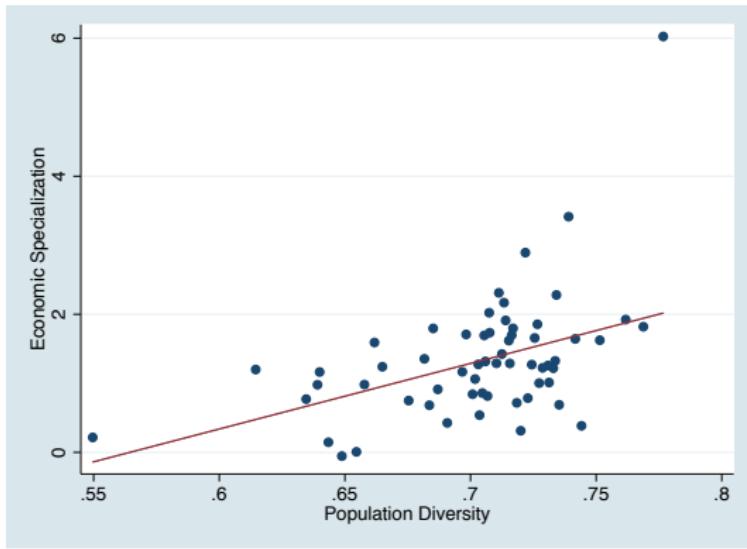


(a) High/Low Specialization and Diversity

Population Diversity and Economic Specialization (OLS)

	Economic Specialization of Labor								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Population Diversity	0.36*** (0.09)	0.41*** (0.10)	0.36*** (0.10)	0.37*** (0.09)	0.34*** (0.11)	0.33*** (0.10)	0.31*** (0.09)	0.40*** (0.11)	0.31*** (0.10)
	Malaria Ecology —	Ecological Diversity +++	Agricultural Suitability (avg.)	Pre-1500 Caloric Suitability (avg. -) (std. +)	CE Corr., avg.)	Temperature (Spatial Volatility, avg. —) (std. ++)	Pct. Area within 100kms of Sea, Coast Length ++	Ruggedness (Avg.), Industrial Mobility (avg. +) (std.)	All
Main Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Altonji et al	-8.86	303.72	-242.74	13.92	10.19	6.36	-11.69	6.34	
δ	0.83	1.26	0.89	1.03	1.01	1.02	0.84	1.18	
β -Oster	0.62	0.36	0.38	0.12	0.04	0.03	0.76	0.30	
R^2	0.20	0.27	0.26	0.23	0.24	0.26	0.23	0.50	
Adjusted- R^2	0.15	0.22	0.21	0.17	0.18	0.20	0.17	0.40	
Observations	116	116	116	116	116	116	116	116	116

Population Diversity and Economic Specialization

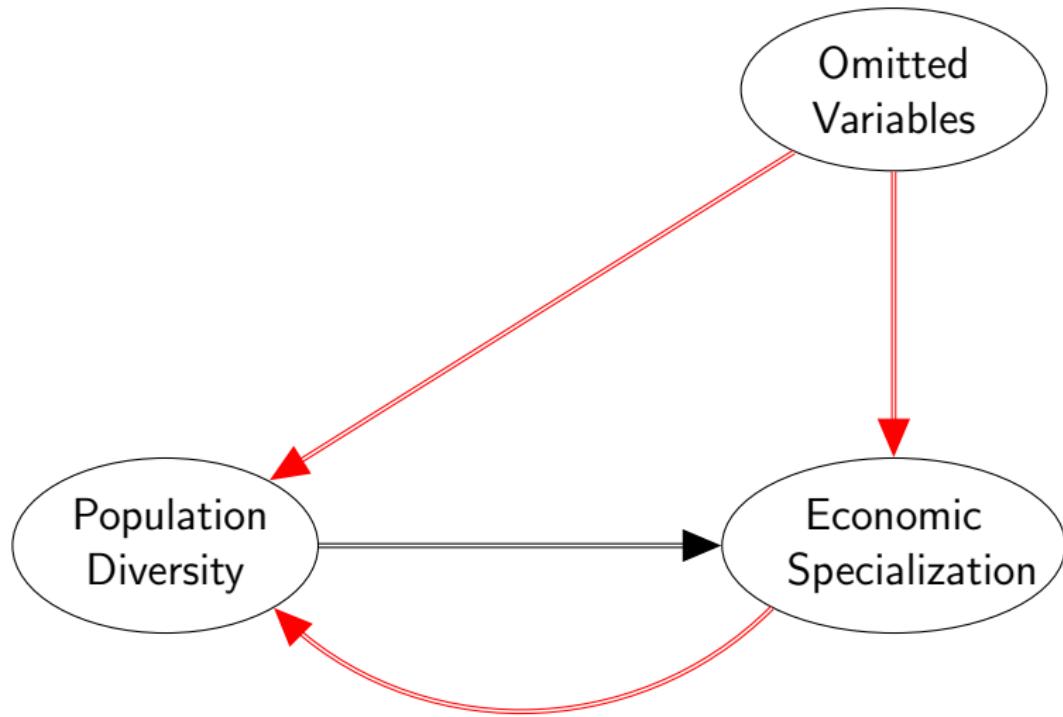


(a) Conditional Association

Causal Graph I



Causal Graph I



Identification Strategy

Potential Concerns:

Identification Strategy

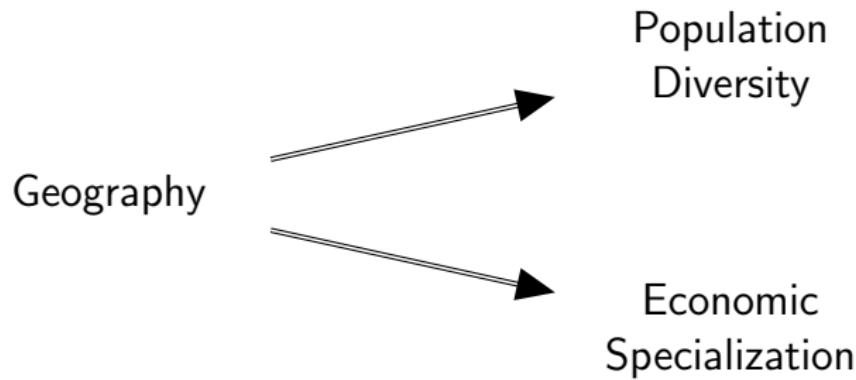
Potential Concerns:

- Omitted Variable:

Identification Strategy

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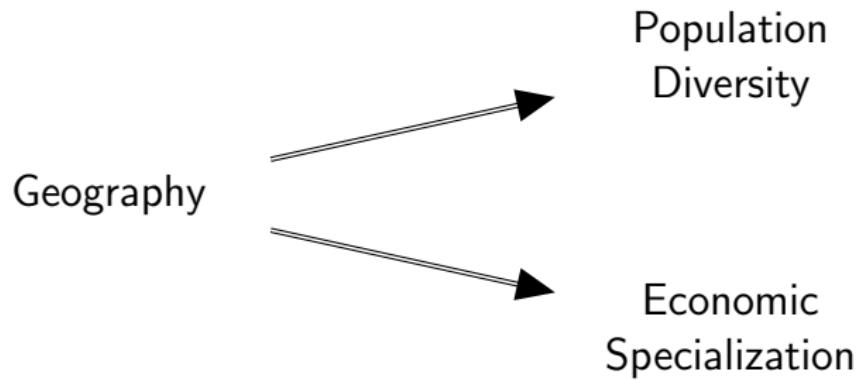
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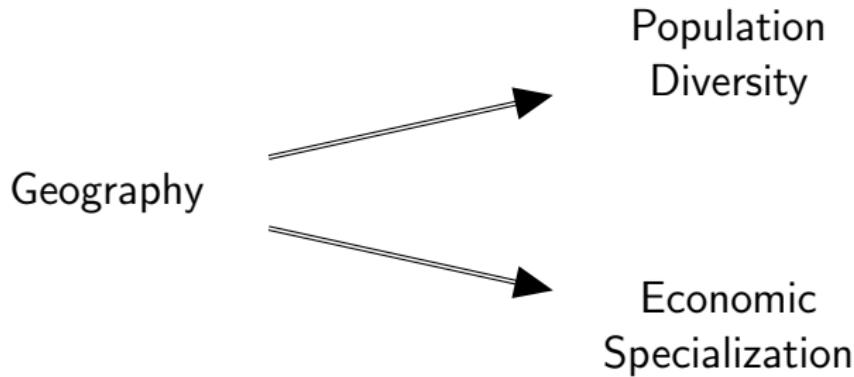


Remedy:

Identification Strategy

Potential Concerns:

- Omitted Variable:



Remedy:

- Account for confounding effect of geographical and climatic controls (absolute latitude, elevation, ruggedness, accessibility to water, precipitation, temperature, isolation measures, disease environment, land endowments, etc.)

Identification Strategy

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- Reverse causality:

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Economic Specialization \Rightarrow Observed Population Diversity

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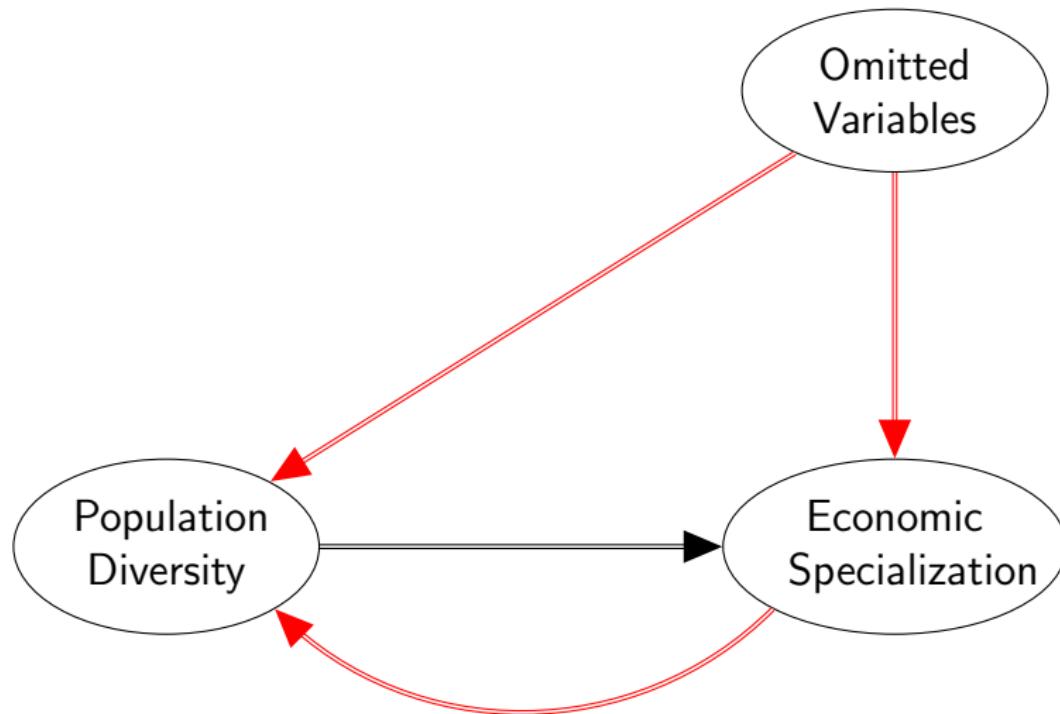
Economic Specialization \Rightarrow Observed Population Diversity

- Segregation / isolation / admixture / assimilation \Longrightarrow population composition

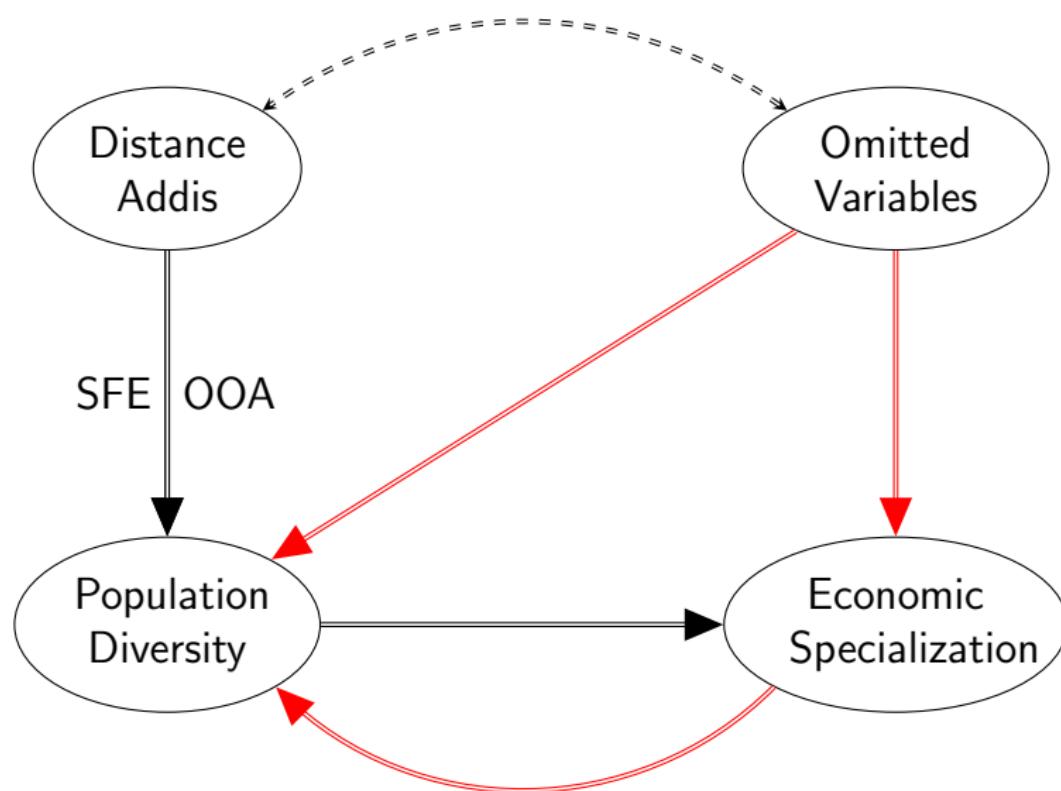
Remedy:

- Exploit variation in Population Diversity generated by
 - Serial Founder Effect
 - “Out-of-Africa” migration of anatomically modern humans

Causal Graph I



Causal Graph I



Exogenous Source of Variation in Diversity I

Serial Founder Effect

Exogenous Source of Variation in Diversity I

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- Statistical sampling process leading to a loss of diversity

Exogenous Source of Variation in Diversity I

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⇒ Diversity decreases along historical migratory routes

Exogenous Source of Variation in Diversity II

“Out-of-Africa” migration of anatomically modern humans

Exogenous Source of Variation in Diversity II

“Out-of-Africa” migration of anatomically modern humans

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Exogenous Source of Variation in Diversity II

"Out-of-Africa" migration of anatomically modern humans

- Historical migration process leading to peopling of planet earth
 - Started in East Africa 70-90K years ago

Exogenous Source of Variation in Diversity II

“Out-of-Africa” migration of anatomically modern humans

- Historical migration process leading to peopling of planet earth
 - Started in East Africa 70-90K years ago
 - Departing populations carry only a subset of the diversity of parental colonies

Exogenous Source of Variation in Diversity II

“Out-of-Africa” migration of anatomically modern humans

- Historical migration process leading to peopling of planet earth
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⇒ “Out-of-Africa” + Serial Founder Effect

Exogenous Source of Variation in Diversity II

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 - Started in East Africa 70-90K years ago
 - Departing populations carry only a subset of the diversity of parental colonies

⇒ "Out-of-Africa" + Serial Founder Effect

- Greater migratory distances from East Africa

Exogenous Source of Variation in Diversity II

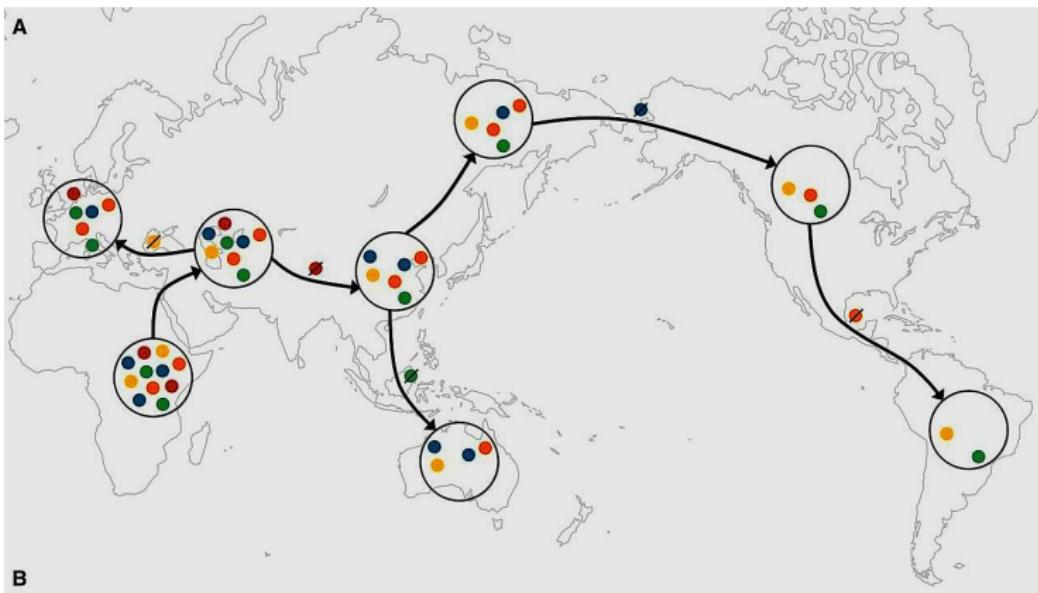
"Out-of-Africa" migration of anatomically modern humans

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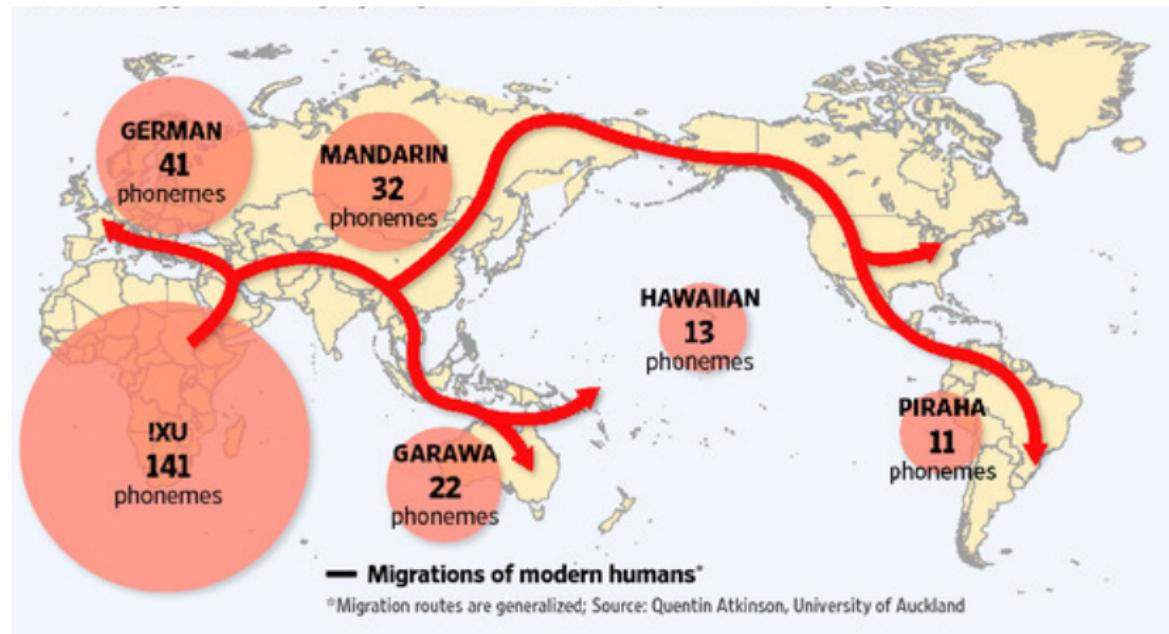
⇒ "Out-of-Africa" + Serial Founder Effect

- Greater migratory distances from East Africa
- ⇒ Lower population diversity among indigenous populations

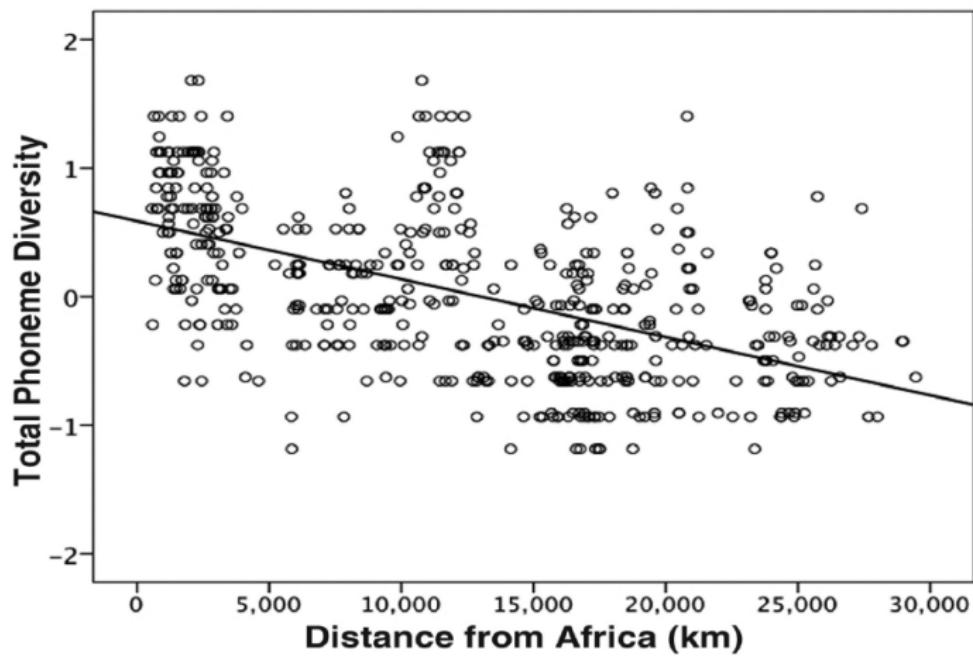
Serial Founder Effect and the Out-of-Africa Migration



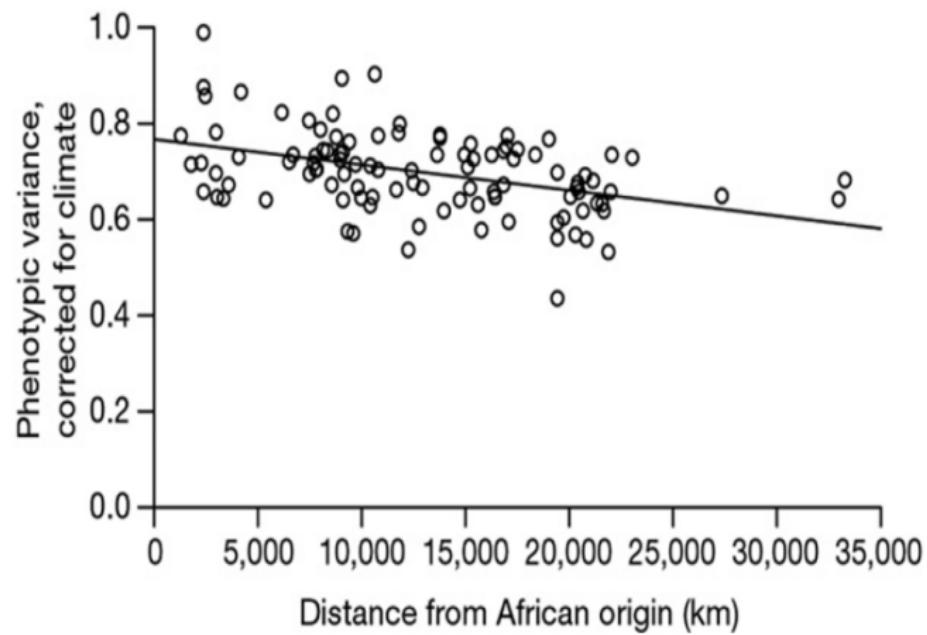
Distance to Africa and Linguistic Diversity



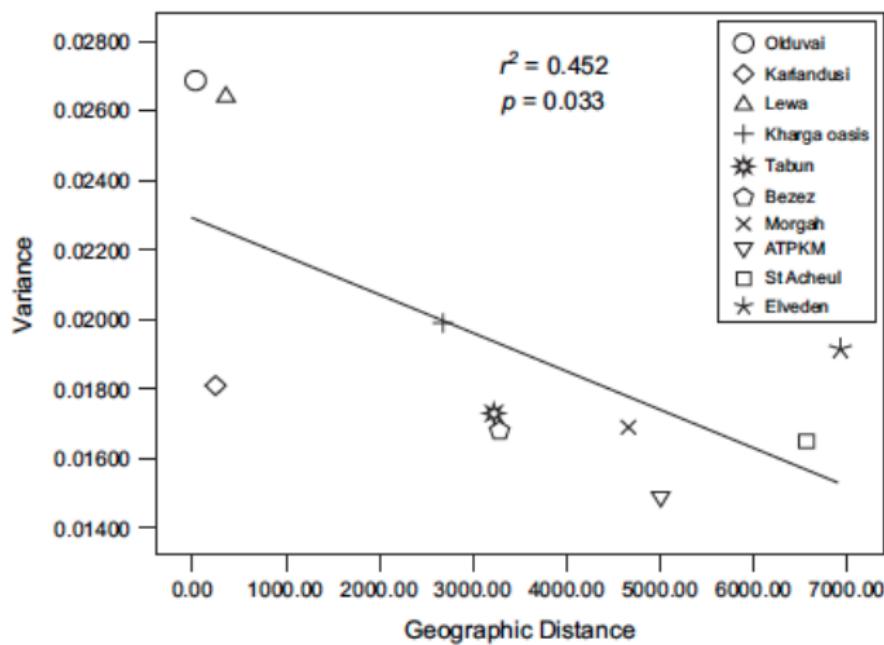
Distance to Africa and Phoneme Diversity



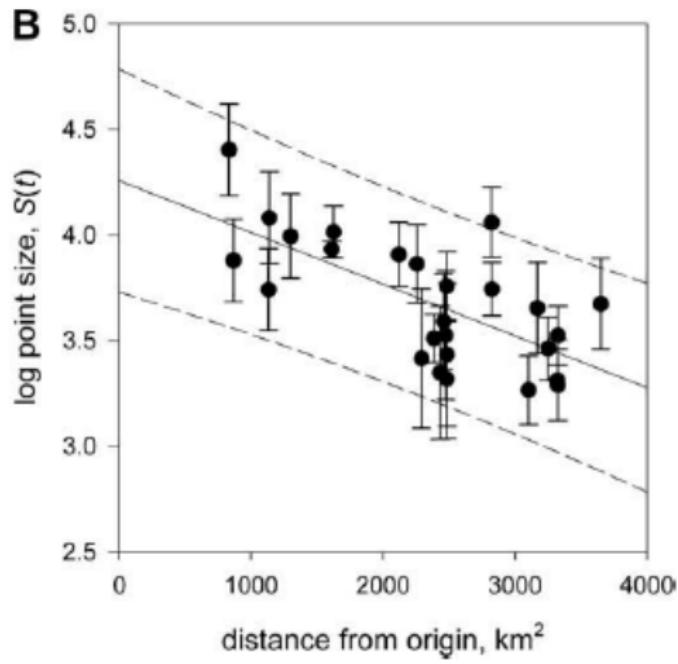
Distance to Africa and Phenotypic Variance



Distance to Africa and Acheulean Handaxe Head Variance



Serial Founder Effect and Clovis Arrow Head Variance



Data - Migratory Distance

Historical Migratory Distance

Data - Migratory Distance

Historical Migratory Distance

- Human Mobility Index with Seafaring (Özak; 2010, 2012)

Why?

How?

HMI

HMISea

Data - Migratory Distance

Historical Migratory Distance

- Human Mobility Index with Seafaring (Özak; 2010, 2012)

Why? How? HMI HMISea

- Estimated time required to walk across each sq. km of land

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Why? How? HMI HMISea

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- Accounts for topographic, climatic, terrain conditions, and human biological abilities

Data - Migratory Distance

Historical Migratory Distance

- Human Mobility Index with Seafaring (Özak; 2010, 2012)

Why? How? HMI HMISea

- Estimated time required to walk across each sq. km of land
- Accounts for topographic, climatic, terrain conditions, and human biological abilities
- Accounts for time required to cross major seas with pre-industrial technologies

Data - Migratory Distance

Historical Migratory Distance

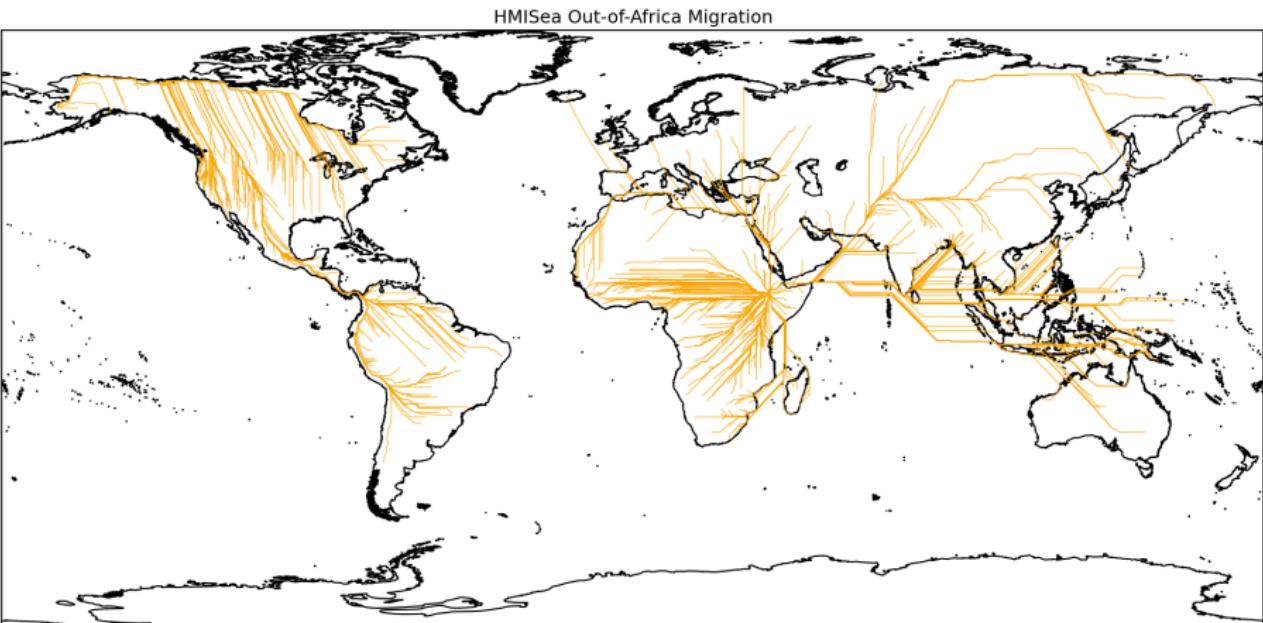
- Human Mobility Index with Seafaring (Özak; 2010, 2012)

Why? How? HMI HMISea

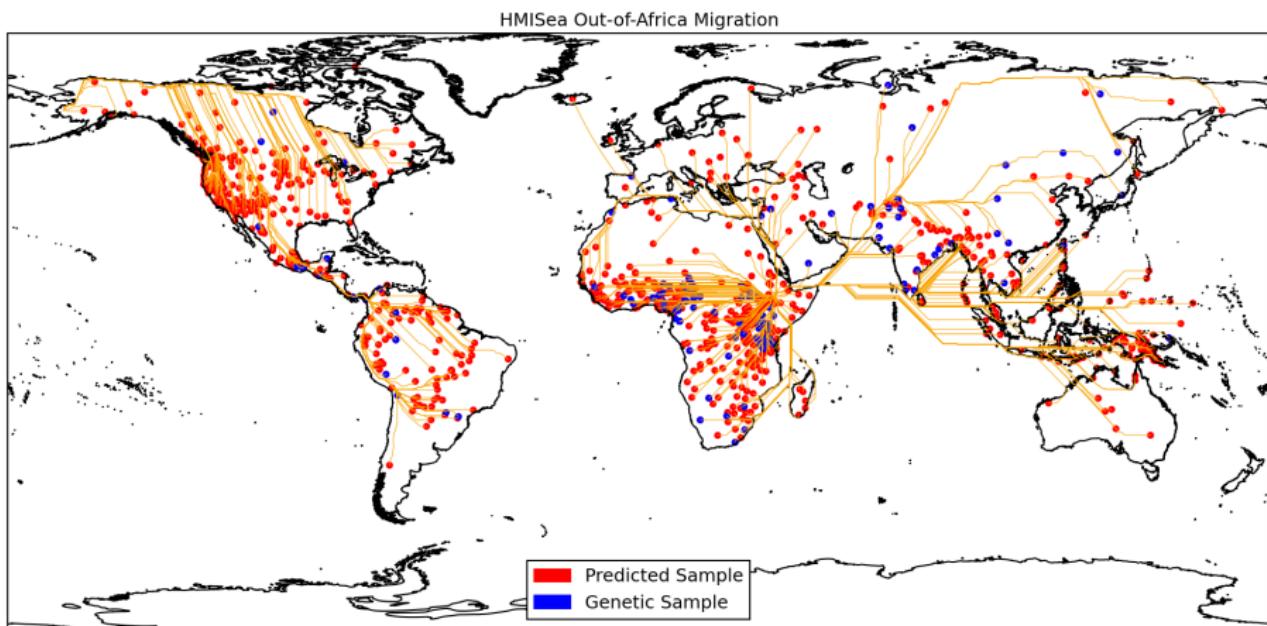
- Estimated time required to walk across each sq. km of land
- Accounts for topographic, climatic, terrain conditions, and human biological abilities
- Accounts for time required to cross major seas with pre-industrial technologies

- Minimal travel time to East Africa (Addis Ababa)

HMISea Migratory Routes I



HMISea Migratory Routes II



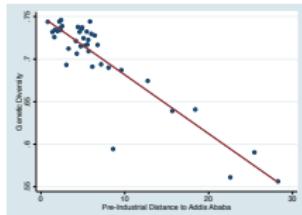
Population Diversity and Distance to Addis Ababa

Population Diversity (Genetic)									
	Full Sample								Specia- lization
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pre-Industrial	-0.85***	-0.80***	-0.80***	-0.81***	-0.80***	-0.79***	-0.80***	-0.82***	-0.85***
Distance to Addis Ababa	(0.07)	(0.10)	(0.09)	(0.09)	(0.10)	(0.10)	(0.10)	(0.09)	(0.09)
	Malaria Ecology +++	Agricultural Suitability (avg.)	Pre-1500 Caloric Suitability (avg.)	CE within 100kms Sea, Coast Length	Pct. of Pre- Industrial Mobility (avg.)	Ruggedness (Avg.), Industrial Mobility (avg.)	All	All	
Main Controls	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted- R^2	0.72	0.72	0.74	0.72	0.72	0.72	0.73	0.75	0.73
R^2	0.72	0.74	0.75	0.74	0.74	0.74	0.75	0.78	0.76
Observations	144	144	144	144	144	144	144	144	116

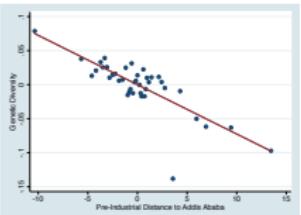
Population Diversity and Distance to Addis Ababa

	Population Diversity (Linguistic)								
	Consonant Inventory			Vowel Quality Inventory			Number of Genders		
	Full Sample		Specia-	Full Sample		Specia-	Full Sample		Specia-
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pre-Industrial Distance to Addis Ababa	-0.42*** (0.05)	-0.37*** (0.06)	-0.37*** (0.07)	-0.30*** (0.06)	-0.31*** (0.07)	-0.33*** (0.08)	-0.25*** (0.06)	-0.30*** (0.09)	-0.33*** (0.08)
Main Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Additional Geographical Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Adjusted- R^2	0.17	0.27	0.27	0.08	0.19	0.22	0.06	0.20	0.23
R^2	0.17	0.31	0.32	0.09	0.23	0.27	0.06	0.28	0.32
Observations	299	299	255	301	301	256	152	152	131

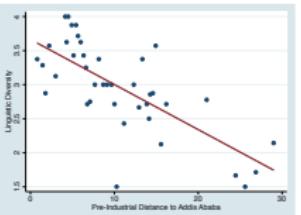
Population Diversity and Distance to Addis Ababa



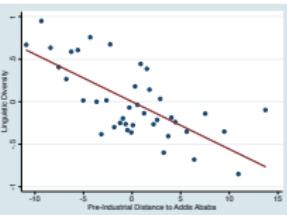
(a) GD
(Unconditional)



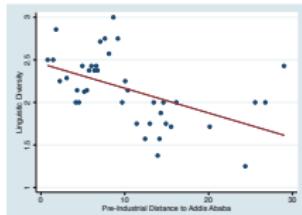
(b) GD (Conditional)



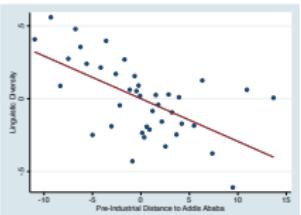
(c) LD (Consonant,
Unconditional)



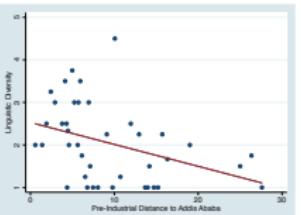
(d) LD (Consonant,
Conditional)



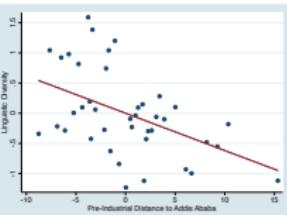
(e) LD (Vowel,
Unconditional)



(f) LD (Vowel,
Conditional)



(g) LD (Genders,
Unconditional)



(h) LD (Genders,
Conditional)

Population Diversity and Economic Specialization (IV)

	Economic Specialization of Labor									
	OLS					IV				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Population Diversity	0.36*** (0.09)	0.51*** (0.12)	0.53*** (0.12)	0.54*** (0.12)	0.54*** (0.13)	0.45*** (0.14)	0.49*** (0.13)	0.44*** (0.11)	0.56*** (0.14)	0.46*** (0.14)
	Malaria Ecology —	Ecological Diversity +++	Agricultural Suitability (avg.) (std. +)	Pre-1500 Caloric Suitability (avg.) (std. +++)	CE Corr., avg. (Volatility, avg. —)	Temperature (Spatial 100kms Corr., avg.) (Sea, Coast Length ++	Pct. Area within 100kms of Pre- Industrial Mobil- ity ++	Ruggedness (Avg.), All Rugginess (Avg.) (std.)		
Main Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F-statistic	56.99	59.31	59.04	65.63	52.61	55.27	53.29	63.44	81.54	
Adjusted- <i>R</i> ²	0.15	0.14	0.21	0.19	0.15	0.17	0.16	0.19	0.15	0.39
Observations	116	116	116	116	116	116	116	116	116	116

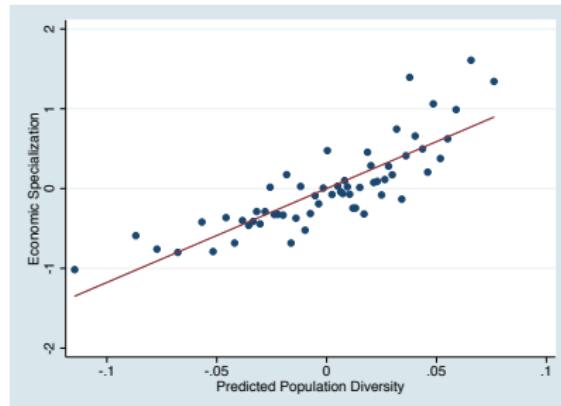
Population Diversity and Economic Specialization (IV)

	Economic Specialization								
	Linguistic Diversity (Consonant Inventory)			Linguistic Diversity (Vowel Quality Inventory)			Linguistic Diversity (Number of Genders)		
	OLS		IV	OLS		IV	OLS		IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Population Diversity	0.19*** (0.06)	1.13*** (0.20)	1.25*** (0.28)	0.39*** (0.06)	1.13*** (0.24)	1.34*** (0.35)	0.11 (0.08)	1.18*** (0.29)	0.90*** (0.33)
Main Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Additional Geographical Controls	No	No	Yes	No	No	Yes	No	No	Yes
First-stage F-statistic		45.11	27.63		22.85	18.08		29.40	17.22
Adjusted- R^2	0.06	-0.69	-0.81	0.17	-0.34	-0.59	-0.02	-1.04	-0.50
Observations	255	255	255	256	256	256	131	131	131

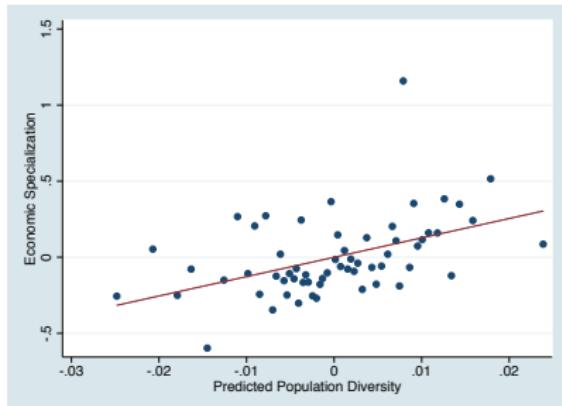
Exploiting Predicted Population Diversity Sample

	Economic Specialization of Labor										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Predicted Population Diversity	0.44*** (0.02)	0.42*** (0.03)	0.49*** (0.04)	0.42*** (0.03)	0.41*** (0.03)	0.46*** (0.04)	0.40*** (0.03)	0.42*** (0.05)	0.42*** (0.04)	0.53*** (0.07)	0.60*** (0.21)
	Malaria Ecology —	Ecological Diversity +++	Agricultural Suitability (avg.) (std. ++)	Pre-1500 CE Caloric Suitability (avg.++) (std. +++)	Temperature (Spatial Corr., avg.) (Volatility, avg. —)	Pct. Area within 100kms of Sea, Coast Length	Ruggedness (Avg. ++), Pre-Industrial Mobility (avg. ++) (std.)	All	All		
Main Controls	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Continental FE	No	No	No	No	No	No	No	No	No	No	Yes
Adjusted- <i>R</i> ²	0.19	0.22	0.23	0.24	0.22	0.24	0.22	0.21	0.23	0.29	0.32
Observations	934	934	934	934	934	934	934	934	934	934	934

Predicted Population Diversity and Economic Specialization



(a) Without Continental FE



(b) With Continental FE

Robustness to Specialization Measure

	Economic Specialization Measures								
	Main			Share			Dev		
	OLS (1)	IV (2)	Full (3)	OLS (4)	IV (5)	Full (6)	OLS (7)	IV (8)	Full (9)
Population Diversity	0.27*** (0.05)	0.46*** (0.14)	0.59*** (0.21)	0.33*** (0.05)	0.37*** (0.12)	0.73*** (0.17)	0.13** (0.06)	0.31** (0.14)	0.41** (0.18)
Main Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
All Additional Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Continental FE	No	No	Yes	No	No	Yes	No	No	Yes
First-stage F-statistic		81.54			81.54			81.54	
R ²	0.08	0.49	0.34	0.11	0.49	0.40	0.02	0.46	0.25
Adjusted-R ²	0.07	0.39	0.32	0.10	0.39	0.39	0.01	0.35	0.23
Observations	116	116	934	116	116	934	116	116	934

Robustness

Result is robust to

- Estimation method

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 - Main: Poisson, Negative Binomial, Zero-Inflated Poisson, Zero-Inflated Negative Binomial Count

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 - Share: Fractional Regression (Logit & Probit), Zero-Inflated Beta Share

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 - Main: Poisson, Negative Binomial, Zero-Inflated Poisson, Zero-Inflated Negative Binomial Count
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- Standard Errors

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 - Clustering at language family/genus

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 - Main: Poisson, Negative Binomial, Zero-Inflated Poisson, Zero-Inflated Negative Binomial Count
 - Share: Fractional Regression (Logit & Probit), Zero-Inflated Beta Share
- Standard Errors
 - Clustering at language family/genus
 - Spatial-autocorrelation (ML, GMM)

Complementarities between Population and Environment

Were there complementarities between population and environment diversity that fostered economic specialization of labor?

Complementarities between Population and Environment

	Economic Specialization					
	(1)	(2)	(3)	(4)	(5)	(6)
Predicted Population Diversity	0.59*** (0.25)	0.49*** (0.26)	0.45*** (0.26)	0.46*** (0.30)	0.55*** (0.26)	0.54*** (0.28)
Predicted Population Diversity × Ecological Diversity		0.80*** (0.38)				
Predicted Population Diversity × Precipitation (Volatility, Std.)			1.16** (0.57)			
Predicted Population Diversity × Temperature (Spatial Corr., Std.)				0.70* (0.65)		
Predicted Population Diversity × Precipitation (Spatial Corr., Std.)					0.77** (0.43)	
Predicted Population Diversity × Ruggedness (Avg.)						1.08** (0.59)
Main Controls & Main Effects	Yes	Yes	Yes	Yes	Yes	Yes
All Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Continental FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted- <i>R</i> ²	0.32	0.33	0.33	0.34	0.34	0.33
Observations	934	934	934	934	934	934

Accounting for Other Historical Processes

	Economic Specialization					
	(1)	(2)	(3)	(4)	(5)	(6)
Predicted Population Diversity	0.59*** (0.25)	0.63*** (0.27)	0.35** (0.22)	0.38** (0.21)	0.43** (0.22)	0.58*** (0.26)
Distance Neolithic Frontier		-0.12*** (0.06)				
Distance Frontier (1CE)			-0.21*** (0.05)			
Distance Frontier (1000CE)				-0.21*** (0.05)		
Distance Frontier (1500CE)					-0.22*** (0.05)	
Duration of Continuous Human Presence						0.03 (0.16)
Main Controls	Yes	Yes	Yes	Yes	Yes	Yes
All Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Continental FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted- R^2	0.32	0.34	0.35	0.35	0.35	0.33
Observations	934	932	932	932	932	925

Ethnicities with and without Centralized States

	Economic Specialization					
	No Centralized State			Any Centralized State		
	(1)	(2)	(3)	(4)	(5)	(6)
Predicted Population Diversity	0.46*** (0.05)	0.39*** (0.05)	0.50*** (0.09)	0.30*** (0.03)	0.36*** (0.04)	0.40*** (0.06)
Main Controls	No	Yes	Yes	No	Yes	Yes
Additonal Controls	No	No	Yes	No	No	Yes
Adjusted- <i>R</i> ²	0.21	0.24	0.30	0.09	0.14	0.24
Observations	433	433	433	479	479	479

Economic Specialization and Development in the Pre-modern Era

Did economic specialization have a positive impact on economic development during the pre-modern era?

Economic Specialization and Development in the Pre-modern Era

Did economic specialization have a positive impact on economic development during the pre-modern era?

- Technological and socio-political complexity

Economic Specialization and Development in the Pre-modern Era

Did economic specialization have a positive impact on economic development during the pre-modern era?

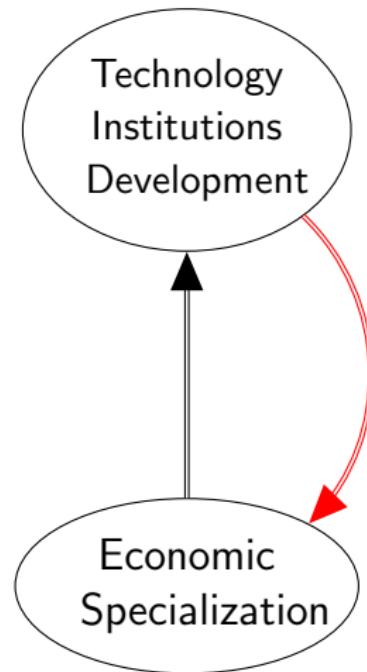
- Technological and socio-political complexity
- Population density, urbanization

Economic Specialization and Development in the Pre-modern Era

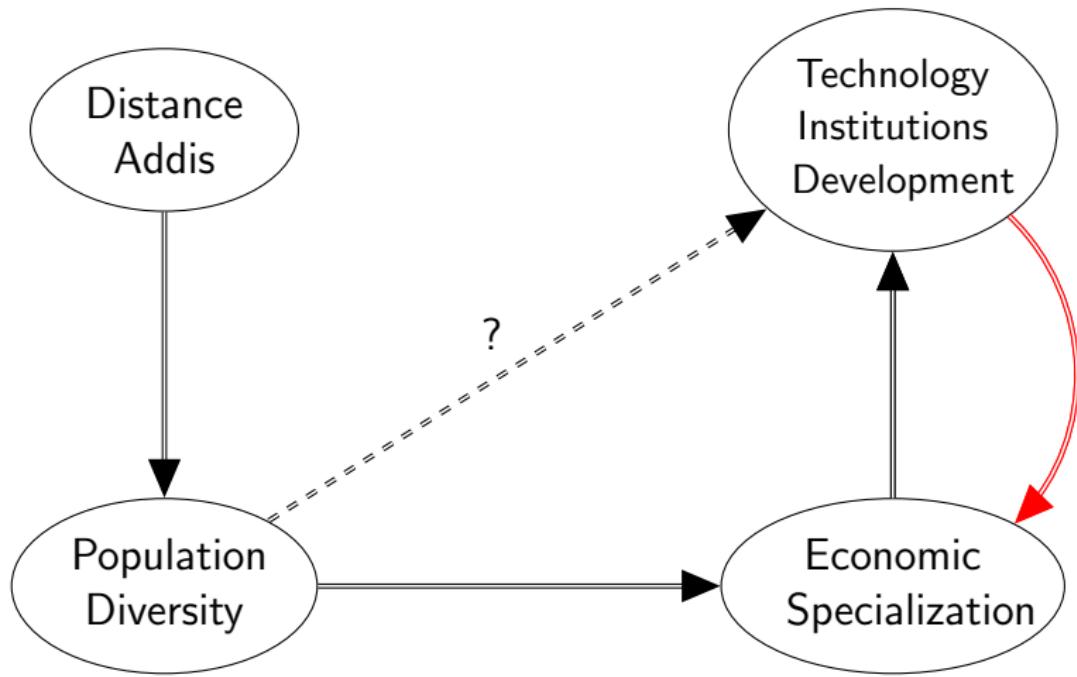
Did economic specialization have a positive impact on economic development during the pre-modern era?

- Technological and socio-political complexity
- Population density, urbanization
- Emergence of states and class stratification

Causal Graph II



Causal Graph II



Population Diversity, Economic Specialization and Economic Development

	Pre-Industrial Development						
	Technological Specialization	Complexity	Population Density	Mean of Communities	Size Local Level	Statehood	Class Stratification
	(1)	(2)	(3)	(4)	(5)	(6)	
Panel A: Effect of Specialization							
Economic Specialization	0.45*** (0.08)	0.52*** (0.07)	0.39*** (0.07)	0.38*** (0.04)	0.43*** (0.03)	0.22*** (0.03)	
Adjusted- R^2	0.50	0.57	0.51	0.46	0.48	0.32	
Panel B: Mediation (OLS)							
Economic Specialization	0.45*** (0.08)	0.52*** (0.07)	0.40*** (0.07)	0.40*** (0.04)	0.43*** (0.03)	0.21*** (0.03)	
Predicted Population Diversity	-0.16 (0.35)	-0.32 (0.25)	-0.33 (0.33)	-0.30* (0.18)	0.15 (0.12)	0.38** (0.16)	
Adjusted- R^2	0.49	0.57	0.51	0.46	0.48	0.32	
Main Controls	Yes	Yes	Yes	Yes	Yes	Yes	
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes	
Continental FE	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	168	168	166	509	912	879	

Establishing the direction of causality

Potential Concerns:

Establishing the direction of causality

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- Reverse causality: Technology, Institutions and Economic Development might have historically shaped pattern of economic specialization

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- Exploit IV approach to instrument economic specialization

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 - Lewbel (2012)'s (atheoretical) method
 - Exploits the moment conditions in a cross section
 - Generated instruments from available data:

$$Z_{ji} = (X_j - E(X_j)) * \epsilon_i$$

Establishing the direction of causality

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 - Exploits the moment conditions in a cross section
 - Generated instruments from available data:

$$Z_{ji} = (X_j - E(X_j)) * \epsilon_i$$

- where ϵ is vector of (heteroskedastic) residuals from the “first-stage regression”

$$S_i = X' \Delta + \epsilon_i$$

Population Diversity, Economic Specialization and Economic Development

	Pre-Industrial Development						
	Technological Specialization	Complexity	Population Density	Mean of Communities	Size Local Level	Statehood	Class Stratification
	(1)	(2)	(3)	(4)	(5)	(6)	
Panel C: Mediation (IV)							
Economic Specialization	0.38*** (0.09)	0.42*** (0.09)	0.34*** (0.08)	0.39*** (0.04)	0.42*** (0.04)	0.24*** (0.03)	
Predicted Population Diversity	-0.14 (0.32)	-0.30 (0.23)	-0.32 (0.30)	-0.29* (0.17)	0.15 (0.12)	0.36** (0.15)	
Breusch-Pagan F-stat	22.63	22.63	20.48	32.61	51.23	48.84	
Breusch-Pagan p-value	0.00	0.00	0.00	0.00	0.00	0.00	
First-stage F-statistic	26.21	26.21	27.43	47.88	54.85	51.89	
Hansen's J-statistic	34.80	25.19	23.47	32.34	28.17	34.83	
J-stat p-value	0.04	0.29	0.38	0.07	0.17	0.04	
Adjusted- <i>R</i> ²	0.49	0.57	0.51	0.46	0.48	0.32	
Main Controls	Yes	Yes	Yes	Yes	Yes	Yes	
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes	
Continental FE	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	168	168	166	509	912	879	

Population Diversity, Economic Specialization and Conflict

Did population diversity and economic specialization have an effect on internal and external conflict?

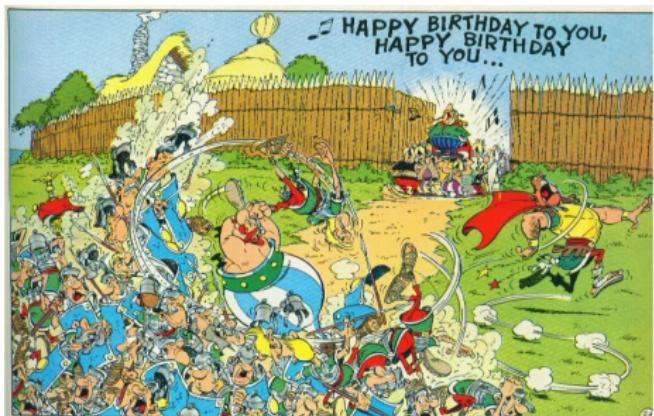
Predicted Population Diversity, Economic Specialization and Conflict

	Pre-Industrial Measures of Conflict							
	Local Conflict	Inter-community Conflict	Violence against Non-members of the Group	Internal Warfare	External Warfare	Moderate or Frequent Inter-personal Violence	Police	Trust
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Economic Specialization	0.20 (0.16)	-0.06 (0.21)	0.28* (0.15)	-0.04 (0.18)	0.34** (0.15)	0.29* (0.17)	0.33*** (0.09)	-0.13 (0.15)
Predicted Population Diversity	-0.03 (0.13)	-0.09 (0.14)	-0.05 (0.12)	0.02 (0.16)	-0.23* (0.13)	-0.22* (0.12)	0.06 (0.09)	0.18 (0.12)
Main Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F-statistic	9.28	17.62	25.46	153.19	196.69	19.78	26.76	29.87
Hansen's J-statistic	20.54	19.98	24.35	13.92	15.25	12.62	23.96	10.34
J-stat p-value	0.20	0.22	0.08	0.60	0.51	0.70	0.09	0.85
Adjusted- <i>R</i> ²	0.02	0.14	0.12	0.02	0.17	0.07	0.28	0.16
Observations	85	84	136	81	83	126	163	123

This suggests



(a) Less of this



(b) More of this

Historical Persistence

Does pre-modern economic specialization still matter?

Pre-modern Economic Specialization Predicts Contemporary Economic Development

	Average Light Density (Inverse Hyperbolic Sine Transformation)							
	Whole World				Old World			
	OLS		IV		OLS		IV	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pre-modern Economic Specialization	0.13*** (0.03)	0.15*** (0.03)	0.12*** (0.03)	0.17*** (0.03)	0.16*** (0.04)	0.19*** (0.04)	0.15*** (0.04)	0.18*** (0.04)
Regional FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Main Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
All Additional Controls	No	No	Yes	Yes	No	No	Yes	Yes
First-stage F-statistic				63.88				34.34
Hansen's J-statistic				40.32				40.31
J-stat p-value				0.29				0.18
Adjusted- <i>R</i> ²	0.37	0.42	0.53	0.25	0.41	0.48	0.56	0.25
Observations	932	932	932	932	591	591	591	591

Mechanism

	Contemporary Occupational Heterogeneity					
	Unweighted			Weighted		
	OLS		IV	OLS		IV
	(1)	(2)	(3)	(4)	(5)	(6)
Pre-modern Economic Specialization	1.01*** (0.36)	0.83** (0.37)	0.80** (0.31)	0.63** (0.30)	0.65** (0.29)	0.63** (0.25)
Main Controls	Yes	Yes	Yes	Yes	Yes	Yes
All Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Regional FE	No	Yes	Yes	No	Yes	Yes
First-stage F-statistic				367.81		10643.43
Hansen's J-statistic				18.34		25.38
J-stat p-value				0.63		0.23
Adjusted- R^2	0.10	0.11	0.11	0.13	0.20	0.20
Observations	101	101	101	101	101	101

Skill-biased effect?

Contemporary Occupational Heterogeneity					
	Primary		Secondary		
	All	Low	High	Low	
	(1)	(2)	(3)	(4)	(5)
Economic Specialization	0.83** (0.37)	0.29** (0.14)	0.54** (0.27)	0.35** (0.15)	0.48* (0.25)
Main Controls	Yes	Yes	Yes	Yes	Yes
All Additional Controls	Yes	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes	Yes
Adjusted- R^2	0.11	0.16	0.10	0.18	0.10
Observations	101	101	101	101	101

Pre-modern Economic Specialization and Economic Complexity

	Contemporary Development											
	Economic Complexity Index			# Goods Exported			Ratio # Goods Exported/Imported			Share of Global GDP		
	Main	Share	Dev	Main	Share	Dev	Main	Share	Dev	Main	Share	Dev
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Pre-modern Economic Specialization	0.19*** (0.07)	0.22*** (0.07)	0.17*** (0.06)	0.21*** (0.08)	0.31*** (0.10)	0.16* (0.09)	0.19** (0.08)	0.28*** (0.10)	0.14* (0.08)	0.22*** (0.06)	0.22*** (0.07)	0.16** (0.06)
Regional FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Years Neolithic Transition	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted- R^2	0.62	0.62	0.61	0.46	0.49	0.45	0.46	0.48	0.45	0.60	0.60	0.58
Observations	95	95	95	80	80	80	80	80	80	120	120	120

Conclusions

- Deep determinants of pre-modern economic specialization

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 - Contemporary occupational heterogeneity (skill-biased)

Conclusions

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 - Population diversity had a positive causal impact on Economic Specialization
 - Complementarity between population and geographical diversity
 - States not necessary
- Pre-modern levels of economic specialization associated with
 - Pre-industrial economic development
 - Contemporary economic development
 - Contemporary occupational heterogeneity (skill-biased)
 - Contemporary economic complexity

The Origins and Long-Run Consequences of the Division of Labor

Emilio Depetris-Chauvin and Ömer Özak

UCSB, January 2017

Problem with Traditional Measures

Country 1	Country 2	Distance [†]
Argentina	Chile	1364
Austria	Belgium	1353
Bhutan	Myanmar	1313
Ecuador	Peru	1309
France	Germany	1259
Colombia	Panama	773
Germany	Switzerland	776
Germany	Italy	809
Benin	Ethiopia	4027
Chile	Colombia	4024
China	India	4486
Egypt	Spain	4000
Ecuador	USA	4011
Iraq	Rwanda	4033

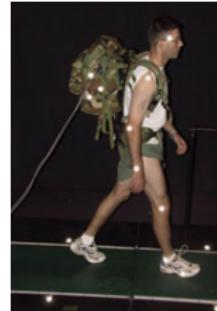
† in kilometers.

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Human Mobility Index with Seafaring (HMISea)

Use data from

- U.S. Army data on human mobility (Hayes; 1994)

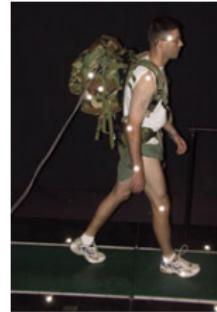


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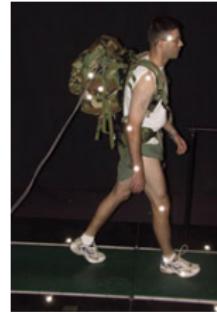
- Travel Time on Land = $f(slope, temp, rel. hum., terrain, sky)$

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Human Mobility Index with Seafaring (HMISea)

Use data from

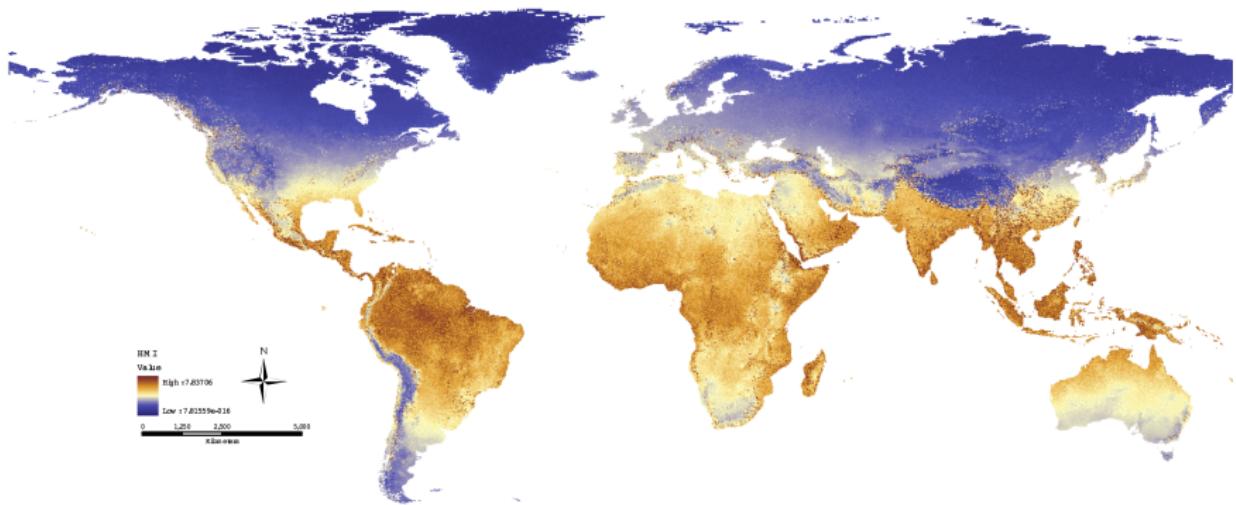
- U.S. Army data on human mobility (Hayes; 1994)



- Travel Time on Land = $f(slope, temp, rel. hum., terrain, sky)$
- Historical data on seafaring in Old World (Casson; 1951, 1989)

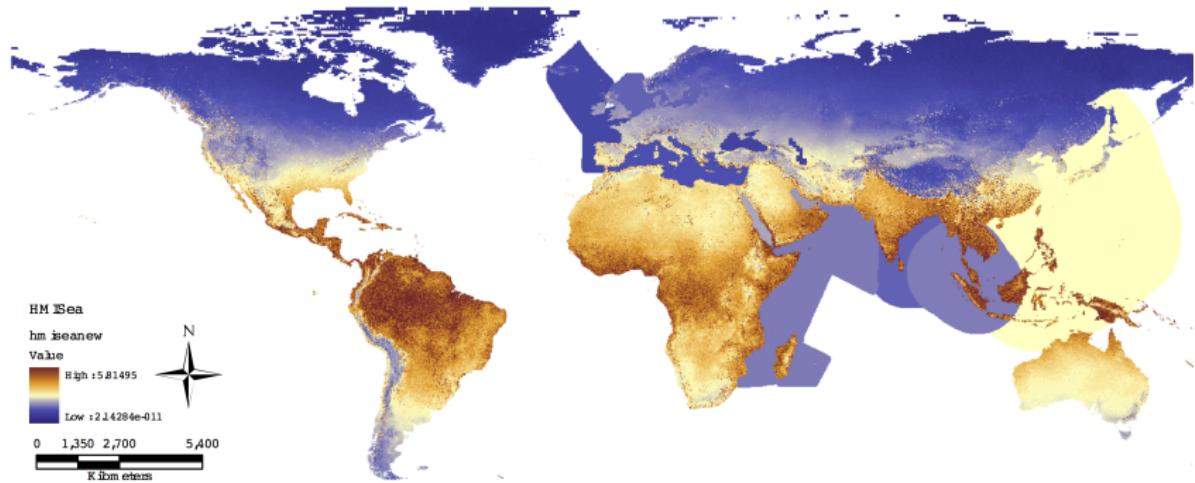
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Human Mobility Index (HMI)



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Human Mobility Index with Seafaring (HMISea)

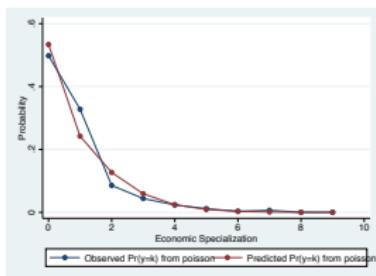
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Robustness - Estimation Method

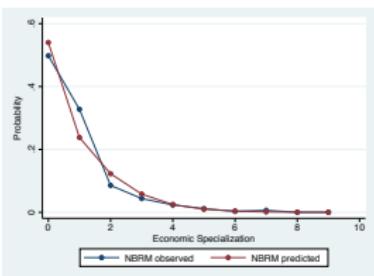
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	Economic Specialization			
	Poisson	Negative Binomial	Zero-inflated Poisson	Zero-inflated Negative Binomial
	(1)	(2)	(3)	(4)
Panel D: Economic Specialization				
Predicted Population Diversity	0.59*** (0.22)	0.59*** (0.23)	0.62*** (0.22)	0.62*** (0.23)
Panel E: Probability Economic Specialization is always equal to Zero				
Predicted Population Diversity			-10.54** (4.72)	-10.69** (4.91)
Continental FE	Yes	Yes	Yes	Yes
Main Controls	Yes	Yes	Yes	Yes
Additonal Controls	Yes	Yes	Yes	Yes
Pseudo- R^2	0.25	0.21		
Observations	934	934	934	934
α		0.05		0.04
Log-likelihood	-932.93	-932.07	-911.76	-911.08
BIC	2043.70	2048.81	2049.23	2054.70
AIC	1917.87	1918.14	1889.53	1890.16

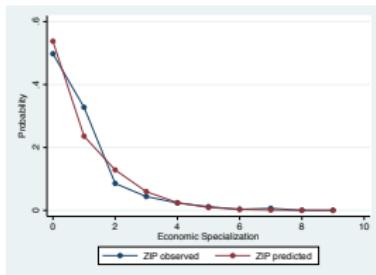
Observed and Predicted Probabilities in Count Regressions



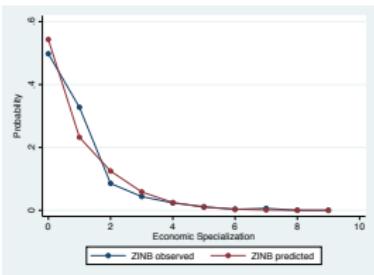
(a) Poisson



(b) Negative Binomial



(c) Zero-Inflated Poisson



(d) Zero-Inflated Negative Binomial

Robustness - Estimation Method

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	Economic Specialization (Share)		
	Fractional Regression		
	Logit	Probit	Zero-inflated Beta
	(1)	(2)	(3)
Panel F: Economic Specialization			
Predicted Population Diversity	0.88*** (0.28)	0.49*** (0.15)	0.42* (0.22)
Std- β	0.09*** (0.03)	0.09*** (0.03)	0.11*** (0.02)
Panel G: Probability Economic Specialization is always equal to Zero			
Predicted Population Diversity			-1.85*** (0.19)
Continental FE	Yes	Yes	Yes
Main Controls	Yes	Yes	Yes
Additonal Controls	Yes	Yes	Yes
Observations	934	934	934
Log-likelihood	-303.26	-303.19	-68.34
BIC	784.36	784.20	369.22
AIC	658.53	658.37	204.68