Arable Land in Antiquity Explains Modern Gender Inequality

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- Hazarika, Jha, and Sarangi (2019): Fewer missing women in societies whose ancestors were endowed with better ecological resources (measured by average annual caloric yields per hectare based on the agro-climatic yields of pre-Columbian crops).

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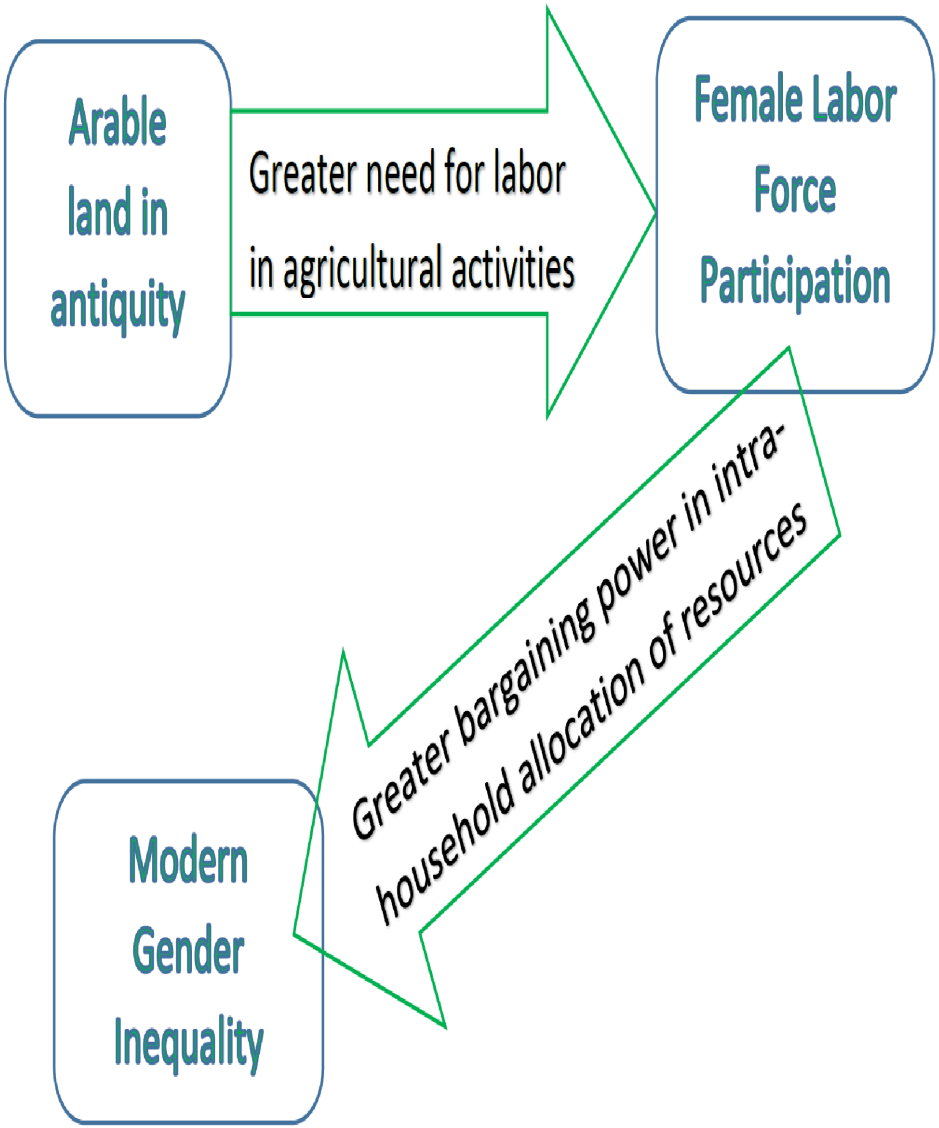

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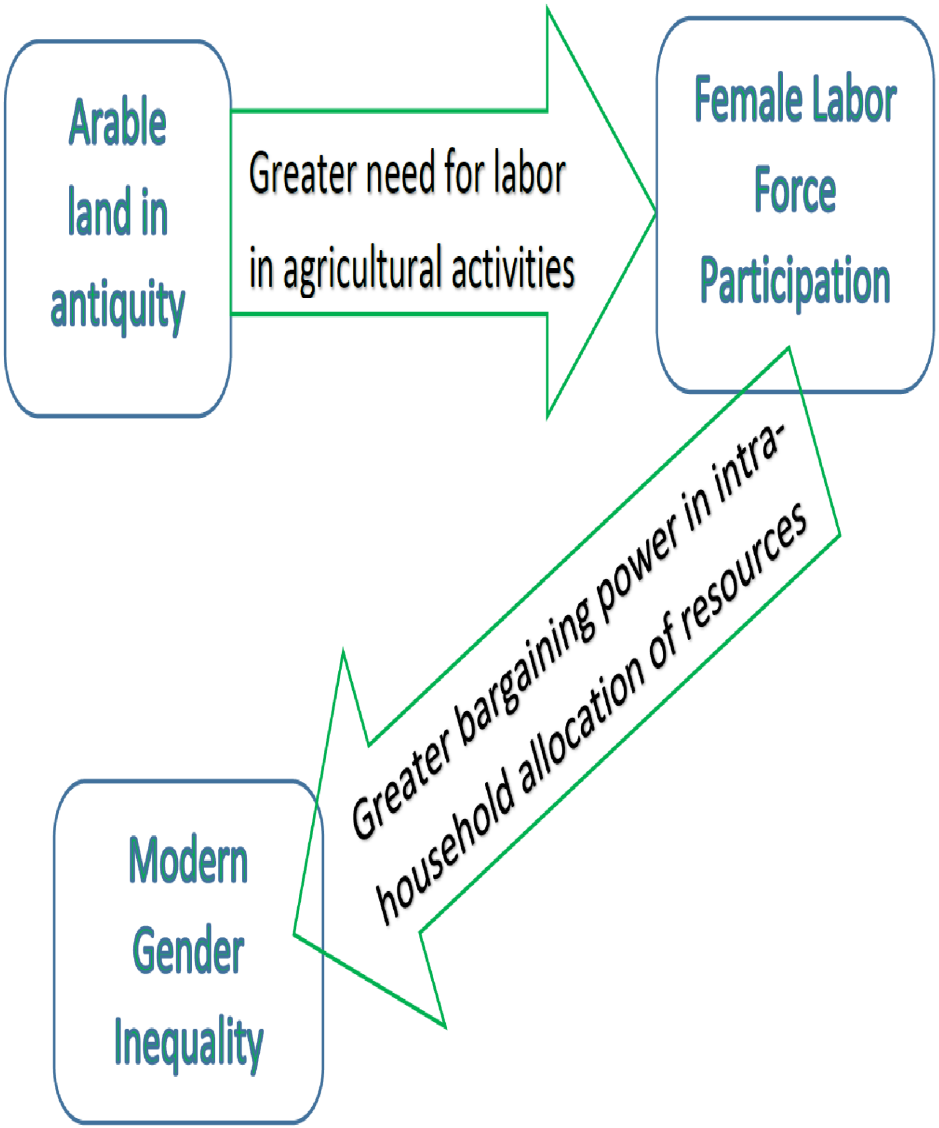

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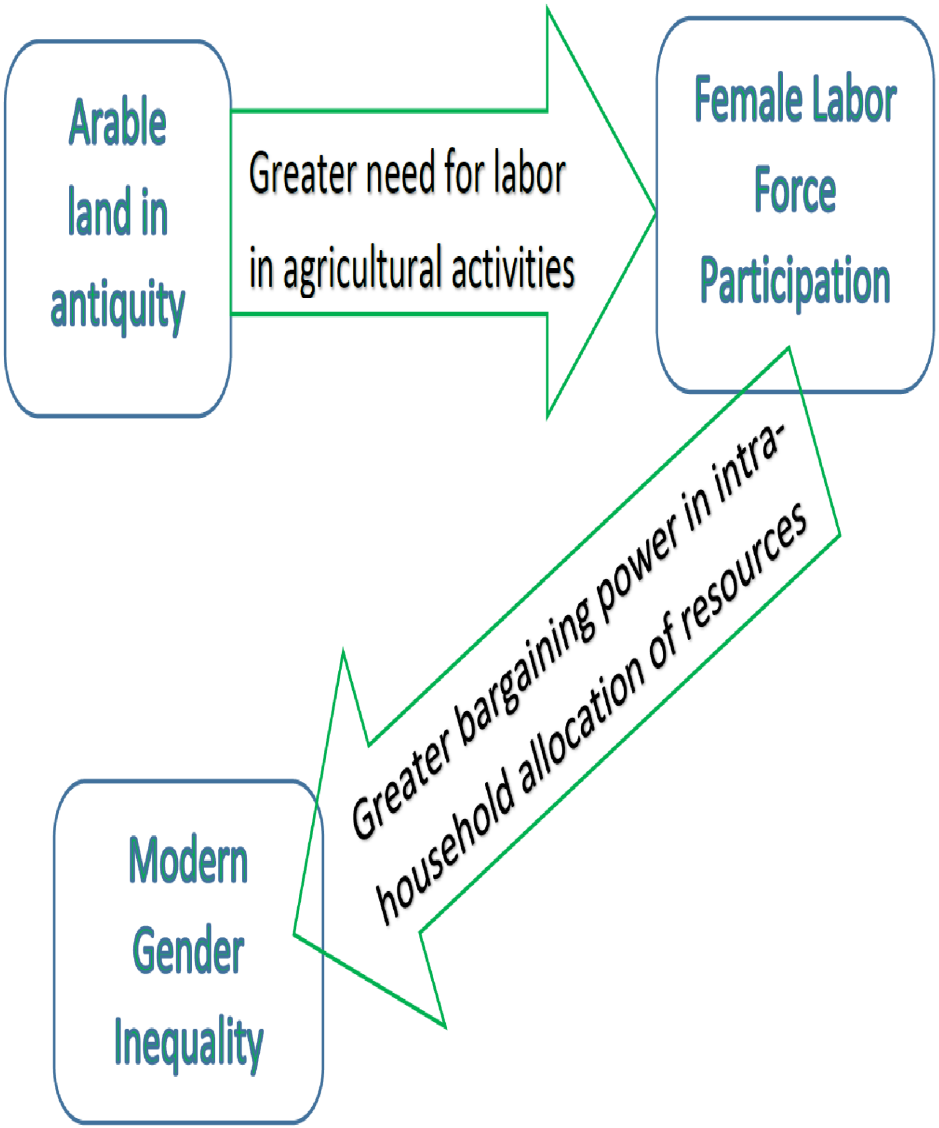

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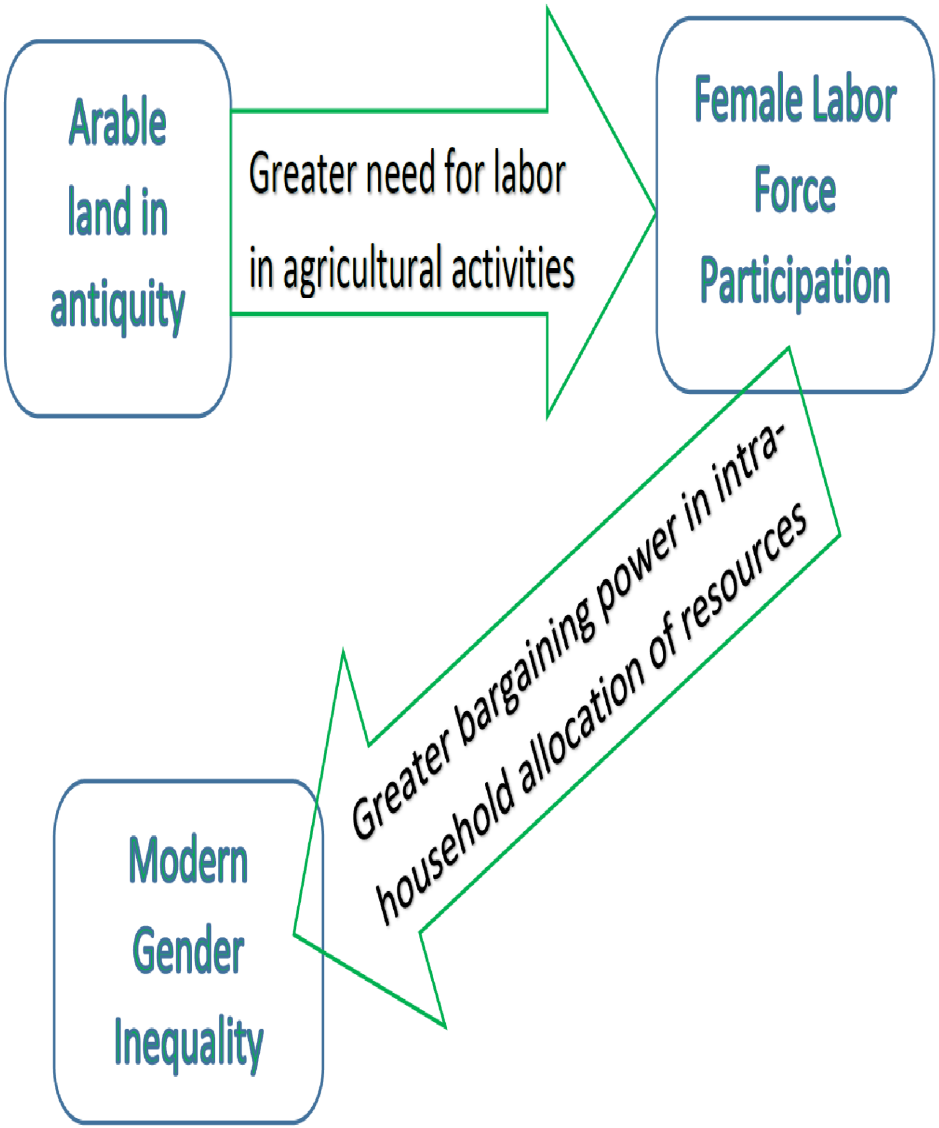

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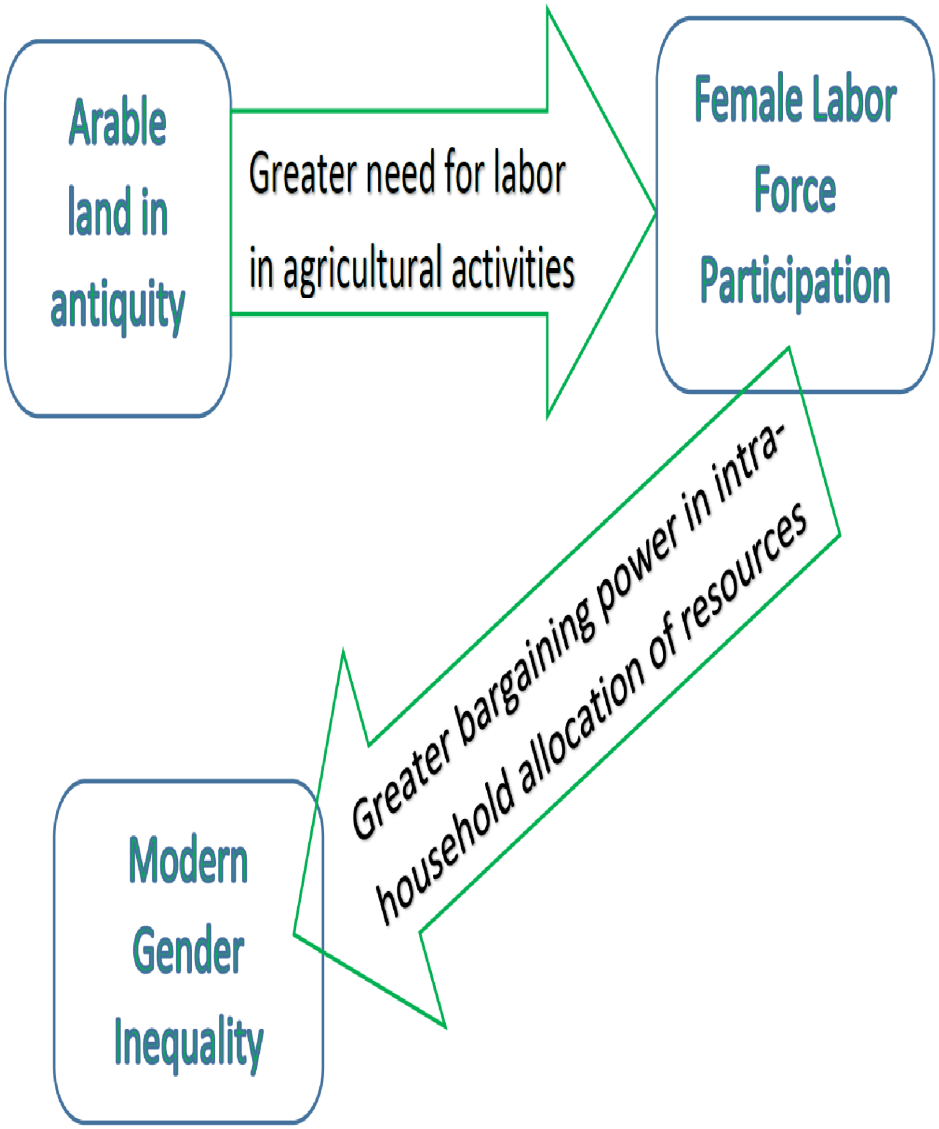

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  - By making cultivation more labor intensive, scarcity of land places a premium on male brawn (Iversen and Rosenbluth, 2010).
  - Labor force participation and economic contributions increase women's bargaining power and improve their health outcomes (Heath and Jayachandran, 2017; Westeneng and d'Exelle, 2015).

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- "The male comparative advantage in brawn was accentuated by growing land scarcity, which increased the value not only of a man's labor but also his ability to defend the farm against marauders" (Iversen and Rosenbluth, 2010).
- Societies exposed to external threats (such as wars) and resource scarcity enforce existing social norms more stringently (Gelfand et al., 2011).

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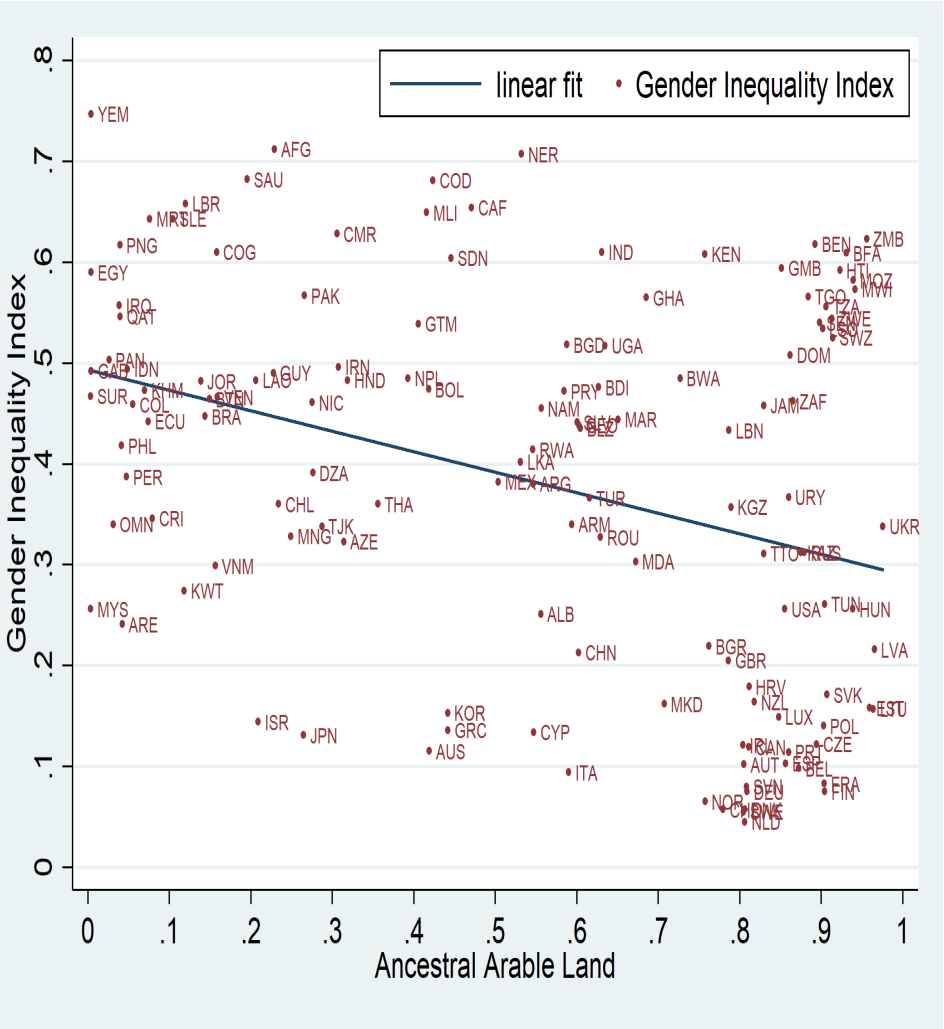

Figure: Gender Inequality Index

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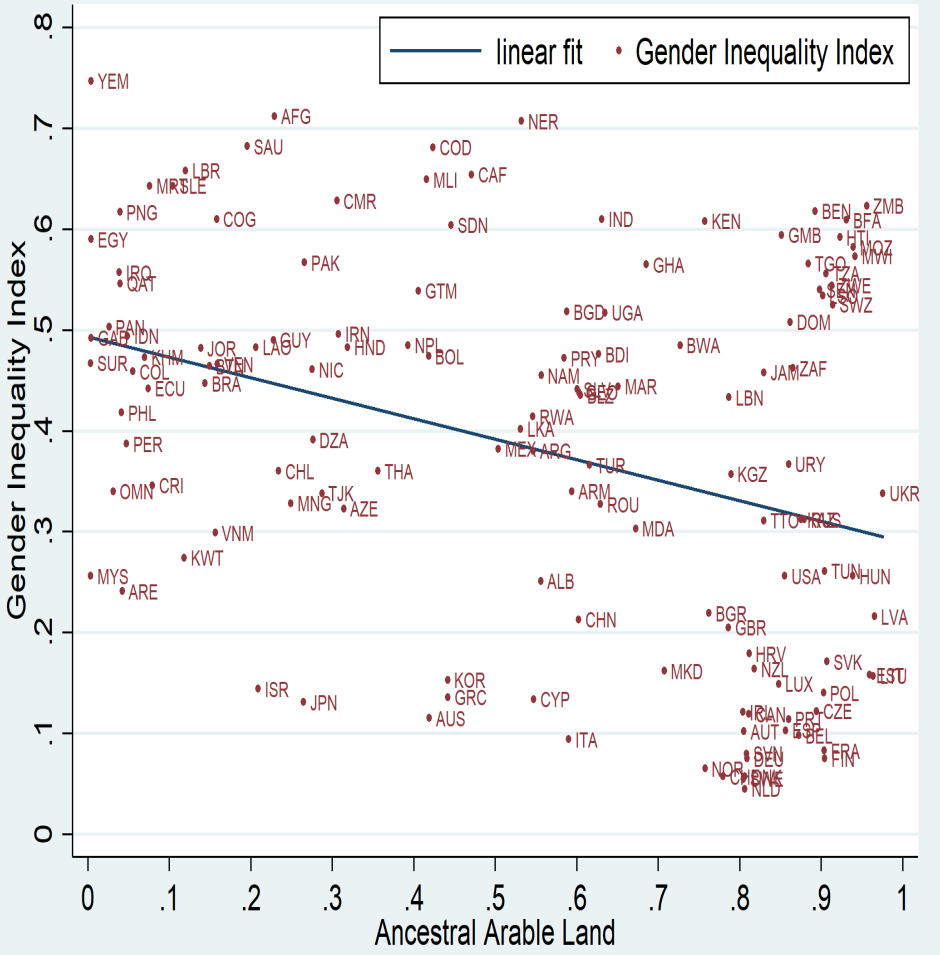

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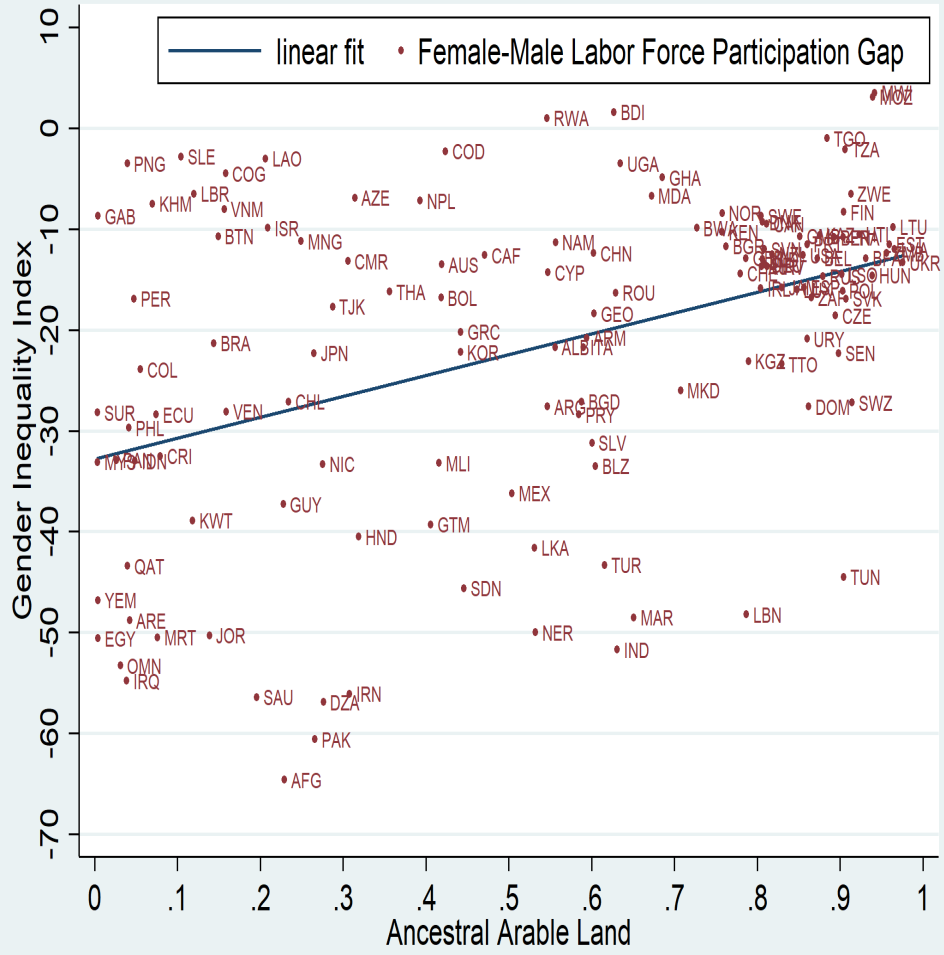

Figure: Female-Male LFP Gap

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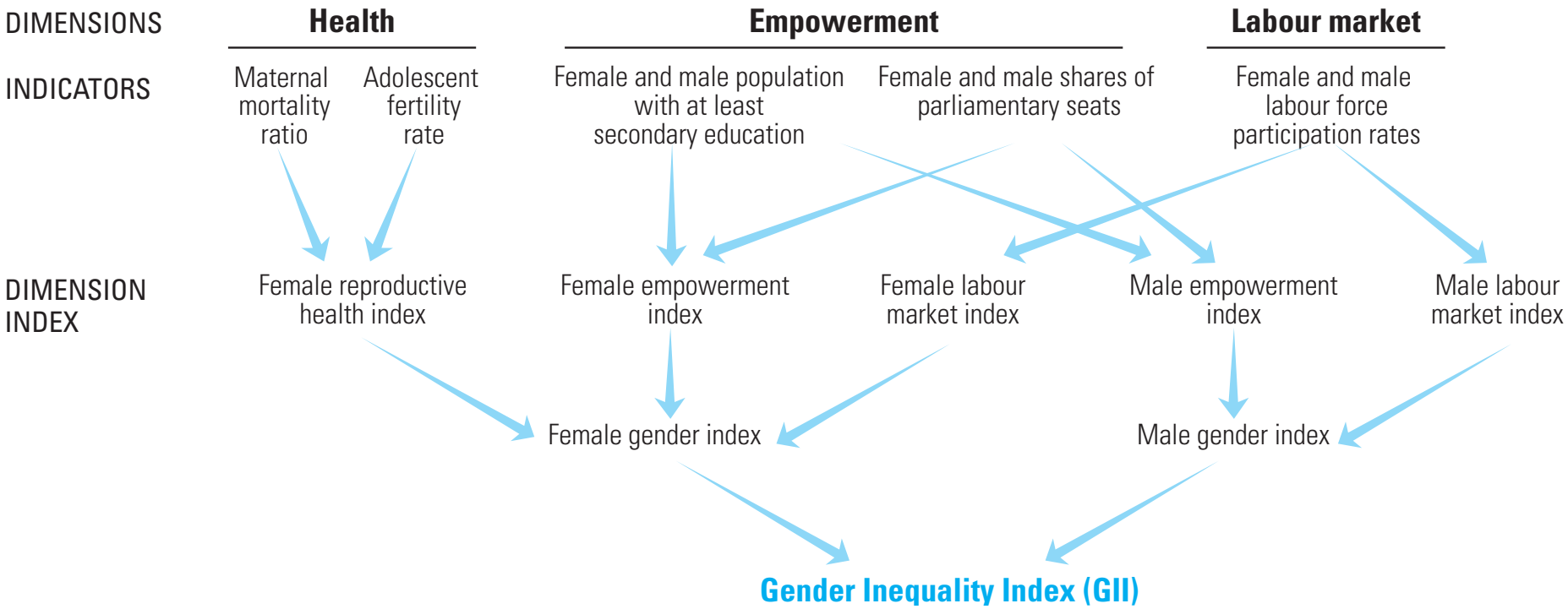

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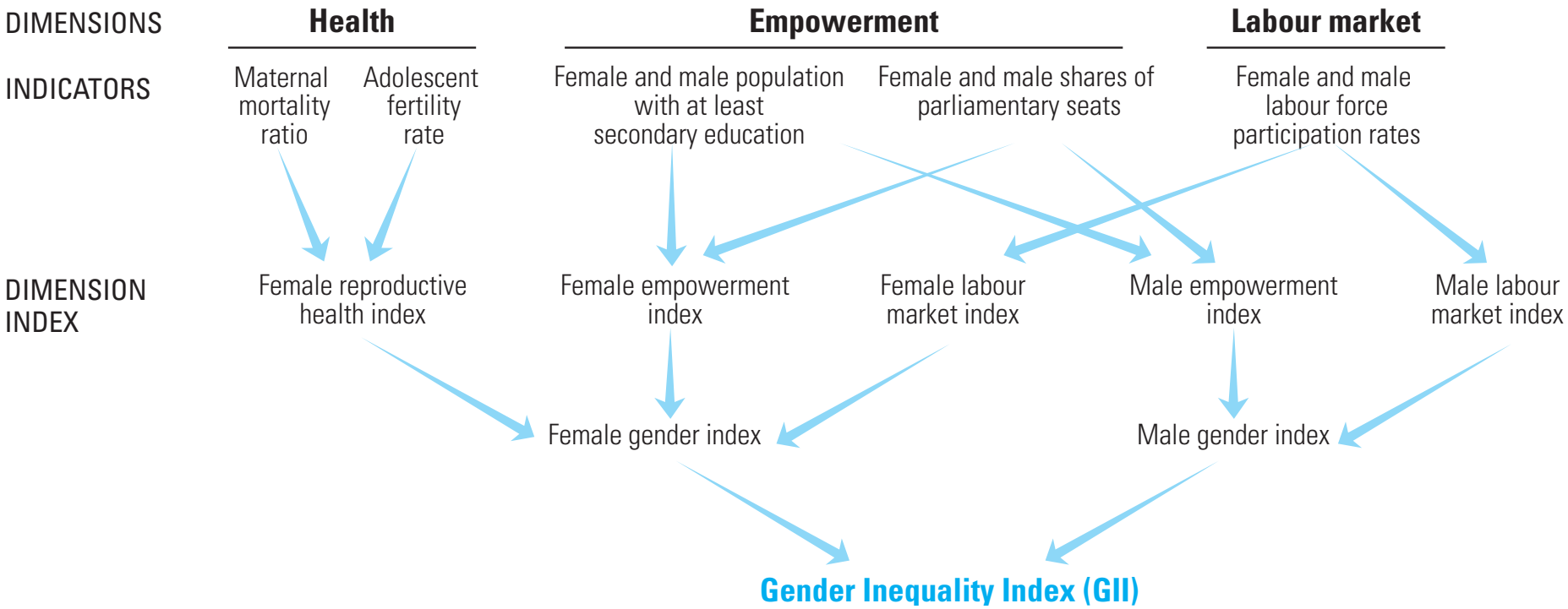

- Unlike previous studies, ours is a composite measure of gender inequality that consists of both gender roles and outcomes and hence takes their interaction into account.

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    - a modern soil map of the world is also historical, as are the climatic and soil requirements of mankind's main crops.

Empirical Specification

Baseline econometric specification:

$$\textit{Gender Inequality Index}_i = \beta_1 + \beta_2 \text{fraction of ancestral land suited to agriculture}_i + \mathbf{X_i}'\beta_3 + \varepsilon_i \quad (1)$$

$$\textit{Gender Inequality Index}_i = \alpha_1 + \alpha_2 \text{migration-adjusted potential arable land}_i + \mathbf{X_i}'\alpha_3 + \epsilon_i \quad (2)$$

Table: Ancestral Arable Land and Gender Inequality

	(1)	(2)	(3)	(4)	(5)
Dependent Variable: Gender Inequality Index					
Ancestral arable land	-0.106***	-0.106***	-0.0911***	-0.0668*	-0.0885**
	(0.0337)	(0.0340)	(0.0335)	(0.0346)	(0.0396)
Ancestral plow use		-0.00676	-0.00480	-0.0196	0.0710**
		(0.0530)	(0.0523)	(0.0471)	(0.0334)
Years since neolithic transition			0.0121**	0.0127**	0.00571
			(0.00590)	(0.00508)	(0.00750)
Pre-1500 CE average crop yield				-0.00006***	-0.00005**
				(0.00002)	(0.00002)
Baseline controls	Yes	Yes	Yes	Yes	Yes
Additional controls					Yes
Continent dummies	Yes	Yes	Yes	Yes	Yes
Observations	134	134	133	133	96
Adjusted R^2	0.773	0.771	0.775	0.798	0.877

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Baseline controls: Ln(per capita income) and its squared term, land area in geographical tropics, distance to nearest coastline or sea-navigable river. Additional controls: share of agriculture in GDP, share of industry in GDP, religious fractionalization, democracy, state antiquity index, legal origins, social infrastructure index, and the experience of communism. Constant not reported.

Table: Ancestral Arable Land and Female Labor Force Participation

	(1)	(2)	(3)	(4)	(5)
Ancestral arable land	18.22***	18.18***	12.40**	9.449**	15.14**
	(5.508)	(5.351)	(4.899)	(4.734)	(5.965)
Ancestral plow use		-4.084	-4.847	-3.041	-4.509
		(6.187)	(6.180)	(5.125)	(4.696)
Years since neolithic transition			-4.397***	-4.466***	-2.315**
			(0.921)	(0.974)	(1.063)
Pre-1500CE average crop yield				0.0072***	0.0066***
				(0.00213)	(0.00236)
Baseline controls	Yes	Yes	Yes	Yes	Yes
Additional controls					Yes
Continent dummies	Yes	Yes	Yes	Yes	Yes
Observations	134	134	133	133	96
Adjusted R^2	0.384	0.382	0.489	0.536	0.608

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Baseline controls: Ln(per capita income) and its squared term, land area in geographical tropics, distance to nearest coastline or sea-navigable river. Additional controls: share of agriculture in GDP, share of industry in GDP, religious fractionalization, democracy, state antiquity index, legal origins, social infrastructure index, and the experience of communism. Constant not reported.

Table: Ancestral Arable Land and Gender Inequality Index: Does Labor Force Participation Play a Mediating Role?

	(1)	(2)	(3)	(4)
Ancestral arable land	-0.0486	-0.0483	-0.0500	-0.0406
	(0.0384)	(0.0385)	(0.0382)	(0.0378)
Ancestral plough use		-0.0198	-0.0209	-0.0280
		(0.0427)	(0.0433)	(0.0418)
Years since neolithic transition			-0.00243	0.000284
			(0.00654)	(0.00597)
Pre-1500 CE average crop yield				-0.0000391***
				(0.0000137)
Female Labor Force Participation	-0.00317***	-0.00320***	-0.00331***	-0.00278***
	(0.000714)	(0.000726)	(0.000843)	(0.000827)
Continent dummies	Yes	Yes	Yes	Yes
Baseline controls	Yes	Yes	Yes	Yes
Observations	134	134	133	133
Adjusted R^2	0.817	0.817	0.815	0.823

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Constant not reported.

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- Secondary mechanism: Resource scarcity
  - The inclusion of the resource availability causes the relationship between ancestral arable land and gender inequality index to weaken (last column of Table 1).

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- Health dimension

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- Labor market dimension
  - Female-male labor force participation gap

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	Health Dimension		*Empowerment Dimension*		*Labor Market Dimension*
	MMR	ABR	WP	Education gap	LFP Gap
	(1)	(2)	(3)	(4)	(5)
Ancestral arable land	-135.8***	-19.89**	1.998	-1.023	14.10**
	(45.12)	(9.769)	(4.025)	(3.228)	(5.710)
Ln(Per capita income)	-274.5***	-24.61	-12.84*	7.793	-9.497
	(76.15)	(22.88)	(6.926)	(5.256)	(8.471)
Ln(Per capita income)–squared	12.26***	0.750	0.744*	-0.255	0.529
	(4.043)	(1.221)	(0.386)	(0.278)	(0.447)
Fraction of land area in the geographical tropics	-6.725	1.545	-2.196	0.900	4.828
	(33.54)	(6.951)	(3.077)	(2.648)	(5.112)
Distance to nearest coastline or sea-navigable river	17.00	3.102	0.753	1.756	1.835
	(23.59)	(6.055)	(2.279)	(1.659)	(3.031)
Continent dummies	Yes	Yes	Yes	Yes	Yes
Observations	133	133	133	133	133
Adjusted R^2	0.796	0.658	0.094	0.254	0.344

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. MMR = Maternal Mortality Ratio. ABR = Adolescent Birth Rate. WP = Percentage of Women in Parliament. Education gap = Percentage of females with at least secondary education −Percentage of males with at least secondary education. LFP gap = Female Labor Force Participation Rate − Male Labor Force Participation Rate. Constant not reported.

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  - Being healthy was important for women to work in agriculture, being educated and empowerment were not.
  - Hence, in arable land-abundant societies, norms developed that would restrict the number of pregnancies and devote more resources to new mothers to enable them to return to fields as soon as possible implying better reproductive health outcomes.

Ancestral Arable Land and Individual Gender Attitudes Around the World

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$$y_{i,d,c} = \alpha_c + \beta \textit{Ancestral Arable Land}_d + \mathbf{X'}_i\theta + \mathbf{X'}^H_d\delta + \varepsilon_{i,d,c} \quad (3)$$

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- Country-level controls: income per capita and income per capita squared in natural logs measured in the same year, as the dependent variable.

Table: Ancestral Arable Land and Attitudes Regarding Women's Rights and Capabilities: Individual-Level Estimates

	Men Make Better Political Leaders		When Jobs are scarce, men should have more right		Female Labor Force Participation	
	(1)	(2)	(3)	(4)	(5)	(6)
Ancestral arable land	-0.621***	-0.423**	-0.177***	-0.196***	0.117***	0.0195
	(0.0919)	(0.170)	(0.0444)	(0.0642)	(0.0442)	(0.0405)
Individual-level controls	Yes	Yes	Yes	Yes	Yes	Yes
District-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Country-level controls	Yes		Yes		Yes	
Continent dummies	Yes		Yes		Yes	
Country dummies		Yes		Yes		Yes
Countries	48	53	70	74	69	73
Districts	453	479	674	700	672	698
Observations	64215	72152	80303	87528	43801	47587
Adjusted R^2	0.191	0.258	0.206	0.275	0.169	0.266

Standard errors clustered at district-level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Concluding Remarks

- The availability of arable land in antiquity played a role in the shaping of gender norms that promoted women's labor force participation and resulted in better reproductive health outcomes for them.

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  - Creating employment opportunities (especially for women) that improve their bargaining power (Heath and Jayachandran, 2017).

Thank You!

Validity of Measures of Arable Land in Antiquity

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  2. there should be no significant difference in the relationship between our measures of arable land in antiquity and gender inequality for the New World and the Old World.
- If our hypothesis, the arable land in antiquity has an effect on modern gender inequality via an effect on gender norms, is correct then ancestral arable land should have a primacy over current potential arable land.

Table: Validity of Measures of Arable Land in Antiquity

	(1)	(2)	(3)
Migration-unadjusted potential arable land	-0.128***		
	(0.0436)		
Migration-unadjusted potential arable land × Countries in the Americas and Oceania	0.174***		
	(0.0636)		
Migration-adjusted potential arable land		-0.111**	
		(0.0430)	
Migration-adjusted potential arable land × Countries in the Americas and Oceania		0.0345	
		(0.122)	
Ancestral arable land			-0.123***
			(0.0375)
Ancestral arable land × Countries in the Americas and Oceania			0.0679
			(0.0581)
Baseline Controls	Yes	Yes	Yes
Continent dummies	Yes	Yes	Yes
Observations	133	133	134
Adjusted R^2	0.770	0.766	0.773

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Arable Land and Gender Inequality: An Effect of Culture?

Table: Ancestral Arable Land and Gender Inequality: An Effect through Culture?

	GII	MMR	ABR	WP	Education gap	LFP Gap
	(1)	(2)	(3)	(4)	(5)	(6)
The effect of norms? Horse-race between current and ancestral arable land						
Current potentially arable land	0.0379	68.44	20.29	-5.852	-5.712*	16.37***
	(0.0467)	(51.36)	(12.88)	(4.165)	(3.139)	(5.593)
Ancestral arable land	-0.125***	-128.8**	-23.25***	5.799	0.145	9.479**
	(0.0386)	(52.54)	(7.914)	(3.544)	(3.534)	(4.148)
Continent dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	133	133	133	133	133	133
Adjusted R^2	0.620	0.690	0.569	0.096	0.098	0.396

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Constant not reported.

Relative Importance of Historical Factors

- Arable land in antiquity *is* a complementary input to all the historical agricultural factors shown to influence gender inequality.

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Table: Relative Importance of Historical Factors in Determining Gender Inequality

	GII	MMR	ABR	WP	Education gap	LFP Gap
	(1)	(2)	(3)	(4)	(5)	(6)
	Horse-race between historical factors					
Ancestral arable land	-0.0970**	-117.2**	-19.65**	4.414	-1.104	8.392**
	(0.0423)	(50.15)	(7.893)	(3.695)	(3.563)	(3.992)
Years since neolithic transition	0.00586	-6.589	0.196	-0.772	-1.144**	-3.960***
	(0.00874)	(7.487)	(1.647)	(0.627)	(0.498)	(0.900)
Ancestral Plough use	-0.0651	-5.131	-14.78*	0.133	2.565	-4.285
	(0.0413)	(34.52)	(8.648)	(2.907)	(2.450)	(5.355)
Pre-1500 CE average crop yield	-0.00002	-0.00177	0.00287	-0.0001	-0.00195*	0.00663***
	(0.00002)	(0.0142)	(0.00411)	(0.00166)	(0.0011)	(0.00193)
Continent dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	133	133	133	133	133	133
Adjusted R^2	0.627	0.683	0.568	0.074	0.120	0.496

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Constant not reported.

Table: Migration-Adjusted Potential Arable Land and Gender Inequality Index

	(1)	(2)	(3)	(4)
Migration-adjusted potential arable land	-0.109***	-0.109***	-0.103**	-0.0372
	(0.0401)	(0.0413)	(0.0398)	(0.0368)
Fraction of population with ancestors who used the plough		-0.0103	-0.00792	-0.0199
		(0.0491)	(0.0484)	(0.0454)
Years since neolithic transition (migration-adjusted)			0.0150***	0.0152***
			(0.00558)	(0.00490)
Pre-1500 CE average crop yield (ancestry-adjusted)				-0.0000584***
				(0.0000155)
Baseline controls	Yes	Yes	Yes	Yes
Continent dummies	Yes	Yes	Yes	Yes
Observations	133	133	133	133
Adjusted R^2	0.768	0.766	0.774	0.793

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Constant not reported.

Table: Arable Land in Antiquity and Alternative Measures of Gender Inequality

	Gender Development Index in 2013		Female-male life expectancy gap at birth in 2013	
	(1)	(2)	(3)	(4)
Migration-adjusted potential arable land	0.0783**		1.866**	
	(0.0304)		(0.849)	
Ancestral arable land		0.0840***		1.682***
		(0.0217)		(0.600)
Ln(per capita income)	0.126**	0.127***	6.049***	6.124***
	(0.0491)	(0.0464)	(1.074)	(1.138)
Ln(Per capita income)–squared	-0.00584**	-0.00593**	-0.348***	-0.351***
	(0.00256)	(0.00242)	(0.0613)	(0.0643)
Fraction of land area in the geographical tropics	-0.00474	0.0252	0.275	0.923
	(0.0230)	(0.0241)	(0.559)	(0.580)
Distance to nearest coastline or sea-navigable river	0.0248*	0.0110	1.747***	1.459***
	(0.0130)	(0.0115)	(0.414)	(0.359)
Baseline Controls	Yes	Yes	Yes	Yes
Continent dummies	Yes	Yes	Yes	Yes
Observations	128	129	146	146
Adjusted R^2	0.507	0.530	0.559	0.561

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Constant not reported.

References I

- Alesina, Alberto, Paola Giuliano, and Nathan Nunn (2013). "On the origins of gender roles: Women and the plough". *Quarterly Journal of Economics* 128.2, 469–530.
- — (2018). "Traditional agricultural practices and the sex ratio today". *PloS One* 13.1, e0190510.
- Beaman, Lori, Raghabendra Chattopadhyay, Esther Duflo, Rohini Pande, and Petia Topalova (2009). "Powerful women: Does exposure reduce bias?" *Quarterly Journal of Economics* 124.4, 1497–1540.
- Boserup, Ester (1970). *Woman's role in economic development*. London: George Allen and Unwin Ltd.
- Cohen, Mark Nathan and Sharon Bennett (1993). "Skeletal evidence for sex roles and gender hierarchies in prehistory". *Sex and Gender Hierarchies*, 273–296.
- Diamond, Jared (1987). "The worst mistake in the history of the human race". *Discover* 8.5, 64–66.
- Fredriksson, Per G and Satyendra Kumar Gupta (2018). "The neolithic revolution and contemporary sex ratios". *Economics Letters* 173, 19–22.

References II

- Geary, David C (2015). *Evolution of vulnerability: implications for sex differences in health and development*. Academic Press.
- Gelfand, Michele J, Jana L Raver, Lisa Nishii, Lisa M Leslie, Janetta Lun, Beng Chong Lim, Lili Duan, Assaf Almaliach, Soon Ang, Jakobina Arnadottir, et al. (2011). "Differences between tight and loose cultures: A 33-nation study". *Science* 332.6033, 1100–1104.
- Hansen, Casper Worm, Peter Sandholt Jensen, and Christian Volmar Skovsgaard (2015). "Modern gender roles and agricultural history: the Neolithic inheritance". *Journal of Economic Growth* 20.4, 365–404.
- Hayden, Brian, Michael Deal, Aubrey Cannon, and Joanna Casey (1986). "Ecological determinants of women's status among hunter/gatherers". *Human Evolution* 1.5, 449–473.
- Hazarika, Gautam, Chandan Kumar Jha, and Sudipta Sarangi (2019). "Ancestral ecological endowments and missing women". *Journal of Population Economics* 32.4, 1101–1123.

References III

- Heath, Rachel and Seema Jayachandran (2017). "The causes and consequences of increased female education and labor force participation in developing countries". In: *The Oxford Handbook of Women and the Economy*. Oxford University Press, pp. 345–367.
- Iversen, Torben and Frances McCall Rosenbluth (2010). *Women, work, and politics: The political economy of gender inequality*. Yale University Press.
- Westeneng, Judith and Ben d'Exelle (2015). "How economic empowerment reduces women's reproductive health vulnerability in Tanzania". *Journal of Development Studies* 51.11, 1459–1474.
- Wrangham, Richard W (1986). "Ecology and social relationships in two species of chimpanzee". In: *Ecological Aspect of Social Evolution*. Princeton University Press.