

**The Role of Historical Resource Constraints in Modern Gender Inequality:
A Cross-Country Analysis⁺**

by

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Abstract

We suggest that historical resource scarcities played a role in the emergence of gender norms inimical to women, culture that persists to this day. This thesis is supported by our finding that nations' historical resource endowments, measured by the availability of arable land, are statistically significantly negatively related to their present levels of gender inequality.

⁺ Any opinion, findings, and conclusions expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation

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1. Introduction

Two recent studies, by Hansen, Jensen, and Skovsgaard (2012), and Alesina, Giuliano, and Nunn (2013), investigate historical factors in modern gender inequality. Both contend that cultural norms prescribing a domestic role for women may be traced to an ancient gender-based division of labor whereby women made their contributions from home. The focus of both is gender difference in societal roles rather than in well-being or plight. The studies only differ in their proffered explanations of this culturally consequential gendered division of labor.

Alesina, Giuliano, and Nunn (2013) argue, as did Boserup (1970), that the adoption of the plough by early agrarian societies diminished women's role in agriculture and led to a gendered division of labor by which the role of women was principally domestic. The advent of the plough was unfavorable to women's place in economic life for at least three reasons. First, its use calls for more upper body strength than women typically possess, both because it is a heavy implement and since the large draft animals that draw it must be controlled. Second, since small children in the vicinity of its operation are endangered by it, and ploughing isn't an activity conducive to frequent and unanticipated interruption, the plough may not be handled by persons whose other responsibility is childcare. Third, since the plough can sever the roots of weeds, its use may obviate the need for weeding, a task that mostly fell to women and children. The thesis that the adoption of the plough was a factor in the evolution of cultural norms favoring domesticity in women, is supported by Alesina's, Giuliano's, and Nunn's finding that female labor force participation at present, female ownership of businesses, and female representation in parliament is lower in countries in which a larger proportion of the population traces its ancestry to ethnic groups that employed the plough.

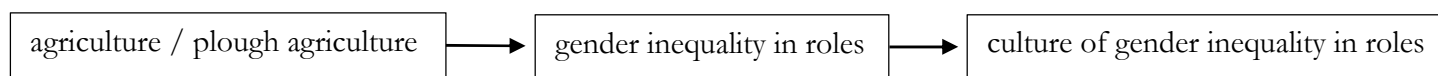
On the other hand, Hansen, Jensen, and Skovsgaard (2012) maintain that a gendered division of labor by which women were turned to the domestic sphere, was a product of agriculture

itself, whether by, or without, the means of the plough. They note, for example, that Chinese grave goods from an era preceding the adoption of the plough are yet indicative of a gendered division of labor, and that such a division of labor is already observable in the branch of the Kalahari's !Kung tribe recently settled to primitive agriculture absent the plough, with the result that women in the tribe's branch that continues hunting and gathering enjoy more autonomy and wield greater influence than their agrarian sisters. The authors observe that women's contribution to the caloric intake of their communities is generally very high among modern hunter-gatherers. On the other hand, agriculture, particularly the cultivation of cereals, concentrates food production in the hands of men, with women playing a greater role in the home-bound processing of crops. The thesis that patriarchal cultural norms may be traced to man's transformation from hunter-gatherer to farmer, is supported by Hansen's, Jensen's, and Skovsgaard's finding that gender roles are more unequal in countries with longer histories of agriculture.

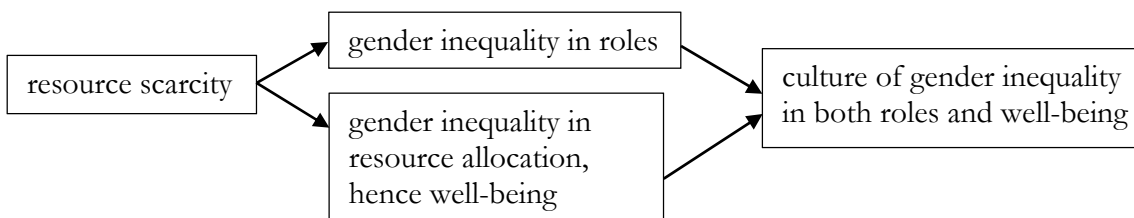
Though neither of these studies dwells on gender inequality in well-being, a connection between gender inequality in roles and that in well-being may be inferred from Collective Models of household behavior (Bourguignon and Chiappori, 1992). Domesticity may have diminished women's intra-household bargaining power, held to depend on women's options outside the home. It is conceivable this erosion of bargaining power reduced women's well-being. So, these studies may be viewed as delineating a causal relationship between a primeval gendered division of labor and a culture of gender inequality in roles, and, in turn, between this culture and women's plight.

This study approaches the issue differently, though in a manner that complements these earlier theses. We propose that historical resource scarcity is a factor capable of directly influencing both women's role and their plight. Resource scarcity may have led to restrictions upon women's societal role, and, independently, to gender inequality in the allocation of resources germane to well-being, and both effects may have become enshrined in a culture of gender inequality. Whereas

Hansen's, Jensen's, and Skovsgaard's (2012), and Alesina's, Giuliano's, and Nunn's (2013) arguments concern the emergence of a culture of gender inequality in roles that presumably led to inequality in well-being, we contend that gender inequality in well-being may not simply be the outcome of a culture of gender inequality in roles but that resource scarcity may have brought about a culture of gender inequality in both roles and well-being. In sum, Hansen's, Jensen's, and Skovsgaard's (2012), and Alesina's, Giuliano's, and Nunn's (2013) theses may be summarized as



whereas our arguments may be rendered as



That resource scarcity may have produced restrictions upon women's role finds support in a study of hunter-gatherer societies by Hayden, Deal, Cannon, and Casey (1986), which ascertains that the lack of subsistence resources is apt to diminish women's decision-making role in the domestic and political spheres¹. It is notable that this occurs among pre-agricultural peoples. An independent connection between resource scarcity and gender inequality in well-being is supported by the observation that poverty contributes to gender bias in the intra-household allocation of resources in many a developing country. For example, DeTray (1988) discovers that Malaysian households' demand for the schooling of girls is more income-elastic than their demand for boys' schooling, Behrman (1988) learns that rural Indian households' favoring of boys in the allocation of nutrition is greatest during the lean agricultural season, and Alderman and Gertler (1997) find that Pakistani

¹ By these authors, hunter-gatherers suffering resource stress are under pressure to control their numbers, and fertility control is facilitated by the subjugation of women of child-bearing age. This conclusion is borne out in the authors' observation that strictures upon women are significantly loosened upon their reaching the age of menopause.

households' demand for the health care of unwell children is more income-elastic in the instance of ill girls.

It is noteworthy that a connection between resource scarcity and gender inequality has been hypothesized by primatologists studying differences in the social behaviors of the bonobo (*Pan paniscus*) and the common chimpanzee (*Pan troglodytes*), species 99.7% genetically similar to humans. Chimpanzee society is characterized by severe gender inequality. Male chimpanzees almost always dominate females and there is much male violence against female chimpanzees. Gender relations in bonobo society are markedly different. Female bonobos dominate males and there is no significant male violence against them. This striking difference between these similar species of ape has been attributed to the following twin factors. First, unlike female chimpanzees, bonobo females tend to band together into powerful coalitions capable of thwarting males. Second, unlike male chimpanzees, bonobo males tend not to form strong coalitions with other males. Some primatologists (e.g., Wrangham, 1986) argue that the historical resource environments of these species lie behind these factors. Wild bonobos are only to be found in a resource abundant region south of the Congo River in the Democratic Republic of the Congo, and it is likely that this is where they evolved. On the other hand, the common chimpanzee is indigenous to regions less endowed with food resources, in which the gorilla, a competitor, too resides. Hence, female chimpanzees, fearing competition for limited food, prefer to forage alone, and this solitude is an impediment to their forging close bonds with other females. On the other hand, male chimpanzees commonly ally with some males against other males so as to control limited food resources. A mix of coalitions of males and relatively solitary females makes for unequal gender relations. In contrast, since theirs is a resource abundant environment, bonobo females are not averse to feeding together, and this affords them opportunities to forge alliances, whereas bonobo males have less incentive to form strategic coalitions to control resources since these are abundant.

It is notable as well that anthropologists have exhumed evidence of differential effects of changes in the resource environment upon men's and women's nutrition in prehistory. Nutrition may be inferred from human skeletal remains, and these indicate that prehistoric human sexual dimorphism (differences between men and women in their physical dimensions) in parts of North America increased during periods of declining nutrition, i.e., females became shorter relative to males when average human height fell, whereas this gap decreased during periods of improved nutrition (Cohen and Bennett, 1993). In other words, women tended to fare worse than men when resources were scarce, even though males' biological growth processes may be more sensitive to environmental conditions (Hall, 1978). If male stature is ordinarily more responsive to nutrition than female stature, a widening gap between the two during periods of resource stress must be at the hand of man, by the means of gender inequality in resource allocations.

The thesis that historical resource scarcity may have fomented a culture of gender inequality is supported by our finding of a statistically significant negative relationship, robust to the inclusion of a variety of controls, between nations' historical resource endowments, as measured by the availability of arable land, and their current levels of gender inequality.

The remainder of this paper is organized as follows. Section 2 describes the empirical strategy as well as the utilized data. Section 3 presents the study's findings. Section 4 offers certain supportive stylized facts and a brief conclusion.

2. Empirical Model and Data

Our empirical model consists of cross-country regression equations, in each of which the dependent variable measures national gender inequality and the primary independent variable gauges nations' historical resource constrainedness.

National gender inequality is measured in the main by the UNDP's Gender Inequality Index for the year 2012. The Gender Inequality Index summarizes women's disadvantages in the areas of reproductive health, empowerment, and the labor market². Their hardships in the area of reproductive health are described by the Maternal Mortality Ratio (MMR), equivalent to the number of maternal deaths per 100,000 live births, and the Adolescent Fertility Rate (AFR), computed as the number of births per 1000 fifteen to nineteen year old women. Women's and men's shares of seats in parliament, and the proportions of adult women and men with secondary or higher education, gauge the levels of empowerment of the genders, and women's and men's labor force participation rates measure the genders' standing in the labor market. Whereas women's standing in the labor market and their empowerment concern their societal role, their predicament in the area of reproductive health may be considered a reflection of their plight. Thus, the Gender Inequality Index may be taken to measure inequality between the sexes in both roles and well-being. The Index increases in gender inequality, ranging, in 2012, from 0.045 (Netherlands) to 0.747 (Yemen). Figure 1 presents a world choropleth map of gender inequality per the Index. It indicates that gender inequality is concentrated in South Asia, the Middle East, and North-East, Central, and West Africa.

A nation's historical resource endowment is measured in two principal alternative ways. Our first measure consists of the percentage share of its land that is potentially arable, which is to say, suited to rainfed cultivation. The Food and Agricultural Organization of the United Nations (FAO) has estimated each country's potential arable land (FAO, 2000). In most cases, potential arable land exceeds actual arable land, in that a portion of potential arable land, such as currently forested land, hasn't yet been brought under cultivation. In a few countries, however, such as Egypt, modern irrigation has permitted actual arable land to exceed land suited to rainfed cultivation. The FAO bases its estimates of potential arable land on a soil map of the world that identifies major soil

² The UNDP's methodology is described in http://hdr.undp.org/sites/default/files/hdr14_technical_notes.pdf.

constraints such as salinity, a global climatic database, and a database on the climatic and soil requirements of 21 major crops. For the following reasons, the FAO's estimate of a nation's current potential arable land is a plausible measure of its historical resource constrainedness. First, agriculture has become the mainstay of mankind since the Neolithic Revolution 12,000 years ago, and potential arable land speaks to the agricultural potential of a region in the absence of modern irrigation and technologies that mitigate soil constraints. Second, a modern soil map of the world is also historical, as are the climatic and soil requirements of mankind's main crops, in that almost nothing has changed in their regard. Third, while the world's climate has seen considerable change during the geological epoch of the Holocene³, within which the Neolithic Revolution occurred, it has, at any rate, been fairly stable for the past one to two millennia (Jones and Mann, 2004).

We obtain our second principal measure of nations' historical resource constrainedness from the study by Alesina, Giuliano, and Nunn (2013). This measure pertains to *ancestral* rather than mere historical resource constrainedness. Alesina, Giuliano, and Nunn recognize that nations are often made up of a number of ethnic groups. Each ethnic group has a historical centroid, a place whence they originated. Alesina, Giuliano, and Nunn acquire the geographical coordinates of these ethnic centroids from a colossal piece of ethnographic scholarship by the late American anthropologist George Peter Murdock called the *Ethnographic Atlas*⁴. They then use GIS software to identify land within 200 kilometers of each such centroid. This land may be termed the concerned ethnic group's ancestral land. Alesina, Giuliano, and Nunn employ an FAO database to calculate the share of each ethnic group's ancestral land suited to agriculture, that is, to the cultivation of six major crops. Finally, they compute the share of a nation's ancestral lands suited to agriculture as the weighted mean of the shares of its constituent ethnic groups' ancestral lands suited to agriculture, the weights

³ For example, there is evidence of ancient lakes in what is now the Sahara desert.

⁴ Electronic versions of Murdock's *Ethnographic Atlas* may be downloaded at the links 'Ethnographic Atlas coded data in Excel' or 'Ethnographic Atlas coded data in SPSS' in <http://eclectic.ss.uci.edu/~drwhite/worldcul/SCCSarticles.htm>.

being the shares of these groups' numbers in the national population. Converted to percentages, these shares of nations' ancestral lands suited to agriculture make up our second measure of national historical resource constrainedness⁵.

We estimate the linear regression equations

$$\text{Gender Inequality Index}_i = a_1 + a_2 (\log \text{percentage of land that is potentially arable}_i) + \mathbf{X}_i' \mathbf{a}_3, \quad (1)$$

and

$$\text{Gender Inequality Index}_i = b_1 + b_2 (\log \text{percentage of ancestral land suited to agriculture}_i) + \mathbf{X}_i' \mathbf{b}_3, \quad (2)$$

wherein the subscript i alludes to country i , and the regressors \mathbf{X}_i consist of a host of controls. Each equation is estimated upon a sub-sample of nations for which data in regard to its dependent and independent variables are obtainable.

We also estimate supplementary regression equations whose dependent variables gauge gender inequality in alternative ways: the gender difference in life expectancy at birth, and the UNDP's Gender Development Index, a composite measure, first announced in 2014, of gender inequality in health, education, and command over resources.

3. Results

Table 1 reports the means and standard deviations of all utilized variables. The Gender Inequality Index in 2012 has a mean value of 0.38, that for Argentina. The range of the Index in theory is $[0, 1]$, and, as mentioned, gender inequality by it was least in the Netherlands and highest in Yemen. As discussed, the percentage share of a nation's land that is potentially arable, and the percentage of its ancestral lands suited to agriculture, are our principal measures of its historical resource constrainedness. These are brought into the analysis in natural logs since the marginal effects of the variables upon gender inequality may be diminishing. The mean value of the share of

⁵ These data may be found in http://scholar.harvard.edu/files/nunn/files/plough_replication_files.zip.

national land area suited to rainfed cultivation is 42.72%, which is approximately that for Ethiopia, and the mean value of the share of national ancestral lands suited to agriculture is 54.19%, roughly that for Guinea.

Table 2 presents estimates of the coefficients of rudimentary versions of (1) and (2), of which the specification corresponding to the estimates in column (3) is the baseline specification of (1), and the specification pertaining to the estimates in column (6) is the baseline specification of (2). Since this study investigates the effect of historical economic circumstances upon modern gender inequality, the baseline regressions are careful to control for contemporary economic circumstances as measured by per capita income in 2012. The fraction of land in the tropics is included as a regressor since, as Gallup, Sachs, and Mellinger (1999) put it, “tropical regions are hindered in development relative to temperate regions, probably because of higher disease burdens and limitations on agricultural productivity.” In other words, nations in the tropics will, *ceteris paribus*, have suffered greater resource scarcity. Distance from the coast or sea-navigable river is included as a regressor since it is a factor in resource generating trade. In three of the four specifications in which it is included, the fraction of land in the tropics is significantly positively related to gender inequality, from which may be inferred that historical resource scarcity is indeed a factor in modern gender inequality. Importantly, this may be concluded as well from the consistently statistically significant negative relationship between gender inequality at present and our principal measures of historical resource endowment.

Table 3 reports estimates of the coefficients of the baseline versions of (1) and (2) augmented to accommodate Hansen’s, Jensen’s, and Skovsgaard’s (2012) and Alesina’s, Giuliano’s, and Nunn’s (2013) theses. Whereas these estimates indicate greater gender inequality in countries with longer histories of agriculture, they don’t point to the plough being a significant correlate of gender inequality as measured by the UNDP’s Gender Inequality Index. It is clear that even by these

expanded versions of (1) and (2), modern gender inequality significantly decreases in the historical endowment of resources.

Table 4(a) presents estimates of the coefficients of the baseline version of (1) sequentially expanded to account for international differences in institutions and level of democracy. Nations' levels of democracy are gauged by the Polity2 Index for the year 2000, a 21 point scale ranging from -10 (hereditary monarchy) to +10 (consolidated democracy)⁶. Since a nation's historical resource environment may have been improved by the past sophistication of political organization within its borders, Putterman's and Bockstette's State Antiquity Index is included as a regressor. The State Antiquity Index takes low values for nations within which the level of government has mostly been tribal, and higher values for nations within which political organization has been more sophisticated since antiquity⁷. Next, we account for the origins of nations' legal systems. La Porta, Lopez-de-Silanes, and Shleifer (2008) argue that all national legal systems are of either British, French, German, or Scandinavian extraction. Since the laws of Britain, France, Germany, and Scandinavia differ in their support of private market outcomes, British Common Law being most supportive of such outcomes, the origins of nations' legal systems may be a significant influence upon their economies, hence historical resource environments. Besides, legal systems may differ in their protections afforded women. Next, the Social Infrastructure Index developed by Hall and Jones (1999) is introduced as a regressor. This index measures the "institutions and government policies that determine the economic environment within which individuals accumulate skills, and firms accumulate capital and produce output". It is the combination of a measure of the contemporary efficacy of government support for production and a measure of current openness to trade, and, so, may be considered a factor in nations' contemporary economic circumstances. Finally, experience of

⁶ The Polity2 Index may be found in <http://www.systemicpeace.org/inscr/p4v2013.xls>.

⁷ Putterman's and Bockstette's State Antiquity Index may be found in http://www.econ.brown.edu/fac/louis_putterman/Statehist_v3%201%20web.xls.

communism is controlled for since gender equality was a communist ideal. The estimates indicate that legal systems originating in Germany are favorable to gender equality, and that gender inequality decreases in social infrastructure conducive to economic development. Moreover, they indicate that a statistically significant negative relationship between modern gender inequality and historical resource endowment is robust to the inclusion of the above host of variables. Similarly, table 4(b) reports estimates of the coefficients of the baseline version of (2) consecutively enlarged to control for differences between nations' institutions and level of democracy. By these as well, modern gender inequality decreases in the historical endowment of resources.

Table 5 reports estimates of the baseline versions of (1) and (2) expanded to control for the contemporary structure of nations' economies. They too inform of a statistically significant negative relation between modern gender inequality and historical resource endowment. Table 6 presents estimates of the baseline versions of (1) and (2) augmented to account for religious composition. Religion often shapes culture directly, but its influence may be indirect as well by way of its role in the resource environment. For example, Weber (1930) famously wrote of a 'Protestant Ethic' conducive to prosperity, and Kuran (2011) holds that the inheritance rules of Islam may have held back economic development by hindering the accumulation of wealth, the longevity of commercial partnerships, and the establishment of large-scale enterprises. It seems Islam, Hinduism, and versions of Christianity other than Catholicism and Protestantism widen gender inequality. It is noteworthy that the variables gauging historical resource scarcity continue to exert a statistically significant effect upon modern gender inequality. It is true these levels of significance are lower than in the preceding regressions, but religion, an aspect of culture, may be influenced by the historical resource environment. In other words, the inclusion of religious composition may constitute 'over-controlling'.

Table 7 reports estimates of the baseline specifications of (1) and (2) expanded to include all the above controls. It appears our hypothesized negative association between modern gender inequality and the historical endowment of resources is robust to this broad inclusion. These estimates support Alesina's, Giuliano's, and Nunn's (2013) thesis as well, in that they demonstrate a statistically significant positive relationship between modern gender inequality and the ancestral use of the plough.

Next, we examine whether historical resource scarcity is an influence upon two alternative measures of gender inequality. These are the UNDP's Gender Development Index in 2013 and the gender difference in life expectancy at birth in 2013. The Gender Development Index, first reported for the year 2013, is a composite measure of gender gaps in three areas of human development: health as measured by life expectancy at birth, education as measured by the expected years of schooling of children and the mean years of schooling of adults, and command over resources as measured by estimated earned income. It is the ratio of the UNDP's Human Development Index for females to that for males⁸. Since gender differences in estimated earned income certainly reflect differences between the sexes' culturally prescribed societal roles, the Gender Development Index, like the Gender Inequality Index, may be considered a measure of gender inequality in both roles and plight. On the other hand, gender differences in life expectancy, bespeaking gender differences in health, is directly tied to gender differences in well-being. Table 8 presents estimates of equations analogous to the baseline versions of (1) and (2), in which the dependent variables are, respectively, the Gender Development Index in 2013 and female life expectancy at birth in 2013 less that of males. The estimates indicate that female human development relative to male human development, as well female life expectancy less male life expectancy, are positively and statistically significantly related to the historical endowment of resources as gauged by the availability of arable land.

⁸ The UNDP's methodology is described in http://hdr.undp.org/sites/default/files/hdr14_technical_notes.pdf.

In sum, all our modes of cross-country inquiry point to a statistically significant negative relationship between modern gender inequality and historical access to cultivable land. We consider this supportive of our thesis that past economic scarcity had a hand in the shaping of biased gender norms that persist to this day.

4. Conclusion

Besides summarizing our findings, this section offers certain stylized facts that, we hope, bolster our conclusion that historical resource constraints are a factor in modern gender inequality. Figure 2 presents a scatter plot of per capita income against the UNDP's Gender Inequality Index. This scatter diagram has sizeable lateral spread. In other words, there is a considerable range of gender inequality among countries with comparable per capita incomes. Contrast, for example, Qatar to Switzerland, the United Arab Emirates to France, Saudi Arabia to Slovenia, and Afghanistan to Macedonia. Might differences in historical access to arable land explain some of the difference in gender inequality between, say, Saudi Arabia and Slovenia? By figure 3, Switzerland, France, Slovenia, and Macedonia are considerably better endowed with potential arable land than, respectively, Qatar, the United Arab Emirates, Saudi Arabia, and Afghanistan. Some may question these particular comparisons for the reason that Islam, which, arguably, enshrines a degree of gender inequality, is the dominant religion in all four of the above countries in which women are more disadvantaged. In other words, that these are apples-to-oranges comparisons may be an objection. However, religions arose within social contexts. Therefore, it is wholly plausible that they embraced aspects of the cultures within which they were born. After all, Christianity began to "absorb and Christianize pagan religious ideas and practices" in the fourth century (Bradshaw, 2002). Thus, Islam's view of women may really predate Islam, and it is not inconceivable that this view was shaped in part by the resource-poor environment of the Arabian Peninsula.

Figure 3 is suggestive of a negative relation between gender inequality and the endowment of arable land, in that the portrayed vertical spikes appear taller near the Y-axis than further along the X-axis, that is, countries in which there is less gender inequality appear better endowed with potentially arable land.

The final stylized facts supportive of our thesis are found in table 9, which lists the country with the least gender inequality and that with the most gender inequality within each decile of per capita income. In the majority of deciles, the country with the least gender inequality has a larger percentage of potential arable land than the country with the most gender inequality. The 4th and 8th deciles are exceptions, in that Mongolia, with a much smaller proportion of potential arable land than the Republic of the Congo, nevertheless suffers less gender inequality, and Slovenia sees less gender inequality than Uruguay despite possessing a smaller percentage of potential arable land. Perhaps Slovenia, carved from former communist Yugoslavia, benefits from communism's preoccupation with gender equality. Mongolia too was communist once, but its advantage may lie as well in the nomadic pastoral character of its people⁹. Diamond (1987) writes that "freed from the need to transport their babies during a nomadic existence, and under pressure to produce more hands to till the fields, farming women tended to have more frequent pregnancies¹⁰". He also holds that "women in agricultural societies were sometimes made beasts of burden". So it is possible women in Mongolia suffer less gender inequality because theirs was never a life of settled agriculture.

In conclusion, this study seeks to discover whether historical resource constrainedness, gauged by the historical availability of arable land, is an influence upon modern gender inequality. It finds that the proportion of national land area that is potentially arable, and the proportion of

⁹ Some 30 percent of its population remains nomadic or semi-nomadic.

¹⁰ Recall that the Gender Inequality Index incorporates the Maternal Mortality Ratio and the Adolescent Fertility Rate. More frequent pregnancies tend to raise the Maternal Mortality Ratio, and the pressure to produce more hands to till the fields may well bring large numbers of adolescent girls into matrimony and child bearing. It is notable that the Total Fertility Rate in Mongolia is 2.4 as opposed to 5 in the Republic of the Congo.

national ancestral land suited to agriculture, are each statistically significantly negatively related to the UNDP's Gender Inequality Index, and positively related to both the UNDP's Gender Development Index and females' less males' life expectancy at birth. We consider this finding supportive our thesis that historical resource constrainedness played a role in the emergence of gender norms biased against women that remain to this day.

Table 1
Summary Statistics

Variable	Obs.	Mean	S.D.
<i>Dependent Variables</i>			
UNDP Gender Inequality Index in 2012	148	0.38	0.19
UNDP Gender Development Index in 2013	148	0.93	0.07
Female life expectancy at birth in 2013 less that of males	183	4.77	2.43
<i>Explanatory Variables</i>			
Ln(percentage of country's land area that is potentially arable)	159	3.14	1.95
Ln(percentage of country's ancestral lands suited to agriculture)	203	3.67	1.20
Ln(nominal per capita income in 2012 – USD)	184	8.60	1.50
Ln(nominal per capita income in 2012 – USD) squared	186	76.47	26.48
Fraction of land area in the geographical tropics	161	0.48	0.48
Mean distance in '000 kms. To nearest coastline or sea-navigable river	159	0.34	0.47
Years of agriculture in '000 years in 2000 (Putterman & Trainor)	165	4.81	2.43
Fraction of population with ancestors who used the plough (Alesina, Giuliano, and Nunn)	228	0.48	0.48
Index of Democracy (Polity2 in 2000)	158	2.94	6.61
State Antiquity Index (Putterman & Bockstette)	149	0.45	0.24
Origins of national legal system = Britain (La Porta et al.)	216	0.34	0.48
Origins of national legal system = France	216	0.54	0.50
Origins of national legal system = Germany	216	0.09	0.29
Origins of national legal system = Scandinavia	216	0.02	0.15
Social Infrastructure Index (Hall & Jones)	128	0.47	0.25
Indicator of experience of communism	200	0.25	0.43
Percentage share of agriculture in GDP	147	12.25	12.65
Percentage share of industry in GDP	147	30.33	12.93
Catholics as a fraction of the population	189	0.29	0.33
Protestants as a fraction of the population	189	0.14	0.21
Other Christian denominations as a fraction of the population	189	0.08	0.11
Muslims as a fraction of the population	189	0.23	0.35
Hindus as a fraction of the population	189	0.02	0.09
Region = Northern Africa	228	0.04	0.20
Region = Asia	228	0.22	0.41
Region = Europe	228	0.19	0.40
Region = North America	228	0.16	0.37
Region = Oceania	228	0.11	0.32
Region = South America	228	0.06	0.24
Region = Sub-Saharan Africa	228	0.21	0.41

Table 2
The Endowment of Arable Land and Gender Inequality
Dependent Variable = UNDP Gender Inequality Index in 2012

Variable	OLS Coefficient Estimates					
	(1)	(2)	(3) Baseline	(4)	(5)	(6) Baseline
Constant	0.428*** (0.028)	0.659*** (0.224)	0.516* (0.28)	0.524*** (0.04)	0.806*** (0.287)	0.676** (0.316)
Ln(percentage of country's land area that is potentially arable)	-0.013* (0.008)	-0.025*** (0.007)	-0.025*** (0.006)			
Ln(percentage of country's ancestral lands suited to agriculture)				-0.040*** (0.011)	-0.029*** (0.01)	-0.029*** (0.01)
Ln(nominal per capita income in 2012 - USD)		0.028 (0.052)	0.053 (0.062)		-0.002 (0.062)	0.02 (0.067)
Ln(nominal per capita income in 2012 - USD) squared		-0.006** (0.003)	-0.007** (0.004)		-0.004 (0.004)	-0.005 (0.004)
Fraction of land area in the geographical tropics		0.110*** (0.023)	0.027 (0.024)		0.079*** (0.024)	-0.007 (0.03)
Mean distance in '000 kms. to nearest coastline or sea-navigable river		-0.008 (0.019)	-0.031 (0.023)		0.02 (0.017)	-0.008 (0.022)
Region dummy variables (Asia, Europe, N. America, S. America, Oceania, Sub-Saharan Africa; Northern Africa omitted)	No	No	Yes	No	No	Yes
Observations	139	133	133	145	134	134
Adjusted R-squared	0.015	0.762	0.812	0.07	0.72	0.78

Notes: robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Table 3
 Robustness – Years since the Neolithic Transition, and Ancestral Use of the Plough
 Dependent Variable = UNDP Gender Inequality Index in 2012

Variable	OLS Coefficient Estimates			
	(1)	(2)	(3)	(4)
Constant	0.462* (0.276)	0.462 (0.282)	0.587* (0.319)	0.598* (0.313)
Ln(percentage of country's land area that is potentially arable)	-0.024*** (0.007)	-0.024*** (0.007)		
Ln(percentage of country's ancestral lands suited to agriculture)			-0.025** (0.01)	-0.026** (0.01)
Years of agriculture in '000 years in 2000	0.012** (0.005)	0.012** (0.005)	0.013** (0.006)	0.013** (0.006)
Fraction of population with ancestors who used the plough		-0.001 (0.032)		-0.007 (0.052)
Baseline controls	Yes	Yes	Yes	Yes
Observations	133	133	134	134
Adjusted R-squared	0.818	0.816	0.787	0.786

Notes: robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Table 4(a)
 Robustness – Democracy and Institutions
 Dependent Variable = UNDP Gender Inequality Index in 2012
 Principal Dependent Variable = Ln(percentage of a country’s land area that is potentially arable)

Variable	OLS Coefficient Estimates				
	(1)	(2)	(3)	(4)	(5)
Constant	0.469* (0.275)	0.355 (0.268)	0.286 (0.26)	0.318 (0.239)	0.296 (0.234)
Ln(percentage of country’s land area that is potentially arable)	-0.024*** (0.007)	-0.025*** (0.007)	-0.026*** (0.006)	-0.032*** (0.005)	-0.033*** (0.006)
Index of democracy in 2000	-0.002 (0.002)	-0.0001 (0.002)	0.0001 (0.002)	0.001 (0.002)	0.001 (0.002)
State Antiquity Index		0.014 (0.038)	0.028 (0.037)	0.016 (0.043)	0.008 (0.046)
Origins of national legal system = France			-0.009 (0.017)	-0.01 (0.017)	-0.008 (0.018)
Origins of national legal system = Germany			-0.051* (0.026)	-0.065** (0.03)	-0.056* (0.03)
Origins of national legal system = Scandinavia			-0.013 (0.026)	-0.027 (0.025)	-0.027 (0.025)
Social Infrastructure Index				-0.127** (0.048)	-0.127** (0.049)
Indicator of experience of communism					-0.017 (0.023)
Baseline controls	Yes	Yes	Yes	Yes	Yes
Observations	129	120	120	96	96
Adjusted R-squared	0.818	0.858	0.859	0.895	0.895

Notes: robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Table 4(b)
 Robustness – Democracy and Institutions
 Dependent Variable = UNDP Gender Inequality Index in 2012
 Principal Dependent Variable = Ln(percentage of a country’s ancestral lands suited to agriculture)

Variable	OLS Coefficient Estimates				
	(1)	(2)	(3)	(4)	(5)
Constant	0.628** -0.308	0.461 -0.288	0.371 -0.281	0.456 -0.285	0.455 -0.29
Ln(percentage of country’s ancestral lands suited to agriculture)	-0.026** -0.011	-0.027*** -0.01	-0.027*** -0.01	-0.030*** -0.01	-0.030*** -0.01
Index of democracy in 2000	-0.004* -0.003	0.001 -0.002	0.001 -0.002	0.001 -0.002	0.001 -0.002
State Antiquity Index		0.039 -0.039	0.055 -0.038	0.057 -0.046	0.057 -0.047
Indicator of French origins of national legal system			-0.013 -0.018	-0.013 -0.02	-0.013 -0.02
Indicator of German origins of national legal system			-0.045* -0.025	-0.073** -0.033	-0.073** -0.035
Indicator of Scandinavian origins of national legal system			0.015 -0.03	0.005 -0.03	0.005 -0.03
Social Infrastructure Index				-0.088 -0.063	-0.088 -0.062
Indicator of experience of communism					-0.0003 -0.029
Baseline controls	Yes	Yes	Yes	Yes	Yes
Observations	130	121	121	96	96
Adjusted R-squared	0.795	0.852	0.853	0.878	0.876

Notes: robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Table 5
 Robustness – Contemporary Structure of the Economy
 Dependent Variable = UNDP Gender Inequality Index in 2012

Variable	OLS Coefficient Estimates	
	(1)	(2)
Constant	0.511 (0.32)	0.783** (0.381)
Ln(percentage of country's land area that is potentially arable)	-0.023*** (0.007)	
Ln(percentage of country's ancestral lands suited to agriculture)		-0.024** (0.011)
Percentage share of agriculture in GDP	0.001 (0.001)	0.001 (0.001)
Percentage share of industry in GDP	0.001 (0.001)	0.002 (0.001)
Baseline controls	Yes	Yes
Observations	133	134
Adjusted R-squared	0.813	0.786

Notes: robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Table 6
 Robustness – Religious Composition
 Dependent Variable = UNDP Gender Inequality Index in 2012

Variable	OLS Coefficient Estimates	
	(1)	(2)
Constant	0.16 (0.259)	0.204 (0.299)
Ln(percentage of country's land area that is potentially arable)	-0.017** (0.007)	
Ln(percentage of country's ancestral lands suited to agriculture)		-0.018* (0.01)
Catholics as a fraction of the population	0.05 (0.033)	0.05 (0.034)
Protestants as a fraction of the population	0.04 (0.048)	0.042 (0.047)
Other Christian denominations as a fraction of the population	0.159*** (0.06)	0.187*** (0.061)
Muslims as a fraction of the population	0.150*** (0.033)	0.185*** (0.04)
Hindus as a fraction of the population	0.168** (0.076)	0.176** (0.072)
Baseline controls	Yes	Yes
Observations	133	134
Adjusted R-squared	0.835	0.824

Notes: robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Table 7
 Robustness – All Controls
 Dependent Variable = UNDP Gender Inequality Index in 2012

Variable	OLS Coefficient Estimates	
	(1)	(2)
Constant	-0.192 (0.274)	-0.019 (0.302)
Ln(percentage of country's land area that is potentially arable)	-0.023*** (0.007)	
Ln(percentage of country's ancestral lands suited to agriculture)		-0.020** (0.01)
Years of agriculture in '000 years in 2000	0.007 (0.006)	0.007 (0.007)
Fraction of population with ancestors who used the plough	0.063** (0.027)	0.073** (0.029)
Index of democracy in 2000	0.001 (0.002)	0.001 (0.002)
State Antiquity Index	0.012 (0.043)	0.033 (0.046)
Origins of national legal system = France	0.022 (0.018)	0.025 (0.02)
Origins of national legal system = Germany	-0.015 (0.03)	-0.016 (0.033)
Origins of national legal system = Scandinavia	-0.009 (0.068)	0.013 (0.066)
Social Infrastructure Index	-0.115** (0.05)	-0.109** (0.051)
Indicator of experience of communism	0.007 (0.021)	0.017 (0.023)

Table 7 (continued)
 Robustness – All Controls
 Dependent Variable = UNDP Gender Inequality Index in 2012

Variable	OLS Coefficient Estimates	
	(1)	(2)
Percentage share of agriculture in GDP	0.002* (0.001)	0.001 (0.001)
Percentage share of industry in GDP	0.0001 (0.001)	0.0003 (0.001)
Fraction of population that is Catholic	0.043 (0.042)	0.029 (0.044)
Fraction of population that is Protestant	0.084 (0.084)	0.082 (0.085)
Fraction of population belonging to other Christian denominations	0.249*** (0.087)	0.289*** (0.081)
Fraction of population that is Muslim	0.128*** (0.042)	0.155*** (0.044)
Fraction of population that is Hindu	0.210** (0.098)	0.200** (0.093)
Baseline controls	Yes	Yes
Observations	96	96
Adjusted R-squared	0.912	0.905

Notes: robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Table 8
The Endowment of Arable Land and Gender Equality by Alternate Measures

	Dependent variable = UNDP Gender Development Index in 2013		Dependent variable = Female life expectancy at birth in 2013 less that of males	
Variable	OLS Coefficient Estimates			
	(1)	(2)	(3)	(4)
Constant	0.201 (0.241)	0.12 (0.244)	-22.729*** (4.794)	-24.742*** (5.299)
Ln(percentage of country's land area that is potentially arable)	0.007** (0.003)		0.231*** (0.066)	
Ln(percentage of country's ancestral lands suited to agriculture)		0.016*** (0.006)		0.327*** (0.125)
Ln(nominal per capita income in 2012 - USD)	0.123** (0.051)	0.135*** (0.05)	5.912*** (1.078)	6.272*** (1.148)
Ln(nominal per capita income in 2012 - USD) squared	-0.006** (0.003)	-0.006** (0.003)	-0.336*** (0.062)	-0.358*** (0.065)
Fraction of land area in the geographical tropics	0.003 (0.02)	0.025 (0.025)	0.453 (0.51)	0.917 (0.608)
Mean distance in '000 kms. to nearest coastline or sea-navigable river	0.018 (0.012)	0.01 (0.012)	1.633*** (0.393)	1.426*** (0.379)
Observations	129	129	147	146
Adjusted R-squared	0.492	0.51	0.562	0.554

Notes: robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Table 9
Gender Inequality and Potential arable land: An Illustrative Summary

			Value of the Gender Inequality Index in 2012	Percentage of Land Area that is Potentially Arable
1 st decile of per capita income in 2012	Country with least gender inequality	Rwanda	0.414	30.24
	Country with most gender inequality	Niger	0.707	8.11
2 nd decile of per capita income	least inequality	Tajikistan	0.338	13.55
	most inequality	Afghanistan	0.712	4.66
3 rd decile of per capita income	least inequality	Vietnam	0.299	37.39
	most inequality	Yemen	0.747	0.01
4 th decile of per capita income	least inequality	Mongolia	0.328	0.11
	most inequality	Rep. Congo	0.610	67.34
5 th decile of per capita income	least inequality	Macedonia	0.162	39.93
	most inequality	Jordan	0.482	6.34
6 th decile of per capita income	least inequality	China	0.213	21.62
	most inequality	Iraq	0.557	10.14
7 th decile of per capita income	least inequality	Poland	0.140	91.99
	most inequality	Panama	0.503	31.79
8 th decile of per capita income	least inequality	Slovenia	0.080	50.15
	most inequality	Uruguay	0.367	81.39
9 th decile of per capita income	least inequality	Germany	0.075	80.69
	most inequality	Saudi Arabia	0.682	0.00
10 th decile of per capita income	least inequality	Netherlands	0.045	55.03
	most inequality	Qatar	0.546	0.09

Figure 1: World Choropleth Map of Gender Inequality Per the UNDP's Gender Inequality Index in 2012

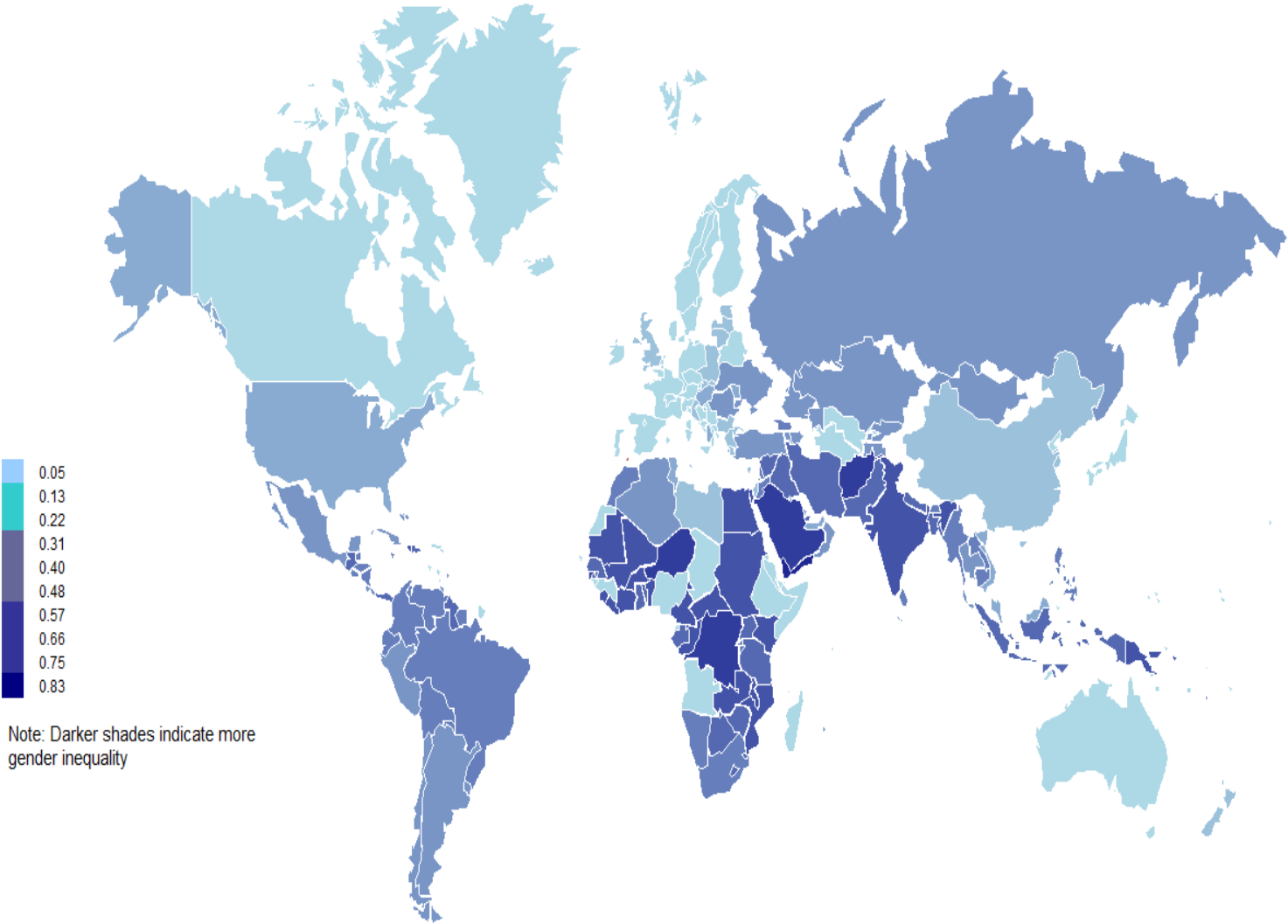
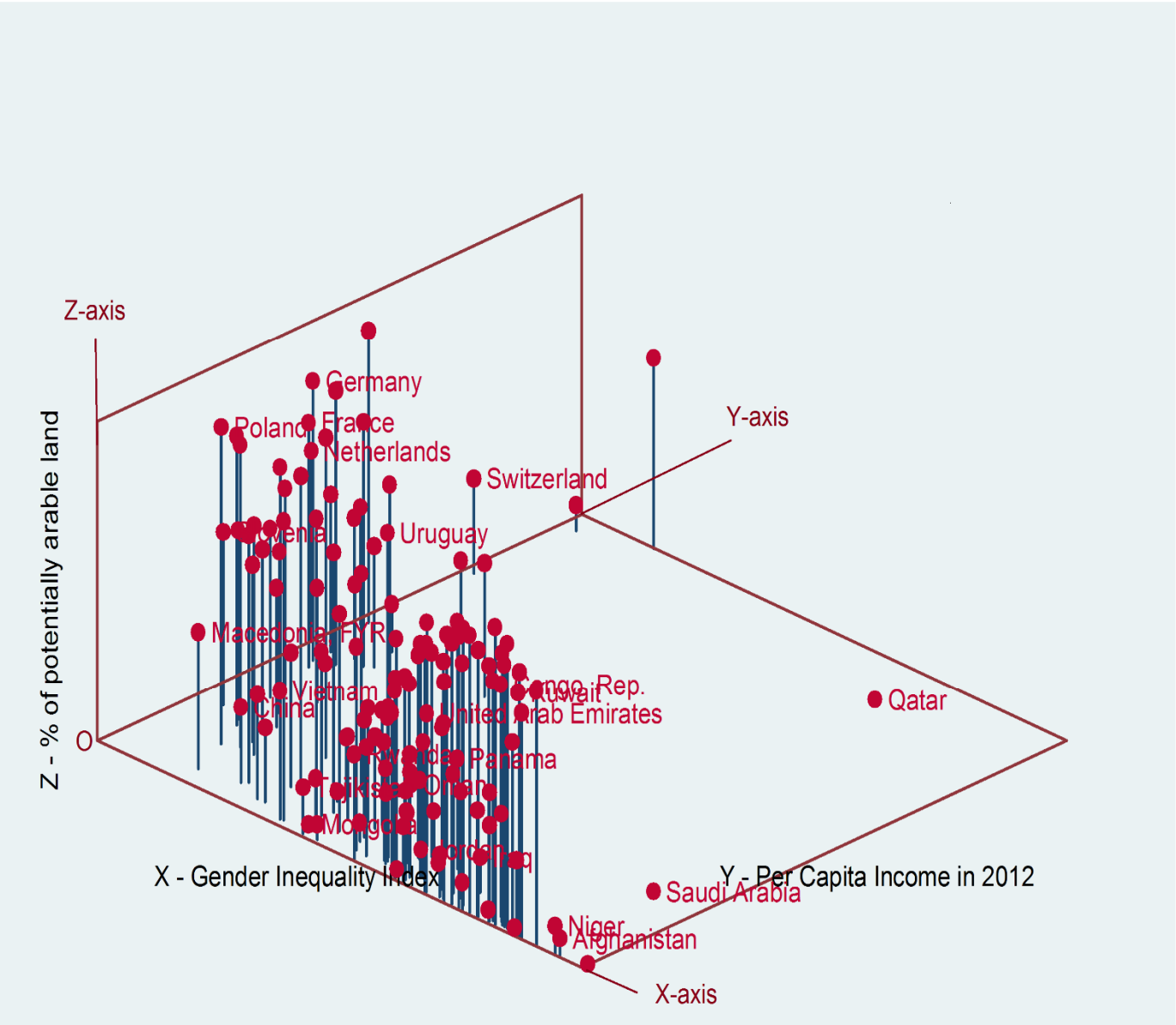


Figure 2: Scatter Plot of Per Capita Income Against the Gender Inequality Index



Figure 3: Three-Dimensional Scatter Plot of the Proportion of National Land Area that is Potentially Arable Against Both the Gender Inequality Index and Per Capita Income



References

- Alderman, H., Gertler, P., 1997. Family Resources and Gender Differences in Human Capital Investments: the Demand for Children's Medical Care in Pakistan. In: Haddad, L., Hodinott, J., Alderman, H. (Eds.), *Intrahousehold Resource Allocation in Developing Countries: Methods, Models, and Policy*. Baltimore: Johns Hopkins University Press.
- Alesina, A., Giuliano, P., and Nunn, N., 2013. On the Origins of Gender Roles: Women and the Plough. *The Quarterly Journal of Economics*, 128(2), pp. 469-530.
- Behrman, J. R., 1988. Intrahousehold Allocation of Nutrients in Rural India: Are Boys Favoured? Do Parents Exhibit Inequality Aversion? *Oxford Economics Papers*, 40(1), pp. 32-54.
- Boserup, E., 1970. *Woman's Role in Economic Development*. London: George Allen and Unwin Ltd.
- Bourguignon, F. and Chiappori, P., 1992. Collective Models of Household Behavior: An Introduction. *European Economic Review*, 36(2-3), pp. 355-364.
- Bradshaw, P. F., 2002. *The Search for the Origins of Christian Worship: Sources and Methods for the Study of Early Liturgy*. New York: Oxford University Press.
- Cohen, M. N. and Bennett, S., 1993. Skeletal Evidence for Sex Roles and Gender Hierarchies in Prehistory. In: Miller, B. D. (Ed.), *Sex and Gender Hierarchies*. Cambridge: Cambridge University Press.
- DeTray, D., 1988. Government Policy, Household Behavior, and the Distribution of Schooling: A Case Study of Malaysia. In: Schultz, T. P. (Ed.), *Research in Population Economics*, Vol. 6. Greenwich: JAI Press.
- Diamond, J., 1987. The Worst Mistake in the History of the Human Race. *Discover* magazine, May 1987.

- FAO, 2000. Land Resource Potential and Constraints at Regional and Country Levels. World Soils Report 90, Land and Water Division, Food and Agricultural Organization of the United Nations, Rome.
- Gallup, J. L., Sachs, J. D., and Mellinger, A. D., 1999. Geography and Economic Development. *International Regional Science Review*, 22(2), pp. 179-232.
- Hall, R. L., 1978. Sexual Dimorphism for Size in Seven Nineteenth Century Northwest Populations. *Human Biology*, 50(2), pp. 159-171.
- Hall, R. E. and Jones, C. E., 1999. Why Do Some Countries Produce So Much More Output Per Worker Than Others? *The Quarterly Journal of Economics*, 114(1), pp. 83-116.
- Hansen, C. W., Jensen, P. S., and Skovsgaard, C., 2012. Modern Gender Roles and Agricultural History: The Neolithic Inheritance. Mimeo.
- Hayden, B., Deal, M., Cannon, A., and Casey, J., 1986. Ecological Determinants of Women's Status Among Hunter/Gatherers. *Human Evolution*, 1(5), pp. 449-474.
- Jones, P. D. and Mann, M. E., 2004. Climate Over Past Millennia. *Review of Geophysics*, 42(2), pp. 1-42.
- Kuran, T., 2011. *The Long Divergence: How Islamic Law Held Back the Middle East*. Princeton: Princeton University Press.
- La Porta, R., Lopez-de-Silanes, F., and Shleifer, A., 2008. The Economic Consequences of Legal Origins. *Journal of Economic Literature*, 46(2), pp. 285-332.
- Weber, M., 1930. *The Protestant Ethic and the Spirit of Capitalism*. New York: Scribner.
- Wrangham, R. W., 1986. Ecology and Social Relationships in Two Species of Chimpanzee. In: Rubenstein, D. I., Wrangham, R. W. (Eds.), *Ecological Aspects of Social Evolution in Birds and Mammals*. Princeton: Princeton University Press.