The Role of Historical Resource Scarcity in Modern Gender Inequality*

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Abstract

This study detects a curious correlation between historical resource scarcity and modern gender inequality: current economic circumstances held constant, there tends to be more gender inequality in regions less endowed with agro-ecological resources, considered historical given the stability of geographical conditions. The proportion of national land area that is potentially arable, and the proportion of national ancestral land suited to agriculture, are each 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. Such a connection holds at the sub-national level as well. Indian districts better endowed with rainfall and cultivable land have, on average, proportionately fewer 'missing women', that is, higher population sex-ratios. Further, respondents of the World Values Survey residing in sub-national regions with ancestral lands better suited to agriculture are less likely to hold the opinions that men ought to have more right to scarce jobs and that men make better political leaders than women. We consider these findings consistent with historical resource scarcity having played a role in the evolution of gender norms biased against women that prevail to this day.

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1 Introduction

This study uncovers an intriguing correlation between regions' historical resource endowments and their present levels of gender inequality. Even upon controlling for current economic conditions, it finds that gender inequality is apt to be more pronounced in regions historically less endowed with resources. While there has been considerable research upon the relation between household poverty and intra-household gender inequality in less developed countries (Duflo, 2012; Jayachandran, 2014), the possibility of a connection between past poverty and present gender inequality in the aggregate doesn't seem to have been entertained. This study supplies extensive evidence of such a connection and offers an explanatory hypothesis.

Two recent studies, by Hansen, Jensen, and Skovsgaard (2012), and Alesina, Giuliano, and Nunn (2013), investigate the role of historical factors in modern gender inequality. Both argue that conditions in the past influence gender relations in the present by having had an effect upon culture. They maintain that cultural norms prescribing domesticity in women may be traced to an ancient gendered division of labor whereby women made their contributions from home.

Alesina, Giuliano, and Nunn (2013) follow Boserup (1970) in arguing 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 authors hypothesize that this occurred for at least three reasons. First, the use of the plough calls for more upper body strength than women typically possess, both because it is a heavy implement and since control of the large draft animals that draw it is strenuous. 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 prescribing 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 who employed the plough.

On the other hand, Hansen, Jensen, and Skovsgaard (2012) hold 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 such a division of labor, and that it is already observable in the branch of the Kalahari's !Kung tribe recently settled to primitive agriculture absent the plough. The authors observe that women's contribution to the caloric intake of their communities is generally very high in modern hunter-gatherer societies, whereas 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. It is not surprising, therefore, that women in the !Kung tribe's branch that continues hunting and gathering enjoy more autonomy and wield greater influence than their agrarian sisters. 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' principal concern is 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 too hypothesizes that conditions in the past influence gender relations in the present by having had an effect upon culture. It theorizes that historical resource scarcity in parts of the world, caused by unfavorable agro-ecological conditions, has been conducive to the development of cultures in which girls and women are discriminated against in the intra-household allocation of resources. Poor agro-ecological endowments may have promoted cultures of gender inequality as follows. First, they increased gender inequality in prehistory. Then, the persistence, due to the stability of geographical conditions, of this increased gender inequality caused it to become entrenched in culture. Naturally, this is a valid thesis only if scarcity indeed encouraged gender inequality in prehistory. Is there archaeological evidence that it did? Hayden (1992) discusses archaeology's approaches to deducing the relative status of women in prehistory. These are: comparative ethnography, skeletal and mortuary studies, the study of early texts, the study of art and mythology, physiological studies, and comparative zoology. Of these, at least three, namely, comparative ethnography, skeletal and mortuary studies, and comparative zoology, yield evidence of a connection between resource scarcity and gender inequality in prehistory.

Archaeologists use comparative ethnographical studies of gender relations in contemporary hunter-gatherer and horticultural societies to make inferences about gender inequality in prehistory. It is noteworthy, then, that Hayden's, Deal's, Cannon's, and Casey's (1986) study of 33 modern hunter-gatherer societies finds that the lack of subsistence resources is liable to diminish women's status in the domestic and political spheres.[1] Besides, in many

[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.

less developed countries in which large sections of the population continue to subsist in a mode of agriculture little changed since antiquity, resources to girls and women are disproportionately curtailed in times of want. For example, Behrman (1988) learns that rural Indian households' favoring of boys in the allocation of nutrition is greatest during the lean agricultural season, Alderman and Gertler (1997) find that rural Pakistani households' demand for the health care of unwell children is more income-elastic in the instance of ill girls, and Rose (1999) discovers that the adverse effect of a deficit of rainfall upon children's survival to school age in rural India is more acute in the case of girls.

Skeletal and mortuary studies can uncover prehistoric gender differences in nutrition, diets, longevity, and physical stress. It is notable 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 of height in parts of the world increased during periods of declining nutrition, i.e., women became shorter relative to men when average human height fell, whereas this gap decreased during periods of improved nutrition (Cohen and Bennett, 1993). In other words, even though boys' biological growth processes may be more sensitive to environmental conditions (Overfield, 1985),[2] girls tended to fare worse than boys when resources were scarce. If human male stature is ordinarily more responsive to nutrition than female stature, a widening gap between the two during periods of resource stress must have been at the hand of man, by the means of gender inequality in resource allocations.

Comparative zoology considers the gender behavior of other primate species, particularly

[2] Geary (2015), for example, supplies an evolutionary-biological explanation of this excess sensitivity. Height in human males may be a sex-selected trait, i.e., one involved in competition for mates or mate choice. Such traits, such as the bright plumage of certain male birds, are exaggerated since their purpose is the signalling of health, fitness, and genetic endowment. It follows that when health and fitness are compromised by an adverse environment, sex-selected traits sharply advertise this dissipation. Hence, it is possible human male height is more sensitive to environmental conditions than female height.

those genetically most similar to humans, and extrapolates from this to human gender relations in prehistory. The two non-human primate species genetically most similar to humans are the chimpanzee (Pan troglodytes) and the bonobo (Pan paniscus). Chimpanzee society is characterized by severe gender inequality. Female chimpanzees are almost always dominated by males and there is much male violence against them. 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.

In sum, the archeological methods of comparative ethnography, skeletal and mortuary studies, and comparative zoology supply evidence of a connection between resource scarcity and gender inequality in human prehistory. It is plausible, then, that chronic scarcity born

of a lack of agro-ecological resources led to a persistent increase in gender inequality that gradually became ingrained in culture.

How does this hypothesis compare with, for example, Boserup's (1970) that the arrival of the plough is a factor in modern gender inequality? Boserup (1970) believed that the adoption of the plough in antiquity thrust women into lives of domesticity and that this domesticization gradually became entrenched in culture. Her observations of rural life in the developing world led her to note that agriculture by the means of the plough "shows a predominantly male labor force. The land is prepared for sowing by men using draught animals, and this ... leaves little need for weeding the crop, which is usually the women's task... Because village women work less in agriculture, a considerable fraction of them are completely freed from farm work. Sometimes such women perform purely domestic duties, living in seclusion within their own homes, only appearing in the street wearing a veil, a phenomenon associated with plough culture and seemingly unknown in regions of shifting cultivation where women do most of the agricultural toil" (Boserup, 1970, pp. 13-14). Boserup inferred that this was true as well in antiquity, and that the domesticization of women in societies employing the plough eventually led to cultural beliefs that women's place was the home. Thus, of the six archeological methods of deducing the relative status of women in prehistory listed by Hayden (1992), Boserup utilized the one method of comparative ethnography, and she held that the modes of behavior arising from the use of the plough became enshrined in culture owing to their persistence, the plough having come to stay. Our thesis is no different in spirit from Boserup's. We employ three of the six archaeological methods listed by Hayden (1992) to infer that agro-ecological scarcity promoted gender discrimination in prehistory, and we too hold that this behavior became ingrained in culture due to its persistence born of the stability of agro-ecological conditions.

Is our hypothesis deficient in comparison to Boserup's in lacking a concrete mechanism by which gender inequality was promoted in prehistory? Boserup's mechanism hinges upon

the sheer weight of the plough and the difficulty of controlling the powerful draft animals that drew it. That there exists a brawnier gender is the kernel of her thesis. And it is likely that this sexual dimorphism of size and strength was the basis of a degree of gender inequality even before the arrival of the plough. In other words, it is probable that gender inequality was a preexisting condition which farmers' adoption of the plough exacerbated. After all, women suffer inequality even in hunter-gatherer societies. For example, Tonkinson (2000), writing of a certain western Australian aboriginal society, notes that "In marriage, women clearly enjoyed far fewer rights than their spouses, for example, the right to divorce their husbands, or practice polyandry... Major decisions concerning their future were made for them by older relatives, most often males... Women's greater contribution to the family's diet did not accord them more power than men; hunting received greater cultural emphasis and was accorded higher value" (pp. 348). This preexisting gender inequality, rooted in human sexual dimorphism of size and strength, may be sufficient to explain prehistoric discrimination against women in the intra-household allocation of resources when these were scarce. In sum, both Boserup's thesis and ours depend in the end upon men's relative brawn.

The remainder of this paper is organized as follows. Section 2 describes the empirical strategy and data utilized in our cross-country analyses. Section 3 presents the ensuing empirical results. Section 4 summarizes our analyses at the sub-national level. Section 5 offers certain supportive stylized facts and a brief conclusion.

2 Cross-Country Empirical Strategy and Data

Our cross-country empirical analyses rely on regression equations whose dependent variables measure national gender inequality in the present, and primary independent variables gauge nations' historical resource endowments, and which, importantly, control for nations' present economic circumstances.

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 market.[3] 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. 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, taken to reflect agro-ecological conditions, 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 constraints such as salinity, a global climatic database, and a database of the climatic and soil requirements of 21 major crops. The FAO's estimate of a nation's current potential

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

arable land is a plausible measure of its historical resource endowment for the following reasons. First, agriculture has been 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 Holocene,[4] 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 environments from the study by Alesina, Giuliano, and Nunn (2013). This measure pertains to ancestral rather than mere historical resource scarcity. Alesina, Giuliano, and Nunn recognize that nations are often made up of a number of ethnic groups. Each group has a historical centroid, a place whence it 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.[5] They then use GIS software to identify land within 200 kilometres of each such centroid. This land may be termed the concerned ethnic group's ancestral land. Alesina, Giuliano, and Nunn employ the FAO's Global Agro-Ecological Zones 2002 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 being the shares of these groups' numbers in the national population.

[4] For example, there is evidence of ancient lakes in the Sahara desert.

[5] 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.

Converted to percentages, these shares of nations' ancestral lands suited to agriculture make up our second measure of national historical resource scarcity.[6]

Per capita income in 2012 is our principal measure of nations' current economic circumstances. This is supplemented by the sectoral composition of GDP in 2012 and Hall's and Jones's (1999) Social Infrastructure Index. While it is true that agro-ecological endowments continue to influence resource environments and economic well-being in the present, that we include current per capita income, gauge of this well-being, in our regressions likely permits current agro-ecological conditions, stable for ages, to describe nations' resource scarcity in the past when agriculture was the basis of livelihoods.

We estimate the linear regression equations

$$Gender\ Inequality\ Index = \alpha_1 + \alpha_2(log\ percentage\ of\ land\ that\ is\ potentially\ arable_i) + \mathbf{X_i'}\alpha_3 + \epsilon_i \quad (1)$$

$$Gender\ Inequality\ Index = \beta_1 + \beta_2(log\ percentage\ of\ ancestral\ land\ suited\ to\ agriculture_i) + \mathbf{X_i'}\beta_3 + \varepsilon_i \quad (2)$$

wherein the subscript i alludes to country i, the regressors $\mathbf{X_i}$ consist of a host of controls, and the ϵ_i and ε_i represent regression error terms. Each equation is estimated upon a subsample 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 reported in 2014, of gender inequality in health, education, and command over resources.

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

3 Cross-Country Estimates

Table 1 reports the means and standard deviations of the variables utilized in the cross-country analyses. 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 share 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 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 resources 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 in-

equality, from which might be inferred that historical resource scarcity is indeed a correlate of modern gender inequality. Importantly, this may be concluded as well from the consistently statistically significant negative relationships 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).[7] 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 antiquity.[8] 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

[7] The Polity2 Index may be found in http://www.systemicpeace.org/inscr/p4v2013.xls.

[8] 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.

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 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 are associated with greater 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 itself 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 of the above controls. It seems a negative association between modern gender inequality and the historical endowment of resources is robust to this broad inclusion. These estimates are consistent with Alesina's, Giuliano's, and Nunn's (2013) thesis 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 males.[9]

Table 8 presents estimates of the coefficients 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

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

estimates indicate that female human development relative to male human development, as well as female life expectancy less male life expectancy, are positively and statistically significantly related to the national historical endowment of resources as gauged by the availability of arable land.

In sum, all our modes of cross-country inquiry point to a statistically significant negative relationship between modern gender inequality and the historical resource base, consistent with our hypothesis that past economic scarcity had a hand in the shaping of biased gender norms that persist to this day.

3.1 Robustness Check

Couldn't factors conducive to agriculture influence prehistoric, hence modern, gender relations in a manner that has little directly to do with historical scarcity? Perhaps agro-ecological conditions are correlated with the timing of the Neolithic Transition. Indeed, there is evidence that hunter-gatherer first settled to farming in relatively arid Southwest Asia. If countries less endowed with agro-ecological resources are also those with longer histories of agriculture, mightn't negative correlation between agro-ecological endowments and gender inequality in the present be driven by the positive correlation, discovered by Hansen, Jensen, and Skovsgaard (2012), between time since the Neolithic Transition and gender inequality? While this is an interesting thesis, bear in mind that our estimates in tables 3 and 7 indicate that negative correlation between agro-ecological endowments and modern gender inequality is robust to controlling for nations' years of agriculture.

Boserup (1965) argued that the plough is especially useful when the fallow period between crops is so short that fallow land is taken over by mere grass rather than more substantial vegetation like bushes and trees. Slashing and burning easily clear bushes and trees, but the roots of grass are so resilient to fire that their removal is greatly aided by the plough. The duration of the fallow period, in turn, depends on the availability of arable land. Where

arable land is scarce, farmers can ill afford to keep land fallow for long, implying that the scarcity of arable land may hasten adoption of the plough. Therefore, mightn't poor agro-ecological endowments have led to more gender inequality in prehistory by precipitating the adoption of the plough? In other words, mightn't the relationship between agro-ecological resource scarcity and modern gender inequality be an indirect one? This is a provocative thesis, but note that, by the estimates in tables 3 and 7, negative correlation between agro-ecological endowments and modern gender inequality is robust to controlling for nations' ancestral use of the plough.

Is the historicity of our measures of nations' historical resource scarcity, the percentage share of land suited to rainfed cultivation in the present, and the percentage share of ancestral lands suited to agriculture in the present, questionable? Is it possible that the two primarily gauge nations' current resource environments despite our controlling for national per capita income in 2012? If so, all that this paper uncovers is a connection between gender inequality in the present and resource scarcity, or poverty, in the present, already established at the level of the household (Duflo, 2012; Jayachandran, 2014). Therefore, it is vital that we assess the historicity of our measures of resource scarcity. The following reasoning may be applied.

First, if our measures, the percentage share of land suited to rainfed cultivation in the present and the percentage share of ancestral lands suited to agriculture in the present, primarily gauge nations' current resource environments despite our controlling for per capita incomes in 2012, then it stands to reason that their effect upon modern gender inequality shall be greater in nations in whose economies agriculture plays a larger role. This may be tested by the means of estimation of baseline versions of (1) and (2) expanded to include our measures of resource scarcity interacted with the percentage share of agriculture in GDP. The ensuing estimates, presented in table 9, indicate that the effects of our measures of resource scarcity upon gender inequality do not significantly vary with agriculture's present share in GDP. From this may plausibly be surmised that, once current per capita income is

controlled for, agro-ecological conditions do not mostly pertain to nations' present resource environments.

Second, if it were a historical influence upon culture, the percentage share of land suited to rainfed cultivation in the present ought to be less significant a correlate of gender inequality in the New World, extensively repopulated after 1492, than of gender inequality in the Old World. After all, gender inequality in the New World ought to derive in large part from the cultures of its European, African, and Asian settlers, influenced by conditions in their Old World nations of origin. On the other hand, since Alesina, Giuliano, and Nunn (2013) take this repopulation into account when constructing the percentage shares of nations' ancestral lands suited to agriculture in the present, this measure, if it were historical, ought to be just as significantly correlated with gender inequality in the New World as with that in the Old World. This may be tested by the means of estimation of baseline versions of (1) and (2) expanded to include our measures of resource scarcity interacted with an indicator of nations in the Americas and Oceania. The resulting estimates, presented in table 10, indicate that whereas the percentage share of land suited to rainfed cultivation in the present is statistically significantly negatively correlated with modern gender inequality in the Old World, correlation between these variables isn't statistically significantly different from zero in the New World.[10] On the other hand, it is indicated that negative correlation between the percentage share of ancestral lands suited to agriculture and modern gender inequality doesn't significantly vary between countries in the New and Old Worlds. These results are certainly consistent with the contention that our measures of agro-ecological endowments in the present largely gauge nations' past resource environments once current per capita income is controlled for.

[10] An F-test fails to reject the null hypothesis that the coefficients of $Ln\,(percentage\,of\,country's\,land\,area\,that\,is\,potentially\,arable)$ and $Ln\,(percentage\,of\,country's\,land\,area\,that\,is\,potentially\,arable) \times Country\,in\,the\,New\,World$ sum to zero.

4 Sub-National Analyses

Does a negative relationship between historical resource endowment and modern gender inequality hold at the sub-national level? We discover that it does. Our investigation proceeds as follows. First, we probe a connection between sub-national regions' endowments of agricultural resources, considered historical given the stability of agro-ecological conditions, and these regions' population sex-ratios. The regions considered are the districts of India, akin to counties in the United States, at the time of the 2001 Census of India. Next, we employ data[11] from the 1995 – 2007 waves of the World Values Survey to explore links between sub-national regions' ancestral lands suited to agriculture and 15 – 64 year old women's labor force participation as well as individuals' attitudes about the rights and abilities of women.

The population sex-ratio, defined as the number of females per 1000 males in the population, has been considered an important indicator of gender inequality at least since Sen (1990) famously wrote of the demographic deficit of more than a hundred million women worldwide. Skewed sex ratios are largely due to excess female mortality caused by the relative neglect of girls and women in the allocation of resources to them, healthcare in particular, though sex-selective abortions are to blame as well in some countries (Klasen and Wink, 2003). It is conceivable, therefore, that historical resource scarcity, a factor, by our thesis, in the evolution of cultural norms governing gender bias in resource allocations, is an influence upon current population sex-ratios. This hypothesis is tested upon demographic data from the districts of India, well-suited to this analysis for two reasons. First, it is an agro-ecologically diverse sub-continent. Second, there has largely been no coercive governmental program to limit fertility of the kind seen in China, whose One-Child Policy has played a part in skewing its population sex-ratio. India's sex-ratio is notoriously skewed, nevertheless. It was 933 females per 1000 males in 2001. If we consider, as did Sen (1990), that the sex-ratio

[11] obtainable in http://scholar.harvard.edu/files/nunn/files/plough_replication_files.zip

ought to have been about 1020 as in economically comparable Sub-Saharan Africa, there was a deficit of 1020 less 933, or 87, females per thousand males. According to the 2001 Census of India, males numbered 532,223.09 thousand. Hence, a Sen-style estimate of the number of missing females in India in 2001 is 87 times 532,223.09, or 46.3 million. Might a degree of sub-national variation underlie this disturbing aggregate?

We obtain district-wise sex-ratios from the 2001 Census of India. Districts' historical resource endowments are taken to be their current endowments of agricultural resources. A district's agricultural resources are measured by its average annual rainfall[12] and the percentage of its land area that was cultivable in 2001.[13] The former is likely a truer measure of historical resource scarcity than the latter, since cultivable land in 2001 was so on the basis of water resources deployable in 2001. After all, it is possible for an arid district, one that was poorly endowed with arable land in the past, to be well-endowed at present on the strength of modern irrigation.

We are careful to control for districts' current resource environments. Since per capita income isn't reported at the district level, we substitute districts' median per capita expenditure, data obtained from the 55^{th} (1999 – 2000) round of the National Sample Survey. Since sex-ratios may be influenced by migration, we also control for the fractions of districts' populations made up of male and female migrants. These fractions are small since Indians are relatively geographically immobile (Anderson, 2011).[14] A recent study (Carranza, 2014) discovers that the agricultural practice of deep tillage, possible only in loamy soils, reduces the demand for labor in Indian agriculture, so shrinks the employment opportunities

[12] obtained from Daily District-wise Normals of Meteorological Parameters published by the Indian Meteorological Department of the Govt. of India

[13] Cultivable land is the sum of fallow land, net area sown, area under miscellaneous tree crops and groves, and culturable waste land. District-wise land use statistics may be found at http://lus.dacnet.nic.in/dt_lus.aspx, or downloaded as a whole at https://data.gov.in/resources/classified-area-under-land-use-statistics-lus/download.

[14] Anderson (2011) observes that, by the 1991 and 2001 Census, 24% to 29% of the population of India consists of migrants, with 60% of these moving within the same district and 25% moving within the same state.

of women, lowers their economic value, and, as a result, lowers the local rural child sex-ratio. Therefore, we control for the shares[15] of districts' land areas made up of clayey, as opposed to loamy, soils.

In sum, we estimate the equation

$$\begin{aligned} sex\text{-}ratio_i = \delta_1 + \delta_2 \left(log\, average\, annual\, rainfall_i\right) \\ + \delta_3 \left(log\, percentage\, of\, land\, that\, is\, cultivable_i\right) + \mathbf{Z_i'}\delta_4 + e_i \end{aligned} \tag{3}$$

wherein the subscript i alludes to district i, the regressors $\mathbf{Z_i}$ consist of the aforesaid controls as well as state dummy variables, and e_i denotes the regression error term. Table 11 presents the sample means and standard deviations of all the employed variables, and Table 12 reports OLS estimates of the coefficients δ above. By these estimates, district sex-ratios statistically significantly increase in both rainfall and cultivable land, measures of historical resource endowment. In contrast, sex-ratios are more skewed in districts economically better-off at present. This is in keeping with Duflo's (2012) observations that sex-ratios at birth remain skewed in prosperous Taiwan and South Korea and that sex-ratios are becoming more skewed in India's most prosperous states,[16] and it lends credence to the argument that cultures of gender inequality were moulded in the distant past.

The World Values Survey supplies international data on a variety of personal attitudes. We employ individuals' responses, coded as 'disagree' (0) and 'agree' (1), to the statement "When jobs are scarce, men should have more right to a job than women" to measure attitudes concerning the rights of women. Responses, coded as 'strongly disagree' (1), 'disagree' (2), 'agree' (3), and 'agree strongly' (4), to the statement "On the whole, men make better political leaders than women do" are taken to gauge attitudes regarding women's abilities.

[15] obtainable from Soils of India published by the National Bureau of Soil Survey and Land Use Planning, Indian Council of Agricultural Research.

[16] One of these is (East) Punjab, called the 'wheat bowl of India', but its high agricultural productivity is driven by modern irrigation given its annual rainfall of but 649 millimeters.

These data also identify female labor force participants, enabling analysis of the determinants of this participation. It is fortunate that Waves 2 onwards of the World Values Survey identify sub-national regions. Alesina, Giuliano, and Nunn (2013) identify the ethnic groups in a sub-national region, look up these groups' historical centroids in the Ethnographic Atlas, and mark land within 200 kilometres of each such centroid, taken to be the concerned ethnic group's ancestral land. They then ascertain the share of each ethnic group's ancestral land suited to agriculture. Finally, they calculate the share of the sub-national region'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 being the shares of these groups' numbers in the region's population. This measure of the ancestral arability of land at the sub-national level is our present measure of historical resource scarcity, whose links to female labor force participation and individuals' views of the rights and abilities of women we proceed to explore. Our control variables include age, gender, marital status, education, and country dummy variables. We also control for the fractions of these sub-national regions' populations with ancestors who employed the plough.

Table 11 reports the sample means and standard deviations of the utilized variables, and Table 13 presents estimates of the coefficients describing the relationships between the explanatory variables and, respectively, women's participation in the labor force, individuals' attitudes in regard to women's rights, and their attitudes pertaining to women's abilities. By these estimates, residents of sub-national regions with ancestral lands better suited to agriculture are significantly less likely to agree that men ought to have more right to a scarce job, as well as less likely to agree that men make better political leaders. On the other hand, the arability of regions' ancestral lands isn't a statistically significant correlate of women's participation in the labor force. Perhaps this indicates that a culture of gender inequality isn't contingent on gender inequality in roles.

In sum, it appears that there are higher population sex-ratios, that is, less gender in-

equality, in Indian districts better endowed with rainfall and cultivable land, and less bigoted attitudes in regard to women's rights and abilities in sub-national regions of the world whose ancestral lands are better suited to agriculture. In other words, agricultural resources, measuring historical resource endowment, seem negatively associated with modern gender inequality even at the sub-national level.

5 Conclusion

Besides summarizing our findings, this section offers certain stylized facts that, we hope, bolster our conclusion that historical resource scarcity is a correlate of 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.

Note that 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 14, 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 4^{th} and 8^{th} 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 people.[17] 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 pregnancies".[18] 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 discovers a curious correlation between historical resource scarcity

[17] Some 30 percent of its population remains nomadic or semi-nomadic.

[18] 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.

and modern gender inequality: there is, in general, more gender inequality at present in regions less endowed with agro-ecological resources even once their current economic circumstances are controlled for. The proportion of national land area that is potentially arable, and the proportion of national ancestral land suited to agriculture, are each 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. Such a connection holds at the subnational level as well, in that Indian districts better endowed with rainfall and cultivable land have, on average, proportionately fewer 'missing women', that is, higher population sex-ratios, and respondents of the World Values Survey residing in sub-national regions with ancestral lands better suited to agriculture are less likely to hold the opinions that men ought to have more right to scarce jobs and that men make better political leaders than women. We consider these findings consistent with our thesis that historical resource scarcity played a role in the evolution of gender norms biased against women that remain to this day.

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Table 1
Summary Statistics: Cross-Country Analyses

Dependent Variables	**Obs.**	**Mean**	**S.D.**
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
Explanatory Variables			
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	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
Endowments 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
Robustness - Interaction with Agriculture's Share in GDP
Dependent Variable = UNDP Gender Inequality Index in 2012

Variable	**OLS Coefficient Estimates**	
	(1)	(2)
Constant	0.463 (0.325)	0.685* (0.375)
Ln(percentage of country's land area that is potentially arable)	**-0.027*** **(0.009)**	
Ln(percentage of country's land area that is potentially arable) x Percentage share of agriculture in GDP	**0.0003** **(0.001)**	
Ln(percentage of country's ancestral lands suited to agriculture)		**-0.034**** **(0.014)**
Ln(percentage of country's ancestral lands suited to agriculture) x Percentage share of agriculture in GDP		**0.0005** **(0.001)**
Percentage share of agriculture in GDP	-0.001 (0.003)	-0.002 (0.002)
Ln(nominal per capita income in 2012 - USD)	0.065 (0.067)	0.023 (0.075)
Ln(nominal per capita income in 2012 - USD) squared	-0.008** (0.004)	-0.005 (0.004)
Fraction of land area in the geographical tropics	0.023 (0.024)	-0.009 (0.031)
Mean distance in '000 kms. to nearest coastline or sea-navigable river	-0.030 (0.022)	-0.009 (0.023)
Region dummy variables (Asia, Europe, N. America, S. America, Oceania, Sub-Saharan Africa; Northern Africa omitted)	Yes	Yes
Observations	133	134
Adjusted R-squared	0.81	0.78

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

Table 10
Robustness - Interaction with Indicator for Countries in the New World (Americas and Oceania)
Dependent Variable = UNDP Gender Inequality Index in 2012

Variable	OLS Coefficient Estimates	
	(1)	(2)
Constant	0.526* (0.279)	0.666** (0.314)
Ln(percentage of country's land area that is potentially arable)	**-0.026*** **(0.007)**	
Ln(percentage of country's land area that is potentially arable) x Country in the New World	**0.043*** **(0.015)**	
Ln(percentage of country's ancestral lands suited to agriculture)		**-0.032*** **(0.012)**
Ln(percentage of country's ancestral lands suited to agriculture) x Country in the New World		**0.013** **(0.014)**
Ln(nominal per capita income in 2012 - USD)	0.051 (0.062)	0.025 (0.067)
Ln(nominal per capita income in 2012 - USD) squared	-0.007* (0.004)	-0.005 (0.004)
Fraction of land area in the geographical tropics	0.021 (0.024)	-0.006 (0.030)
Mean distance in '000 kms. to nearest coastline or sea-navigable river	-0.031 (0.022)	-0.007 (0.022)
Region dummy variables (Asia, Europe, N. America, S. America, Oceania, Sub-Saharan Africa; Northern Africa omitted)	Yes	Yes
Observations	133	134
Adjusted R-squared	0.81	0.78

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

Table 11
Summary Statistics: Sub-National Analyses

	Obs.	Mean	S.D.
Districts of India			
Dependent Variable			
District's Population Sex-Ratio (no. of females per 1000 males) in 2001	584	937.697	61.463
Explanatory Variables			
Ln(district's average annual rainfall in mm)	584	7.059	0.528
Ln(percentage of district's land area that was cultivable in 2001)	567	3.811	1.470
Ln(district's median real per capital monthly expenditure in 1999-2000)	561	6.088	0.257
Ln(district's median real per capital monthly expenditure in 1999-2000) squared	561	37.137	3.159
Fraction of district's population in 2001 made up of male migrants	561	0.071	0.071
Fraction of district's population in 2001 made up of female migrants	561	0.396	0.194
Fraction of district's land area made up of clayey soils	584	0.218	0.269
World Values Survey			
Dependent Variables			
When jobs are scarce, men should have more right to a job than women; 0=disagree, 1=agree	106,462	0.461	0.498
On the whole, men make better political leaders than women do; 1=strongly disagree, 2=disagree, 3=agree, 4=agree strongly	84,566	2.646	0.974
Participation in the labor force by 15-64 years old women; 0=retired, housewife, student; 1=full-time, part-time, or self employed	57,167	0.556	0.497
Explanatory Variables			
Ln(percentage of sub-national region's ancestral lands suited to agriculture)	117,829	3.358	2.831
Age in years	128,904	40.731	16.214
Age squared	128,904	1921.91	1497.309
Married	128,796	0.621	0.485
Primary education	122,606	0.373	0.484
Secondary education	122,606	0.421	0.494
Male	129,323	0.477	0.499
Fraction of sub-national region's population with ancestors who used the plough	113,789	0.759	0.407

Table 12
Indian Districts' Endowments of Agricultural Resources and their Population Sex Ratios
Dependent Variable = District's Population Sex-Ratio in 2001

Variable	**OLS Coefficient Estimates**		
	(1)	(2)	(3)
Constant	3551.867*** (916.853)	3545.640*** (810.940)	3545.736*** (809.845)
Ln(district's average annual rainfall in mm)	**28.604*** (9.585)**	**30.314*** (10.372)**	**30.314*** (10.207)**
Ln(percentage of district's land area that was cultivable in 2001)		**17.930*** (5.083)**	**17.930*** (5.160)**
Ln(district's median real per capital monthly expenditure in 1999-2000)	-901.997*** (308.776)	-924.226*** (269.379)	-924.255*** (271.214)
Ln(district's median real per capital monthly expenditure in 1999-2000) squared	71.909*** (25.766)	73.494*** (22.369)	73.496*** (22.510)
Fraction of district's population in 2001 made up of male migrants	32.901 (55.096)	44.793 (53.352)	44.790 (52.907)
Fraction of district's population in 2001 made up of female migrants	-5.486 (18.680)	-12.701 (19.354)	-12.700 (19.473)
Fraction of district's land area made up of clayey soils			-0.013 (13.987)
State dummy variables	Yes	Yes	Yes
Observations	561	546	546
R-squared	0.590	0.604	0.604

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

Table 13
Sub-national Ancestral Endowments of Arable Land and
Individual Gender Attitudes and Female Labor Force Participation, 1995-2007

Variable	**When Jobs are Scarce**	**Men Make Better Political Leaders**	**Female Labor Force Participation**
	Probit	Ordered Probit	Probit
Constant	-1.353*** (0.190)		-2.746*** (0.160)
/Cut 1: value of the latent dependent variable separating the answers 'strongly disagree' and 'disagree'		-0.060 (0.201)	
/Cut 2: value of the latent dependent variable separating the answers 'disagree' and 'agree'		1.192*** (0.201)	
/Cut 3: value of the latent dependent variable separating the answers 'agree' and 'agree strongly'		2.196*** (0.208))	
Ln(percentage of sub-national region's ancestral lands suited to agriculture)	**-0.039*** **(0.014)**	**-0.030*** **(0.011)**	**0.006** **(0.009)**
Age in years	-0.007*** (0.002)	-0.007*** (0.002)	0.218*** (0.007)
Age squared	0.0002*** (0.00002)	0.0001*** (0.00002)	-0.003*** (0.00009)
Married	0.143*** (0.013)	0.054*** (0.012)	-0.458*** (0.028)
Male	0.377*** (0.019)	0.356*** (0.015)	

Table 13 (continued)
Sub-national Ancestral Endowments of Arable Land and
Individual Gender Attitudes and Female Labor Force Participation

Variable	**When Jobs are Scarce**	**Men Make Better Political Leaders**	**Female Labor Force Participation**
	Probit	Ordered Probit	Probit
Primary education	0.669*** (0.024)	0.305*** (0.026)	-0.644*** (0.038)
Secondary education	0.311*** (0.017)	0.115*** (0.015)	-0.298*** (0.030)
Fraction of sub-national region's population with ancestors who used the plough	0.0006 (0.179)	0.515*** (0.196)	0.007 (0.078)
Country Dummy Variables	Yes (74 countries)	Yes (53 countries)	Yes (73 countries)
Observations	87,576	72,207	47,587 (only female)
Log-Likelihood	-46872.109	-84797.173	-25563.628

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

Table 12
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**
1st 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
2nd decile of per capita income	least inequality	Tajikistan	0.338	13.55
	most inequality	Afghanistan	0.712	4.66
3rd decile of per capita income	least inequality	Vietnam	0.299	37.39
	most inequality	Yemen	0.747	0.01
4th decile of per capita income	least inequality	Mongolia	0.328	0.11
	most inequality	Rep. Congo	0.610	67.34
5th decile of per capita income	least inequality	Macedonia	0.162	39.93
	most inequality	Jordan	0.482	6.34
6th decile of per capita income	least inequality	China	0.213	21.62
	most inequality	Iraq	0.557	10.14
7th decile of per capita income	least inequality	Poland	0.140	91.99
	most inequality	Panama	0.503	31.79
8th decile of per capita income	least inequality	Slovenia	0.080	50.15
	most inequality	Uruguay	0.367	81.39
9th decile of per capita income	least inequality	Germany	0.075	80.69
	most inequality	Saudi Arabia	0.682	0.00
10th decile of per capita income	least inequality	Netherlands	0.045	55.03
	most inequality	Qatar	0.546	0.09

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

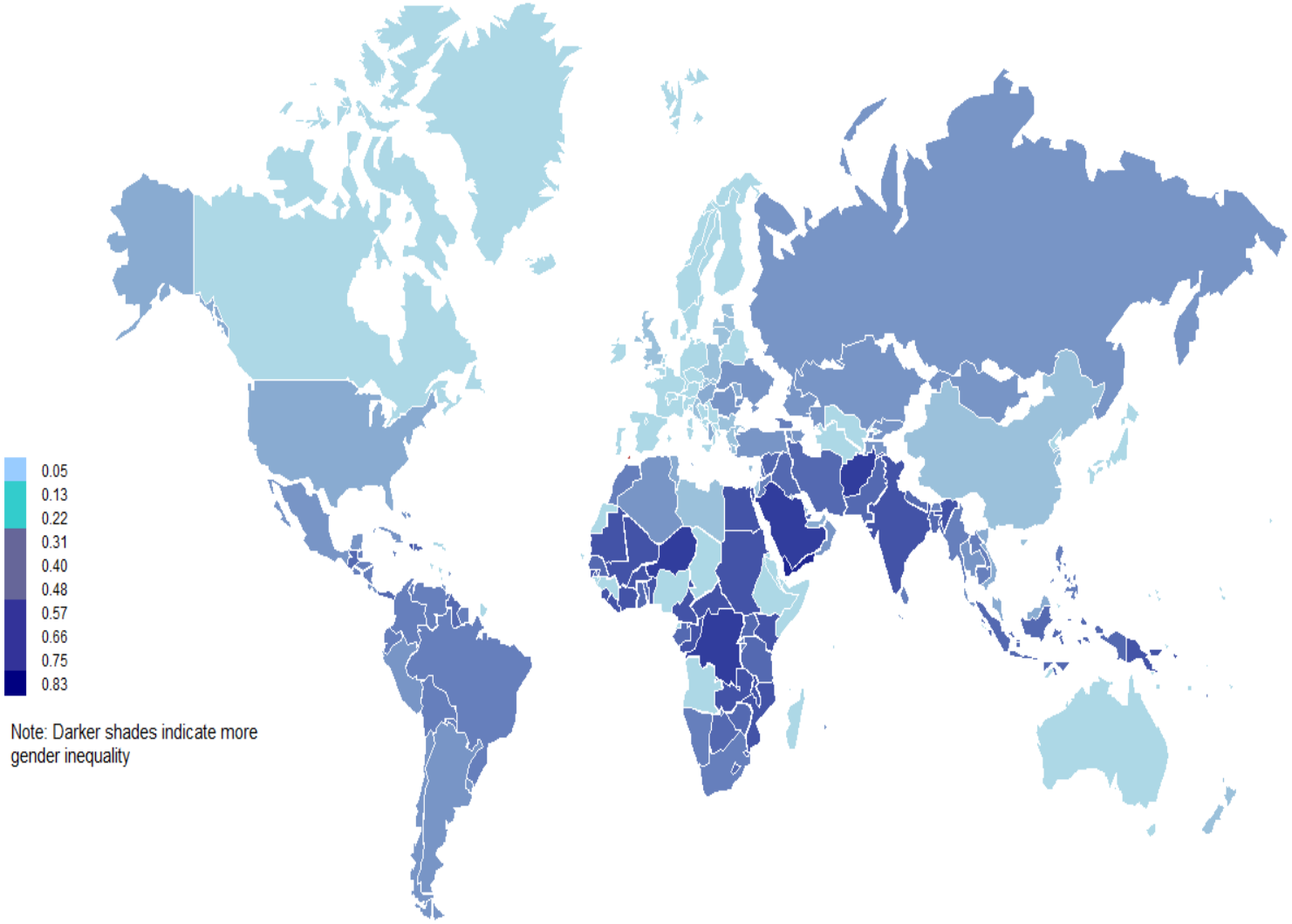

Figure 2: Scatter Plot of Per Capita Income Against the Gender Inequality Index

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