# The Origins of Gender Roles: Women and the Plough*

# (Preliminary)

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Abstract: This paper studies the historic origins of current differences in norms and beliefs about the role of women in society. We show that, consistent with anthropological hypotheses, societies with a tradition of plough agriculture tend to have the belief that the natural place for women is inside the home and the natural place for men is outside the home. Using ethnicity to link individuals today to their ancestors' past plough use, we document a link between traditional plough-use and a number of outcomes today, including female labor force participation, female participation in politics, female ownership of firms, the sex ratio and self-expressed attitudes about the role of women in society. Our identification exploits variation in the historic suitability of the environment of ancestors for growing crops that differentially benefitted from the adoption of the plough. We examine culture as a mechanism by looking at first and second generation immigrants with different cultural backgrounds living within the US.

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## 1. Introduction

The role of women in the family, in society and in the work force varies across nations and cultures. In some, women are expected to stay at home, care for the children, and specialize in home production. In others, women work outside the household almost as much as men and participate in various degrees in the production of income for the family and in other public and political activities.

Female labor force participation has increased strongly in many countries in the last few decades and proximate causes of this dramatic change have been extensively examined.[1] However large cross-country differences still persist and remain very important. To illustrate this point, Table 8 reported in the appendix, shows that the vast majority of the variation in female labor force participation across countries and and over time between 1980 and 2008 is explained by time-invariant country characteristics. The table shows that either a linear time trend or flexible year fixed effects explain 2% of the total variation in the sample (columns 1–2). Time and country varying factors, like per capita income and the share of manufacturing or services in the economy, together account for an additional 27% of the variation (columns 3–5). However, the vast majority of the variation – 68% – is explained by explained by time-invariant country characteristics (column 6). Our point here is that even accounting for changes in gender attitudes over time, and changes associated with economic development, the vast majority of the variation arise from fixed differences across countries. A recent line of research – e.g., Alesina and Giuliano, 2010; Fernandez (2007); Fernandez and Fogli (2009); and Fortin (2005) – has emphasized the importance of cultural norms about the perception of women in society as a relevant factor that could explain these persistent differences across countries.

Although the link between culture and economic outcomes like female labor force participation is rather clear, little is known about the origin of these cultural differences. This paper tackles this question. We are therefore not concerned with the short-term cultural changes in female labor force participation, but with broad historic-based differences that may still affect the role of women today. Our primary focus is on these deep, long-term, historic determinants of social organization.

The hypothesis tested in this paper is whether at least part of the current differences in gender

[1] See Iversen and Rosenbluth (2010), Goldin (2006), Albanesi and Olivetti (2007, 2009) amongst others.

role attitudes arose from the historic mode of agricultural production - e.g., plough agriculture, hoe agriculture, shifting agriculture, etc. - which in turn affected the gender division of labor historically and the subsequent evolution of norms about the natural role of women in the family and society. Ester Boserup (1970) originally put forward this hypothesis in her seminal book *Woman's Role in Economic Development*. She argued that to understand cross-cultural differences in attitudes about female labor force participation, one needs to reach back into history and examine differences in primitive agricultural technologies. She contrasts shifting cultivation to plough cultivation. With shifting cultivation, which is labor intensive and does not use the plough, women do most of the agricultural work. By contrast, plough cultivation requires more strength to manipulate the plough and the animals that pull the plough. Because this requires great muscular strength or quick burst of energy, men have a relative advantage in this activity (Murdock and Provost, 1973*a*).[2] In addition, the use of the plough also leaves less need to weeding, a task which is typically undertake by women an children (Foster and Rosenzweig, 1996) . Finally, it is also the case that plough agriculture is less compatible with child care than hoe agriculture. Child care is most compatible with activities that do not require concentration, do not put the child in danger, and can be stopped and resumed easily. Although these characteristics are true for hoe agriculture, none is true for animal plough agriculture. Because child care is universally undertaken by women, this is another reason why women have a comparative disadvantage in plough agriculture relative to men (Brown, 1970).

Whatever the specific mechanisms at play and the relative importance of each, the important fact is that in plough societies men tend to dominate agricultural work, while women primarily engage in home production and other activities that occur within the household. Boserup (1970) writes that plough cultivation "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

[2]For evidence from Bangladesh and the USA on the distribution of strength by gender see Pitt, Rosenzweig, and Hassan (2010).

cultivation where women do most of the agricultural toil" (Boserup, 1970, pp. 13–14).[3]

In plough societies, a gender division of labor both in the field and in the family becomes predominant. Because women specialize in work in the domestic domain, the home comes to be seen as the "natural" place for women, rather than outside the home in the fields or in the workforce. Interestingly enough, Boserup maintains that this division of roles persisted even after a country moved out of agriculture: factory work appears to be avoided by married women in many part of the developing world and there is considerable evidence that this social norm is widely accepted. The correlation with female employment appears to be strong. For example, in India "... the regional distribution of women's industrial employment has changed considerably in favour of the South. It was seen that women are much more active in agriculture in Southern India than in the North. This pattern is now seen to be repeated in the modern industrial sector."

Since Boserup's initial hypothesis, others have also examined the effect that the plough has had on gender attitudes historically. For example, Fernand Braudel (1998) makes a similar argument in his description of the evolution of Mesopotamia, where the plough was likely introduced in about 4,000 to 6,000 BC. He writes: "Until now, women had been in charge of the fields and gardens where cereals were grown: everything had depended on their tilling the soil and tending the crop. Men had been first hunters, then herdsmen. But now men took over the plough, which they alone were allowed to use. At a stroke, it might seem that the society would move from being matriarchal to patriarchal: that there would be a shift away from the reign of the all-powerful mother goddesses... and towards the male gods and priests who were predominant in Sumer and Babylon. Developments were long-term: domestication of large animals like asses and oxen, followed by horses and camels took centuries and was accompanied with a move towards male domination of society and its beliefs, from a queen resembling the Earth Mother to a king resembling Jupiter, as Jean Przyluski put it". (Braudel, 1998, p. 71).

Our hypothesis is that long-lasting cultural values regarding the role of women in society and therefore the organization of work in the market and at home may depend on the initial technology and its evolution. With the persistence typical of cultural values, even technologies

[3]It is interesting to note that the evidence suggests that this difference in agricultural technology also leads to a different organization of marriage. In areas with shifting technologies women are an asset for men who pay a price for them. In fact polygamy is common since the first wife welcomes other helpers in the field and at home. In plough intensive cultivation instead the wife's family pays a dowry to marry their daughter and polygamy is rare (Goody, 1976, Burton and Reitz, 1981). Although interesting and worthy of a detailed analysis, because of space constraints we do not pursue this specific aspect of plough societies here.

adopted long time ago may still have an influence on current cultures.

We test whether differences in gender roles today originate in different societies' historic use of the plough by combining historic ethnographic data reporting whether societies traditionally used animal plough agriculture with contemporary female involvement in market work as well as information on attitudes about gender roles.

We look across countries, across regions, across individuals within countries and across immigrants from different cultural backgrounds living within the US to test for our hypothesis. We find a strong and robust negative relationship between the historic use of the plough and female labor force participation as well as gender role attitudes.

One concern with our approach is that the choice of technology may have been endogenous to the pre-existing cultural values about women, and these may continue to persist until today. For example it could be that societies with attitudes favoring gender inequality were more likely to adopt the plough historically and that these attitudes continue to persist today. We address this causality problem by instrumenting for the historic use of the plough with certain characteristics of the soil. As Pryor (1985) shows the plough tended to be used with certain type of cultivations , such as teff, wheat, barley, rye and wet rice, which require the land be prepared in a very short period of time. Pryor names these crops as 'plough-positive', as opposed to 'plough-negative' crops, such as maize and various types of root and tree crops. (More details are given below.) Based on Pryor's insights, we examine plough-positive cereals – wheat and rye – and plough-negative cereals – millet and sorghum. Using data from the FAO, we identify the relative suitability of finely defined locations globally for growing these plough-positive and plough-negative cereals. We then use the relative differences in ethnic groups' geo-climatic conditions for growing plough-positive and plough-negative cereals as instruments for historic plough use. We also control for other determinants of plough use.

The first stage of our IV estimates show that being endowed with a plough-positive environment increase the likelihood that the plough was adopted. The second stage shows that the effect of the plough on our outcomes of interest is qualitatively similar to the OLS estimates.

Our analysis then turns to mechanisms. It is possible that part of the long-term effect of the plough we identify arises because historic plough-use facilitated the development of different

policies that are more or less conducive to the participation of women in market activities.[4] This would reinforce the impact that the plough may have on gender attitudes. To isolate the impact of the long lasting effects of the plough on individual's attitudes and beliefs (i.e. culture), we examine variation among immigrants within the US. Specifically, we test whether first and second female generation immigrants from countries that historically used the plough have lower rates of labor force participation in the US. The benefit of studying immigrants is that although they have different cultural backgrounds, they arguably face a very similar institutional environment.

Our paper is not the first to examine the relationship between technology and gender roles. Ross (2008) for instance argues that the technology involved in oil production crowds out women from the labor force: women exit the labor force, are excluded from positions of power, and assume a unequal role in society. Ross (2008) provides evidence that it is not Islam per se but the prevalence of oil production which determines variations in women conditions within oil producing countries. However, the causal mechanism we identify is different from that proposed by Ross. Also our analysis, focusing on culture, is interested in its historical origins. Our paper complements a small number of empirical studies on historic determinants and long-term persistence of cultural values. For instance, Tabellini (2010) looks at how certain moral values are more or less conducive to growth promoting policies. Guiso, Sapienza, and Zingales (2008*b*) test Putnam's hypothesis of the historic origins of regional differences of social capital and trust within Italy.[5] Nunn and Wantchekon (2011) examine the historic roots of mistrust within sub-Saharan Africa. Grosjean (2010*a*) examines the historical origins of a 'culture of honor' in the US South and Grosjean (2010*b*) and Becker, Boeckh, Hainz, and Woessman (2010) examine the lasting impact that historic empires had on cultural outcomes.

The paper is organized as follows. In section 2 we describe how we measure the historic plough use among the ancestors of individuals living in different countries and districts within countries. We also describe how we construct our instruments - the historic suitability of ancestors' climates for cultivating plough-positive and plough-negative crops. Section 3 presents OLS and IV estimates, examining variation across countries, subnational districts and individuals. Section 4 examines first and second generation immigrants to test whether the effect of historic plough-use continues to persist even when individuals face the same external environment.

[4] Alesina, Algan, Cahuc, and Giuliano (2010), Guiso, Sapienza, and Zingales (2008*a*) and Tabellini (2008) investigate feedback effects between culture and institutions.

[5] See also Guiso, Sapienza, and Zingales (2004) on social capital and financial development.

Section 5 concludes.

## 2. Data sources, variable definition and data matching

### A. *Data sources*

Our analysis will use four primary data sources: the *Ethnographic Atlas,* which contains information on ethnic groups' historic use of the plough; the *World Value Survey*, which has data on current attitudes about gender roles and on female labor force participation; the *Current Population Survey*, which includes information from 1994 to 2009 on female labor force participation of US first and second generation immigrants; and the *Ethnologue* and the *Geo-Referencing of Ethnic Groups* which reports the current geographic locations of ethnic groups globally and are used to link the historical plough use (as found in the Ethnographic Atlas data) to current female labor force participation and gender role attitudes obtained from the World Value Survey and the Current Population Survey.

We describe each data source, and the variables we construct below.

#### *a. Historic plough use and the Ethnographic Atlas*

We obtain data on the historic plough use from the *Ethnographic Atlas*, a world wide ethnicity-level database constructed by George Peter Murdock and containing a wealth of ethnographic information for 1267 ethnic groups across the globe. Information for societies in the sample has been coded for the earliest period for which satisfactory ethnographic data are available or can be reconstructed. The earliest observation dates are for Old World groups where early written evidence is available. For the rest of the world, most evidence is taken from observations and documentation that occurred in the nineteenth century. The dataset should capture, to the maximum extent possible, the indigenous characteristics of various ethnic group prior to European contact. The database contains a measure of the historic use of animal plough agriculture, classifying groups in one of the following three mutually exclusive categories: (*i*) the plough was absent, *ii*) the plough existed at the time the group was observed but it was not aboriginal, and (*iii*) the plough was aboriginal and found in the society prior to contact. The are data for 1,158 of the 1,267 societies in the database.

The map in Figure 1 shows the approximate location of each ethnic group (as reported by Murdock, 1967) and whether they had adopted the plough. A number of facts are apparent from the map. First, the number of societies that did not use the plough is greater than the number that did. In the sample, 86% of the ethnicities did not introduce the plough, in 12.18% of the societies, the plough was used, and in 1.5% of the plough was not initially used, but it was adopted after European contact. However, this actually provides an inaccurate description of the extent of plough use historically. This is true for a number of reasons. First, the database under-samples European ethnic groups. Second, ethnic groups that adopted the plough were larger historically, and are larger today. For example, many of the ethnic groups that did not adopt the plough are indigenous groups located in the Americas, with small populations.

More generally, there is no sense in which the ethnic groups are of equal size or importance today as compared to their historical period to which the Ethnographic Atlas refers to. For our analysis (as we describe below) we first link the historical data to information about the current population distributions of ethnic groups, as a second step we link the information about the population weighted distribution on the use of the plough to contemporary datasets on female labor force participation and gender role attitudes. Our analysis is therefore not biased by the fact that the Ethnographic Atlas can oversample small groups or groups that are less populous today. In addition, in past centuries there have been significant migrations of groups, particularly Europeans and Africans across the Atlantic. Our analysis also takes this into account, since we match the ethnographic data to current outcome data based on ethnic groups and not geographic locations and we are able to follow ethnic groups that have moved.

*b. The Ethnologue*

Linking the historic ethnographic data to our current outcome measures requires that we have an estimate of the location and distribution of ethnicities across the globe today. We construct this information using two datasets: the 15th edition of the *Ethnologue: Languages of the World* (Gordon, 2005) and the *Landscan 2000* database. The *Ethnologue* reports the current geographic distribution of 7,612 different languages, each of which we manually matched to the appropriate ethnic group from the Ethnographic Atlas. The database provides a shape file that divides the world's land into polygons, with each polygon indicating the location of a specific language. We also use the *Landscan 2000* database, which reports an estimate of the world population at a very fine level.

The *Landscan 2000* database has been produced by Oakridge Laboratories in cooperation with the US Government and NASA. Based on detailed maps and satellite imagery, a roughly 1 km by 1km (30 arc-second by 30-arc second) raster file covering the globe has been created. For each 1 km grid-cell, an estimated population count is reported. By overlaying the Ethnologue with the Landscan raster file, we obtain an estimate of the full population distribution of ethnic groups across the globe today. This information is then used to link the historic ethnicity-level data to our current outcomes of interest.

We also test the robustness of our results by using an alternative dataset containing information on the location of ethnicities across the globe, the *Geo-Referencing of Ethnic Groups* (GREG) database (Weidmann, Rod, and Cederman, 2010). Like the *Ethnologue*, the GREG database provides a shape file that divides the world's land into polygons, with each polygon indicating the location of a specific ethnicity. The shortcoming of the GREG database is that ethnic groups are much less finely identified relative to the *Ethnologue* database. The GREG database identifies 1,364 ethnic groups, while the *Ethnologue* identifies 7,612 ethnic groups. Because of the finer level of ethnic identification, the linking to the Ethnographic Atlas ethnic groups was much cleaner and more precise when the *Ethnologue* was used.

Although we use the *Ethnologue* to construct our baseline measure, as we report in the online appendix, we find that the results are broadly consistent when we use the GREG measure.

*c. Data Matching*

The core difficulty facing our analysis is that our outcomes of interest -attitudes toward gender equality and female labor force participation- are all measured across locations, either regions or countries, but the historic ethnographic information on historic plough use is measured at the ethnicity/society level. To link the two sources, we need information on the current spatial distribution of ethnic groups globally. As described above, we will obtain this by combining information from the *Ethnologue* and the *Landscan 2000* database.

To illustrate how we match the data among the various datasets, we discuss the case of Ethiopia. The map in Figure **??** shows the land inhabited by various ethnic groups, taken from the 15th Edition of the *Ethnologue*; the map also shows an estimate of the number of individual living on the land (obtained by the *Landscan* raster file). In the figure a darker shade indicates more inhabitants in each 30 arc second grid-cell, whereas the *Ethnologue* ethnicity boundaries are

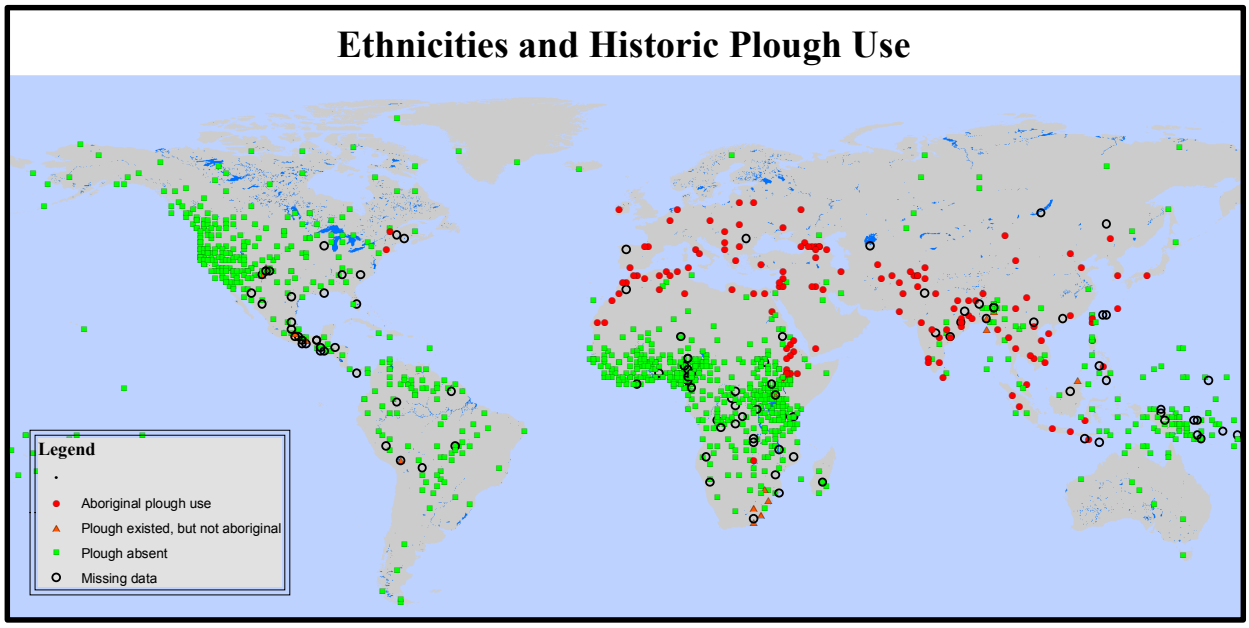


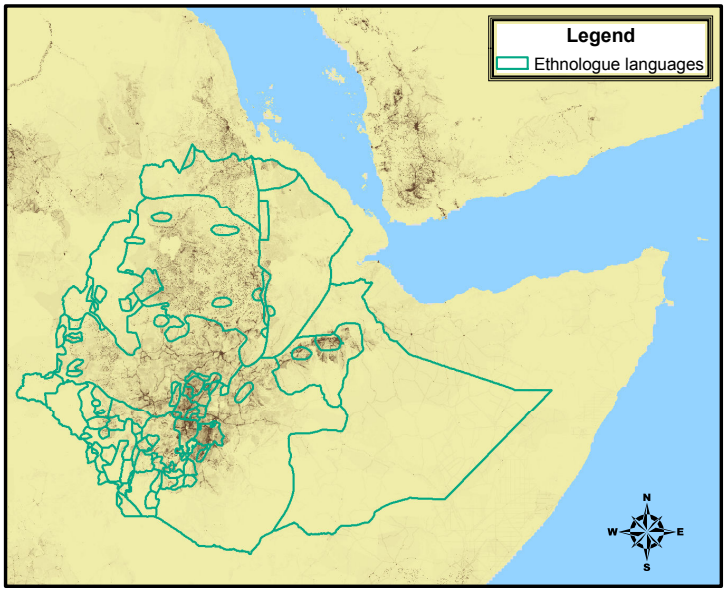

Figure 1: Historic plough use among ethnic groups in Murdock's Ethnographic Atlas.

indicated by the polygons drawn within Ethiopia's borders. The borders should not be thought of as finely measured definitive boundaries, but as rough measures indicating the approximate locations of various ethnic groups.

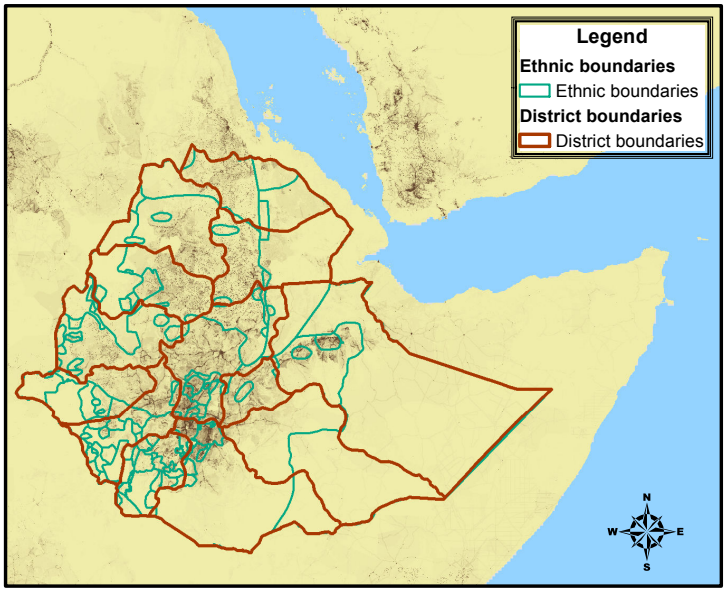
From the *Ethnographic Atlas* we know whether each ethnic group was engaged in plough agriculture. Define $I_e^{plough}$ to be an indicator variable that equals one if ethnic group $e$ used plough agriculture. After matching ethnic groups in the *Ethnographic Atlas* with the different languages listed in the *Ethnologue*, we can then calculate the number of ethnic groups in each region from the *World Value Survey*.[6] The location of ethnic groups mapped by the Ethnologue are shown in Figure 2a, with the regions from the *World Value Survey* overlaid in Figure 2b.

Using the two types of data, we construct an estimate of the number of individuals of each ethnicity in 5 arc minute by 5 arc minute grid cells globally. Let $N_{e,i,c}$ denote this measure – i.e., the number of individuals of ethnicity $e$ living in grid-cell $i$ located in country $c$. The same variable, but defined by its location within districts is: $N_{e,i,d}$. Then we can construct a population-weighted average of $I_e^{plough}$ for all ethnic groups living in a country $c$ (or district $d$). The country level measure of the fraction of the population in a country whose ancestor's traditionally used the

[6]Full details on this dataset will be provided when we describe our dependent variables.




(a) Population density and ethnic groups




(b) Population density, ethnic groups, and WVS district boundaries

Figure 2: Populations, ethnic groups, and WVS districts within Ethiopia.

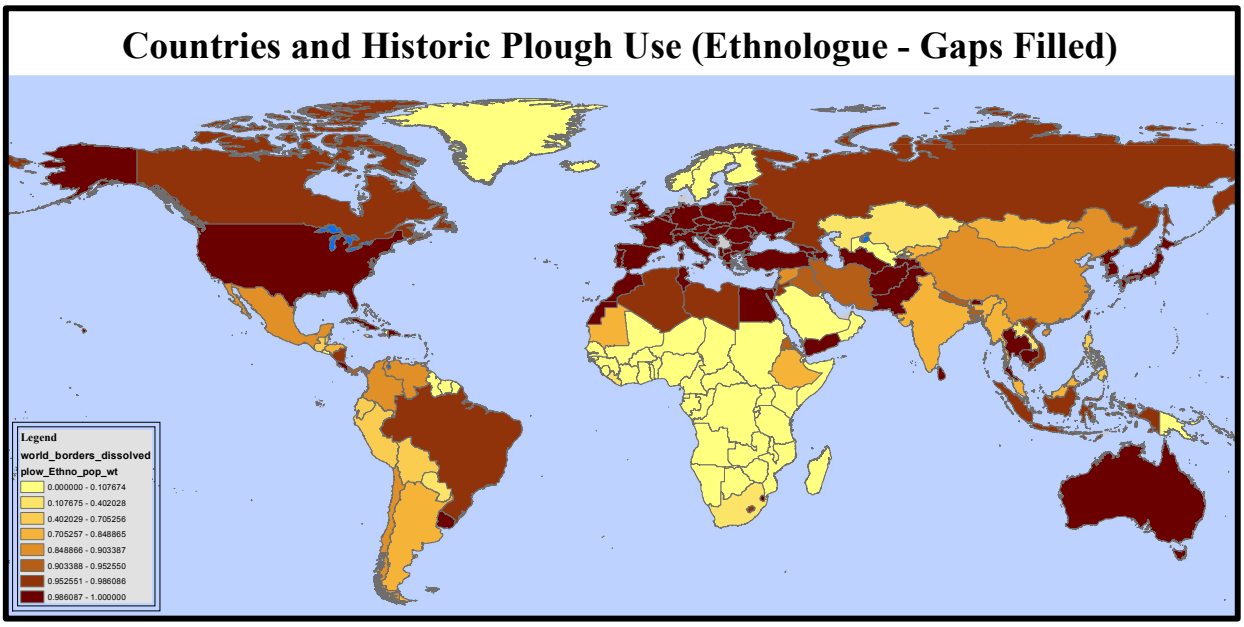



Figure 3: Average historic plough use among the ancestors of each country.

plough is given by:

$$\text{Plough}_c = \sum_e \sum_i \frac{N_{e,i,c}}{N_c} \cdot I_e^{plough} \tag{1}$$

where $N_c$ is the total number of people living in country $c$. The constructed variable, $\text{Plough}_c$, is the share of the population whose ethnic group historically engaged in plough agriculture.

Using the same procedure we also calculate a historic plough-use measure at the district level:

$$\text{Plough}_d = \sum_e \sum_i \frac{N_{e,i,d}}{N_d} \cdot I_e^{plough} \tag{2}$$

where $N_d$ is the total number of people living in district $d$. The definition of a district comes from the classification used in the World Value Surveys. $\text{Plough}_d$ measures the historic use of the plough among the ancestors of those living in each WVS district.

We repeat the same process for the remaining districts and countries in our dataset.

A map showing the predominance of the plough at the country level, as a result of our matching and aggregation process, is shown in Figure 3.

The average use of the plough for the whole sample of 202 countries is 42%. There are still big differences by continent, however after taking into account the population of different ethnicities and aggregate the data at the country level, we observe a lot of cross country variation. Sub-Saharan Africa tends to be predominantly plough negative together with New Zealand, Australia,

Greenland and most of the Northern European countries.[7] At the other extreme, the majority of the European countries used the plough historically, together with many Northern African countries and many Asian countries such as Afghanistan, Armenia, Bhutan, Japan, Pakistan, Korea. Countries in with plough-use that varied among the populations include South Africa, Bolivia, the Philippines, Ethiopia, Myanmar, Kyrgyz Republic, Malaysia, Mongolia, Mauritania, India, China, Eritrea and Syria.

**B.** ***Historic plough-positive and plough-negative environments (instruments)***

The anthropological literature has identified three determinants for the adoption of the plough. Hans Bobek (1962) focuses on certain geographic endowments: if these preconditions are met, the plough is adopted. In particular he focuses on the availability of large domesticated animals and the existence of an appropriate land surface that is not too steep, rocky, swampy, frozen or obstructed by vegetation. The second determinant, which has been emphasized by Boserup (1970), is population density together with the degree of fallowing. Both are important determinants of plough adoption. The third determinant is the physical conditions of the soil and climate which determine the type of crops that could grow in different locations (Pryor, 1985). Because the plough requires a high up-front fixed cost, it is best suited to specific-crops, referred to as plough-positive crops, that produce relatively low yields on larger plots of land. Example of plough-positive crops include wheat, teff, barley and rye. Plough-negative crops, on the other hand, yield high outputs on small plots of land, and therefore benefit less from the use of the plough. Examples of plough-negative crops include sorghum, maize, millet, roots and tubers, and tree crops.

There has been a lively debate about which determinant is the "correct" one, but most likely all three determinants are important. Our IV strategy uses the suitability of the geo-climatic conditions of an ethnic groups historic location for cultivating plough-positive and plough-negative crops, while controlling for a locations overall agricultural suitability. Our identification relies on the assumption that holding overall crop productivity, the *type* of crops a location is endowed with only impacts long-term gender attitudes through the adoption of the plough for cultivation.

[7]It is interesting to note that female labor force participation today is the highest in Europe in Northern European countries; their original ethnic group was one of the few who did not adopt the plough historically in Western Europe.

We use information from the FAO's *Global Agro-Ecological Zones* (GAEZ) 2002 database (see Fischer, van Nelthuizen, Shah, and Nachtergaele, 2002) which reports the suitability for the cultivation of over 25 different crops for grid-cells 5 arc minutes by 5 arc-minutes for the world. We first identify crops that do and do not require plough cultivation We use Pryor's (1985) classification of plough-positive and plough-negative crops: thus plough-positive crops include "those crops, such as wheat, barley, rye, requiring not only extensive land preparation but also a considerable surface area to produce the food calories necessary to feed a family. They also include other crops, such as wet rice, which require the land be prepared in a very short period of time." (Pryor, 1985, p. 732) Plough-negative crops include "maize and various root crops which require relatively little land to produce a sufficient number of food calories to support a family, various types of tree crops and other perennial plants which do not require much cultivation, and crops such as particular types of millet or sorghum which require no extensive preparation of the land because their seeds will take roots without being buried in deep holes." (Pryor, 1985, p. 732).

To ensure that the plough negative and plough positive locations chosen are as otherwise comparable as possible, we focus solely on grain crops, and identify those that are classified as being either plough-positive or plough negative. Specifically, we compare locations more suitable for growing wheat and rye to those more suitable for growing sorghum and millet.

We build the instruments by first constructing an estimate of the amount of land historically inhabited by ethnic group $e$ that could grow each of the crops of interest by first taking the centroid of each ethnic group, identified by Murdock (1967). We then identify all land within 200 kilometers of the centroid and measure the total amount of land within this area that can grow each of the crops in question. Let $x_e^w$, $x_e^r$, $x_e^s$, and $x_e^m$ be the amount of land that could cultivate wheat, rye, sorghum and millet, respectively. Further, let $x^{all}$ be the amount of land that could grow any crop (i.e. amount of arable land). We then construct ethnicity-level instruments. The plough positive instrument is $Area_e^{pos} = 1/2(x^w + x^r)/x^{all}$, and the plough-negative instrument is $Area_e^{neg} = 1/2(x^s + x^m)/x^{all}$.

Using the same procedure shown in equations (1) and (2), we then construct district and country level plough-positive and plough-negative instruments. Intuitively, the instruments measure the proportion of a country or district's population whose ancestor had a climate that could grow plough-positive cereals (wheat and rye) and plough negative cereals (sorghum and

millet).

The geographic locations suitable for the cultivation of plough-positive and plough-negative crops are shown in Figures 4 and 5. Figure 4 shows the locations in the world that are classified as being suitable for the cultivation of wheat and rye, while Figure 5 shows suitability for millet and sorghum. A number of points are clear from the maps. First, there are many parts of the world that can grow plough-positive crops, but not plough-negative crops and vice versa. Therefore, since there is variation in locations relative suitability for growing each crop-type, there is potential for some predictive power. Second, relative to plough-positive crops, plough-negative crops appear to be relatively well suited for tropical and subtropical climates and plough-positive crops for temperate climate. If these differences in climates caused other important differences between societies which affect gender attitudes today, then the exclusion restriction will not be satisfied. Motivated by this concern, throughout our analysis, we control for the proportion of land historically inhabited by an ethnic group that was either tropical or subtropical. We also control for a number of historic measures of political/economic development, which may have been correlated with tropical climate.

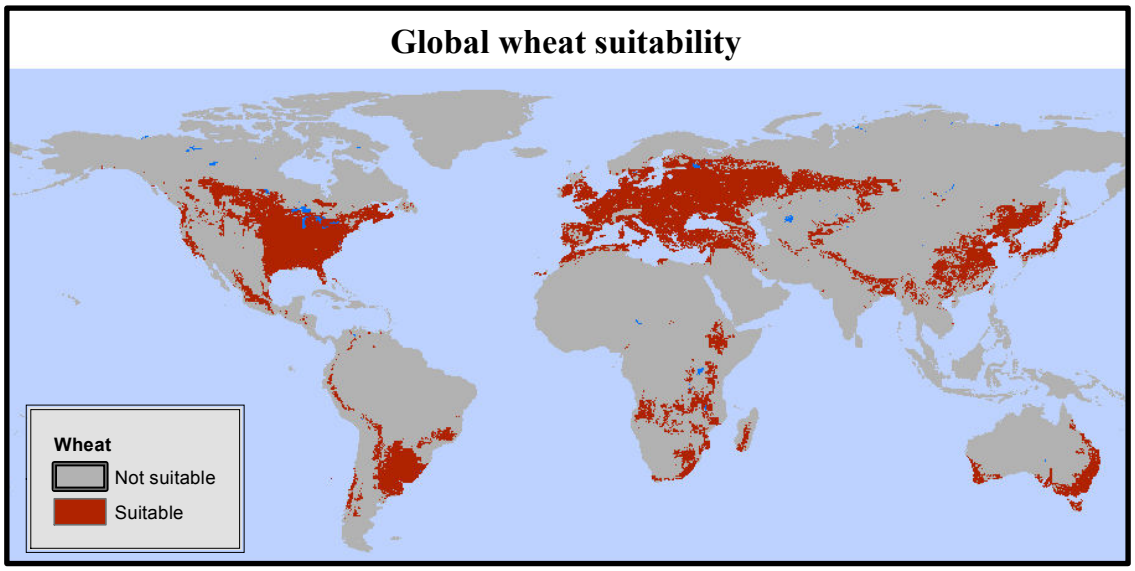
Finally, we also control for the other determinants of plough use that have been identified in the literature. Specifically, we control for a measure of historic population density as measured by settlement patterns. We also control for overall agricultural suitability, which it has been argued, affected the adoption of the plough.

## 3. Examining Differences Across and Within Countries

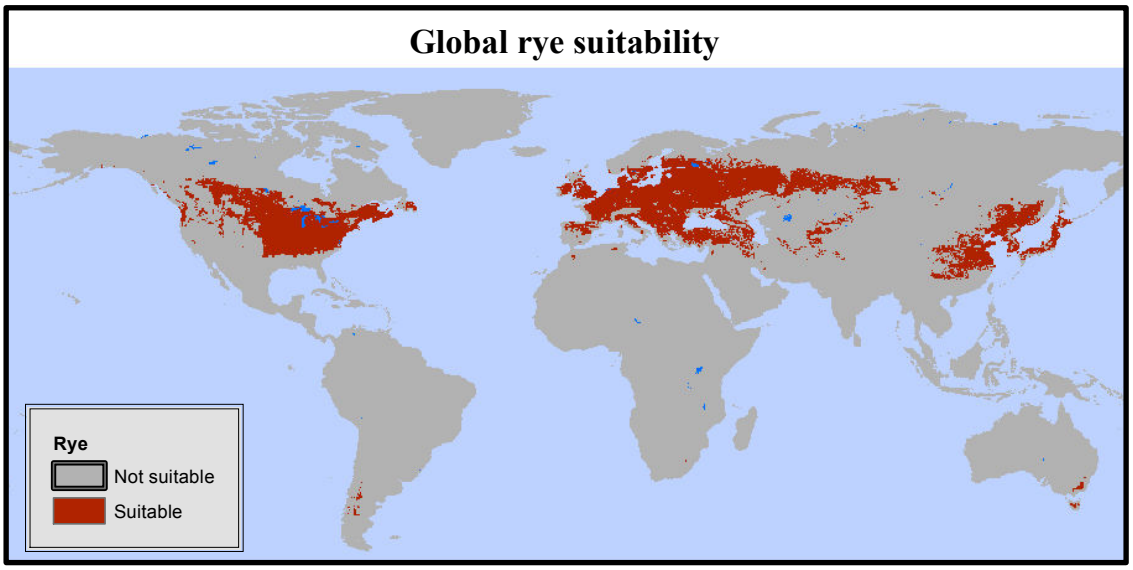
### A. *The Role of Women Historically: Evidence from the Ethnographic Atlas*

We start our analysis by examining the validity of Boserup's hypothesis historically. We mainly look at the correlation between sexual division of labor in agriculture and the use of the plough, using ethnicity level data from the *Ethnographic Atlas.* This part is mainly descriptive and it only serves to show the basic intuition behind Boserup's hypothesis. The sample consists of the societies from the Ethnographic Atlas for which there is coded information about the presence of the plough and female labor force participation in agriculture.

The plough variable is an indicator variable that equals 1 if the plough was present (whether

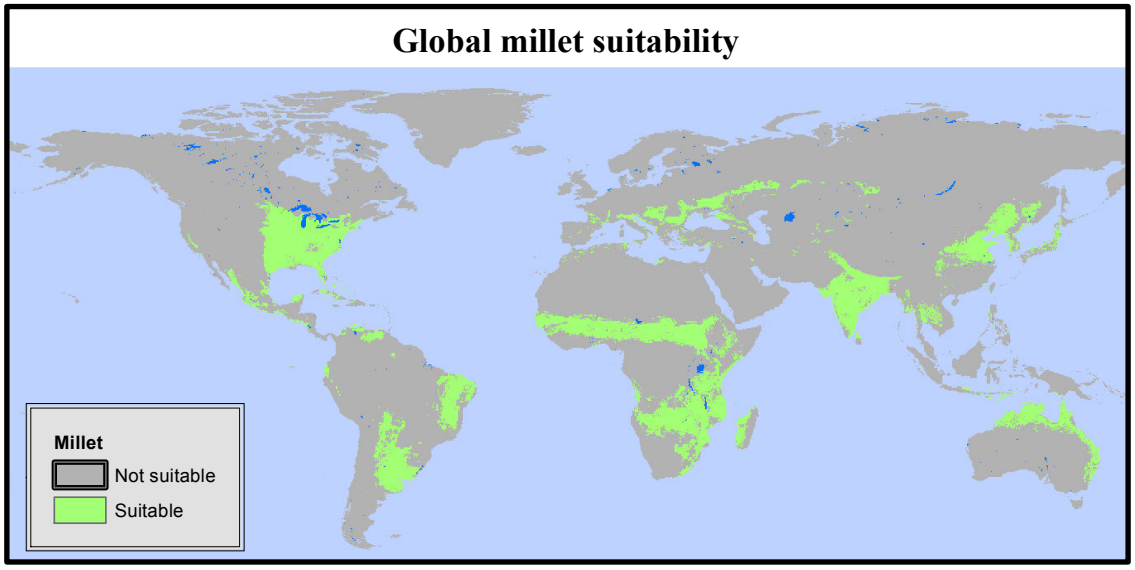



(a) Wheat suitability

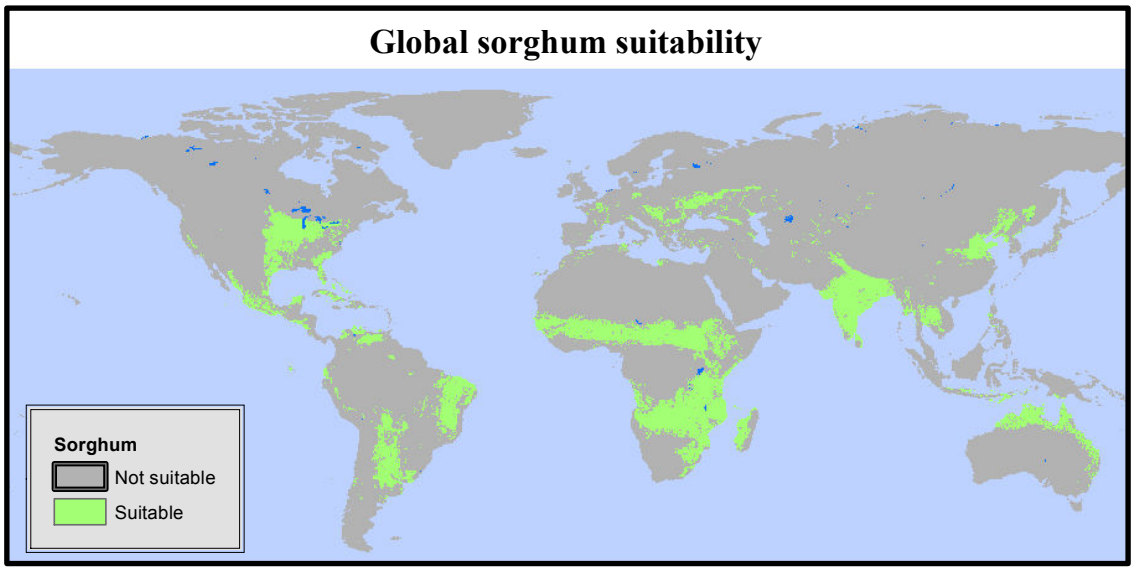



(b) Rye suitability

Figure 4: Maps displaying the global suitability of plough-positive crops, wheat and rye.




(a) Millet suitability




(b) Sorghum suitability

Figure 5: Maps displaying the global suitability of plough-negative crops, millet and sorghum.

aboriginal or not) among the ethnic group and zero otherwise[8]. Female labor force participation is a categorical variable which is increasing in the degree of participation of women in agriculture. In particular, the variable takes on the following values: males only (1), males appreciably more (2), differentiated but equal participation (3), equal participation (4), female appreciably more (5) and female only (6).[9]

Thirty two percent of ethnic groups historically had mostly men working in agriculture, 32 percent had equal participation and the remaining 36 percent had mostly female participation. Nineteen percent of societies in the sample introduced the plough.

We run an OLS regression of female participation in agriculture on the presence of the plough. In all specifications, we control for six region fixed effects – Africa, Circum-Mediterranean, East Asia, Insular Pacific, North and South America – as well as the presence of domesticated bovine or equine animals (low participation of women in agriculture could be due to the male monopoly over the care of large domesticated animals both in agricultural and pastoral societies rather than the introduction of the plough per se), the levels of jurisdictional hierarchy beyond the local community, as a measure of political development of the ethnic groups, and the economic development of the ethnic groups.

We create a measure that captures the presence of domesticated animals: a variable equal to one if the ethnic group has bovine or equine animals as predominant type of animal husbandry. As a measure of economic complexity we include a variable indicating the settlement pattern of the ethnic group and which is increasing in the level of economic complexity.[10] We proxy for political complexity with a variable indicating the complexity of the political organization in terms of the number of distinct jurisdictional levels in society (the variable can go from none to three or more jurisdictional levels). These last two variables have been shown to be correlated with economic development and societal complexity (Murdock and Provost, 1973*b*).

OLS correlations are reported on Table 1. The introduction of the plough is negatively correlated with the participation of women in agriculture. An increase in one standard deviation in the use of the plough, implies a reduction in female labor force participation of 0.20, roughly 6

[8]See the definition of the plough adoption in the data description above.

[9]The number of observations for female labor force participation in agriculture is substantially reduced, as 315 observations are missing and for 232 societies agriculture is either absent or unimportant.

[10]The variable can take the following values: nomadic or fully migratory (1), semi-nomadic (2), semi-sedentary (3), compact but impermanent settlements (4), neighborhoods of dispersed family homesteads (5), separate hamlets, forming a single community (6), compact and relatively permanent settlements (7) and complex settlements (8).

Table 1: Historic female participation in agriculture.

| | Dep var: Historic female participation in agriculture | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Historic plough use | -1.199*** | -0.926*** | -0.479*** |
| | (0.124) | (0.179) | (0.184) |
| Absolute Latitude | | -0.011*** | 0.001 |
| | | (0.004) | (0.001) |
| Domesticated animals | | 0.040 | -0.016 |
| | | (0.122) | (0.132) |
| Political hierarchies | | -0.016 | -0.023 |
| | | (0.055) | (0.056) |
| Economic complexity | | -0.098*** | -0.106*** |
| | | (0.038) | (0.038) |
| Region fixed effects | | No | Yes |
| Observations | 713 | 698 | 698 |
| R-squared | 0.11 | 0.11 | 0.16 |

*Notes*: The unit of observation is an ethnicity. Coefficients are reported with robust standard errors in brackets.

percent of the sample average of labor force participation in agriculture.

### B. *Country-level OLS estimates*

We begin by examining the relationship between current measures of gender attitudes and historic plough use at the country level. Our country estimating equations take the following form:

$$y_c = \alpha + \beta\,\text{Plough}_c + \mathbf{X^C}_c\Gamma + \mathbf{X^H}_c\Pi + \varepsilon_c \tag{3}$$

where $c$ denotes countries, $\text{Plough}_c$ is our measure of the historic use of the plough among the ancestors of the citizens in country $c$, and $\mathbf{X^C}_c$ and $\mathbf{X^H}_c$ are vector of country-level current and historic ethnographic control variables. $\mathbf{X^C}_c$ includes the natural log of a country's real per capita GDP measured in 2000, as well as the variable squared. Controlling for per capita income is important since cultural evolution within each culture is influenced by economic development. Here we are after the cross cultural differences which despite economic development, persist over time. We also include an indicator variable that equals one if the country was formerly communist. The latter is important because the communist ideology minimized the role of the family and made gender equality a critical prescription.[11] The historic ethnographic controls included in $\mathbf{X^H}_c$ are

[11] Alesina (2007) show how the impact of communist regimes on individual beliefs can be long lasting.

agricultural suitability, the presence of domesticated bovine or equine animals, the presence of a tropical climate (either tropical or subtropical), the levels of jurisdictional hierarchy beyond the local community, and the economic development of the ethnic groups currently living within the country (defined above). The variables are meant to capture important historic characteristics of ethnic groups, which if uncontrolled for, may bias our estimates. We construct these in exactly the same manner as we construct the historic plough use variable. Using the structure of either equation (1) or (2), we constructing a population weighted country average of the variable in question.

Table 2 shows the results. In column 1 the dependent variable is a measure of gender attitudes in a country. We examine two questions that quantify individuals' attitudes about gender roles. In the first question respondents are given the following statement: "When jobs are scarce, men should have more right to a job than women". The respondents are then asked to choose between (i) agree, (ii) neither (iii) disagree. We drop the observations in which the respondents answer 'neither', and code 'disagree' as 0 and 'agree' as 1. In the second question, respondents are given the following statement "Being a housewife is just as fulfilling as working for pay". Respondents then chose among the following responses that best represented their view: (1) strongly disagree, (2) disagree, (3) agree, and (4) strongly disagree. We then combine both variables into a single measure using a principal components analysis. The measure is constructed so that it is increasing in beliefs that women should specialize in home production rather than market work (i.e. unequal gender roles).

The data are taken from the *World Value Survey*, a compilation of national individual-level surveys on a wide variety of topics and carried out five times (in 1981-1984, 1990-1993, 1995-1997, 1999-2004 and 2005–2007). The coverage varies depending on the wave (starting with 22 countries in 1980, reaching 81 countries in the fourth wave and 57 in the fifth). The questionnaire contains information on different types of attitudes and preferences, as well as information on standard demographic characteristics, such as gender, age, education, labor market status, income, religion, etc. For the cross country analysis we use the fourth wave as it maximizes the number of countries in which the questions in which we are interested in are asked. We collapsed the data at the country level using the weights provided in the survey.

In column 2, the dependent variable is a country's female labor force participation rate in 2000. The dependent variable in column 3 is the share of non-production workers in the economy

that are female, and in column 5 it is the share of firms with owners or managers that are female. The dependent variable in column 5 is the proportion of seats held by women in national parliament.[12] In this specification we additionally control for each country's level of democracy in 2000, measured using the polity2 variable from the Polity IV database. Polity2 is a variable that takes on integer values ranging from $-10$ (high autocracy) to $+10$ (high democracy). All four measures are from the World Bank.

The estimates show clearly that in countries with a tradition of plough-use, men and women are more likely to disapprove of women working outside of the home (column 1). The beliefs are also reflected in a host of objective measures. The historic use of the plough is associated with lower rates of female participation in the economy overall (column 2), in non-production occupations (column 3), in ownership or management positions within firms (column 4), and in politics (column 5).

The finding of decreased employment outside of agriculture is hard to reconcile if one does not account for gender norms. As Goldin and Sokoloff (1984) have shown historically in the US, low relative productivity of women and children in agriculture can increase their participation in manufacturing. Because a feature of plough societies is that women exhibit low relative productivity, this mechanism predicts that the share of female employment in manufacturing should be greater in plough societies. This is exactly opposite of what we find. By contrast, the effect of the plough working through gender norms suggests that in plough societies it is viewed as being un-natural for women to work outside of the home and therefore in plough societies there is less female participation in non-agricultural sectors. Consistent with the gender norms mechanism, this is what we find.

In column 6, we examine a composite measure called the Gender Gap Index, constructed by Hausman, Tyson, and Zahidi (2009). The composite index is intended to capture the magnitude of gender-based disparities within a country. It is an index that is comprised of four sub-indices, which themselves are comprised of a number of variables, most of which capture ratios of female outcomes, relative to men (e.g., female life expectancy relative to male life expectancy). The sub-indices are: Economic Participation and Opportunity, Educational Attainment, Health and survival, and Political Empowerment. The final index ranges between zero and one and is

[12] As scholars have pointed out for industrial societies (e.g., Martin and Voorhies 1975, White 1978, Werner 1980), when women spend a lot of time in their houses, they are not in public view and this fact may detract from their ability to acquire political status.

Table 2: Country level OLS estimates.

| | Dependent variable | | | | | | |
|---|---|---|---|---|---|---|---|
| | Gender role attitudes | FLFP | Share of female full-time non-production workers | Share of firms with some female ownership | Females in politics | Gender score gap | Sex ratio at birth |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Historic plough use | 0.713*** | -15.578*** | -4.376*** | -13.799*** | -6.535*** | -0.027* | 0.020*** |
| | (0.173) | (3.767) | (1.259) | (4.511) | (2.186) | (0.015) | (0.005) |
| Historic controls: | | | | | | | |
| Agricultural suitability | yes | yes | yes | yes | yes | yes | yes |
| Domesticated animals | yes | yes | yes | yes | yes | yes | yes |
| Tropics | yes | yes | yes | yes | yes | yes | yes |
| Political hierarchies | yes | yes | yes | yes | yes | yes | yes |
| Economic complexity | yes | yes | yes | yes | yes | yes | yes |
| Contemporary controls: | | | | | | | |
| ln income, ln income2 | yes | yes | yes | yes | yes | yes | yes |
| Communism indicator | yes | yes | yes | yes | yes | yes | yes |
| Polity 2 | no | no | no | no | yes | no | no |
| Observations | 81 | 153 | 83 | 103 | 122 | 123 | 151 |
| R-squared | 0.40 | 0.39 | 0.53 | 0.19 | 0.33 | 0.37 | 0.31 |

*Notes*: OLS estimates are reported with robust standard errors in brackets. The unit of observation is a country. ***, ** and * indicate significance at the 1, 5 and 10% levels.

increasing in gender equality. The estimates in column 6 show that countries with a history of plough agriculture have a lower score, indicating greater gender inequality.

The final outcome variable considered, reported in column 7, is the male-to-female sex ratio at birth. Sex ratio at birth has recently emerged as an indicator of certain kinds of sex discrimination in some countries. For instance, high sex ratios at birth in some Asian countries are now attributed to sex-selective abortion and infanticide due to a strong preference for sons. By this measure as well, the results indicate there is a greater bias towards men in countries that historically relied on plough agriculture.

The coefficients for our control variables are generally as expected. For example we find evidence of a U-relationship between per capita income and female participation in the labor force participation, as well as the other outcomes. This is consistent with previous studies that also find this same non-monotonic relationship (see e.g., Goldin, 1995). We also consistently find that countries that experience a period of communism have higher rates of female labor force participation.

### C. *Country-level IV estimates*

Our IV strategy relies on the use of the historic suitability of ethnic groups' locations for the cultivation of plough-positive cereal crops or plough-negative crops. Table 3 reports IV estimates of the specifications from Table 2. The first stage estimates are in the lower panel and the second stage estimates are in the top panel. Suitability for the cultivation of plough-positive cereals is positively correlated with the adoption of the plough, while suitability for the cultivation of plough-negative cereals is negatively correlated with the plough. In all specifications, the difference between the two coefficients is statistically significant, while they are both jointly different from zero. In most of the specifications but one, the Hausman test cannot reject the consistency of OLS at a 5% level or less.

The IV coefficients confirm the OLS estimates. Historic plough use is association with less female participation in non-household activities, attitudes of gender inequality, and a sex ratio that is biased towards boys. The magnitude of the IV coefficients is greater than the OLS coefficients. This is most likely explained by the presence of omitted factors that bias the OLS coefficient towards zero. All else equal, historically advanced societies would have been more likely to adopt the plough. Further, historically advanced societies are more likely to also be advance today with higher per capita incomes and with more progressive attitudes about gender roles. Therefore, omitted factors introduce a negative relationship between the historic plough use and unequal gender attitudes that attenuate the true positive effect. Therefore, the OLS estimates are biased towards zero relative to the IV estimates. A similar explanation also applies to our other outcomes of interest.

Our IV strategy raises a number of concerns and potential caveats. One concern is that environments relatively more suitable for the cultivation of plough-positive cereals tend to be disproportionately located in temperate regions. However, recall that in all specifications, we control for the existence of a tropical climate.

An important caveat for our IV strategy arises from the fact that the plough-positive and plough-negative cereals that we use when constructing our instruments were all originally grown in the Eastern hemisphere and were not cultivated in the Americas until after 1500. This is not a concern to identification, but it is a fact that makes the first stage relationship weaker than it would be otherwise. For the large proportion of the population in the Americas whose ancestors are from the Eastern hemisphere, the instrument will provide predictive power. It is only for the

Table 3: Country level IV estimates.

| | Second Stage | | | | | | |
|---|---|---|---|---|---|---|---|
| | Gender role attitudes | FLFP | Share of female full-time non-production workers | Share of firms with some female ownership | Female in politics | Gender score gap | Sex ratio at birth |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Historic plough use | 1.249* | -31.94** | -6.88** | -17.40 | -26.14** | -0.080** | 0.045** |
| | (0.664) | (13.49) | (3.15) | (10.66) | (11.07) | (0.040) | (0.021) |
| Historic controls: | | | | | | | |
| Agricultural suitability | yes | yes | yes | yes | yes | yes | yes |
| Domesticated animals | yes | yes | yes | yes | yes | yes | yes |
| Tropics | yes | yes | yes | yes | yes | yes | yes |
| Political hierarchies | yes | yes | yes | yes | yes | yes | yes |
| Economic complexity | yes | yes | yes | yes | yes | yes | yes |
| Contemporary controls: | | | | | | | |
| ln income, ln income2 | yes | yes | yes | yes | yes | yes | yes |
| Communism indicator | yes | yes | yes | yes | yes | yes | yes |
| Polity 2 | no | no | no | no | yes | no | no |
| Observations | 80 | 151 | 82 | 102 | 121 | 121 | 149 |
| R-squared | 0.41 | 0.31 | 0.50 | 0.50 | -0.04 | 0.25 | 0.21 |
| | First Stage. Dependent variable: Historic plough use | | | | | | |
| Plough-positive environment | 0.249* | 0.381*** | 0.625*** | 0.714*** | 0.427*** | 0.380*** | 0.379*** |
| | (0.134) | (0.124) | (0.183) | (0.164) | (0.140) | (0.130) | (0.124) |
| Plough-negative environment | -0.155 | -0.068 | -0.069 | -0.038 | -0.056 | -0.254** | -0.082 |
| | (0.123) | (0.093) | (0.105) | (0.102) | (0.107) | (0.098) | (0.095) |
| Equal coeff (p-value) | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| *F*-stat (excl instr) | 3.32 | 5.93 | 7.07 | 10.34 | 5.74 | 9.41 | 6.06 |
| Hansen-J | 0.24 | 0.21 | 0.06 | 0.00 | 0.88 | 0.06 | 0.24 |
| Hausman test (p-value) | 0.229 | 0.073 | 0.324 | 0.662 | 0.024 | 0.073 | 0.235 |

*Notes*: IV estimates are reported with robust standard errors in brackets. The unit of observation is a country. ***, ** and * indicate significance at the 1, 5 and 10% levels.

indigenous populations of the Americas for which the instrument will not vary plough adoption. This point should be kept in mind when interpreting the IV estimates as a local average treatment effect (LATE). In other words, the estimates are an average effect among the ethnic groups whose plough adoption was affected by the geo-climatic suitability for growing the cereal crops. Because the crops were not indigenous to the Americas, we would not necessarily expect the indigenous groups from the Americas to be within the group.

### D. *District level estimates, OLS and IV*

We also examine the relationship between historic plough use and either current female labor force participation or gender role attitudes across individuals within countries. Our outcomes of interest are from the most recent four waves of the *World Values Survey* (WVS). Our district-level analysis uses the second to fifth waves only of the WVS since the first wave does not contain information on the district in which the respondent lives. Because regional classifications often vary by wave, we use the wave with the most finely defined regions.

We use the same gender attitudes measure as in the country-level regressions, but measured at the individual level. The survey also asks respondents to report their employment status. We code a woman as being in the labor force if she reports that she is employed full-time, employed part-time or self-employed. We code a woman as not being in the labor force if she reports that she is retired, a housewife, a student or other.

The individual-level estimating equation is given by

$$y_{i,d,c} = \alpha_{r(c)} + \beta\,\text{Plough}_d + \mathbf{X^C}_c\Gamma + \mathbf{X^H}_d\Pi + \mathbf{X^C}_i\Phi + \varepsilon_{i,d,c} \tag{4}$$

where $i$ denotes an individual, $d$ denotes a district within a country $c$, and $r(c)$ denote the continent of country $c$. $\text{Plough}_d$ is our measure of the historic use of the plough among the ancestors of individuals living in district $d$. $\mathbf{X^C}_c$ are the same current country-level controls as in equation (3). $\mathbf{X^H}_d$ includes the same historic ethnographic variables as in equation (3), but measured at the district level. $\mathbf{X^C}_i$ denotes current individual-level controls: age, age squared, as well as fixed effects for martial status, educational attainment, and income levels. The equation also includes continent fixed effects, denoted $\alpha_r$. To be as conservative as possible, we cluster the standard errors at the country level.

Table 4: Individual-level OLS and IV estimates.

| | FLFP | | Gender attitudes | |
|---|---|---|---|---|
| | OLS | IV | OLS | IV |
| | (1) | (2) | (3) | (4) |
| Historic plough use | -0.317*** | -0.754*** | 0.945*** | 1.564*** |
| | (0.045) | (0.234) | (0.115) | (0.537) |
| Individual controls | yes | yes | yes | yes |
| Current country controls | yes | yes | yes | yes |
| Historic district controls | yes | yes | yes | yes |
| Observations | 38,376 | 38,034 | 62,379 | 62,379 |
| R-squared | 0.19 | 0.17 | 0.18 | 0.18 |

Notes: The table reports IV and OLS estimates, with standard errors clustered at the district level. The instruments for the IV estimates are plough-positive climate and plough-negative cliamte. Individual controls are age, age squared, education, gender (for gender attitudes only), marital status, and income. Current country controls include ln income, ln income squared and a communism indicator variable. Historic district controls include agricultural suitability, domesticated animals, tropical areas, political hierarchies, and economic complexity. ***, ** and * indicate significance at the 1, 5 and 10% levels.

Table 4 reports the OLS and IV estimates of equation (4) are. The historic use of the plough is associated with lower female labor force participation and less symmetric gender role attitudes.

Since the variation in the variable of interest is at the district level, we check that our results hold if one aggregates all data from the individual to the district level and estimate a district level version of equation (4).[13] Table 5 reports the results. The results continue to hold looking across district averages.

## 4. The Persistence of Culture: Evidence from US immigrants

It is possible that part of the long term effect of the historic use of the plough we have identified may arise because historic plough-use may have facilitated the development of different forms of welfare systems that are more or less conducive to the participation of women in market activities. This channel could also reinforce the impact of the plough on female labor force participation and gender role attitudes. To isolate the impact of the long lasting effects of the plough on individual's attitudes, beliefs, and preferences (i.e. culture) from impacts on the evolution of institutions, we examine variation among immigrants within the US. Immigrants face the same institutional

[13] In the district level specification, we do not control for individual characteristics.

Table 5: District level OLS and IV estimates.

| | FLFP | | Gender attitudes | |
|---|---|---|---|---|
| | OLS | IV | OLS | IV |
| | (1) | (2) | (3) | (4) |
| Historic plough use | -0.246** | -0.981** | 0.794*** | 1.527** |
| | (0.12) | (0.452) | (0.253) | (0.686) |
| Current country-level controls | yes | yes | yes | yes |
| Historic district-level controls | yes | yes | yes | yes |
| Continent FEs | yes | yes | yes | yes |
| Observations | 696 | 689 | 638 | 631 |
| R-squared | 0.36 | 0.06 | 0.48 | 0.46 |

Notes: The table reports IV and OLS estimates, with robust standard errors. The unit is observation is a district. The instruments for the IV estimates are plough-positive climate and plough-negative cliamte. Current country controls include ln income, ln income squared and a communism indicator variable. Historic region controls include agricultural suitability, domesticated animals, tropical areas, political hierarchies, and economic complexity. ***, ** and * indicate significance at the 1, 5 and 10% levels.

environment, since they are all located in the same country. When estimating the impact of the plough we can be more confident that we are holding constant institutional differences and that our estimated coefficients identify the impact of historic plough use that arise through cultural mechanisms.

Data on US immigrants is from the March Supplement of the *Current Population Survey* (CPS). Starting in 1994, the CPS asks individuals about their country of origin and their parents' country of origin. We use all the years available since 1994 and examine the determinants of female labor force participation for both first and second generation immigrants. Since the CPS reports data about the country of origin of both parents we run our results defining second generation according to the father, the mother or when both parents come from the same country. We do this to investigate whether cultural transmission of female labor force participation is stronger when comes from the father, the mother or it is maximized when both parents share the same cultural origin.

Using the information on female immigrants, we test whether the historic plough use among in the origin country has a persistent effect on female labor force participation even after women, and their daughters, have migrated to the US. We do this with the following estimating equation:

$$y_{i,s,c} = \alpha_s + \beta\,\text{Plough}_c + \mathbf{X^C}_c\Gamma + \mathbf{X^H}_d\Pi + \mathbf{X}_i\Phi + \varepsilon_{d,r,c} \tag{5}$$

where $i$ denotes individuals currently living in a US state $s$, whose country of origin is country $c$.

As in equation (3), $\text{Plough}_c$ denotes the historic plough-use of those in country $c$. $\mathbf{X^C}_c$ denotes the same vector of current country-level controls as in equation (3), and $\mathbf{X^H}_d$ includes the same historic ethnographic variables as in equation (3). $\mathbf{X}_i$ indicates a vector of individual level controls, which includes dummies for education, a quadratic for age and real personal income. The equation also includes state of residence fixed effects, denoted $\alpha_s$. Because our variable of interest $\text{Plough}_c$ only varies at the country of origin-level, we cluster all standard errors at this level.

We estimate equation (5) using two different samples: all women and married women. For each group, we run the specification for first generation and second generation, this last group is identified by looking at father country of origin, mother country of origin and when both parents come from the same country. We split the sample between all women and married women, because married women normally display largest variation in work outcomes. In addition, when we run our regressions only for married women we can control for the characteristics of the husbands, that can play an important role in the decision of the wife to enter the labor market. In particular we control for a quadratic in age, husband's education and real income.

The OLS estimates show that female immigrants who have an ancestry of historic plough-use have lower rates of female labor force participation within the US. The estimates also show that the estimated effect fades over time for second generation when this is identified by looking at the father country of origin. Further amongst second generation immigrants, the mother country's historic plough use appears to be a stronger determinant than the father's. This is consistent with norms about female behavior being most strongly transmitted from the mother to the daughter. The strongest effect is felt when both parents are from the same country.

In columns 5–8 of Tables 6 and 7, we re-estimate the specification from columns 1–4, but restrict the sample of female immigrants to only include women that are married. Because the historic use of the plough is intimately connected to the division of labor within the family, we want to be sure that the effects exist amongst females that are in a traditional family setting. The estimates show that female immigrants from a country with historic plough use have lower levels of labor force participation.

## 5. Conclusions

We have provided empirical evidence suggesting that contemporary cultural differences in attitudes about the role of women in society have been shaped by historical forces. Specifically, we

Table 6: Immigrant OLS regressions.

| | All women | | | | Married women | | | |
|---|---|---|---|---|---|---|---|---|
| | | Second generation | | | | Second generation | | |
| | First generation | Father's country | Mother's country | Parents same country | First generation | Father's country | Mother's country | Parents same country |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Historic ploug use | -0.067*** | -0.049*** | -0.060*** | -0.086*** | -0.042*** | -0.023* | -0.064*** | -0.073*** |
| | (0.016) | (0.012) | (0.013) | (0.014) | (0.015) | (0.013) | (0.019) | (0.019) |
| Individual controls | yes | yes | yes | yes | yes | yes | yes | yes |
| Husband controls | n/a | n/a | n/a | n/a | yes | yes | yes | yes |
| Historic country | yes | yes | yes | yes | yes | yes | yes | yes |
| Current country | yes | yes | yes | yes | yes | yes | yes | yes |
| State fixed effects | yes | yes | yes | yes | yes | yes | yes | yes |
| Observations | 124,782 | 43,311 | 42,089 | 23,555 | 71,770 | 17,785 | 9,592 | 8,347 |
| R-squared | 0.34 | 0.37 | 0.38 | 0.41 | 0.38 | 0.35 | 0.37 | 0.37 |

Notes: OLS estimates are reported with standard errors clustered at the country level. An observation is a US immigrant. Individual controls include age, age squared, education, marital status and income. Husband controls include husband's age, age squared, education and income. Historic country controls include the origin country's historic agricultural suitability, domestication of animals, tropics, political hierarchies and economic complexity. Current country controls include ln income, ln income squared, and a communism indicator variable. ***, ** and * indicate significance at the 1, 5 and 10% levels.

Table 7: Immigrant IV regressions.

| | All women | | | | Married women | | | |
|---|---|---|---|---|---|---|---|---|
| | | Second generation | | | | Second generation | | |
| | First generation | Father's country | Mother's country | Parents same country | First generation | Father's country | Mother's country | Parents same country |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Historic ploug use | -0.074*** | -0.041*** | -0.056*** | -0.067*** | -0.058** | -0.033** | -0.062*** | -0.062** |
| | (0.024) | (0.015) | (0.017) | (0.022) | (0.024) | (0.017) | (0.021) | (0.029) |
| Individual controls | yes | yes | yes | yes | yes | yes | yes | yes |
| Husband controls | n/a | n/a | n/a | n/a | yes | yes | yes | yes |
| Historic country | yes | yes | yes | yes | yes | yes | yes | yes |
| Current country | yes | yes | yes | yes | yes | yes | yes | yes |
| State fixed effects | yes | yes | yes | yes | yes | yes | yes | yes |
| Observations | 124,772 | 43,309 | 42,089 | 23,555 | 71,763 | 17,784 | 17,390 | 8,347 |
| R-squared | 0.34 | 0.37 | 0.38 | 0.41 | 0.40 | 0.35 | 0.34 | 0.37 |

Notes: IV estimates are reported with standard errors clustered at the country level. An observation is a US immigrant. Individual controls include age, age squared, education, marital status and income. Husband controls include husband's age, age squared, education and income. Historic country controls include the origin country's historic agricultural suitability, domestication of animals, tropics, political hierarchies and economic complexity. Current country controls include ln income, ln income squared, and a communism indicator variable. ***, ** and * indicate significance at the 1, 5 and 10% levels.

have shown that individuals, ethnicities and societies whose ancestors used plough agriculture today have beliefs that exhibit greater gender inequality. We have considered both cross country evidence but that drawn form immigrants in the US. the later piece of evidence is meant to hold constant institutional differences in different countries which may be related to the use of the plough historically. Causality is dealt with an instrument related to the type of soil, more or less compatible with plow use.

Our results suggest a very long persistence of cultural traits. This of course does not mean that cultures do not evolve. It is obvious that women role in many societies to day is different that of only a century ago. But our findings imply that cross cultural differences remain even though cultures evolve.

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## Appendix A. Data Appendix

### *A.. Dependent variables*

The data on female labor force participation and measures of gender roles are taken from the most recent four waves of the *World Value Survey* (WVS), which is a compilation of national surveys on values and norms on a wide variety of topics. It has been carried out five times, in 1981–1984, 1990–1993, 1995–1997, 1999–2004 and 2005–2007. The coverage varies depending on the wave, starting with 22 countries in 1980 and covering 81 countries in the fourth wave. The fifth wave has been carried out in 57 countries in the World. The questionnaires contain information on different types of attitudes, religion and preferences, as well as information on standard demographic characteristics, such as sex, age, education, labor market status, and income.

Our analysis uses the last four waves of the WVS since the first wave does not contain information on the district of origin of the respondent which is essential for our subnational estimates. Because district classifications often vary by wave, we use the wave with the most finely defined districts.

We examine two questions that quantify individuals' attitudes about gender roles. In the first question respondents are given the following statement: "When jobs are scarce, men should have more right to a job than women". The respondents are then asked to choose between (i) agree,

(ii) neither (iii) disagree. We drop the observations in which the respondents answer "neither", and code 'disagree' as 0 and 'agree' as 1.

In the second question, respondents are given the following statement "Being a housewife is just as fulfilling as working for pay". Respondents then chose among the following responses that best represented their view: (1) strongly disagree, (2) disagree, (3) agree, and (4) strongly disagree.

We then combine both variables into a single measure using principal components. The constructed gender attitudes variable takes on higher values for more unequal beliefs about the role of women, namely that their natural place is in the home.

Female labor force participation measured at the country level is taken from the World Bank's *World Development Indicator's*. The variable is measured in the standard way, as the percentage of women in the labor force. The variable, measured at the district level, is taken from the WVS. The survey asks respondents to report their employment status. We code a woman as being in the labor force if she reports that she is employed full-time, employed part-time or self-employed. We code a woman as not being in the labor force if she reports that she is retired, a housewife, a student or other.

### *B.. Plough-positive and plough-negative climatic conditions*

We construct our geo-climate instruments using information comes from the FAO's *Global Agro-Ecological Zones* (GAEZ) 2002 database. The data are publicly available from:
`http://www.iiasa.ac.at/Research/LUC/SAEZ/index.html`. The database reports the suitability for the cultivation of over 25 different crops for grid-cells 5 arc minutes by 5 arc-minutes (approximately 56 km by 56 km) for the world. From the database we extract the raster files for sorghum, millet, wheat and rye. For each crop, we know whether it can be grown in each grid globally. This information is used to construct our instrument, as described in the body of the text.

### *C.. US Immigrants*

Our main datasets are the March Supplement of the Current Population survey and the American Time Use Survey. The March Supplement of the Current Population Survey is the only recent available dataset in which individuals were asked (starting from 1994) about their parents' country of origin. We pool fifteen years of data to obtain the maximum sample size. We use

the CPS to study female labor force participation of second generation immigrant women in the US.

### *D.. Ethnographic Controls*

The measure of historic economic development is from question v30 of the Ethnographic Atlas. Each ethnic group is identified as falling within one of the following settlement pattern categories: nomadic or fully migratory (80 ethnicities), semi-nomadic (187), semi-sedentary (93), compact, but temporary settlements (15), neighborhoods of dispersed family homes (149), separated hamlets forming a single community (106), compact and relatively permanent (504), complex settlements (29). We construct a variable that takes on the values of 1 to 8, with 1 indicating fully nomadic groups and 8 groups with complex settlement. We then construct an average measure among the ethnic groups of individuals living in each district or country as described in Section 2.1.

As an alternative measure of development, we quantify the political sophistication of ethnic group. We use the number of jurisdictional hierarchies beyond the local community (question v33). Our control for the historic existence of domesticated bovine or equine animals is constructed from question v40 of the Ethnographic Atlas.

The two ethnographic controls that measure the historic geographic environment are constructed in the following manner. We first identify the centroid of each ethnic group, which is reported in the Atlas. We then identify land that is within 200 kilometers of the centroid. Using information on global geo-climatic conditions for crop cultivation from the FAO's GAEZ 2002 database, we calculate the fraction of this land that is suitable for the cultivation of crop for human consumption. We use this measure to construct the average suitability of the land historically inhabited by a location's ancestors. We also identify the proportion of this land that is classified as having either a tropical or sub-tropical climate. This is then used to construct a measure of how tropical the land historically inhabited by a location's ancestors was.

## Appendix B. Appendix tables

Table 8: The importance of time-invariant country characteristics.

| | Dependent variable: female labor force participation | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| ln income | | | -5.204 | -52.37 | -52.43 | -6.98 |
| | | | (0.925) | (11.46) | (12.41) | (6.62) |
| ln income squared | | | | 2.817 | 2.786 | 0.408 |
| | | | | (0.673) | (0.724) | (0.397) |
| Time trend | 0.269 | | | | | |
| | (0.060) | | | | | |
| Manuf. Share of GDP | No | No | No | No | Yes | Yes |
| Services share of GDP | No | No | No | No | Yes | Yes |
| Year FEs | No | Yes | Yes | Yes | Yes | Yes |
| Country FEs | **No** | **No** | **No** | **No** | **No** | **Yes** |
| R-squared | **0.02** | **0.02** | **0.17** | **0.26** | **0.29** | **0.97** |
| Observations | 3,743 | 3,743 | 3,743 | 3,743 | 3,743 | 3,743 |

*Notes*: An observation is a country and year. The sample includes 168 countries from 1980 to 2008. Coefficients are reported with standard errors clustered at the country level.