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

Alberto Alesina† Paola Giuliano‡ Nathan Nunn§

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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 test the hypothesis that the way people farmed historically influenced gender division of labor and attitudes about women's role that tend to persist today. We find that societies with a tradition of plough agriculture developed the belief that the natural place for women is inside the home. In these societies women participate less in the market and are less represented in positions of power. 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 the importance of cultural persistence by looking at second generation immigrants with different cultural backgrounds living within the US.

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†Harvard University, IGIER Bocconi, NBER and CEPR. (email: aalesina@harvard.edu)

‡University of California Los Angeles, NBER, CEPR and IZA. (email: paola.giuliano@anderson.ucla.edu)

§Harvard University, NBER and BREAD. (email: nnunn@fas.harvard.edu)

## 1. Introduction

The role of women in the family, in the work force, and in society varies across nations. In some cultures the social norm is for women to work outside the house, while in others the norm is that they stay at home and are not involved in market or public activities. This study seeks to better understand the underlying determinants of these differences.

We test the hypothesis, originally put forth by Boserup (1970), that cross-cultural differences in gender role attitudes and observed female participation outside of the domestic sphere arose from differences in agricultural technologies used traditionally. In particular, she identifies important differences between shifting cultivation and plough cultivation. Shifting cultivation is labor intensive and the standard implements include the hoe and digging stick. With this form of agriculture women actively participate in farm work. Plough cultivation, by contrast, is more capital intensive, using the plough to prepare the soil. Unlike the hoe, the plough requires significant upper body strength, grip strength, and burst of power to manipulate the plough, while either pulling the plough or controlling the animal that pulls it.[1] Because of these requirements, when plough agriculture is practices, men have a comparative advantage in farming relative to women (Murdock and Provost, 1973a). The use of the plough also leaves less need to weeding, a task which is typically undertaken by women and children (Foster and Rosenzweig, 1996). As well, child care, a task normally performed by women, is mostly compatible with activities that can be stopped and resumed easily and do not put children in danger. These are characteristics that hold for hoe agriculture, but not for plough agriculture.[2] The traditional division of labor in agriculture generates norms about the appropriate role of women in society. It societies characterized by plough agriculture, the view that the natural place for women is within the home develops. Because of the persistence of these deep seeded cultural beliefs, even after the economy industrialized, the beliefs persist affecting the participation of women on other activities outside of the home besides agriculture.

To test of Boserup's hypothesis, we combine historic ethnographic data, reporting whether

[1] See Pitt, Rosenzweig and Hassan (2010) for evidence from Bangladesh and the USA on the distribution of strength by gender.

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

societies traditionally used plough agriculture, with contemporary measures of individuals' views about gender roles, as well as measures of female participation outside of the home. Our analysis examines variation across countries, subnational districts, ethnic groups, and immigrants from different cultural backgrounds living within the US. Consistent with Boserup's hypothesis, we find a strong and robust negative relationship between historic plough-use and attitudes of gender equality today. We also find that historic plough-use is negative correlated with female participation in activities outside of the home, such as market employment, firm ownership, and participation in politics.

Although these correlations are consistent with Boserup, they are also consistent with other interpretations. For example, we would observe the same relationships if societies with attitudes favoring gender inequality were more likely to adopt the plough historically and these attitudes continue to persist today. To better understand whether past plough use did have a causal impact on subsequent cultural beliefs and norms, we instrument historic plough-use with the historic geo-climatic conditions of a society. As Pryor (1985) shows, the plough tended to be used with certain types of cultivations, such as teff, wheat, barley, rye and wet rice, which require the land to be prepared in a very short period of time. Pryor labels these crops as 'plough-positive', as opposed to 'plough-negative' crops, such as maize and various types of root and tree crops. 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 relative differences in ethnic groups' geo-climatic conditions for growing plough-positive and plough-negative cereals as instruments for historic plough use.

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 institutions and policies that are more or less conducive to the participation of women in market activities.[3] This would reinforce the impact that the plough may have on gender role 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 second generation immigrants within the US, thus holding constant institutions. Second generation US immigrant women from countries that historically used the plough have lower rates of labor force participation in the US. Since

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

differences emerge even amongst immigrants we conclude that some cultural traits are persistent even when individuals share the same legal system and institutional setting.

Obviously, the plough is not the only determinant of women's role in society, both female labor force participation and beliefs about the role of women in society have changed dramatically in many countries in the last few decades. Many papers have studied their proximate determinants (including economic development, medical progress, the change in the production structure of the economy[4]). However, even accounting for these important factors, large cross-country differences still persist and remain important. In addition, even though labor force participation of women has evolved over time, the correlation between past and current levels is quite strong.

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 as being an important factor underlying the persistent differences in gender roles across societies. Although the link between culture and female labor force participation is rather clear, little is known about the origin of these cultural differences. The main contribution of this paper is to show that long-lasting cultural values regarding the role of women in society may depend on the initial technology and its evolution. With the persistence typical of cultural values, even technologies adopted long time ago may still have an influence on current cultures.

Our paper is not the first to examine the relationship between the nature of production and gender roles. Since Boserup's initial hypothesis, others have also examined the effect that the plough has had on gender attitudes historically. To begin with, 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

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

a king resembling Jupiter, as Jean Przyluski put it" (Braudel, 1998, p. 71). Ross (2008) examines the current production structure of economies, and argues that economies with large endowments of oil, are not competitive in the production of low-end export-oriented manufacturing activities that are particularly well-suited for female employment e.g., textiles and footwear. Our paper complements Ross's analysis by showing that not only do current aspects of a society's production process matter for gender role attitudes, but aspects of historic production also matter and have long-term impacts. However, unlike Ross, we are interested in identifying a much more specific channel – culture – through which aspects of production affect gender role attitudes.

Our paper is related to a number of recent studies that try to explain the historic determinants of cultural values today. For instance, Guiso, Sapienza and Zingales (2008a) 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 (2010b) examines the historical origins of a 'culture of honor' in the US South, and Grosjean (2010a) 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 the data on the historic use of the plough across different ethnicities and document the correlation between plough use and female participation in agriculture in historical societies. In section 3, we describe the matching procedure to link the historical use of the plough across different ethnicities to the current geographical distribution of different ethnic groups living in different districts and countries. Section 4 presents OLS estimates, examining variation across countries. Section 5 presents our instrumental variables strategy, test alternative hypotheses suggested in literature to explain differences in gender roles and provide further robustness checks. Sections 6 and 7 study differences in labor force participation using individual data and looking at second generation immigrant women to test whether the effect of historic plough-use continues to persist even when individuals face the same external environment. The last section concludes.

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

## 2. Gender based division of labor and the plough: Historical evidence

### A. *Data*

The data on historic plough use are from the *Ethnographic Atlas*, a world wide ethnicity-level database constructed by George Peter Murdock that contains ethnographic information for 1,267 ethnic groups around the world. Information for societies in the sample have been coded for the earliest period for which satisfactory ethnographic data are available or can be reconstructed. The earliest observation dates are for groups in the Old World where early written evidence is available. For the parts of the world without a written history the information is from the earliest observers of these cultures. For some cultures the first recorded information is from the early 20th century. However, even for these observations, the data should capture, to the maximum extent possible, the characteristics of the ethnic group prior to European contact. For all groups in the dataset, the variables are taken from the societies prior to industrialization.

The database contains a measure of the historic use of plough agriculture. Groups are classified into one of 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. There are data on plough use for 1,158 of the 1,267 societies in the database. There is hardly any evidence of groups repeatedly switching from one form of agriculture to another. In other words, the use (or non-use) of the plough remains stable over time.

The database does record adoption if it occurred after European contact. However, we do not have the exact date of adoption for the other cases of adoption. It is possible that the plough has a bigger effect on gender norms amongst groups that adopted early, and therefore have used the technology for a longer period of time. However, because of data limitation, we are unable to test for this. Therefore our estimates should be interpreted as the average effect of having adopted the plough among all ethnic groups that did so prior to industrialization. There may be heterogeneity within the group of adopted, but we are only able to estimate an average effect.

The number of societies that did not use the plough is greater than the number that did. Descriptive statistics for all the data used in the paper are reported in Appendix Table A1. In the sample, 86% of the ethnicities did not use the plough, 12.18% of the societies used the plough, and in 1.5% of the societies 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. First of all, 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, the ethnic groups are not of equal size or importance today as compared to the 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* over-samples 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 therefore able to follow ethnic groups that have moved.

**B.** ***Female participation in agricultural activities and plough use in historical societies***

We define a plough variable as a dummy equal to one if the plough was present (whether aboriginal or not) among the ethnic groups and zero otherwise. Female labor force participation is a categorical variable which is increasing in the degree of participation of women in agriculture. In particular, the variable indicates whether agriculture is a male or female dominated activity and can take 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).[6] 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 estimate an OLS regression of female participation in agriculture on the presence of the plough. In all specifications, we control for the presence of domesticated bovine or equine animals since low participation of women in agriculture could be due to the female monopoly

[6]The number of observations for female labor force participation in agriculture is lower than the full sample as 315 observations are missing and for 232 societies agriculture is either absent or unimportant.

over the care of domesticated animals. This variable equals one if the ethnic group has bovine or equine animals as predominant type of animal husbandry. We also include measures of economic and political complexity of the ethnic groups. Economic complexity is measured by a variable (increasing in the level of economic complexity) indicating the settlement pattern of the ethnic group. This 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). We proxy for political complexity with a variable that measures the number of levels of jurisdictional hierarchy beyond the local community. The last two variables have been shown to be correlated with economic development and societal complexity(Murdock and Provost, 1973b).

OLS results are reported in Table 3. Column 1 shows a negative relationship between historic plough use and historic participation of women in agriculture. A one standard deviation increase in the use of the plough, implies a reduction in female participation in agriculture of 0.41 (12% of the sample average of the left hand side variable). The *Ethnographic Atlas* unfortunately does not provide any detail on the type of tasks women do when they work in agriculture. We therefore complement our analysis by using ethnographic information from Murdock and White's (1969) *Standard Cross-Cultural Sample* (*SCCS*). This dataset contains information on 186 societies globally.[7] We first replicate the *Ethnographic Atlas* regression on female participation in agriculture with the *SCCS* sample (column 2), finding similar results.[8] In columns 3–14, we then look specifically at gender role specialization in detailed tasks:[9] land clearance, soil preparation, planting, crop tending, harvesting, care of small and large animals, milking, cooking, fuel gathering, water fetching and burden carrying. We find that women tend to do significantly less in the majority of agricultural activities (soil preparation, planting, crop tending and harvesting), there is not significant difference in land clearance, care of small animals, milking, cooking or water fetching.

[7]The *SCCS* is a dataset developed by Murdock and White, which contains only 186 societies which are relatively independent from each other, i.e. they have relatively weak phylogenetic and cultural diffusion relationships. Murdock began with the 1267 societies present in the *Ethographic Atlas*, dividing them into roughly 200 "sampling provinces"t of closely related cultures. Murdock and White, then chose one particularly well-documented culture from each sampling province to create the *SCCS*. The number of cultures has been considered among anthropologists large and varied enough to provide a sound basis for statistical analysis.

[8]The magnitude of the coefficients is sligthly higher, an increase in one standard deviation in the use of the plow implies a decline in female labor force participation of 0.56, which is roughly equal to 17% of the sample average of this variable in the *SCCS*.

[9]All the variables reported in columns 3 to 14 are coded on a 1 to 5 scale: male exclusively (1), males predominantly (2), equal division (3), females predominantly (4) and females exclusively (5).

Table 1: Historic plough use and historic female participation in agriculture.

| | Panel A. Dependent variables: Female participation in the following (agriculture-related) tasks: | | | | | | |
|---|---|---|---|---|---|---|---|
| | Participation in agriculture | | Land clearance | Soil preparation | Planting | Crop tending | Harvesting |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Historic plough use | -1.079*** | -1.362*** | -0.28 | -1.055*** | -1.150*** | -0.895** | -0.704** |
| | (0.156) | (0.383) | (0.204) | (0.353) | (0.342) | (0.367) | (0.307) |
| Observations | 698 | 132 | 137 | 132 | 139 | 129 | 139 |
| R-squared | 0.098 | 0.171 | 0.040 | 0.092 | 0.097 | 0.148 | 0.156 |

| | Panel B. Dependent variables: Female participation in the following (additional) tasks: | | | | | | |
|---|---|---|---|---|---|---|---|
| | Caring for small animals | Caring for large animals | Milking | Cooking | Fuel gathering | Water fetching | Burden carrying |
| | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| Historic plough use | 0.349 | 0.22 | 0.738 | 0.085 | -0.940** | -0.219 | -1.160*** |
| | (0.560) | (0.276) | (0.711) | (0.149) | (0.410) | (0.240) | (0.374) |
| Observations | 95 | 96 | 48 | 182 | 166 | 159 | 144 |
| R-squared | 0.034 | 0.049 | 0.030 | 0.019 | 0.041 | 0.046 | 0.151 |

Notes: The un unit of observation is ethnicity. Coefficients are reported with robust standard errors in brackets. ***, ** and * indicate significance at the 1, 5 and 10% levels. Column 1 reports evidence from the *Ethnographic Atlas*; Columns 2-14 report evidence from the *Standard Cross Cultural Sample*. Participation in agriculture is a 1-6 variable describing sex differences in agriculture where 1 indicates that agriculture it mostly male dominated and 6 mostly female dominated. Columns 3-14 are variables coded from 1-5, where 1 is "males exclusively" and 5 "females exclusively".

Women also do less in some other activities performed outside the house, including fuel gathering and burden carrying. Overall, we find that the amount of time women were spending in the fields outside the home is substantially lower in plough societies; in these societies women spent more time in home activities (although the differences are not significant).

## 3. The role of women in current societies and the historic use of the plough

### A. *Data Matching*

In order to look at the long term effect of plough use we need to link historic ethnographic data, measured at the ethnicity level, with our outcomes of interest, measured at the location-level, either countries or districts within countries. Thus we need 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 former 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.[10] Based upon maps and satellite imagery, we create a (roughly) 1 km by 1km (30 arc-second by 30-arc second) raster file covering the globe and for each one we have an estimated population count. 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 illustrate our procedure with the example of Ethiopia. Figure 1a shows a map of the land inhabited by different ethnic groups, i.e. groups speaking different languages. Each polygon represent the approximate borders of a group (from the *Ethnologue*). One should not think of the borders as precisely defined boundaries, but rather as rough measures indicating the approximate locations of different language groups. The map also shows an estimate of the number of individuals living in each cell within the country, from the *Landscan* database. A darker shade indicates more inhabitants.

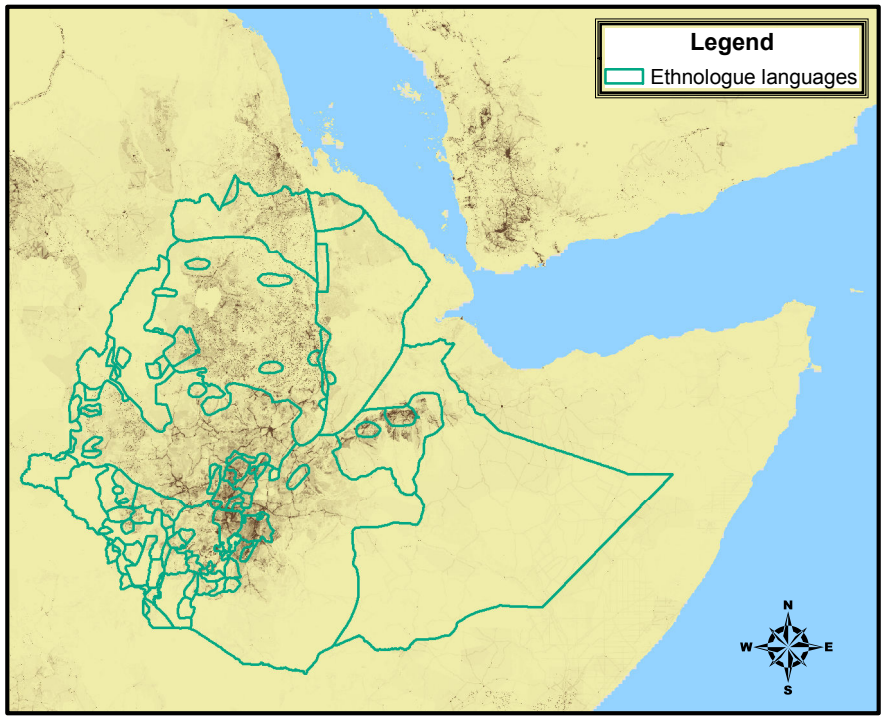
From the *Ethnographic Atlas* we know whether each ethnic group used the plough. Define $I_e^{plough}$ as a variable equal to one if ethnic group $e$ used plough agriculture and zero otherwise. We first match to each of the 7,612 language groups globally, one of the 1,267 ethnic groups for which we have plough-use data. After the matching procedure, we know for each language group whether their ancestor's engaged in plough agriculture. This information is shown in figure 1b.

Combining the *Landscan* population data and the measure of historic plough use among all ethnic groups with information on the location of modern district boundaries we are able to construct district-level averages of the historic plough measure. The procedure is shown visually in figures 2a and 2b. We average over all grid-cells within a district, weighting by total population in a grid-cell. More precisely, let $N_{e,i,d,c}$ denote the number of individuals of ethnicity $e$ living in grid-cell $i$ located in district $d$ in country $c$. We then construct a population-weighted average of $I_e^{plough}$ for all ethnic groups living in a district $d$. The district-level measure of the fraction of the population with ancestors that traditionally used the plough, $\text{Plough}_{d,c}$, is given by:

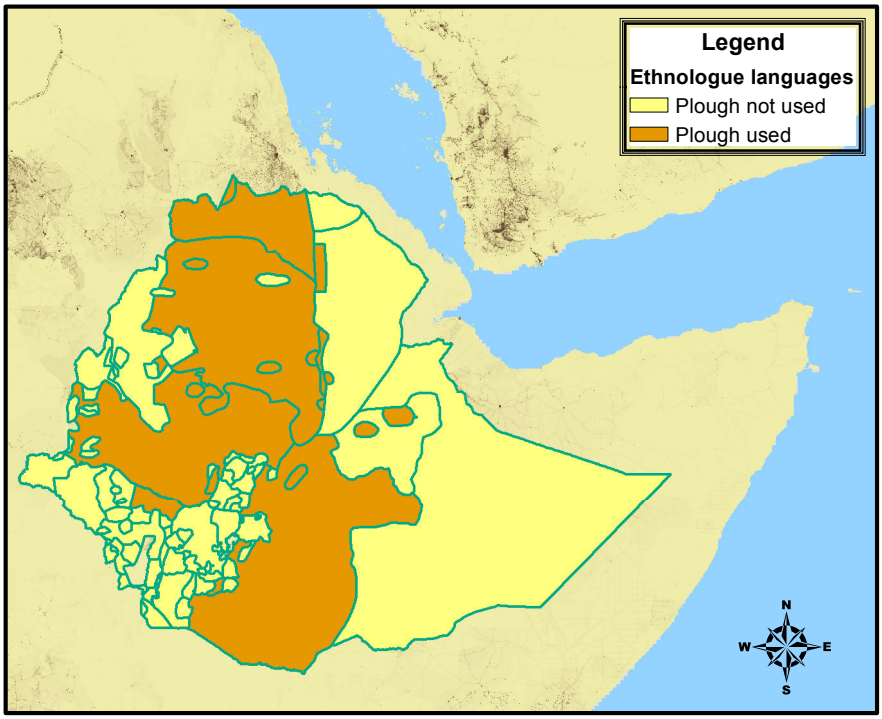
$$\text{Plough}_{d,c} = \sum_e \sum_i \frac{N_{e,i,d,c}}{N_{d,c}} \cdot I_e^{plough} \tag{1}$$

where $N_{d,c}$ is the total number of people living in district $d$ in country $c$. The same procedure is used to construct a country-level measure $\text{Plough}_c$ as well, except that an average is taken over

[10] The *Landscan 2000* database has been produced by Oakridge Laboratories in cooperation with the US Government and NASA.

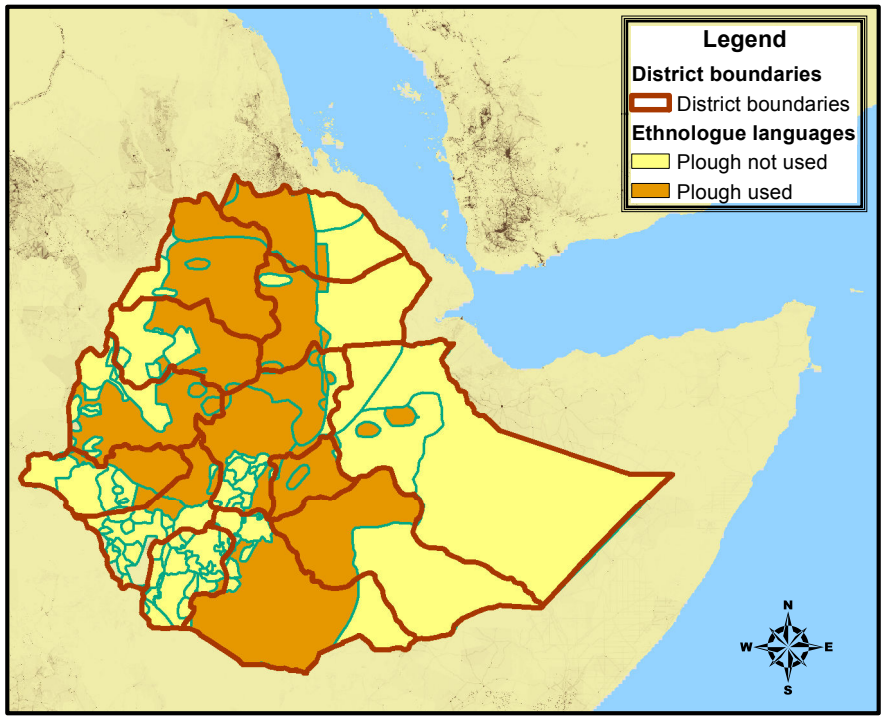



(a) Population density and language groups

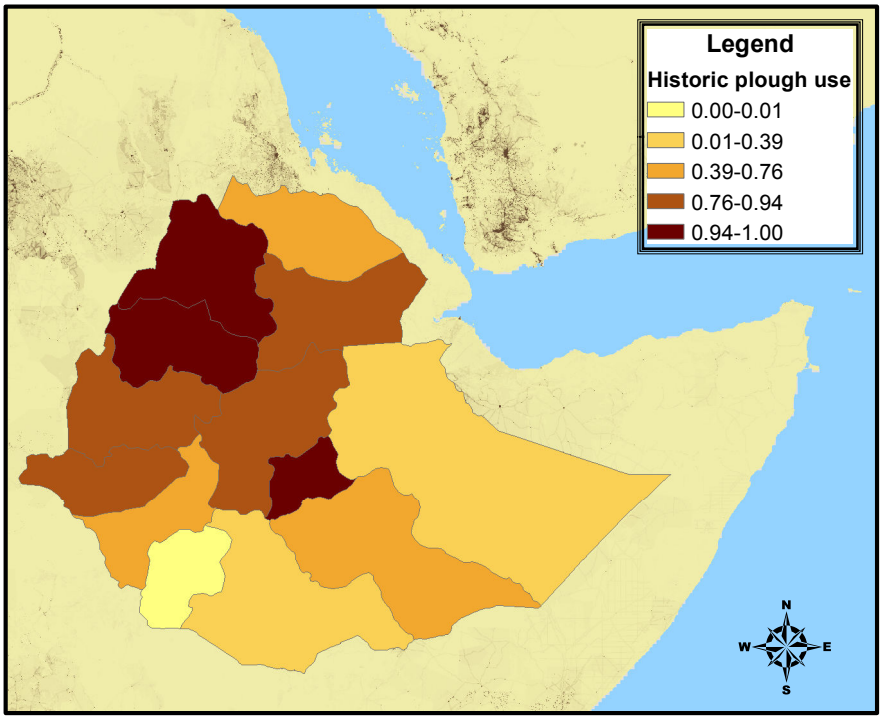



(b) Population density, language groups and their traditional plough use

Figure 1: Populations, language groups, and historic plough-use within Ethiopia.




(a) Population density, language groups their traditional plough use, and districts today




(b) District averages of plough use among inhabitants' ancestors

Figure 2: Traditional plough-use across districts within Ethiopia

all grid-cells in country $c$.

Figure 3a shows the global distribution of languages based on the Ethnologue data, as well as historic plough use for each group. As is clear from the figure, one problem with the Ethnologue data is that the information is missing for some parts of the world, most notably large parts of Latin America and Australia.[11] We undertake three strategies in order to address this issue. The first one and most conservative is to simply ignore the missing languages and calculate country and district measures using the existing data. Our second strategy is to assume that all inhabitants in the unclassified territories speak the national language of the country. Our third strategy is to impute the language of the inhabitants using information on the spatial distribution of ethnic groups from 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.[12]

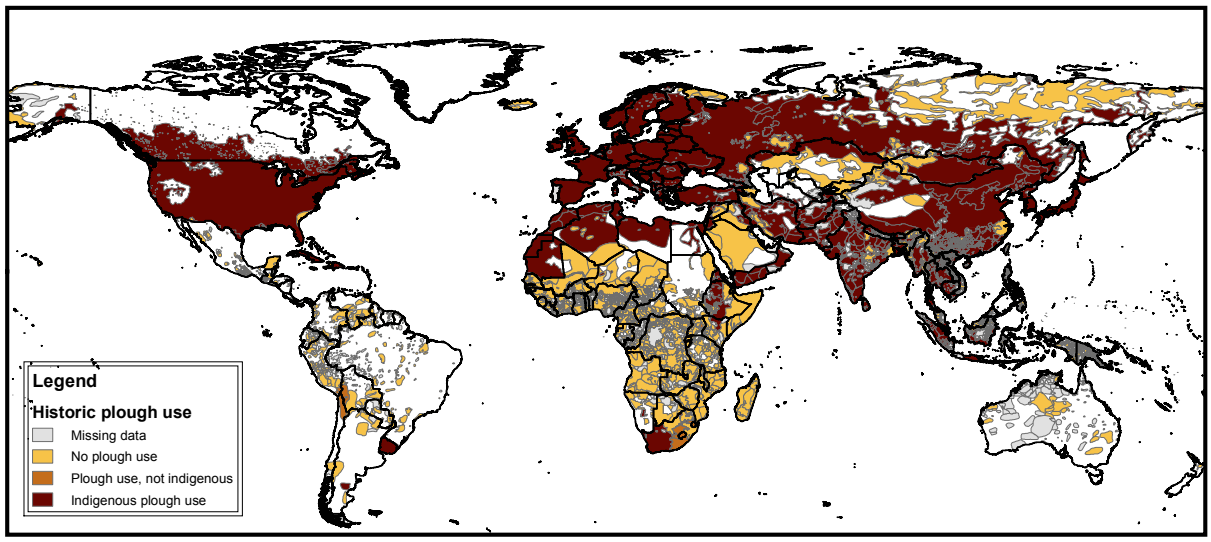
The spatial distribution of historic plough use using each of the two imputation procedures is reported in figures 3b and 3c.

In figures 4a–4c, we report population weighted country-level averages of historic plough use. We report the country-level averages for each of our three procedures to deal with the missing language data.

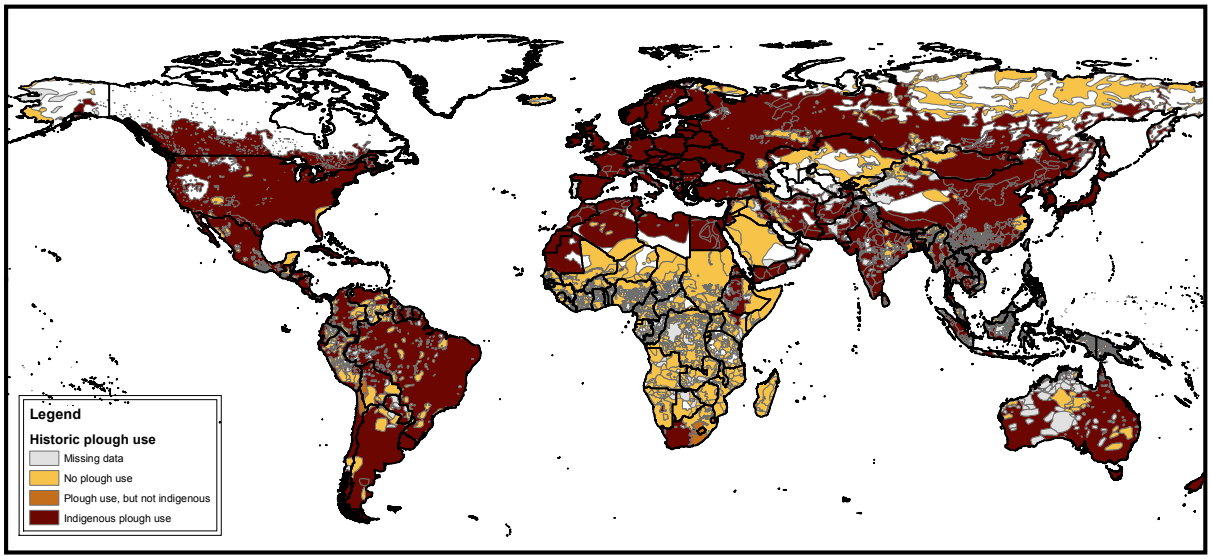
Some general patterns appear no matter which methodology we choose. Groups within sub-Saharan Africa generally did not use the plough. The majority of the European countries used the plough historically, together with some African countries like Eritrea, Ethiopia and the countries of Northern and Southern Africa, as well as a number of Asian countries. Throughout our analysis we use the first procedure to deal with missing data that is to simply exclude them, we also show the robustness of our results when we use the other two variables obtained with the two other procedures described above. The robustness of our result stems from the fact that the three procedures lead to highly correlated measures. The correlations are: (1) 0.89 between

[11] The missing data for Northern Canada, Greenland, and Northern Russia arises because these are locations that are uninhabited.

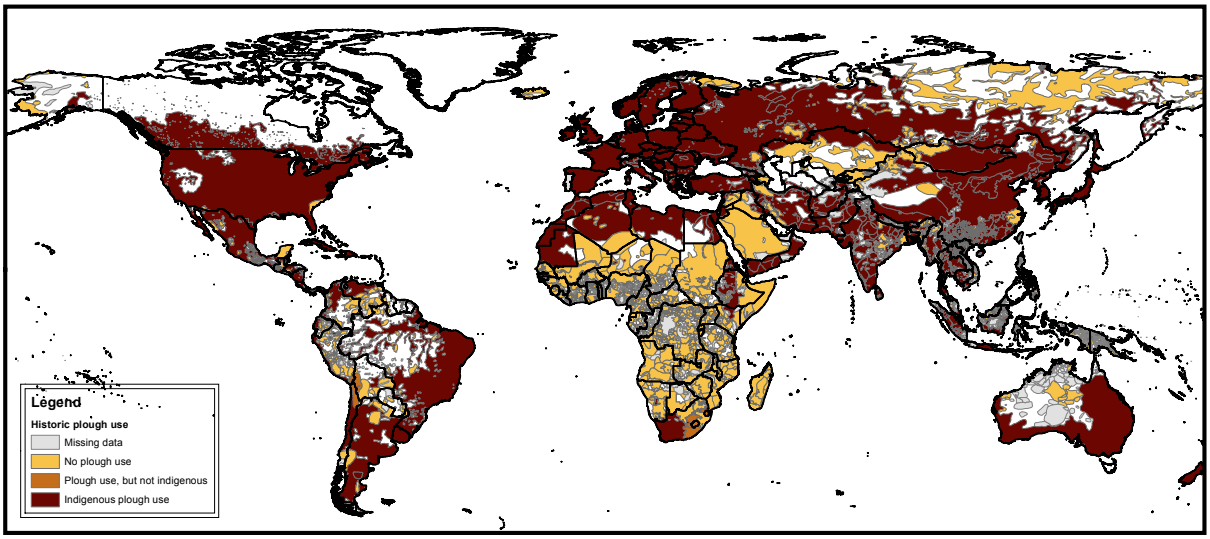
[12] An alternative strategy is to rely only on the coarser GREG classification and map. Our results are robust to this procedure as well.




(a) Missing language information not imputed

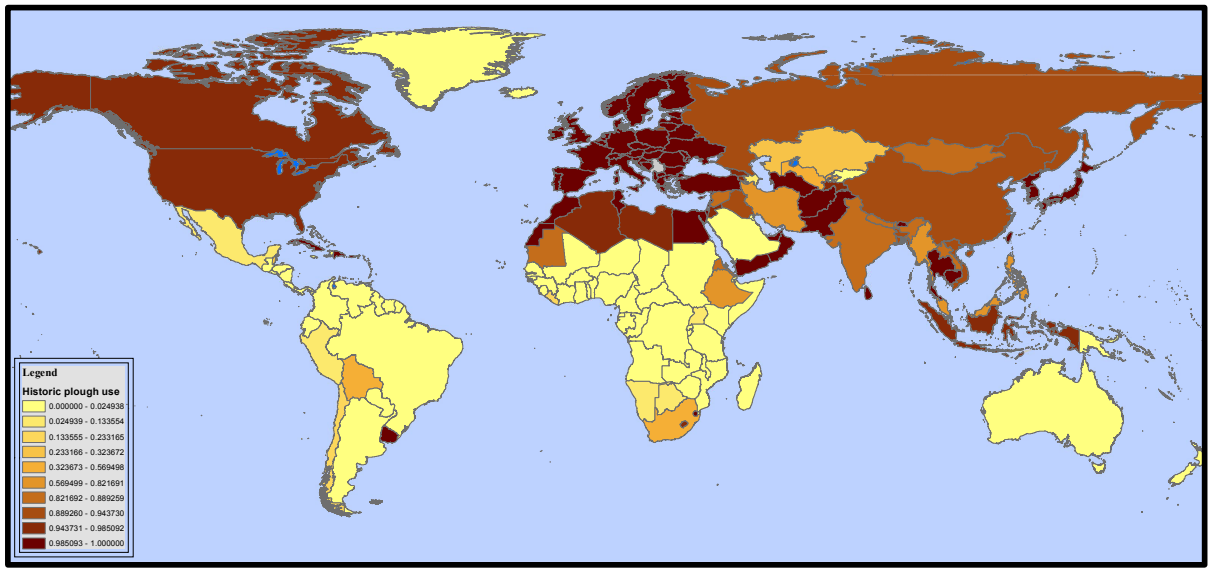



(b) Missing language information imputed using the country's official language

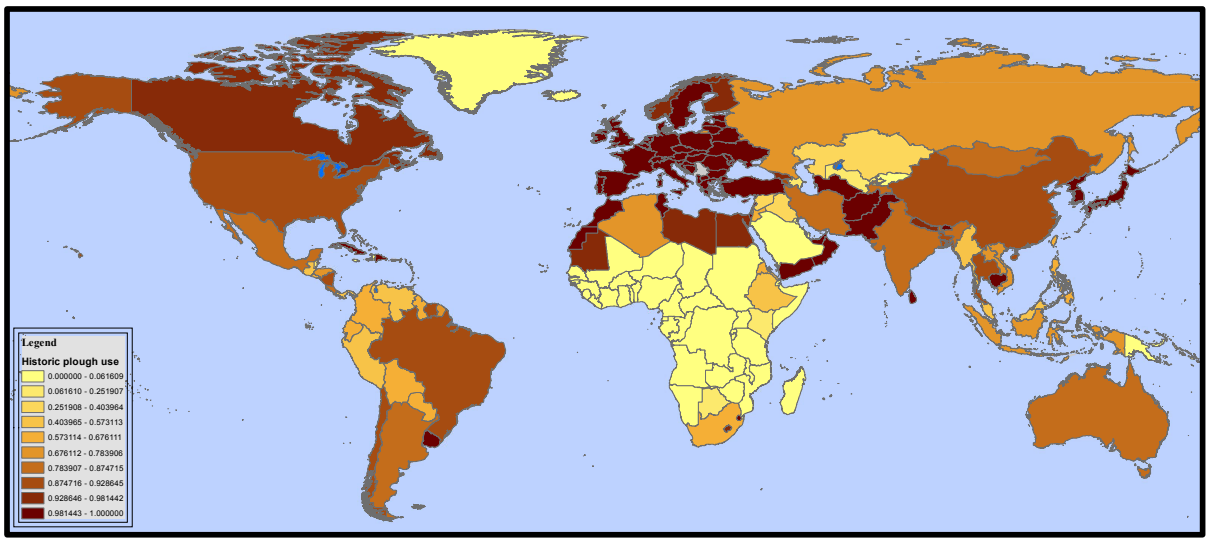



(c) Missing language information imputed using GREG ethnic groups

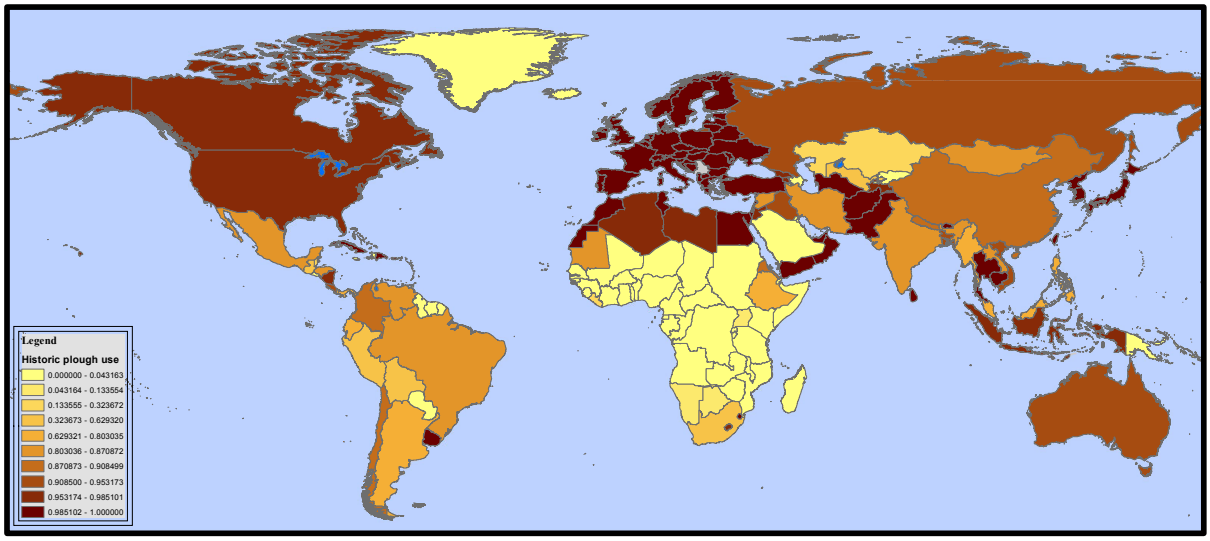
Figure 3: Historic plough use among the ethnic/language groups in the Ethnologue




(a) Missing language information not imputed




(b) Missing language information imputed using the country's official language




(c) Missing language information imputed using GREG ethnic groups

Figure 4: Average historic plough use among the ancestors of each country

the conservative measure and the measure where the missing values are filled with the national languages; (2) 0.91 between the conservative measure and the measure where the missing values are filled using information coming from the GREG database; (3) 0.99 between the measures where the missing values are filled (with national languages and using the GREG database). Descriptive statistics for the three measures are shown in Table A1.

## 4. Country-level OLS estimates

We test our hypothesis by estimating equations of the following form:

$$y_c = \alpha + \beta \, \text{Plough}_c + \mathbf{X^C}_c\mathbf{\Gamma} + \mathbf{X^H}_c\mathbf{\Pi} + \varepsilon_c \tag{2}$$

where $y$ is the outcome of interest, $c$ 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 vectors of current controls and historic ethnographic controls, all measured at the country level. $\mathbf{X^C}_c$ includes the natural log of a country's real per capita GDP measured in 2000, as well as the variable squared. This is important since economic development is known to be associated with higher female labor force participation and the relationship has proven to be non-linear (see Goldin (1995)). We also include an indicator variable that equals one if the country was formerly communist, since these regimes in fact made a policy goal to eliminate gender differences within the family.[13] The historic ethnographic controls included in $\mathbf{X^H}_c$ are 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). We construct these variables in exactly the same manner as we construct the historic plough use variable: using the structure of equation (1), we construct a population weighted country average of the variables in question.

Table 2 reports our estimates. In columns 1 and 2, the dependent variable is a country's female labor force participation rate in 2000. In columns 3–6, we examine women's participation in more narrowly defined occupations, namely entrepreneurship and national politics. In columns 3 and 4, the dependent variable is the share of firms with owners or managers that are female, and in

[13] Alesina and Fuchs-Schundeln (2007) show how the impact of communist regimes on individual beliefs can be long lasting.

column 5 and 6 it is the proportion of seats held by women in national parliaments. The even numbered columns include controls for continent fixed effects, which the odd numbered columns do not. The estimates show that in countries with a tradition of plough-use, women are less likely to participate in the labor market, are less likely to own or manage firms, and are less likely to participate in politics.[14]

The point estimates (using the odd numbered columns) suggest that an increase in one standard deviation in plough use is associated with a reduction of female labor force participation of 7.82 (equivalent to 15% of the sample average of female labor force participation), of 5.23 of the share of firms with some female ownership (16% of the sample average) and a reduction of the participation of women in politics of 2.66 (22% of the sample average).

Columns 7 and 8 report mean effects estimates for the three dependent variables from columns 1–6. The statistic reported is the average effect size (AES) across the three outcome. The significance of the AES is tested against the null hypothesis of no effect, with the estimates derived from a seemingly unrelated regression framework. We computed the AES across outcomes following O'Brien (1984) and Kling, Liebman, Katz and Sanbonmatsu (2004). Letting $\beta^i$ indicate the estimated plough coefficient for outcome variable $i$ and $\sigma^i$ the standard deviation of outome $i$, the average effect size (AES) is equal to $\sum_{i=1}^{N} \frac{\beta^i}{\sigma^i}$. The coefficients $\beta^i$ are jointly estimated in a seemingly unrelated regression framework to obtain the correct covariance matrix.[15] The AES estimates confirm the findings when examining the outcomes individually. Historic plough use is associated with less female participation in activities outside of the home.

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

The magnitudes of our estimates suggest that historic plough use explains a sizable proportion of differences in gender roles across countries. For example, in our specification with female labor force participation as the dependent variable (column 1 of Table 2), the inclusion of the historic

[14]Because of the possibility that the participation of women in government is affected by how democratic the government is, we also control for each country's level of democracy in 2000 when the outcome variable is female participation in politics. The extent of democracy is measured using the 'polity2' measure from the Polity IV database, which is a variable that takes on integer values ranging from $-10$ (high autocratic) to $+10$ (highly democratic).

[15]See Clingingsmith, Khwaja and Kremer (2009) for an alternative application and further details.

Table 2: Country level OLS estimates.

| | Dependent variable: | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Female labor force participation | | Share of firms with some female ownership | | Females in politics | | Average effect size (AES) | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Historic plough use | -16.506*** | -15.417*** | -11.052** | -11.540** | -5.606*** | -4.245* | -0.849*** | -0.796*** |
| | (3.547) | (3.561) | (4.287) | (5.152) | (2.128) | (2.218) | (0.140) | (0.137) |
| *Historic controls:* | | | | | | | | |
| Agricultural suitability | yes | yes | yes | yes | yes | yes | yes | yes |
| Domesticated animals | yes | yes | yes | yes | yes | yes | yes | yes |
| Tropics | yes | yes | yes | yes | yes | yes | yes | yes |
| Political hierarchies | yes | yes | yes | yes | yes | yes | yes | yes |
| Economic complexity | yes | yes | yes | yes | yes | yes | yes | yes |
| *Contemporary controls:* | | | | | | | | |
| ln income, ln income2 | yes | yes | yes | yes | yes | yes | yes | yes |
| Communism indicator | yes | yes | yes | yes | yes | yes | yes | yes |
| Polity2 | no | no | no | no | yes | yes | no | no |
| Continent fixed effects | no | yes | no | yes | no | yes | no | yes |
| Observations | 159 | 159 | 105 | 105 | 125 | 125 | 135[a] | 135[a] |
| R-squared | 0.412 | 0.429 | 0.154 | 0.205 | 0.279 | 0.315 | | |

*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. [a]This is the average number of observations in the regressions for the three outcomes.

plough measure increases the $R$-squared by 0.086, from 0.326 to 0.412. Therefore, traditional plough use accounts for 8.6% of the total variation in FLFP and 12.8% of the residual variation in FLFP that is unaccounted for by our control variables.[16]

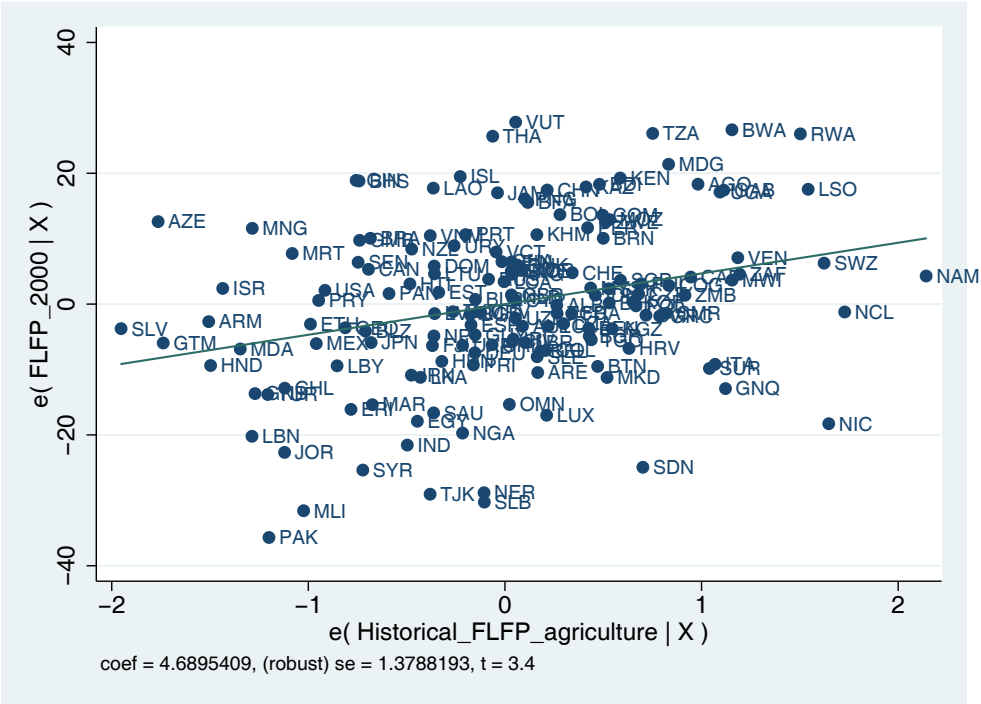
*Current and historic female labor force participation*

To this point, we have shown that (*i*) historic plough use is associated with less female participation in agriculture, and (*ii*) this is persistent so that historic plough use is also associated with less female participation today. These two correlations imply long-term persistence in female involvement outside of the home, historically in agriculture and today in the economy in general.

As a check of the persistence of cross-country differences in the participation of women in the labor market, we regress female labor force participation today on the measure of women's participation in agriculture constructed from the *Ethnographic Atlas*. The regression also controls for our full set of covariates from our estimating equation, described above. The partial correlation plot, showing the relationship between historic female participation in agriculture and FLFP today, is shown in figure 3. As it is apparent from the figure, there is a very strong persis-

[16]This is calculated as: $(.412 - .326)/(1 - .326) = .128$ or 12.8%. Traditional plough use accounts for 5% of the total variation in the share of firms with female ownership (the $R$-squared increases from 0.104 to 0.154) and 6% of the residual variation. For the participation of women in politics, historic plough use explains 3 and 4% of the total and residual variation.

Table 3: Historic female participation in agriculture and current FLFP.




tence between female labor market participation today and female participation in agriculture in historical societies, even after countries went through different stages of development and industrialization processes.

This persistence is far from obvious a priori. In fact, Goldin and Sokoloff (1984) document that within the Northeastern United States, the low relative productivity of women and children in agriculture spurred industrialization and their participation in the manufacturing sector. In their setting, female labor force participation is inversely related to participation in manufacturing and this suggests a lack of continuity of female work outside of the home over time. Our results, however, show that this example does not appear to be the norm. Instead, areas with low female participation in agriculture and plough use – because of the persistence of norms and beliefs today continue to have low levels of female participation in activities outside of the home.

### A. *Alternative hypotheses*

Several other factors have been proposed in cross-cultural studies to explain differences in the status of women in pre-industrial societies.[17] The classical marxist argument poses that the lower

[17]For an overview of competing hypotheses see Whyte (1978).

status of women in pre-industrial societies can be attributed to the emergence of the private property and centralized political institutions. In particular, Engels (1902) claims that prior to the emergence of complex agrarian societies, property was communally owned by matrilineal groups, where women participated equally in the subsistence work and ran the affairs of the extended matrilineal household. With the domestication of plants and animals, and then the intensification of agriculture, the ownership of productive property – land in particular – became increasingly important, as did the male role in farming, who also monopolized private property. The control of private property allowed men to subjugate women and to introduce exclusive paternity over their children. In order to do this, they subverted matriliny and replaced it with patrilineal descent, making their wives dependent upon them and their property. As a result the wife was no longer an active and equal participant in the community life.[18] We account for this potential mechanism by including the following additional controls in our estimating equation: a variable indicating the intensity of agriculture (this variable represents whether the ethnicity had intensive agriculture or intensive irrigated agriculture);[19] an indicator variable for the absence of inheritance of real property;[20] and a measure of matrilocal versus patrilocal post-marital residence rules.[21] Estimation results including these additional controls are reported in columns 1–3 of Table 4. The estimated coefficient for traditional plough use remains unchanged.

An alternative hypothesis is that the status of women in societies is lower if they do not participate to subsistence activities. We account for this potential channel by including a variable that measures the dependence of hunting and animal husbandry as subsistence activity[22] and the

[18]This argument has been criticized on several grounds: private property in the means of production was not only typical of agricultural societies; horticultural and even hunting and gathering societies had mixtures of private property and broader ownership of important forms of productive property; in addition, there is no evidence for a general matrilineal stage in human evolution.

[19]In the original dataset the variable describing the intensity of agriculture can take the following values: no agriculture (1), casual agriculture (2), extensive or shifting agriculture (3), horticulture (4), intensive agriculture (5) and intensive irrigated agriculture (6).

[20]The original *Ethnographic Atlas* question indicating the inheritance distribution for real property is coded as follows: equal or relatively equal (1), exclusively or predominantly to the one adjudged best qualified (2), ultimogeniture (3), primogeniture (4) and absence of inheritance of real property (9).

[21]The original variable in the *Ethnographic Atlas* describes marital residence with kin and is coded as follows: avuncular (1), ambilocal (2), opiionally uxorilocal or avunculocal (3), optionally patrilocal (4), matrilocal (5), neolocal (6), no common residence (7), patrilocal (8), uxorilocal (9) or virilocal (10).

[22]The *Ethnographic Atlas* has two variables describing the dependence of the society on hunting and animal husbandry. Each variable can take the following values: 0-5% dependence (0), 6-15% dependence (1), 16-25% dependence (2), 26-35% dependence (3), 36-45% dependence (4), 46-55% dependence (5), 56-65% dependence (6), 66-75% dependence (7), 76-85% dependence (8), 86-100% dependence (9). Our variable regression is the average of the original *Ethnographic Atlas* variable.

results do not change (see column 4).[23]

Women may also have lower status in cultures with larger extended families compared to cultures with smaller nuclear families. The argument is that larger families typically have a hierarchical rather than egalitarian set of internal relationships and since typically hierarchies tend to be dominated by men, such large families will have women in a more subordinate status compared to smaller families (Engels, 1902, Boserup, 1970, Barry, Bacon and Child, 1957). Another argument stresses competence and not authority: in large families adults of both sexes tend to develop a sharp sexual division of labor (when some members of one sex are absent, others of the same sex can substitute for them). On the contrary, in a nuclear family, with the husband and his wife (or wives), each adult will be willing to substitute for the other since no other adult will be easily available. In this case the wife will be involved in activities ordinarily done by men and, as result, she will be less likely to be dominated by the other sex. To account for this, we use information from the Ethnographic Atlas on the structure of the family and construct two variables that measure the proportion of individuals with ancestors with nuclear and extended families, respectively.[24] As reported in column 5, the importance of the plough remains robust to controlling for different types of family structures.

It is possible that the role of women may also be affected by a society's religion: different denominations could have different views on the role of women in society. We control for this possibility in column 6 by including the current fraction of Catholics, Protestants, other Christians, Muslims, and Hindus in each country. The data are taken from McCleary and Barro (2006) Religion Adherence dataset. Muslims and Hindus typically have much lower female labor force participation, followed by the Catholics. The impact of religion, however, marginally reduces the impact of the plough on female labor force participation.

Some of the variation in plough use across the world is driven by European migration, which may itself have an independent effect on gender norms. To account for this, in column 7, we control for the fraction of each country's population in 2000 whose ancestors came from Europe.

[23]Differences for the status of women in societies could also be explained by different participation of societies in warfare. Whyte (1978) shows that the status of women is higher in culture with constant warfare, making the women having a higher level of domestic authority. Unfortunately we cannot specifically test for this hypothesis, since the Ethnographic Atlas does not have a variable on how often the different ethnicities were involved in warfare.

[24]The original variable in the *Ethnographic Atlas* describing family structures are defined as follows is coded as follows: independent nuclear family, monogamous (1), independent nuclear family, occasional polygyny (2), independent polyandrous families (3), polygynous with unusual co-wives pattern (4), polygynous with usual co-wife pattern (5), minimal (stem) extended families (6), small extended families (7), large extended families (8). We define a dummy for nuclear families and one for extended families; polyandrous or polygynous societies are the extended groups.

Table 4: Robustness of OLS estimates to alternative controls.

| | Dependent variable: FLFP | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Historic plough use | -14.734*** | -16.814*** | -17.073*** | -15.417*** | -14.570*** |
| | (4.856) | (3.769) | (3.568) | (3.692) | (3.568) |
| Intensity of agriculture | yes | | | | |
| Absence of private property | | yes | | | |
| Patrilocal and matrilocal societies | | | yes | | |
| Hunting and herding of large animals | | | | yes | |
| Nuclear and extended families | | | | | yes |
| Baseline historic and contemporary controls | yes | yes | yes | yes | yes |
| Observations | 159 | 156 | 159 | 159 | 159 |
| R-squared | 0.41 | 0.41 | 0.42 | 0.43 | 0.46 |
| | (6) | (7) | (8) | (9) | (10) |
| Historic plough use | -12.041*** | -15.375*** | -16.435*** | -15.767*** | -18.474*** |
| | (3.967) | (3.844) | (3.536) | (3.538) | (4.112) |
| Fraction of major religious denomin. | yes | | | | |
| Fraction of European descent | | yes | | | |
| Oil production | | | yes | | |
| Trade/GDP | | | | yes | |
| Agric., manuf. and services share of GDP | | | | | yes |
| Baseline historic and contemporary controls | yes | yes | yes | yes | yes |
| Observations | 157 | 157 | 159 | 157 | 151 |
| R-squared | 0.57 | 0.43 | 0.42 | 0.42 | 0.42 |

*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.

The measure is taken from Nunn and Puga (2011), who calculate the variable using Weil and Putterman's (2010) World Migration Matrix.

In recent work, Ross (2008) argues that differences in the treatment of women globally, and in the Middle East in particular, can be explained by differences in oil reserves. Oil causes an increase in the strength of the domestic currency, which makes exports less competitive and causes a decline in light manufacturing which is particularly well-suited for female employment. In columns 8 and 9, we account for this possible determinant by controlling for per capita oil production in 2000 (the data are from BP Oil), and the trade-to-GDP ratio in 2000, taken from the World Development Indicators.

Lastly, in column 10, we control for a country's economic structure, which may impact the demand and return to female employment outside of the home. We control for the share of agriculture, manufacturing and services over GDP. Controlling for the economic structure of a country makes the impact of the plough on female labor force participation even stronger.

The estimated impact of the plough remains remarkably stable across the different specifica-

tions. The coefficient is always negative and statistically significant. The point estimate remains reasonably stable, ranging from $-0.12$ to $-0.18$.[25]

## 5. Instrumental variable estimation

The core concerns of our OLS strategy are selection and omitted variables bias. For example, locations that historically had attitudes prone to less equal gender roles may have been more likely to invent or adopt the plough (in this case our OLS estimates would be biased away from zero). On the other hand, locations that were economically more developed were more likely to adopt the plough. Today these areas are richer and more prone to attitudes about gender role equality (this effect should bias our OLS towards zero). To take care of these concerns we already controlled in the previous section for a very large set of observable characteristics of the historical ethnicities. In this section, we perform an instrumental variable strategy.

### A. *Description and construction of the instruments*

Our IV strategy exploits a determinant of historic plough use that has been emphasized in the anthropological literature. This is the geo-climate environment which determined the type of crops that could grow in different locations (Pryor, 1985). Because the use of the plough involves a trade-off between larger up-front fixed costs, but an ability to cultivate large amounts of land over a short period of time, the benefit of the plough is greater for crops that have short cultivation periods (even multiple cropping per year) and require large amounts of land for a fixed yield of calories. Based upon these criteria Pryor (1985) has classified crops into those whose cultivation benefits greatly from the adoption of the plough – called plough positive – and those whose cultivation benefits less – called plough-negative. 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. Example of plough-positive crops include wheat, teff, barley and rye. Examples of plough-negative crops include sorghum, maize, millet, roots and tubers, and tree crops (Pryor, 1985, p. 732). In his study, Pryor shows that indeed the historic cultivation of plough positive crops is positively correlated with the actual adoption of the plough.

[25]The other two outcomes variables, the share of firms with female ownership and the participation of women in politics, are also robust to the inclusion of all these controls. The inclusion of continent fixed effects also does not change the results.

Our IV strategy uses the geo-climatic conditions of an ethnic group's historic location for cultivating plough-positive and plough-negative crops as instruments for the historic adoption of the plough, while controlling for a location's 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. In other words, the plough-positive and plough-negative crops distinction only matters for long-term gender roles through the historic adoption of the plough.

We obtain information on the geo-climatic environment for cultivating plough-positive and plough-negative crops from the FAO's *Global Agro-Ecological Zones* (GAEZ) 2002 database (Fischer, van Nelthuizen, Shah and Nachtergaele, 2002). The database reports the suitability for the cultivation of over 25 different crops of grid-cells 5 arc minutes by 5 arc-minutes for the world. The FAO measures are constructed from a host of data on the geo-climatic conditions of a location: precipitation, frequency of wet days, mean temperature, daily temperature range, vapor pressure, cloud cover, sunshine, ground-frost frequency, wind speed, soil slope, and soil characteristics. These data are then combined with the specific growing requirements of crops to produce a measure of whether the crop could be grown in that location, and if so, how productively. It is important to note that the climate models are very sophisticated and therefore the crop suitability measures are not simply functions of the geographic characteristics the models use. In addition, the measures are objectively calculated, and not affected by where crops are actually cultivated.[26]

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, barley and rye to those more suitable for growing sorghum and millet. An additional benefit of the crops is that they are all crops that have been grown in the Old World for millennia. The results also including New World crops are similar.[27]

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

[26]For a detailed discussion of the data and a different application see Nunn and Qian (2011).

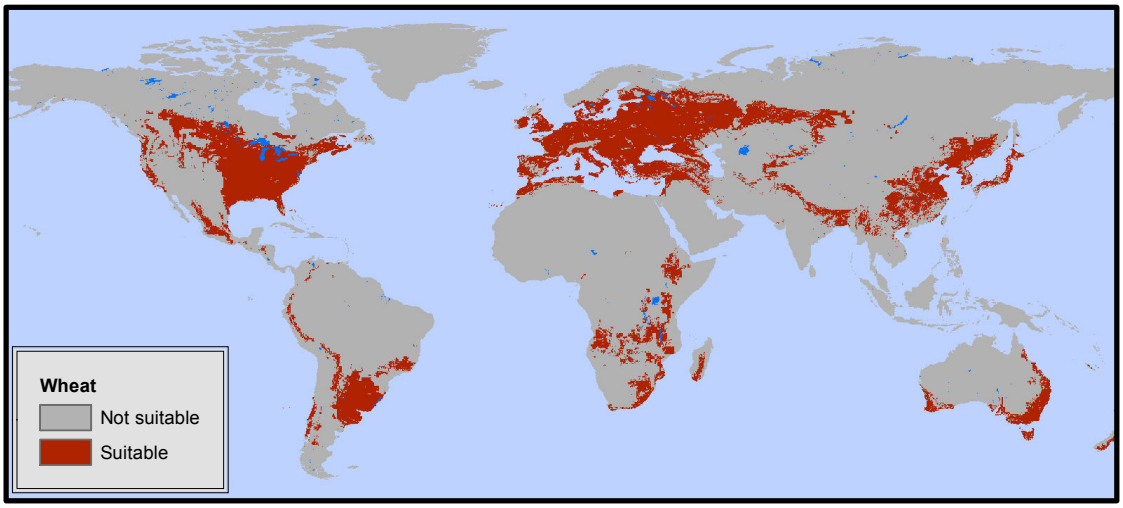
[27]Because our instruments only include Old World crops, the IV estimates must be interpreted as a local average treatment effect amongst Old World societies since the instruments should not affect plough adoption for New World societies.

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 $x_e^w$, $x_e^b$, $x_e^r$, $x_e^s$, and $x_e^m$ be the amount of land that can cultivate wheat, barley, rye, sorghum and millet, respectively. Further, let $x^{all}$ be the amount of land that could grow any crop (i.e., the amount of arable land). We then construct ethnicity-level instruments. The plough positive instrument is $Area_e^{pos} = \frac{1}{3}(x_e^w + x_e^b + x_e^r)/x_e^{all}$, and the plough-negative instrument is $Area_e^{neg} = \frac{1}{2}(x_e^s + x_e^m)/x_e^{all}$.

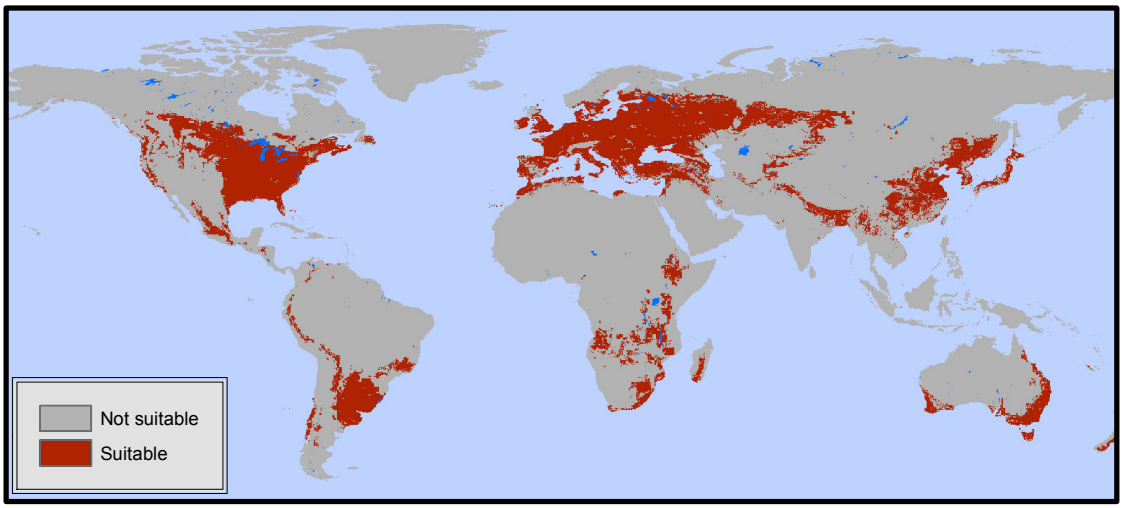
Using the same procedure as shown in equation (1), we construct district and country level plough-positive and plough-negative instruments. Intuitively, the instruments measure the proportion of a country or district's population whose ancestor had a climate that could grow plough-positive cereals (wheat,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

Figure 5 shows the locations in the world that are classified as being suitable for the cultivation of the plough positive wheat, barley and rye, while figure 6 shows suitability for the plough negative millet and sorghum. 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. In addition, 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 climate 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 include in our regressions 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.[28]

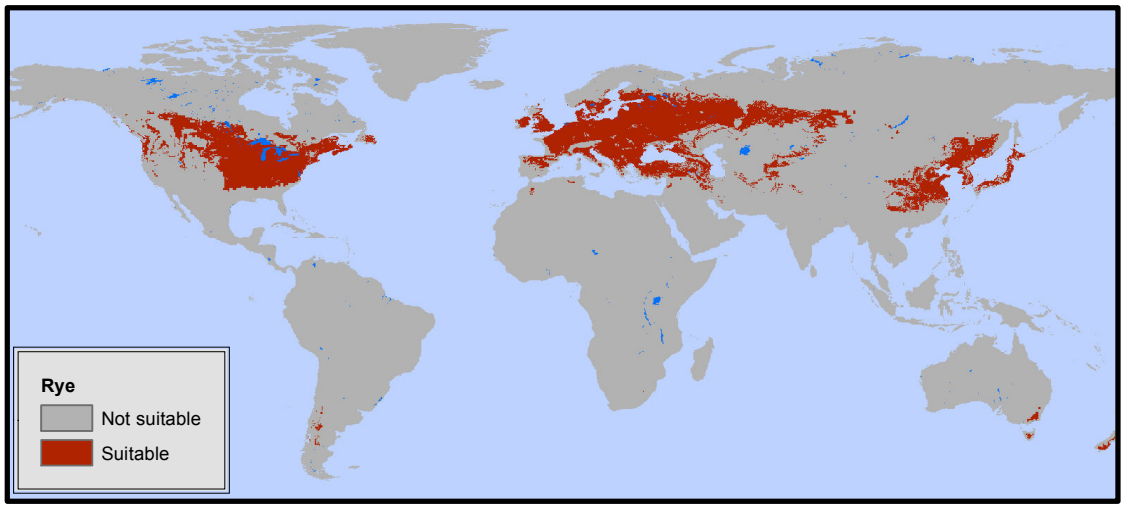
[28]Hans Bobek (1962) focuses on natural endowments and geographic characteristics that are associated with plough adoption, such as the availability of large domesticated animals, as well as land that is not too steep, rocky, swampy, frozen or obstructed by vegetation. Other determinants, which has been emphasized by Boserup (1970), is population density.




(a) Wheat suitability

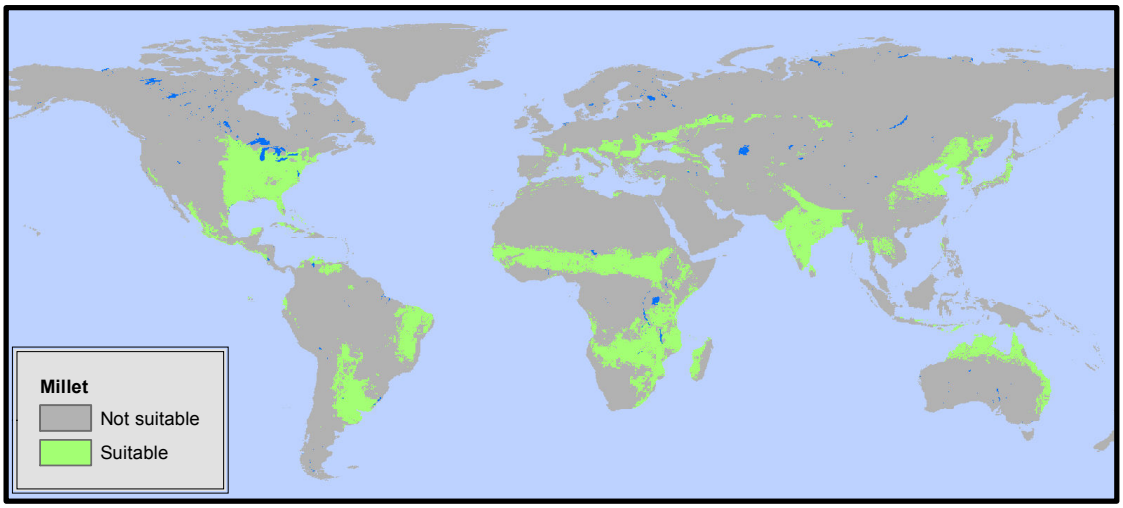



(b) Barley suitability

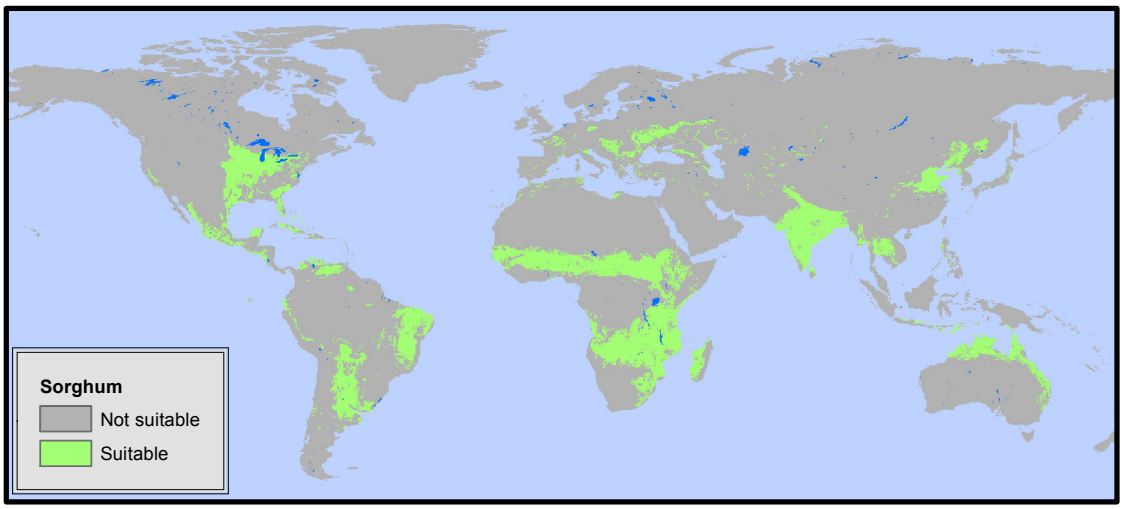



(c) Rye suitability

Figure 5: Maps displaying the global suitability of plough-positive crops, wheat, barley and rye.




(a) Millet suitability




(b) Sorghum suitability

Figure 6: Maps displaying the global suitability of plough-negative crops, millet and sorghum.

**B.** ***Country-level IV estimates***

Table 5 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 all three specifications, the Hausman test cannot reject the consistency of the OLS estimates.

The test for joint significance of the two instruments is also reported in the table. In two of the three specifications, the $F$-statistic is above ten, which suggests that weak instruments are not a significant problem. However, we also report the conditional likelihood ratio (CLR) confidence intervals for the plough coefficients and estimate the effects of the plough on our outcomes of interest using the LIML estimator, which is more robust to weak instruments than 2SLS.[29]

The IV estimates confirm the OLS estimates. Historic plough use is associated with less female participation in non-household activities, and attitudes of gender inequality. 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 advanced today with higher per capita incomes and 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.

Similarly to the OLS, the last two columns of Table 5 report AES estimates.[30] The AES estimates are similar to the individual components: a history of plough use is associated with less female

[29]CLR have been used to overcome the distortions of standard tests by adjusting the critical values for hypothesis tests from sample to sample so that, for given data, the critical values used yield a correct significance level because they are conditioned on that data. This method has come to be the test of choice in over-identified instrumental variable applications when the instruments are weak and there is a single endogenous variable (Andrews, Moreira and Stock, 2005, 2006)).

[30]Similarly to the OLS specification, the AES for the instrumental variable regressions averages the normalized treatment effects obtained by a seemingly unrelated regression in which we stack the three outcomes and use the treatment effects regression fully interacted with dummy variables for each outcome as the right-hand side.

Table 5: Country level IV estimates.

| | Panel A. Second stage. Dependent variable: | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Femal labor force participation | | Share of firms with some female ownership | | Females in politics | | Average effect size (AES) | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Historic plough use (2SLS) | -25.853** | -26.423** | -19.939* | -26.274* | -16.820* | -23.089* | -1.451*** | -1.946*** |
| | (10.051) | (12.465) | (11.932) | (14.439) | (9.243) | (12.331) | (0.467) | (0.635) |
| Historic plough use (LIML) | -27.099 | -28.25 | -28.761 | -43.12 | -16.826 | -23.16 | | |
| p-value | 0.01 | 0.03 | 0.03 | 0.02 | 0.05 | 0.03 | | |
| CLR intervals | [-54.88, - | [-66.24, -3.47] | [-71.65, - | [-142.60, -6.77] | [-47.06, 0.29] | [-75.07, -2.55] | | |
| *Historic controls:* | | | | | | | | |
| Agricultural suitability | yes | yes | yes | yes | yes | yes | yes | yes |
| Domesticated animals | yes | yes | yes | yes | yes | yes | yes | yes |
| Tropics | yes | yes | yes | yes | yes | yes | yes | yes |
| Political hierarchies | yes | yes | yes | yes | yes | yes | yes | yes |
| Economic complexity | yes | yes | yes | yes | yes | yes | yes | yes |
| *Contemporary controls:* | | | | | | | | |
| ln income, ln income2 | yes | yes | yes | yes | yes | yes | yes | yes |
| Communism indicator | yes | yes | yes | yes | yes | yes | yes | yes |
| Polity 2 | no | no | no | no | yes | yes | no | no |
| Continent FEs | no | yes | no | yes | no | yes | no | yes |
| Observations | 157 | 157 | 104 | 104 | 124 | 124 | 133 | 133 |
| R-squared | 0.393 | 0.427 | 0.014 | 0.128 | 0.167 | 0.045 | | |
| | Panel B. First stage. Dep var: Historic plough use | | | | | | | |
| Plough-positive environment | .412*** | .377*** | .656*** | .561*** | .401*** | .340*** | | |
| | (.119) | (0.101) | (.150) | (0.143) | (.140) | (.117) | | |
| Plough-negative environment | -.120 | -.079 | -.017 | .001 | -.032 | -.026 | | |
| | (.091) | (.075) | (.101) | (.075) | (.103) | (.087) | | |
| Equal coeff (p-value) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | | |
| *F*-stat (excl instr) | 10.76 | 7.90 | 11.68 | 7.71 | 5.63 | 4.54 | | |
| Hausman test (p-value) | 0.15 | 0.19 | 0.44 | 0.29 | 0.18 | 0.09 | | |

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

Table 6: Robustness of IV estimates to additional geographic controls.

| | Dependent variable: FLFP | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Historic plough use | -33.573*** | -25.539** | -27.842*** | -18.427** | -25.089*** |
| | (11.777) | (10.371) | (8.841) | (9.068) | (9.300) |
| Terrain slope | yes | | | | yes |
| Soil depth | | yes | | | yes |
| Average temperature | | | yes | | yes |
| Average precipitation | | | | yes | yes |
| Baseline historic and contemporary controls | yes | yes | yes | yes | yes |
| Observations | 157 | 154 | 157 | 157 | 157 |
| R-squared | 0.29 | 0.38 | 0.38 | 0.38 | 0.44 |

*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.

participation in public sphere activities outside the home. As for the single component, the coefficient is larger than the OLS estimates.

### C. *Robustness checks*

There are a number of potential concerns associated with our IV strategy. Environments relatively more suitable to 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. It is possible that the difference between plough-positive and plough-negative environments may be correlated with certain geographic features that affect gender attitudes today through other channels besides the plough. We check the likelihood of this concern by linearly controlling for a host of geographic characteristics that are likely correlated with the suitability of the environment for plough positive and plough negative crops. IV estimates with these additional geographic controls are reported in Table 6. We control for the terrain slope, soil depth, average temperature and average precipitation of ancestors' locations. (The details of these controls, including their sources are provided in the appendix.) The IV estimates remain robust to the inclusion of these additional factors.

We also check the robustness of our IV estimates to the set of additional controls from Table 4. These estimates, which are reported in Table 7, show that the IV estimate of the impact of the plough on female labor force participation remains robust to these additional controls.[31]

[31] We repeat all the robustness checks with the other two outcome variables and the results, available from the authors, also hold.

Table 7: Robustness of IV estimates to alternative controls.

| | Second stage IV estimates: Dependent variable: FLFP | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Historic plough use | -42.454* | -25.563** | -28.014*** | -25.332*** | -28.969*** |
| | (22.737) | (10.317) | (10.584) | (9.250) | (10.861) |
| Intensity of agriculture | yes | | | | |
| Absence of private property | | yes | | | |
| Patrilocal and matrilocal societies | | | yes | | |
| Hunting and herding of large animals | | | | yes | |
| Nuclear and extended families | | | | | yes |
| Baseline historic and contemporary controls | yes | yes | yes | yes | yes |
| Observations | 157 | 154 | 157 | 157 | 157 |
| R-squared | 0.27 | 0.41 | 0.38 | 0.40 | 0.38 |
| | (6) | (7) | (8) | (9) | (10) |
| Historic plough use | -18.269** | -21.806* | -25.974*** | -25.606** | -25.362** |
| | (9.003) | (11.188) | (10.014) | (9.303) | (9.930) |
| Fraction of major religious denomin. | yes | | | | |
| Fraction of European descent | | yes | | | |
| Oil production | | | yes | | |
| Trade/GDP | | | | yes | |
| Agric., manuf. and services share of GDP | | | | | yes |
| Baseline historic and contemporary controls | yes | yes | yes | yes | yes |
| Observations | 155 | 148 | 157 | 156 | 149 |
| R-squared | 0.55 | 0.44 | 0.40 | 0.40 | 0.43 |

*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.

An important final point arises from the fact that the plough-positive and plough-negative cereals used in the construction of 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 indigenous populations of the Americas that 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.

For many countries the composition of the historical aboriginal population for which we have information in the *Ethnographic Atlas* is very different than the composition of the current population (this is the case for Australia, New Zealand, Canada and the US), for some others (Australia, New Zealand, Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Venezuela) the geographical area for which the match between the *Ethnographic Atlas* and the *Ethnologue* is possible is fairly small, as a result with the most conservative matching strategy the country average could be just representative of a tiny fraction of the population. An example in which different matching techniques produce very different numbers for plough use is Brazil. When we calculate the plough measure using only non-missing Ethnologue information the plough measure is close to zero; imputing using GREG ethnic groups the measure is 85%; and assuming all individuals with missing language data are 'Portuguese' the measure is 84 per cent. Finally Europe is all plough positive and does not provide any source of variation. To address the above mentioned biases we run two additional specifications: one in which we exclude from the sample Australia, New Zealand, Canada, the US and Europe, and the other in which we exclude form the sample Australia, New Zealand, Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru and Venezuela. The results are qualitatively identical with the smaller samples. The results are reported in Appendix Tables A2 and A3.

We also test the robustness of our results to the two different plough measures constructed

imputing missing language data using either the national language of the country or the ethnic group as defined by the GREG database. The results using the alternative plough measures are reported in Appendix Tables A4 and A5. The results are qualitatively identical when the alternative measures are used.

Finally, we use the distinction provided in the *Ethnographic Atlas* between whether the plough was indigenous or adopted following European contact. Both as a robustness check and as a preliminary examination of mechanisms, we estimate the impact of plough use, distinguishing between aboriginal existence and adoption after European contact. Given that it may take time for plough-use to affect the culture and norms of a society, there may be stronger and more robust impacts of having indigenous plough use, relative to plough use that was only adopted after European contact.

The estimates are reported in Table 8. We find the effect of non-indigenous plough use to be less robust, and typically smaller in magnitude, relative to indigenous plough use. With the exception of the share of firms with female ownership, we find that while having the plough aboriginal prior to contact has a significant effect on our outcomes of interest, the non aboriginal plough is typically not significant and with a much smaller effect.

## 6. Individual level estimates

We now turn to individual level regressions using data from the *World Value Survey* (WVS), a compilation of national individual-level surveys on a wide variety of topics and carried out five times.[32] 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. In our analysis, we use the four most recent waves of the *World Values Survey*, 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 examine the relationship between historic plough use and female labor force participation. We code a woman as being in the labor force if she reports that she is employed full-time,

[32]The five waves of the WVS were carried out in the following years: 1981-1984, 1990-1993, 1995-1997, 1999-2004 and 2005–2007.

Table 8: Differential impacts of the plough by length of use.

| | Dependent variable: | | |
|---|---|---|---|
| | FLFP | Share of firms with some female ownership | Females in politics |
| | (1) | (2) | (3) |
| Historic plough use | -17.292*** | -10.890** | -5.679*** |
| (aboriginal) | (3.537) | (4.412) | (2.162) |
| Historic plough use | 0.268 | -14.036** | -3.451 |
| (not aboriginal) | (6.404) | (5.436) | (4.502) |
| *Historic controls:* | | | |
| Agricultural suitability | yes | yes | yes |
| Domesticated animals | yes | yes | yes |
| Tropics | yes | yes | yes |
| Political hierarchies | yes | yes | yes |
| Economic complexity | yes | yes | yes |
| *Contemporary controls:* | | | |
| ln income, ln income2 | yes | yes | yes |
| Communism indicator | yes | yes | yes |
| Polity 2 | no | no | yes |
| Observations | 159 | 105 | 125 |
| R-squared | 0.428 | 0.155 | 0.28 |

*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.

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.[33]

One benefit of using the WVS is that we can control for individual characteristics in the female labor force regression, in addition the survey provides information on individuals attitudes about the role of women in society. 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 agree, disagree, neither or don't know. We drop the observations in which the respondents answered 'neither' or 'don't know', and code 'disagree' as 0 and 'agree' as 1. In the second question, respondents are given the following statement "On the whole, men make better political leaders than women do", and asked to choose between 'strongly disagree', 'disagree', 'agree', 'agree strongly', or 'don't know'. We omit observations in which the respondent answered 'don't know' and create a variable that takes on the value of 1 for 'strongly agree', 2 for 'disagree', 3 for 'agree' and 4 for 'agree strongly'. Both of the constructed variables are increasing in reported

[33]The results remain the same when we exclude retired women and students from the sample.

Table 9: Individual-level OLS estimates.

| | Dependent variables: | | | |
|---|---|---|---|---|
| | FLFP | When jobs are scarse | Men better political leaders | Average effect size (AES) |
| | (1) | (2) | (3) | (4) |
| Historic plough use | -0.214*** | 0.245*** | 0.397*** | 0.451*** |
| | (0.034) | (0.029) | (0.075) | (0.063) |
| Individual controls | yes | yes | yes | yes |
| Current country controls | yes | yes | yes | yes |
| Historic district controls | yes | yes | yes | yes |
| Continent FE | yes | yes | yes | yes |
| Observations | 38,832 | 71,656 | 59,288 | 65,472 |
| R-squared | 0.186 | 0.209 | 0.178 | |

Notes: The table reports OLS estimates, with standard errors clustered at the country level. 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. The AES reported in column 4 is for the two subjective belief measures from columns 2 and 3. ***, ** and * indicate significance at the 1, 5 and 10% levels.

attitudes that favor gender inequality.

The individual-level estimating equation is given by

$$y_{i,d,c} = \alpha_{r(c)} + \beta \, \text{Plough}_d + \mathbf{X^C}_c \mathbf{\Gamma} + \mathbf{X^H}_d \mathbf{\Pi} + \mathbf{X^C}_i \mathbf{\Phi} + \varepsilon_{i,d,c} \tag{3}$$

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 (2), and $\mathbf{X^H}_d$ includes the same historic ethnographic variables as in equation (2), but measured at the district level. $\mathbf{X^C}_i$ denotes current individual-level controls: age, age squared, as well as fixed effects for marital 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.

Tables 9 and 10 reports the OLS and IV estimates of equation (3). Both sets of estimates find a negative relationship between historic plough use and female labor force participation today, and a positive relationship between historic plough use and attitudes about gender inequality today. In terms of the magnitude of the effects, they are, at least for female labor force participation, similar to the cross-country evidence. An increase in one standard deviation in the use of the plough implies a reduction in female labor force participation of 0.09 (which is roughly equal

Table 10: Individual-level IV estimates.

| | Panel A. Second stage. Dependent variable: | | | |
|---|---|---|---|---|
| | FLFP | When jobs are scarce | Men better political leaders | Average effect size (AES) |
| | (1) | (2) | (3) | (4) |
| Historic plough use | -0.585** | 0.576** | 1.383*** | 1.328*** |
| | (0.242) | (0.229) | (0.362) | (0.386) |
| Historic plough use (LIML) | -0.611 | 0.576 | 1.418 | |
| p-value | 0.00 | 0.00 | 0.00 | |
| CLR intervals | [-0.700, -0.524] | [0.501, 0.652] | [1.308, 1.531] | |
| Individual controls | yes | yes | yes | yes |
| Current country controls | yes | yes | yes | yes |
| Historic district controls | yes | yes | yes | yes |
| Continent FE | yes | yes | yes | yes |
| Observations | 36,370 | 67,347 | 55,454 | 61,400 |
| R-squared | 0.154 | 0.170 | 0.105 | |
| | Panel B. First stage. Dependent variable: Historic plough use. | | | |
| Plough-positive environment | 0.273*** | 0.242*** | 0.338*** | |
| | (0.073) | (0.079) | (0.088) | |
| Plough-negative environment | -0.075* | -0.041 | -0.094* | |
| | (0.044) | (0.040) | (0.055) | |
| Equal coeff (p-value) | 0.00 | 0.00 | 0.00 | |
| *F*-stat (excl instr) | 7.13 | 4.74 | 7.29 | |
| Hausman test (p-value) | 0.00 | 0.03 | 0.00 | |

Notes: The table reports IV estimates, with standard errors clustered at the country level. The instruments are plough-positive climate and plough-negative climate. 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. The AES reported in column 4 is for the two subjective belief measures from columns 2 and 3. ***, ** and * indicate significance at the 1, 5 and 10% levels.

to 16% of the sample average of this variable) and an increase in attitudes about gender role inequality of 0.10 and 0.21 (21% and 8% of the sample average of "when job scarce" and "men political leaders" variables).

The magnitude of the IV estimates are typically about twice the magnitude of the OLS estimates (with the exception of the attitude on men political leader, for which the effect is even higher). Since the first stage *F*- statistics are often below 10, we also report the conditional likelihood ratio (CLR) confidence intervals as well as LIML point estimates.

Similarly to the cross country regressions, we also calculate AES across the two attitudes questions. By simultaneously considering the two related atittude questions in an index, we substantially reduce the possibility that the results on each individual attitude component could potentially be due to chance (type I error); in addition, the risk of low statistical power is also mitigated (type II error). Both OLS and IV confirm the results obtained by running single attitudes regressions.

## 7. 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 institutions which are more or less conducive to the participation of women in market activities. In order 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 environment, since they are all located in the same country.

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 among second generation female immigrants. We use the parent's country-of-birth to identify each respondent's country of origin. Doing this results in three different specifications that use different definitions for heritage: the mother's country of birth, the father's country of birth, and both parents country of birth when they are the same. The different definitions provides evidence for whether cultural transmission is stronger from the father to the daughter, the mother to the daughter, or when both occur.

We run the following estimating equation:

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

where $i$ denotes second generation women currently living in a US state $s$, whose country of origin is country $c$. As in equation (2), $\text{Plough}_c$ denotes the historic plough-use of those in country $c$. $\mathbf{X^C}_c$ and $\mathbf{X^H}_c$ denote the same vectors of controls from equation (2), which include current and historic ethnographic controls. $\mathbf{X}_i$ indicates a vector of individual level controls, which includes dummies for education, a quadratic for age, real personal income, marital status and fixed effects for the year the individual was surveyed, the state of residence and whether the person lives in a metropolitan or rural area. 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 (4) using two different samples: all women and married women. When we estimate our regressions only for married women, we can control for the characteristics of the husbands since these may play an important role in the decision of the wife to enter the labor market. In particular, we control for a quadratic in the husband's age, the husband's education, and his income.

The OLS and IV estimates, which are reported in Tables 11 and 12, show that female immigrants with an ancestry of historic plough-use have lower rates of female labor force participation within the US. The effect is similar across specifications and it is a bit larger when both parents come from the same country.

Columns 1-3 show the results for the full sample, whereas in columns 4–6 of Tables 11 and 12 the sample only include married women. 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 also exist in a traditional family setting. Overall, the findings from the restricted sample are consistent with those from the full sample. In columns 7–9, we also look at the effects historic plough use through the husband's country of origin and find similar results.[34]

In terms of magnitude, one increase in one standard deviation in historical plough use implies a decline in female labor force participation of the order of 0.02, roughly 3% of the sample average. The magnitude is, not surprisingly, much smaller than the cross country regressions. This would be in line with the view that often differences in values are accompanied over time by

[34]This finding is also consistent with Fernandez and Fogli (2009).

Table 11: Immigrant OLS regressions.

| | Dependent variable: Labor force participation indicator | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | All women | | | Married women | | | | | |
| | Women's ancestry | | | Women's ancestry | | | Husband's ancestry | | |
| | Father's country | Mother's country | Parents same country | Father's country | Mother's country | Parents same country | Father's country | Mother's country | Parents same country |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Historic plough use | -0.042*** | -0.047*** | -0.065*** | -0.015 | -0.043* | -0.044* | -0.027 | -0.049** | -0.047** |
| | (0.011) | (0.012) | (0.013) | (0.021) | (0.022) | (0.024) | (0.018) | (0.024) | (0.022) |
| Individual controls | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Husband controls | n/a | n/a | n/a | yes | yes | yes | yes | yes | yes |
| Historic country controls | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Current country controls | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| State fixed effects | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Observations | 48,910 | 47,219 | 27,550 | 8,864 | 8,261 | 5,832 | 9,505 | 8,886 | 7,211 |
| R-squared | 0.372 | 0.376 | 0.401 | 0.371 | 0.37 | 0.386 | 0.365 | 0.369 | 0.381 |

*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 12: Immigrant IV regressions.

| | Panel A. Second Stage. Dep var: Labor force participation indicator | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | All women | | | Married women | | | | | |
| | Women's ancestry | | | Women's ancestry | | | Husband's ancestry | | |
| | Father's country | Mother's country | Parents same country | Father's country | Mother's country | Parents same country | Father's country | Mother's country | Parents same country |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Historic plough use | -0.045*** | -0.040** | -0.058*** | -0.026 | -0.064** | -0.060* | -0.050** | -0.079** | -0.068** |
| | (0.013) | (0.016) | (0.019) | (0.025) | (0.029) | (0.031) | (0.025) | (0.034) | (0.030) |
| Individual controls | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Husband controls | n/a | n/a | n/a | yes | yes | yes | yes | yes | yes |
| Historic country controls | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Current country controls | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| State fixed effects | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Observations | 48,908 | 47,075 | 27,550 | 8,863 | 8,245 | 5,832 | 9,503 | 8,870 | 7,209 |
| R-squared | 0.372 | 0.375 | 0.401 | 0.371 | 0.37 | 0.386 | 0.365 | 0.369 | 0.381 |
| | Panel B. First stage. Dep var: Historic plough use | | | | | | | | |
| Plough-positive environ. | 1.195*** | 1.160*** | 1.297*** | 1.211*** | 1.223*** | 1.27*** | 1.194*** | 1.205*** | 1.241*** |
| | (0.168) | (0.176) | (.176) | (.164) | (.170) | (.173) | (.152) | (.150) | (.149) |
| Plough-negative environ. | -.370* | -.360 | -.421* | -.402** | -.372** | -.444** | -.361** | -.348** | -.394** |
| | (.212) | (.222) | (.227) | (.188) | (.187) | (.186) | (.186) | (.180) | (.187) |
| Equal coeff (p-value) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| F-stat (excl instr) | 60.02 | 48.16 | 65.80 | 64.45 | 54.43 | 61.82 | 66.47 | 71.19 | 85.44 |
| Hausman test (p-value) | 0.73 | 0.50 | 0.54 | 0.64 | 0.34 | 0.46 | 0.21 | 0.19 | 0.22 |

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.

a different development in institutions that tend to reinforce initial cultural differences. Or, to put it differently, when individuals with different cultures share the same environment, they tend to fade, slowly but surely.

## 8. Conclusions

The adoption of a farming system where the main farming equipment is operated only by men entails a tremendous change in the economic and social relationship between the sexes. Social anthropologists have considered the distinction between shifting cultivation and plough cultivation as a fundamental criterion for the identification of different social and cultural patterns. We formally test this idea by providing empirical evidence suggesting that contemporary differences in gender role attitudes have been indeed shaped by historical differences in agricultural systems. Specifically, we have shown that individuals, ethnicities and societies whose ancestors used plough agriculture today have beliefs that exhibit greater gender inequality today. In an effort to pin down a channel of cultural persistence, we examined variation across US immigrants from different cultural backgrounds. This analysis holds constant differences in national markets and institutions. Our results suggest a very long persistence of cultural traits.

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