ON THE ORIGINS OF GENDER ROLES: **WOMEN AND THE PLOUGH (2013)**

Alberto Alesina, Paola Giuliano and Nathan Nunn

Andrei Cosmin Redis – 360879

Parth Sharma – 360890

Eric Lundholm Wiik – 362004

Addendum

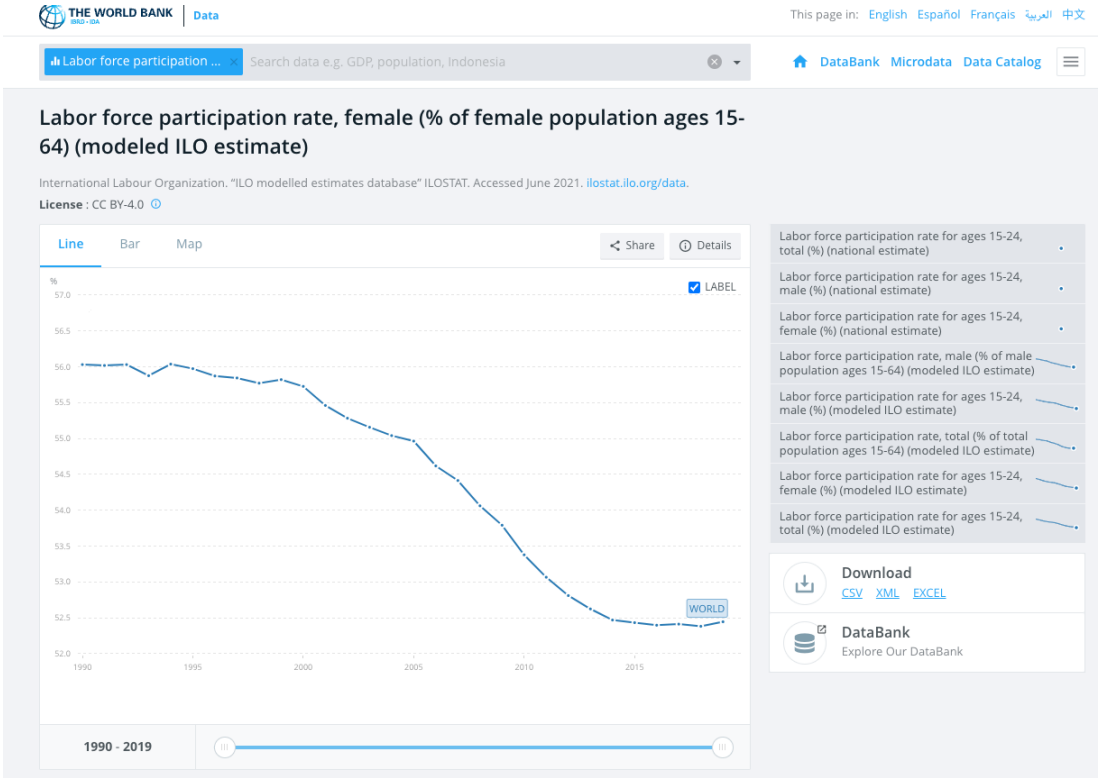
Topics suggested for further exploration during the exam presentation.

Addendum Extension 1. Replicating the claimed results in the paper

Claimed dataset used in paper (2013)

Female labor force participation measured at the country level is taken from the World Bank's *World Development Indicators*. The variable is measured in the standard manner: the percentage of women aged 15 to 64 that are in the labor force. The variable is measured in 2000. The measures for the 1950s–1970s are taken from the ILO's historical archive, accessible at: `http://laborsta.ilo.org/`.

Where we took the data today (2023)



Addendum Extension 1. Replicating the claimed results in the paper

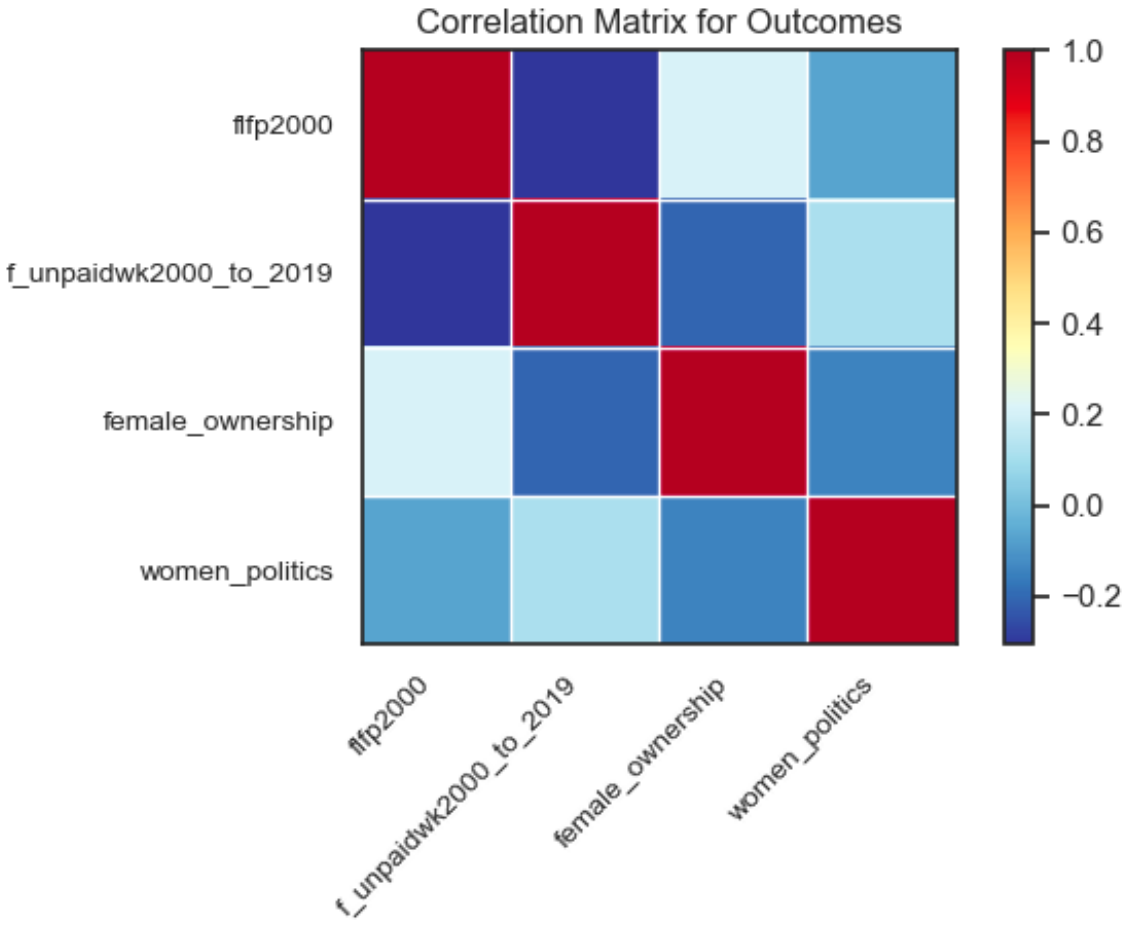
Results of the paper are robust to this dataset. Perhaps a revision of the numbers?

Notable:

- Plow unchanged much
- R^2 similar
- Tropical climate variable changed (+ x3.5 std)

	F_lab_part2000 paper	F_lab_part2000 found in wb
	(1)	(2)
Intercept	51.658***	59.879***
	(6.338)	(7.837)
agricultural_suitability	9.407**	8.482**
	(3.885)	(4.046)
economic_complexity	0.170	1.513
	(0.849)	(1.002)
large_animals	10.903**	7.446
	(5.032)	(5.978)
plow	-14.895***	-14.443***
	(3.318)	(3.838)
political_hierarchies	-0.787	-1.667
	(1.622)	(1.705)
tropical_climate	-8.644***	-16.702***
	(2.698)	(3.050)
Observations	177	175
R^2	0.222	0.241
Adjusted R^2	0.195	0.214
Residual Std. Error	13.980 (df=170)	15.661 (df=168)
F Statistic	7.306*** (df=6; 170)	8.214*** (df=6; 168)
Note:		*p<0.1; **p<0.05; ***p<0.01

Addendum Extension 2. Is the new outcome variable “female unpaid work” orthogonal to the previous outcomes?



Answer is new variable is orthogonal to a great extent (corr. only ranges from 0.37-0.04).

As a side note, as expected, the correlation is negative - the more females do unpaid work the less they tend to participate in the labour force and own businesses.

Addendum Extension 2. Transforming the female unpaid work to capture more variance

New variable transformation: Male unpaid work / female unpaid work (in %)

Interpretation: for every unpaid hour worked by females, what percentage of that hour would males work in a given country?

Conclusion from picture: Plow does not predict inequality as measured in unpaid work done by females. In this sample the trend is even opposite to what is expected (albeit not stat. significant)

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Conclusion from picture: Plow does not predict inequality as measured in unpaid work done by females. In this sample the trend is even opposite to what is expected (albeit not stat. significant)

	f_unpaidwk2000_to_2019	M/F ratio unpaidwk2000_to_2019
	(1)	(2)
Intercept	-24.474*	170.044**
	(14.059)	(66.308)
economic_complexity	-0.778***	-0.309
	(0.267)	(0.946)
fertility2019	0.309	-4.554
	(0.701)	(2.949)
ln_income	10.813***	-35.482**
	(3.017)	(15.098)
ln_income_squared	-0.650***	2.485***
	(0.174)	(0.900)
plow	-1.208	-6.409
	(1.212)	(6.192)
political_hierarchies	1.089*	1.691
	(0.609)	(2.317)
Observations	83	83
R^2	0.256	0.360
Adjusted R^2	0.198	0.309
Residual Std. Error	3.360 (df=76)	14.164 (df=76)
F Statistic	4.780*** (df=6; 76)	5.213*** (df=6; 76)
Note:		*p<0.1; **p<0.05; ***p<0.01

Addendum Extension 2. Transforming the female unpaid work to capture more variance

Replicating the results in the paper using the values present in the regression with the new unpaid female work dataset. (New dataset of 89 countries is more sparse than the one in paper, and sometimes does not match)

Before and after meaning: before - paper original result, after – using new dataset countries only.

Conclusion: 3 out of 4 outcomes with the plow variable are consistent with the new dataset values. That gives more confidence in the lack of relationship for plow and unpaid female labour. This also means that this gender outcome does not prove the hypothesis of the paper.

	flfp2000 before	flfp2000 after	female_ownership before	female_ownership after	women_politics before	women_politics after	aes before	aes after
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
C(continent)[T.Asia]		-6.508		4.266		1.372		0.556*
		(6.956)		(8.630)		(3.292)		(0.325)
C(continent)[T.Europe]		-20.280***		3.608		3.798		0.605
		(7.195)		(12.865)		(5.501)		(0.399)
C(continent)[T.North America]		-19.676***		0.516		5.291		-0.189
		(4.268)		(6.517)		(3.938)		(0.187)
C(continent)[T.Oceania]		-6.242		9.310		0.161		0.056
		(8.977)		(8.426)		(3.687)		(0.318)
C(continent)[T.South America]		-14.037**		7.816		2.624		-0.089
		(5.747)		(7.278)		(4.483)		(0.285)
Intercept	51.658***	61.393***	34.481***	34.940**	17.096***	7.681	2.020***	1.941***
	(6.338)	(10.031)	(10.386)	(16.193)	(4.810)	(7.105)	(0.302)	(0.594)
agricultural_suitability	9.407**	10.534*	1.514	-1.403	1.009	2.210	0.312	0.267
	(3.885)	(5.922)	(5.358)	(8.819)	(2.799)	(4.533)	(0.229)	(0.316)
economic_complexity	0.170	2.199*	1.810*	1.948	1.082**	-0.014	0.048	-0.012
	(0.849)	(1.274)	(1.023)	(1.619)	(0.491)	(0.718)	(0.037)	(0.059)
large_animals	10.903**	-1.011	-0.649	11.147	-9.152**	-4.718	0.174	0.240
	(5.032)	(8.336)	(9.130)	(11.986)	(4.052)	(6.156)	(0.197)	(0.359)
plow	-14.895***	-15.350**	-16.243***	-12.562	-2.522	-3.705	-0.736***	-1.471***
	(3.318)	(7.034)	(3.854)	(8.446)	(1.967)	(3.846)	(0.148)	(0.346)
political_hierarchies	-0.787	1.008	1.502	-2.060	0.906	2.105	0.080	0.164
	(1.622)	(2.339)	(1.845)	(2.967)	(0.740)	(1.383)	(0.070)	(0.120)
tropical_climate	-8.644***	-16.906***	-11.091***	-15.494*	-7.671***	0.423	-0.322**	0.087
	(2.698)	(4.459)	(3.608)	(8.189)	(2.370)	(3.910)	(0.147)	(0.324)
Observations	177	84	128	63	153	72	107	56
R^2	0.222	0.318	0.179	0.209	0.174	0.129	0.254	0.434
Adjusted R^2	0.195	0.214	0.138	0.038	0.140	-0.031	0.209	0.293
Residual Std. Error	13.980 (df=170)	15.291 (df=72)	14.134 (df=121)	15.054 (df=51)	8.390 (df=146)	8.380 (df=60)	0.527 (df=100)	0.510 (df=44)
F Statistic	7.306*** (df=6; 170)	5.598*** (df=11; 72)	4.871*** (df=6; 121)	13.923*** (df=11; 51)	4.415*** (df=6; 146)	1.213 (df=11; 60)	6.490*** (df=6; 100)	3.741*** (df=11; 44)
Note:								*p<0.1; **p<0.05; ***p<0.01

Index

Section 1: Introduction and Discussion

- Theme (motivation and research question)
- Conceptual framework (methodology)
- Robustness checks

Section 2: Replication

- Challenges
- Code replication
- Result comparison

Section 3: Extension

- Do the results hold for newer data? (2000 vs 2019)
- Do the results hold for a new outcome variable?
- What would be the most interesting historical controls to add from the Ethnographic Atlas?

Overview of showing the causal effect of X on Y in observational studies

- Show that X is linked conceptually to Y
- Show the individual effect that X has on Y. i.e. in an observational study that means to disentangle the confounders:
  - Observed confounders
    - Control variables
  - Unobserved confounders
    - Fixed effects
    - Instrumental variable analysis

Overview of the methods in the paper – follow mechanically from the causality template

- Showed that plough is linked to occupations in the past
  - Showed that plough usage is linked to differential gender occupations in the preindustrial era
- Controls for **observed covariates** with plough adoption
  - Showed the individual effect plough agriculture on present gender equality related outcomes, using OLS, controlling for historical and present covariates.

- Controls for **unobserved covariates** with plough adoption
  - **Fixed effects** at the country and continent level to control for unobserved country level differences, to check for robustness.
  - Used an **exogenous instrument** (the presence of differential crops) to check for robustness wrt. reverse causality.

- The **mechanism** of how plough agriculture impacts gender norms today
  - Showed the cultural transmission mechanism of gender norms on children of immigrants. Did the effect of plough on gender norms today comes through it's effect on today's institutions, which force gender norms externally, or did the legacy of the plough persists rather through people's internal beliefs.

Methodology and Discussion

Section 1

Parth

Research Question / Background

Claim: Descendants of societies that traditionally practiced plough agriculture today have less equal gender norms.

Hypothesis: Traditional agricultural practices influences the historical gender division of labor and the evolution of gender norms.

Methodology for table 1 – 3

- Confirming –Plough use = Low female participation in the labour force (in past and today)
- Control variables for plough use:
  - Presence of large animals – V{1,0}
  - Measure of economic development – V{1-8 }, inc. develop
  - Measure of political complexity
  - Tropical / Sub-tropical land fraction – V(0-1)
  - Fraction of land within 200 km radius of location used- V(0-1)
- Female participation in agriculture (activities) :
  - Land clearance, Soil preparation, Planting, crop tending , harvesting

Table 1

Linking plough use and women's historical participation in agriculture

TABLE I

TRADITIONAL PLOUGH USE AND FEMALE PARTICIPATION IN PRE-INDUSTRIAL AGRICULTURE

Closer to 5 means women did the job

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent variable: Traditional participation of females relative to males in the following tasks:						
	Overall agriculture		Land clearance	Soil preparation	Planting	Crop tending	Harvesting
Mean of dep. var.	3.04	2.83	1.45	2.15	2.86	3.16	3.23
Traditional plough agriculture	−0.883***	−1.136***	−0.434**	−1.182***	−1.290***	−1.188***	−0.954***
	(0.225)	(0.240)	(0.197)	(0.320)	(0.306)	(0.351)	(0.271)
Ethnographic controls	yes	yes	yes	yes	yes	yes	yes
Observations	660	124	129	124	131	122	131
Adjusted R-squared	0.13	0.19	0.14	0.10	0.09	0.13	0.16
R-squared	0.14	0.23	0.18	0.14	0.13	0.18	0.20

Table 2

Linking plough use and women's historical participation in household activities

TABLE II

TRADITIONAL PLOUGH USE AND TRADITIONAL FEMALE PARTICIPATION OUTSIDE OF AGRICULTURE IN THE PRE-INDUSTRIAL PERIOD

Closer to 5 means women did the job

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dependent variable: Traditional participation of females relative to males in the following tasks:								
	Caring for small animals	Caring for large animals	Milking	Cooking	Fuel gathering	Water fetching	Burden carrying	Handicrafts	Trading
Mean of dep. var.	3.53	1.73	3.25	4.65	3.90	4.64	3.47	2.78	2.47
Traditional plough use	0.14	0.064	0.63	−0.019	−0.638	−0.052	−0.962**	−0.157	−0.155
	(0.517)	(0.254)	(0.697)	(0.108)	(0.403)	(0.205)	(0.378)	(0.274)	(0.542)
Ethnographic controls	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	88	95	48	173	159	154	135	74	59
Adjusted R-squared	−0.02	−0.02	0.03	0.01	−0.001	0.01	0.12	0.07	−0.01
R-squared	0.05	0.04	0.14	0.04	0.04	0.04	0.16	0.15	0.10

Not Significant

Table 3

Linking plough use and women's present participation in society

TABLE III

COUNTRY-LEVEL OLS ESTIMATES WITH HISTORICAL CONTROLS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variable:							
	Female labor force participation in 2000		Share of firms with female ownership, 2003–2010		Share of political positions held by women in 2000		Average effect size (AES)	
Mean of dep. var.	51.03		34.77		12.11		2.31	
Traditional plough use	−14.895***	−15.962***	−16.243***	−17.806***	−2.522	−2.303	−0.736***	−0.920***
	(3.318)	(3.881)	(3.854)	(4.475)	(1.967)	(2.353)	(0.084)	(0.100)
Historical controls:								
Agricultural suitability	9.407**	9.017**	1.514	4.619	1.009	−0.687	0.312**	0.325**
	(3.885)	(4.236)	(5.358)	(5.836)	(2.799)	(2.925)	(0.129)	(0.133)
Tropical climate	−8.644***	−12.389***	−11.091***	−3.974	−7.671***	−5.618**	−0.322***	−0.004
	(2.698)	(3.302)	(3.608)	(5.542)	(2.370)	(2.265)	(0.083)	(0.102)
Presence of large animals	10.903**	2.35	−0.649	4.475	−9.152**	−7.338	0.174	0.296**
	(5.032)	(5.956)	(9.130)	(10.034)	(4.052)	(4.774)	(0.111)	(0.145)
Political hierarchies	−0.787	0.447	1.502	0.52	0.906	0.699	0.080**	0.062
	(1.622)	(1.624)	(1.845)	(1.773)	(0.740)	(0.777)	(0.040)	(0.043)
Economic complexity	0.170	1.157	1.810*	0.517	1.082**	0.727	0.048**	0.018
	(0.849)	(0.859)	(1.023)	(1.351)	(0.491)	(0.510)	(0.021)	(0.026)
Continent fixed effects	no	yes	no	yes	no	yes	no	yes
Observations	177	177	128	128	153	153	153	153
Adjusted R-squared	0.20	0.24	0.14	0.16	0.14	0.14	0.24	0.27
R-squared	0.22	0.28	0.18	0.23	0.17	0.20	0.25	0.30

Tables 1 –3 (summary)

- Table 1 – historical plough use and less female agricultural participation
- Table 3- Historical plough use and less female Labor force part.
- -> Strong correlation between less female participation in agriculture and less labor force participation

Addressing Causality and Robustness checks for observed covariates (main tables)

- *Reverse causality*: less equal gender roles -> Plough adoption; economic development -> plough use

Observable control variables:

- **Warfare–plough** use impact on country's exposure to warfare during 19th and 20th century
- **Communism and migration–** variable {1,0} ; policy for gender equality
- **Oil reserves** – more oil reserve less light manufacturing
- **Religion –** beliefs manifest cultural views

Robustness checks for observed covariates: a complete list

TABLE VII

ROBUSTNESS OF OLS ESTIMATES TO ADDITIONAL COVARIATES

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variable: Female labor force participation in 2000							
Mean of dep. var.	51.35	51.55	51.35	51.48	51.26	52.09	51.48	52.13
Traditional plough use	−10.892***	−12.714***	−12.356***	−12.336***	−12.721***	−14.618***	−9.913***	−9.234**
	(3.848)	(3.255)	(2.993)	(3.019)	(3.364)	(3.482)	(3.160)	(4.301)
Historical controls:								
Practices intensive agriculture	yes							yes
Prop. of subsist. from herding	yes							yes
Prop. of subsist. from hunting	yes							yes
Absence of private property		yes						yes
Patrilocal marriages		yes						yes
Matrilocal marriages		yes						yes
Nuclear family structure		yes						yes
Extended family structure		yes						yes
Year ethnicity sampled			yes					yes
Contemporary controls:								
Years of civil conflicts (1816–2007)				yes				yes
Years of interstate conflicts (1816–2007)				yes				yes
Ruggedness				yes				yes
Communism indicator					yes			yes

Replication of the paper

Section 2

Eric

Challenges for replication

- We can replicate with the provided data by authors, but we could not replicate the results using world bank indicator data from the website
- For USA we found female labor participation to be:
  - 69.9% World bank 15-65 years, year 2000 (same as cross country)
  - 59.5% Cross country dataset, year 2000
  - 61 % Population reference bureau, year 2000
  - 59.0% World bank, women 15+, year 2000

Datasets

- Ethnographic Atlas – Murdock . Researching ethnicities from the preindustrial era.
- World Bank's World Development Indicators.
- Geographic and climate data

What has been done in their Stata code

Notes:

- Colors correspond to what makes what happened

```
*******************************************************************************************
*** Table III: AES results for columns 7 and 8 can be obtained using the aes_regression.do file ****
*******************************************************************************************

* loads the dataset "crosscountry_dataset.dta" into memory and clears any previously loaded datasets.
use "crosscountry_dataset.dta", clear

* regress flfp2000 on those variables. xi is used for nothing (as we don't have any categorical variables).
* xi is called interaction expansion, and is used to expand categorical variables and maybe the interaction between them.
xi: reg  flfp2000    plow agricultural_suitability tropical_climate large_animals political_hierarchies economic_complexity , r
* generates fit statistics for the fitted model. only used to get adjusted r^2
fitstat
* exports the coefficient estimates, standard errors, and other fit statistics for the fitted model to an Excel file named "TableIII.xls". The "replace" option specifies that the file should be overwritten if it already
exists. The "coefastr" option specifies that the coefficient estimates and standard errors should be exported, and the "se" option specifies that the standard errors should be included in the output.
outreg2 using TableIII.xls, replace coefastr  se
* same as before, but with continent expanded. Continent acts here as a continent level fixed effects variable.
xi: reg  flfp2000    plow agricultural_suitability tropical_climate large_animals political_hierarchies economic_complexity  i.continent, r
fitstat
outreg2 using TableIII.xls, append coefastr  se
* su = set using, sets the working sample to include only observations where the value of the e(sample)==1, which means that only the datapoints used in the previous regression are used also here
su flfp2000 if e(sample)==1
xi: reg  female_ownership       plow agricultural_suitability tropical_climate large_animals political_hierarchies economic_complexity , r
fitstat
outreg2 using TableIII.xls, append coefastr  se
xi: reg  female_ownership   plow agricultural_suitability tropical_climate large_animals political_hierarchies economic_complexity  i.continent, r
fitstat
outreg2 using TableIII.xls, append coefastr  se
su female_ownership if e(sample)==1
xi: reg  women_politics         plow agricultural_suitability tropical_climate large_animals political_hierarchies economic_complexity , r
fitstat
outreg2 using TableIII.xls, append coefastr  se
xi: reg  women_politics         plow agricultural_suitability tropical_climate large_animals political_hierarchies economic_complexity  i.continent, r
fitstat
outreg2 using TableIII.xls, append coefastr  se
```

TABLE III

COUNTRY-LEVEL OLS ESTIMATES WITH HISTORICAL CONTROLS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variable:							
	Female labor force participation in 2000		Share of firms with female ownership, 2003–2010		Share of political positions held by women in 2000		Average effect size (AES)	
Mean of dep. var.	51.03		34.77		12.11		2.31	
Traditional plough use	−14.895***	−15.962***	−16.243***	−17.806***	−2.522	−2.303	−0.736***	−0.920***
	(3.318)	(3.881)	(3.854)	(4.475)	(1.967)	(2.353)	(0.084)	(0.100)
Historical controls:								
Agricultural suitability	9.407**	9.017**	1.514	4.619	1.009	−0.687	0.312**	0.325**
	(3.885)	(4.236)	(5.358)	(5.836)	(2.799)	(2.925)	(0.129)	(0.133)
Tropical climate	−8.644***	−12.389***	−11.091***	−3.974	−7.671***	−5.618**	−0.322***	−0.004
	(2.698)	(3.302)	(3.608)	(5.542)	(2.370)	(2.265)	(0.083)	(0.102)
Presence of large animals	10.903**	2.35	−0.649	4.475	−9.152**	−7.338	0.174	0.296**
	(5.032)	(5.956)	(9.130)	(10.034)	(4.052)	(4.774)	(0.111)	(0.145)
Political hierarchies	−0.787	0.447	1.502	0.52	0.906	0.699	0.080**	0.062
	(1.622)	(1.624)	(1.845)	(1.773)	(0.740)	(0.777)	(0.040)	(0.043)
Economic complexity	0.170	1.157	1.810*	0.517	1.082**	0.727	0.048**	0.018
	(0.849)	(0.859)	(1.023)	(1.351)	(0.491)	(0.510)	(0.021)	(0.026)
Continent fixed effects	no	yes	no	yes	no	yes	no	yes
Observations	177	177	128	128	153	153	153	153
Adjusted R-squared	0.20	0.24	0.14	0.16	0.14	0.14	0.24	0.27
R-squared	0.22	0.28	0.18	0.23	0.17	0.20	0.25	0.30

Our Replication and extension are all in Python

Code Comparison Stata vs Python

Table 3: Python, without and with fixed effects

```python
m_flfp = smf.ols(formula='flfp2000 ~  plow + agricultural_suitability + tropical_climate + large_animals + political_hierarchies + economic_complexity', data=df_cross_country).fit(cov_type='HC1')
m_fown = smf.ols(formula='female_ownership ~  plow + agricultural_suitability + tropical_climate + large_animals + political_hierarchies + economic_complexity', data=df_cross_country).fit(cov_type='HC1')
m_wpol = smf.ols(formula='women_politics ~  plow + agricultural_suitability + tropical_climate + large_animals + political_hierarchies + economic_complexity', data=df_cross_country).fit(cov_type='HC1')
m_aes = smf.ols(formula='aes ~  plow + agricultural_suitability + tropical_climate + large_animals + political_hierarchies + economic_complexity', data=df_cross_country).fit(cov_type='HC1')
Stargazer([m_flfp, m_fown, m_wpol, m_aes])
```

```python
m_flpf_c = smf.ols(formula='flfp2000 ~  plow + agricultural_suitability + tropical_climate + large_animals + political_hierarchies + economic_complexity + C(continent)', data=df_cross_country).fit(cov_type='HC1')
m_fown_c = smf.ols(formula='female_ownership ~  plow + agricultural_suitability + tropical_climate + large_animals + political_hierarchies + economic_complexity + C(continent)', data=df_cross_country).fit(cov_type='HC1')
m_wpol_c = smf.ols(formula='women_politics ~  plow + agricultural_suitability + tropical_climate + large_animals + political_hierarchies + economic_complexity + C(continent)', data=df_cross_country).fit(cov_type='HC1')
m_aes_c = smf.ols(formula='aes ~  plow + agricultural_suitability + tropical_climate + large_animals + political_hierarchies + economic_complexity + C(continent)', data=df_cross_country).fit(cov_type='HC1')
Stargazer([m_flpf_c, m_fown_c, m_wpol_c, m_aes_c])
```

Table 3: Stata, without and with fixed

```
*******************************************************************************************
*** Table III: AES results for columns 7 and 8 can be obtained using the aes_regression.do file ****
*******************************************************************************************

* loads the dataset "crosscountry_dataset.dta" into memory and clears any previously loaded datasets.
use "crosscountry_dataset.dta", clear

* regress flfp2000 on those variables. xi is used for nothing (as we don't have any categorical variables).
* xi is called interaction expansion, and is used to expand categorical variables and maybe the interaction between them.
xi: reg  flfp2000    plow agricultural_suitability tropical_climate large_animals political_hierarchies economic_complexity , r
* generates fit statistics for the fitted model. only used to get adjusted r^2
fitstat
* exports the coefficient estimates, standard errors, and other fit statistics for the fitted model to an Excel file named "TableIII.xls". The "replace" option specifies that the file should be overwritten if it already
exists. The "coefastr" option specifies that the coefficient estimates and standard errors should be exported, and the "se" option specifies that the standard errors should be included in the output.
outreg2 using TableIII.xls, replace coefastr  se
* same as before, but with continent expanded. Continent acts here as a continent level fixed effects variable.
xi: reg  flfp2000    plow agricultural_suitability tropical_climate large_animals political_hierarchies economic_complexity  i.continent, r
fitstat
outreg2 using TableIII.xls, append coefastr  se
* su = set using, sets the working sample to include only observations where the value of the e(sample)==1, which means that only the datapoints used in the previous regression are used also here
su flfp2000 if e(sample)==1
xi: reg  female_ownership       plow agricultural_suitability tropical_climate large_animals political_hierarchies economic_complexity , r
fitstat
outreg2 using TableIII.xls, append coefastr  se
xi: reg  female_ownership   plow agricultural_suitability tropical_climate large_animals political_hierarchies economic_complexity  i.continent, r
fitstat
outreg2 using TableIII.xls, append coefastr  se
su female_ownership if e(sample)==1
xi: reg  women_politics         plow agricultural_suitability tropical_climate large_animals political_hierarchies economic_complexity , r
fitstat
outreg2 using TableIII.xls, append coefastr  se
xi: reg  women_politics         plow agricultural_suitability tropical_climate large_animals political_hierarchies economic_complexity  i.continent, r
fitstat
outreg2 using TableIII.xls, append coefastr  se
su women_politics if e(sample)==1
fitstat
```

We obtained the same results with Python

Table 3: Stata vs Python replication

TABLE III

COUNTRY-LEVEL OLS ESTIMATES WITH HISTORICAL CONTROLS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variable:							
	Female labor force participation in 2000		Share of firms with female ownership, 2003–2010		Share of political positions held by women in 2000		Average effect size (AES)	
Mean of dep. var.	51.03		34.77		12.11		2.31	
Traditional plough use	−14.895***	−15.962***	−16.243***	−17.806***	−2.522	−2.303	−0.736***	−0.920***
	(3.318)	(3.881)	(3.854)	(4.475)	(1.967)	(2.353)	(0.084)	(0.100)
Historical controls:								
Agricultural suitability	9.407**	9.017**	1.514	4.619	1.009	−0.687	0.312**	0.325**
	(3.885)	(4.236)	(5.358)	(5.836)	(2.799)	(2.925)	(0.129)	(0.133)
Tropical climate	−8.644***	−12.389***	−11.091***	−3.974	−7.671***	−5.618**	−0.322***	−0.004
	(2.698)	(3.302)	(3.608)	(5.542)	(2.370)	(2.265)	(0.083)	(0.102)
Presence of large animals	10.903**	2.35	−0.649	4.475	−9.152**	−7.338	0.174	0.296**
	(5.032)	(5.956)	(9.130)	(10.034)	(4.052)	(4.774)	(0.111)	(0.145)
Political hierarchies	−0.787	0.447	1.502	0.52	0.906	0.699	0.080**	0.062
	(1.622)	(1.624)	(1.845)	(1.773)	(0.740)	(0.777)	(0.040)	(0.043)
Economic complexity	0.170	1.157	1.810*	0.517	1.082**	0.727	0.048**	0.018
	(0.849)	(0.859)	(1.023)	(1.351)	(0.491)	(0.510)	(0.021)	(0.026)
Continent fixed effects	no	yes	no	yes	no	yes	no	yes
Observations	177	177	128	128	153	153	153	153
Adjusted R-squared	0.20	0.24	0.14	0.16	0.14	0.14	0.24	0.27
R-squared	0.22	0.28	0.18	0.23	0.17	0.20	0.25	0.30

=

	Female labor force participation in 2000		Share of firms with female ownership, 2003–2010		Share of political positions held by women in 2000		Average effect size (AES)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
agricultural_suitability	9.407**	9.017**	1.514	4.619	1.009	-0.687	0.312	0.325
	(3.885)	(4.236)	(5.358)	(5.836)	(2.799)	(2.925)	(0.229)	(0.240)
economic_complexity	0.170	1.157	1.810*	0.517	1.082**	0.727	0.048	0.018
	(0.849)	(0.859)	(1.023)	(1.351)	(0.491)	(0.510)	(0.037)	(0.047)
large_animals	10.903**	2.350	-0.649	4.475	-9.152**	-7.338	0.174	0.296
	(5.032)	(5.956)	(9.130)	(10.034)	(4.052)	(4.774)	(0.197)	(0.262)
plow	-14.895***	-15.962***	-16.243***	-17.806***	-2.522	-2.303	-0.736***	-0.920***
	(3.318)	(3.881)	(3.854)	(4.475)	(1.967)	(2.353)	(0.148)	(0.180)
political_hierarchies	-0.787	0.447	1.502	0.520	0.906	0.699	0.080	0.062
	(1.622)	(1.624)	(1.845)	(1.773)	(0.740)	(0.777)	(0.070)	(0.078)
tropical_climate	-8.644***	-12.389***	-11.091***	-3.974	-7.671***	-5.618**	-0.322**	-0.004
	(2.698)	(3.302)	(3.608)	(5.542)	(2.370)	(2.265)	(0.147)	(0.185)
Observations	177	177	128	128	153	153	107	107
R^2	0.222	0.284	0.179	0.233	0.174	0.202	0.254	0.300
Adjusted R^2	0.195	0.237	0.138	0.161	0.140	0.140	0.209	0.219
Residual Std. Error	13.980 (df=170)	13.613 (df=165)	14.134 (df=121)	13.946 (df=116)	8.390 (df=146)	8.389 (df=141)	0.527 (df=100)	0.524 (df=95)
F Statistic	7.306*** (df=6; 170)	413.875*** (df=11; 165)	4.871*** (df=6; 121)	272.220*** (df=11; 116)	4.415*** (df=6; 146)	31.295*** (df=11; 141)	6.490*** (df=6; 100)	298.820*** (df=11; 95)
Note:								*p<0.1; **p<0.05; ***p<0.01

Multicollinearity Replication

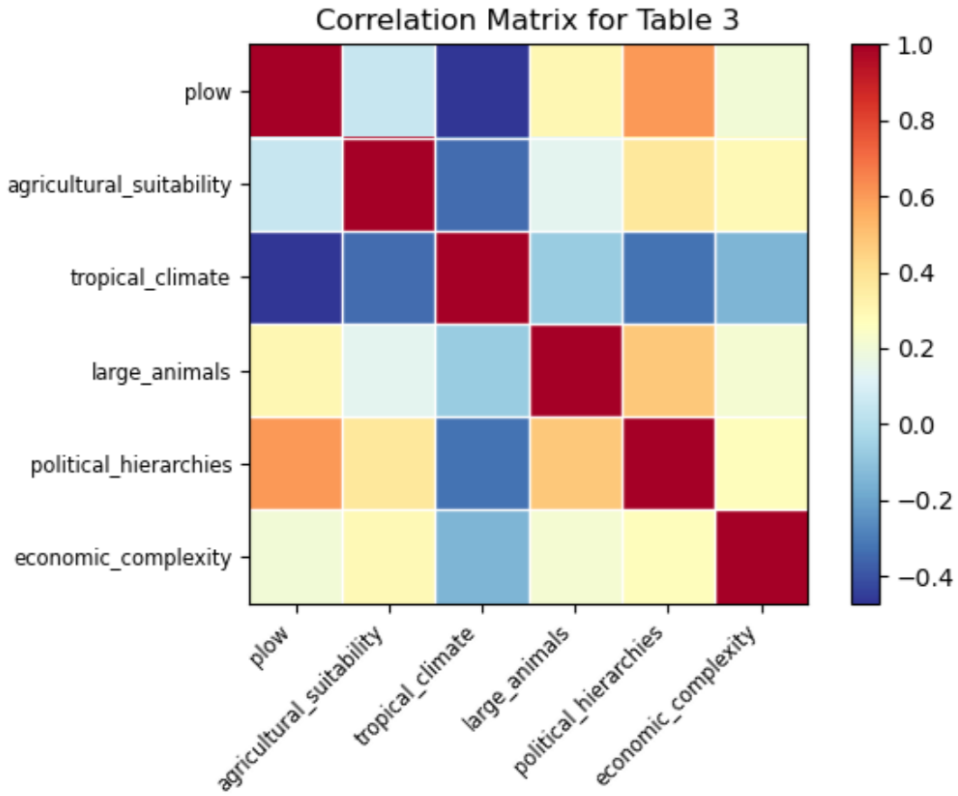
Notes:

- Paper only shows the correlations with plough
- We also show the correlation matrix (which would allow for alternative hypotheses with different explanatory variables to be made)

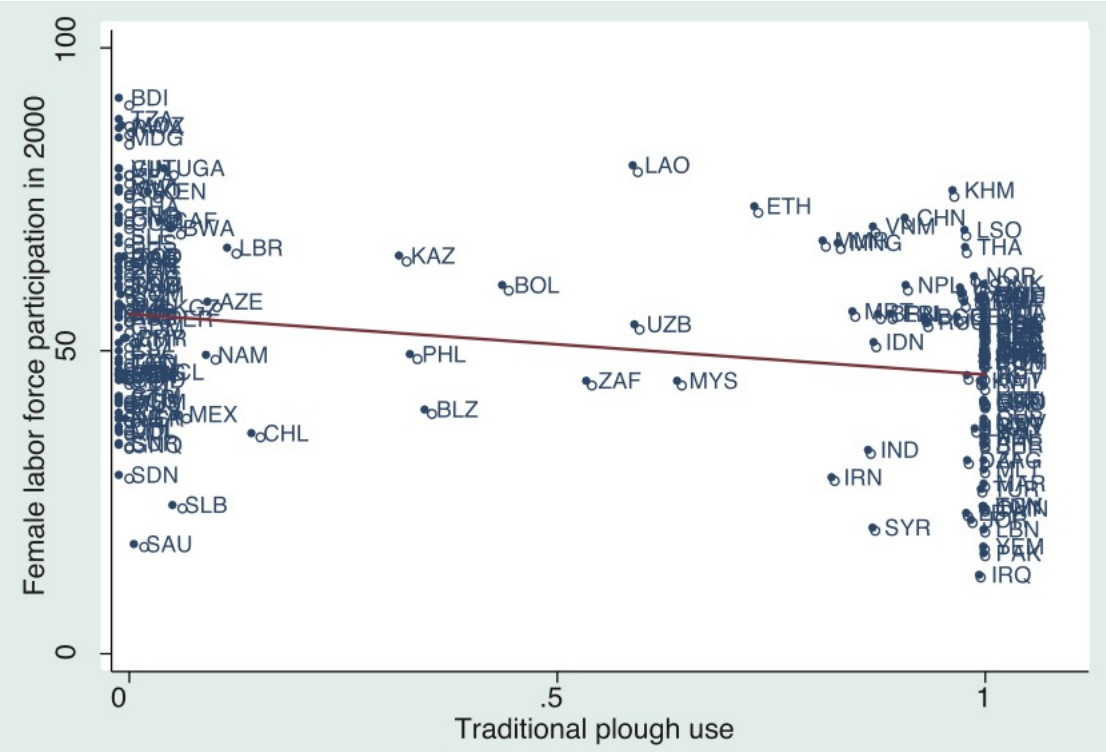
Table A13: Cross-ethnicity correlates of traditional plough use.

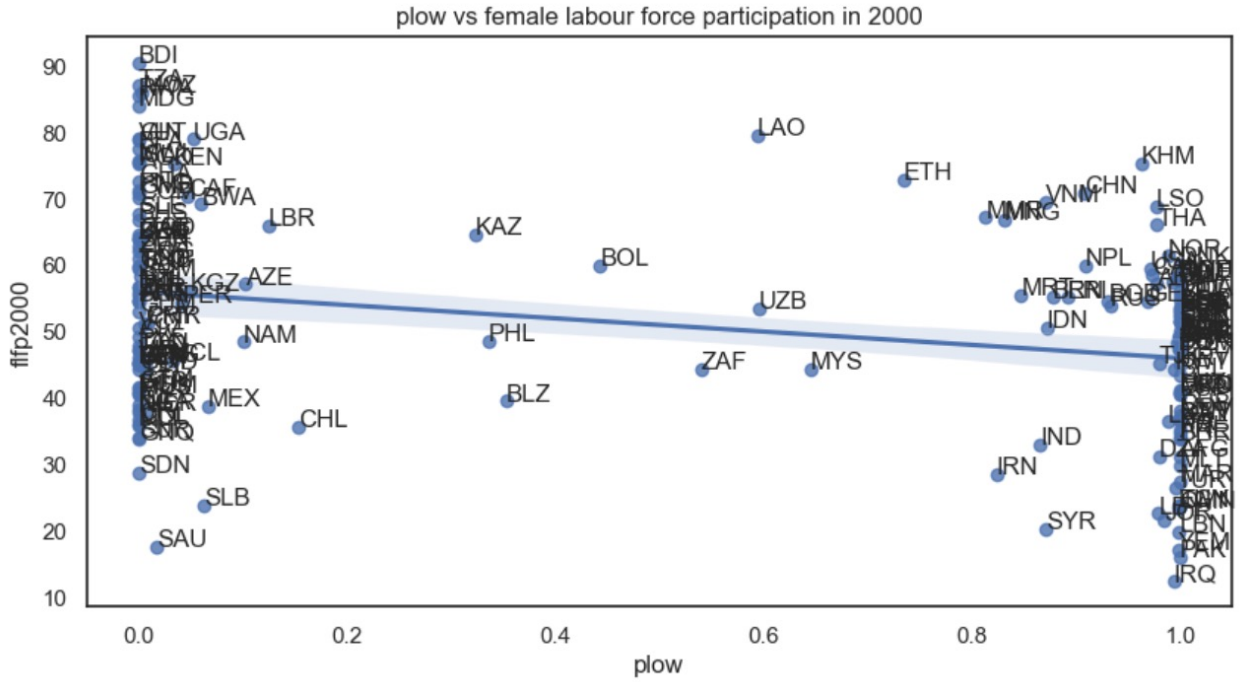
	(1)	(2)	(3)	(4)	(5)
	Dependent variable: Traditional plough use				
Mean of dep. var.	0.14	0.13	0.17	0.14	0.18
Agricultural suitability	-0.001	-0.111***	-0.121***	-0.157***	-0.181***
	(0.025)	(0.024)	(0.030)	(0.041)	(0.046)
Tropical climate	-0.042	-0.107***	-0.141***	0.072**	-0.012
	(0.031)	(0.027)	(0.033)	(0.035)	(0.043)
Presence of large animals		0.065***	0.006	0.157***	0.074**
		(0.016)	(0.024)	(0.023)	(0.032)
Economic complexity		0.009**	0.010	0.019***	0.011
		(0.005)	(0.008)	(0.005)	(0.008)
Political hierarchies		0.151***	0.098***	0.133***	0.083***
		(0.012)	(0.015)	(0.013)	(0.015)
Practices intensive agriculture			0.283***		0.193***
			(0.033)		(0.033)
Absence of private property			-0.005		-0.059*
			(0.030)		(0.033)
Patrilocal marriages			0.0003		0.012
			(0.030)		(0.032)
Matrilocal marriages			0.011		0.016
			(0.052)		(0.063)
Nuclear family structure			0.124***		0.107***
			(0.032)		(0.035)
Extended family structure			0.112***		0.107***
			(0.024)		(0.026)
Prop. of subsist. from hunting			-0.002		-0.022**
			(0.007)		(0.009)
Prop. of subsist. from herding			0.026***		0.024**
			(0.009)		(0.010)
Year ethnicity sampled			-0.00004		-0.00003
			(0.0001)		(0.0001)
Plough-positive environment				0.340***	0.404***
				(0.042)	(0.049)
Plough-negative environment				-0.017	0.067
				(0.078)	(0.089)
Observations	1117	1086	716	898	599
R-squared	0.00	0.27	0.43	0.36	0.51

Notes: OLS estimates are reported with robust standard errors in brackets. The unit of observation is an ethnicity from the Ethnographic Atlas. "Traditional plough use" is an indicator variable that equals one if the society used the plough in pre-industrial agriculture.



Replication of plots: Stata & Python





Extension(s)

Section 3

Eric and Andrei

Extension(s)

1. Do the results hold for newer data? (2000 vs 2019)
2. Do the results hold for a new outcome variable?
3. What would be the most interesting historical controls to add from the Ethnographic Atlas?

1. Do the results hold after 10-20 years of progress?

- We have gathered data for the gender outcomes measured in the paper for 10-20 years later.
- % Female labour participation in 2019
- % Firms with female ownership 2010 – 2019
  - We needed as in the paper to use multiple years, as the data here is sparse
- % Females in politics (parliament) in 2019

The legacy of the plough holds after 20 years, (albeit a little less) – Table 3

	flfp2000	female_ownership	women_politics	aes
	(1)	(2)	(3)	(4)
Intercept	51.658***	34.481***	17.096***	2.020***
	(6.338)	(10.386)	(4.810)	(0.302)
agricultural_suitability	9.407**	1.514	1.009	0.312
	(3.885)	(5.358)	(2.799)	(0.229)
economic_complexity	0.170	1.810*	1.082**	0.048
	(0.849)	(1.023)	(0.491)	(0.037)
large_animals	10.903**	-0.649	-9.152**	0.174
	(5.032)	(9.130)	(4.052)	(0.197)
plow	-14.895***	-16.243***	-2.522	-0.736***
	(3.318)	(3.854)	(1.967)	(0.148)
political_hierarchies	-0.787	1.502	0.906	0.080
	(1.622)	(1.845)	(0.740)	(0.070)
tropical_climate	-8.644***	-11.091***	-7.671***	-0.322**
	(2.698)	(3.608)	(2.370)	(0.147)
Observations	177	128	153	107
R^2	0.222	0.179	0.174	0.254
Adjusted R^2	0.195	0.138	0.140	0.209
Residual Std. Error	13.980 (df=170)	14.134 (df=121)	8.390 (df=146)	0.527 (df=100)
F Statistic	7.306*** (df=6; 170)	4.871*** (df=6; 121)	4.415*** (df=6; 146)	6.490*** (df=6; 100)
Note:				*p<0.1; **p<0.05; ***p<0.01

	flfp2019	female_ownership 2010_2019	women_politics 2019	aes2019
	(1)	(2)	(3)	(4)
Intercept	60.999***	40.582***	33.303***	2.866***
	(8.404)	(11.943)	(5.253)	(0.364)
agricultural_suitability	8.563**	-2.371	4.901	0.245
	(4.052)	(5.407)	(3.469)	(0.246)
economic_complexity	2.562***	2.357**	-0.567	0.060
	(0.908)	(0.958)	(0.483)	(0.042)
large_animals	-2.777	-21.318*	-12.940***	-0.496
	(6.236)	(11.418)	(4.934)	(0.302)
plow	-12.693***	-14.634***	-2.742	-0.893***
	(3.955)	(3.857)	(2.988)	(0.201)
political_hierarchies	-0.375	4.423**	2.514**	0.207***
	(1.598)	(1.877)	(1.271)	(0.076)
tropical_climate	-16.400***	-7.272**	-4.946*	-0.493***
	(3.133)	(3.511)	(2.632)	(0.188)
Observations	175	124	180	119
R^2	0.260	0.154	0.108	0.214
Adjusted R^2	0.233	0.111	0.077	0.172
Residual Std. Error	15.023 (df=168)	15.057 (df=117)	11.695 (df=173)	0.687 (df=112)
F Statistic	9.045*** (df=6; 168)	3.980*** (df=6; 117)	4.099*** (df=6; 173)	5.198*** (df=6; 112)
Note:				*p<0.1; **p<0.05; ***p<0.01

Challenges when finding newer data

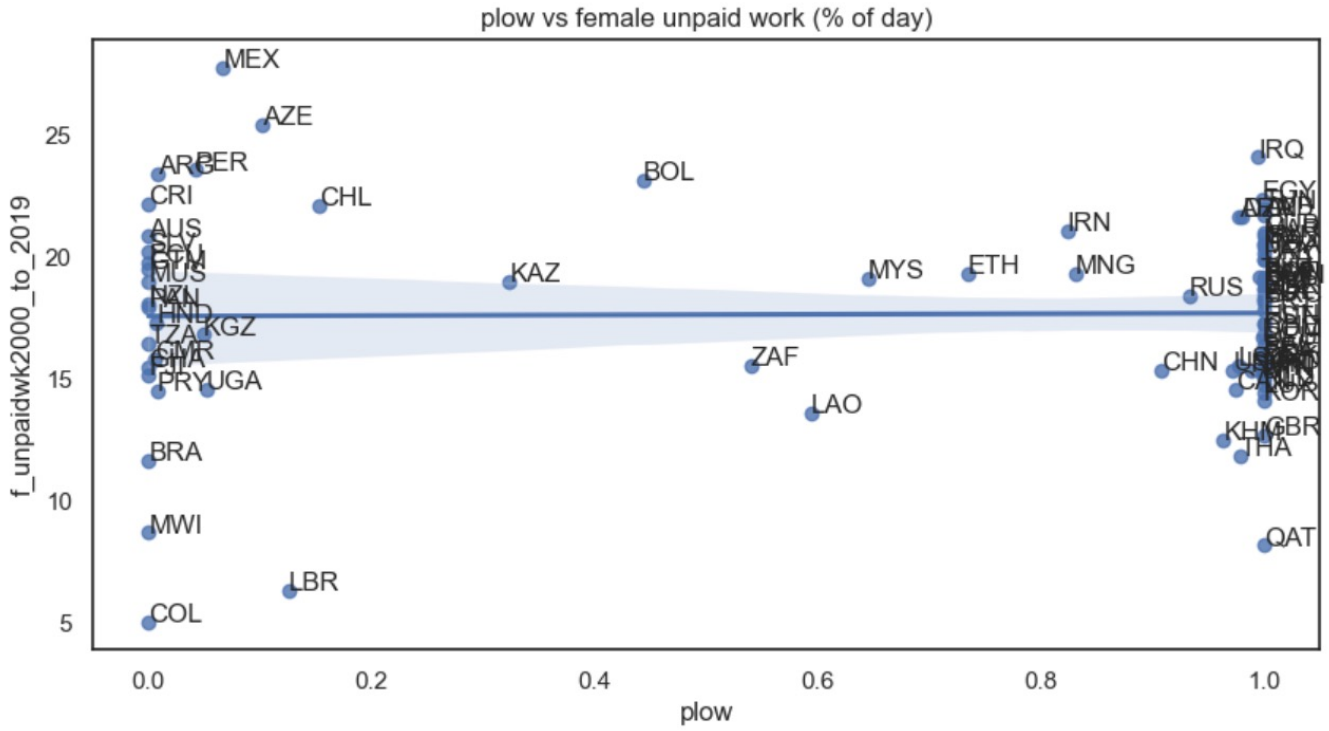
- We can replicate with the provided data by authors, but we could not replicate the results using world bank indicator data from the website
- For USA we found female labor participation to be:
  - 57.4% on US bureau of labor statistics, year 2019,
  - 67.9% in the world bank ILO estimate , year 2019

2. Unpaid work done by females

- Dubbed as the “missing link” in the analysis of gender gaps in labor outcomes by the OECD (2014)
- Around 80 countries from 2000 – 2019 have published a survey on this
  - We replaced missing values from 2019 with existing values from the past
- The World Bank collects all the data

Unpaid work done by females and the legacy of the plough

- Our model suggests that historical plough agriculture does not correlate with this metric of gender inequality
- Although this data suffers from self selection bias, making us unable to capture



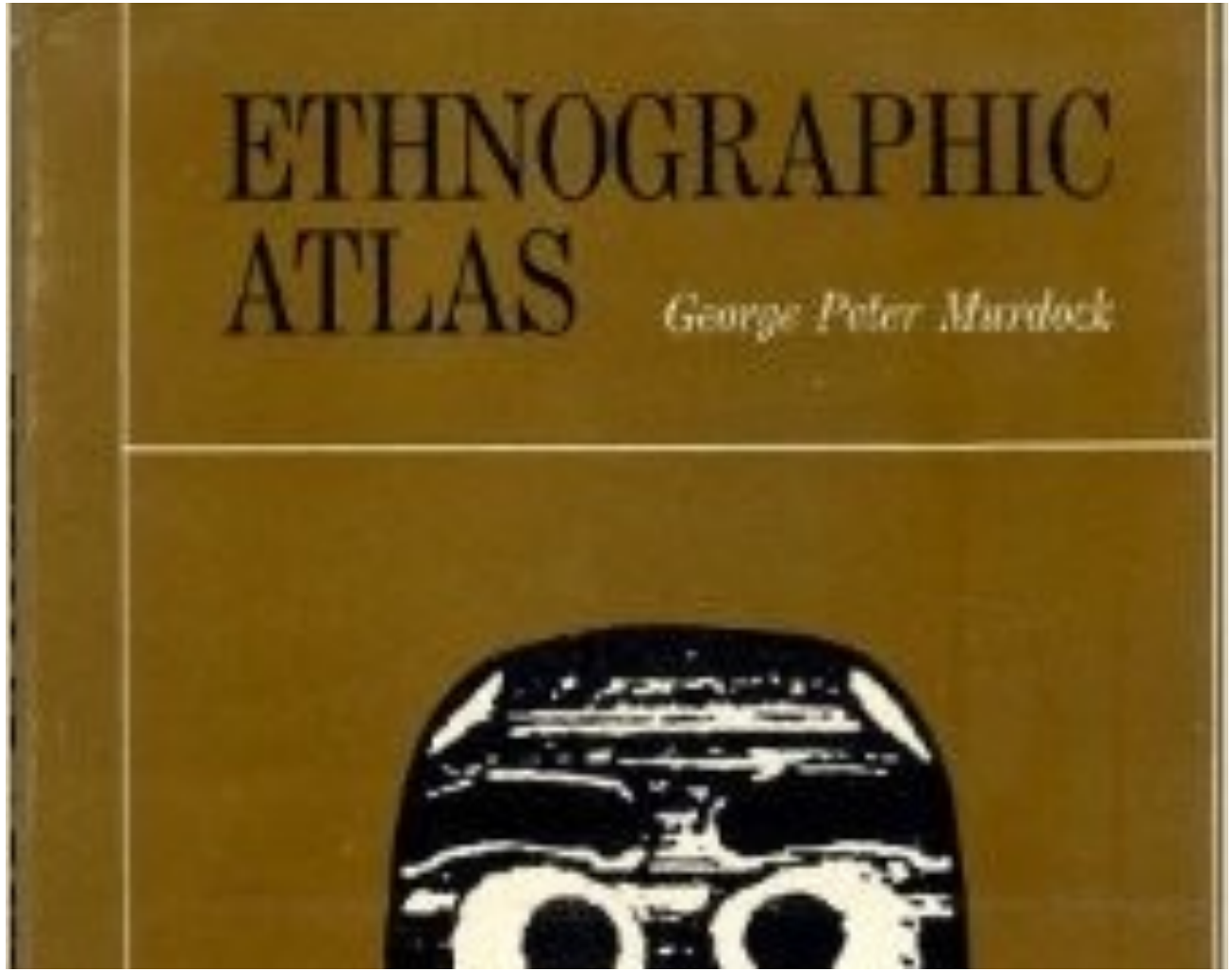
Unpaid work done by females and the legacy of the plough

- The coefficient for plough is not significant, although the historical economic complexity seems to negatively predict this outcome.
- We think that more analysis should be done to make sure the sample is balanced to draw a conclusion from this extension.

	Dependent variable:f_unpaidwk2000_to_2019
	(1)
Intercept	-24.474*
	(14.059)
economic_complexity	-0.778***
	(0.267)
fertility2019	0.309
	(0.701)
ln_income	10.813***
	(3.017)
ln_income_squared	-0.650***
	(0.174)
plow	-1.208
	(1.212)
political_hierarchies	1.089*
	(0.609)
Observations	83
R^2	0.256
Adjusted R^2	0.198
Residual Std. Error	3.360 (df=76)
F Statistic	4.780*** (df=6; 76)
Note:	*p<0.1; **p<0.05; ***p<0.01

3. What are the most interesting historical controls from The Ethnographic Atlas by GP Murdock

- To answer this question we have done a systematic analysis of all the variables in the Atlas, greedily selecting according to r^2



Challenges with The Ethnographic Atlas

Missing dataset to combine ethnographic data with modern day country data ("Ethnologue", only for free for Harvard faculty).

- Geographical approximation.
- Majority. vote on most frequent value

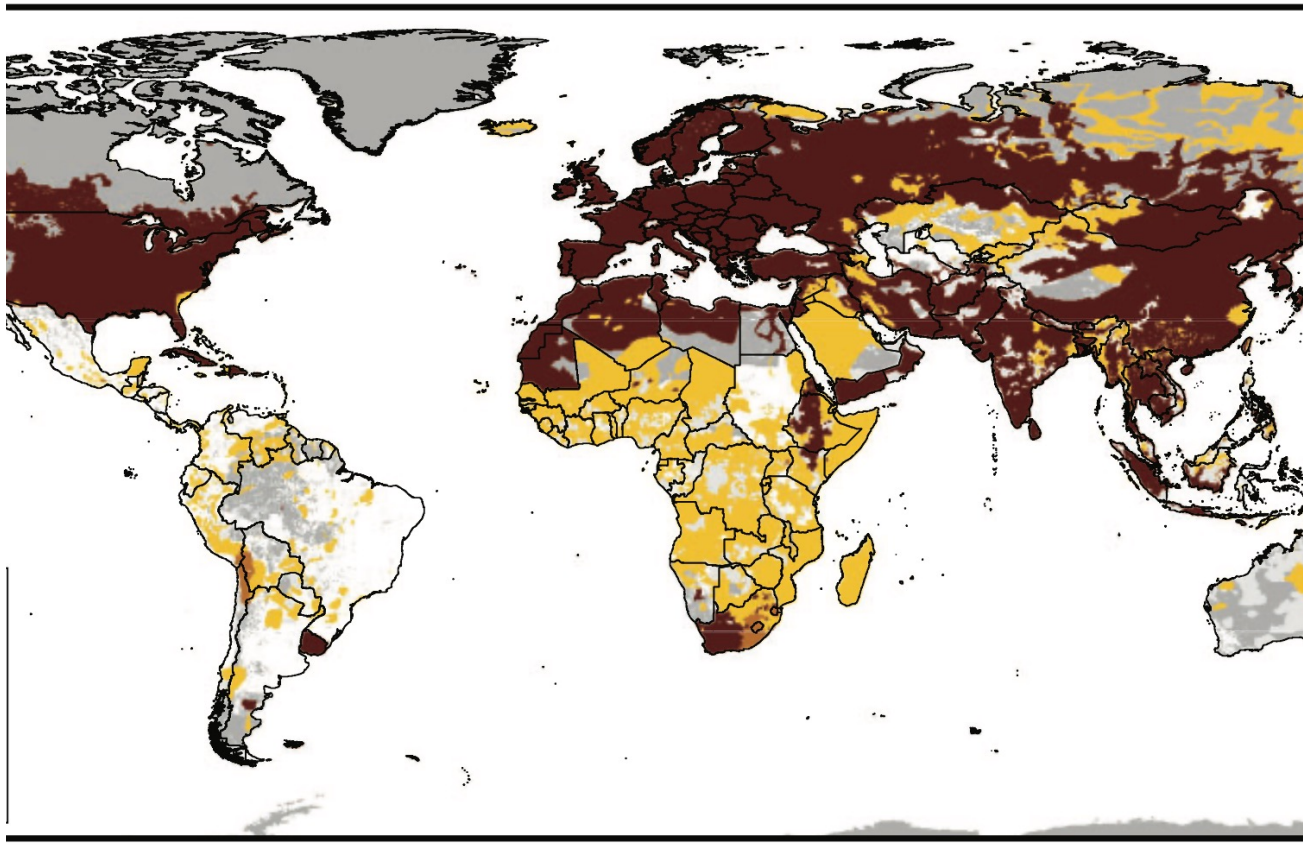
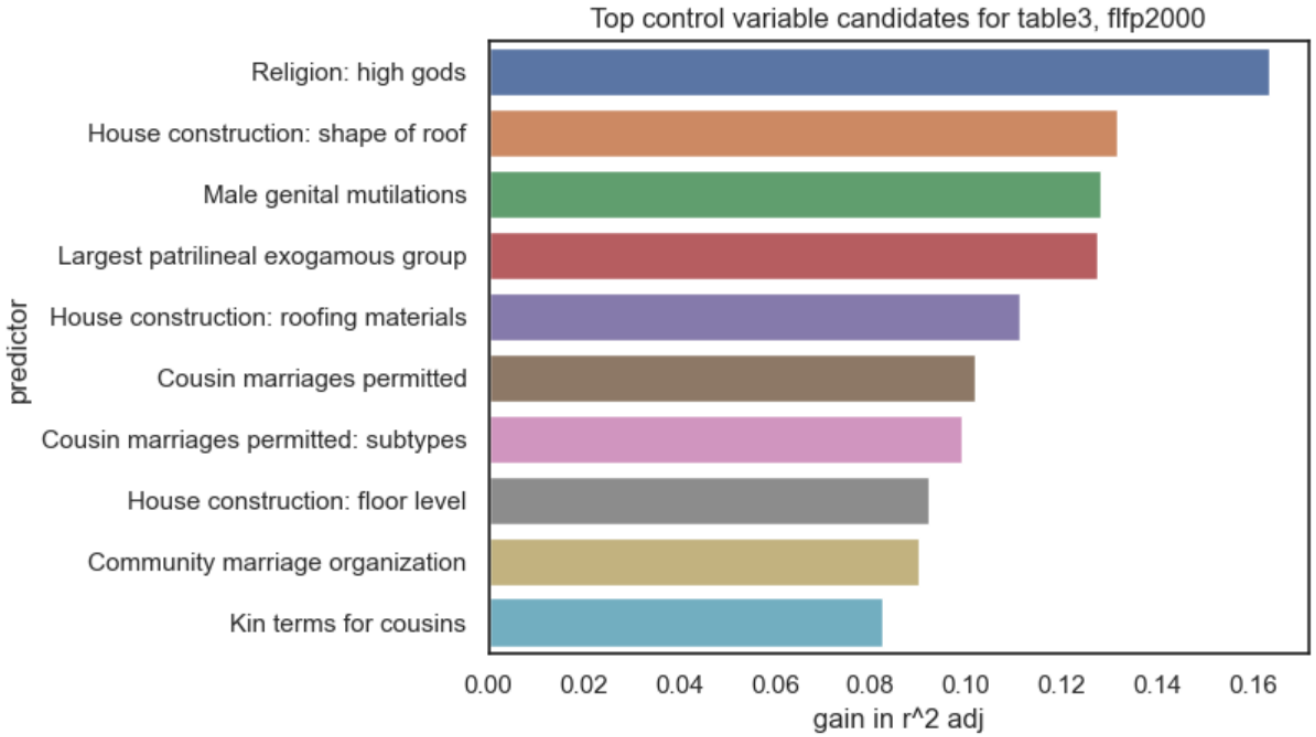


FIGURE II

Traditional Plough Use among the Ethnic/Language Groups Globally

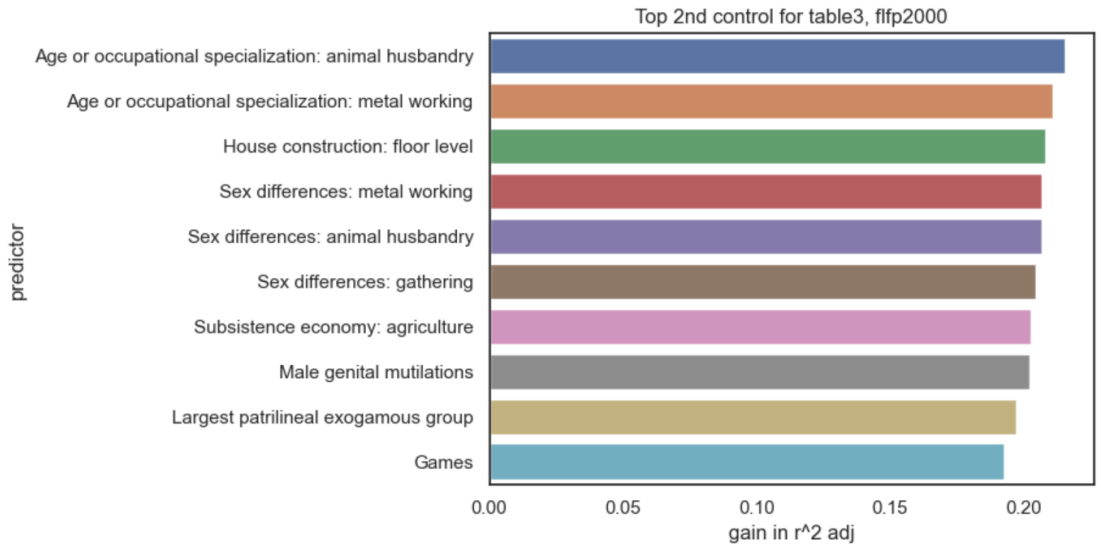
The most interesting historical controls

- For each of the 94 variables in the ethnographic atlas that were not in the dataset, we have included them in the regression equation for table 3 and have noted the gain in r^2 of the model
  - A higher r^2 value means that a given control would have more explanatory power for the outcome of female labour force participation.
  - We have also calculated a VIF score (for multicollinearity) although, due to discretization we couldn't observe significant increases in that, so we don't report
- The results are interesting statistically, but of course controls should also be based on domain knowledge as well which we lack.

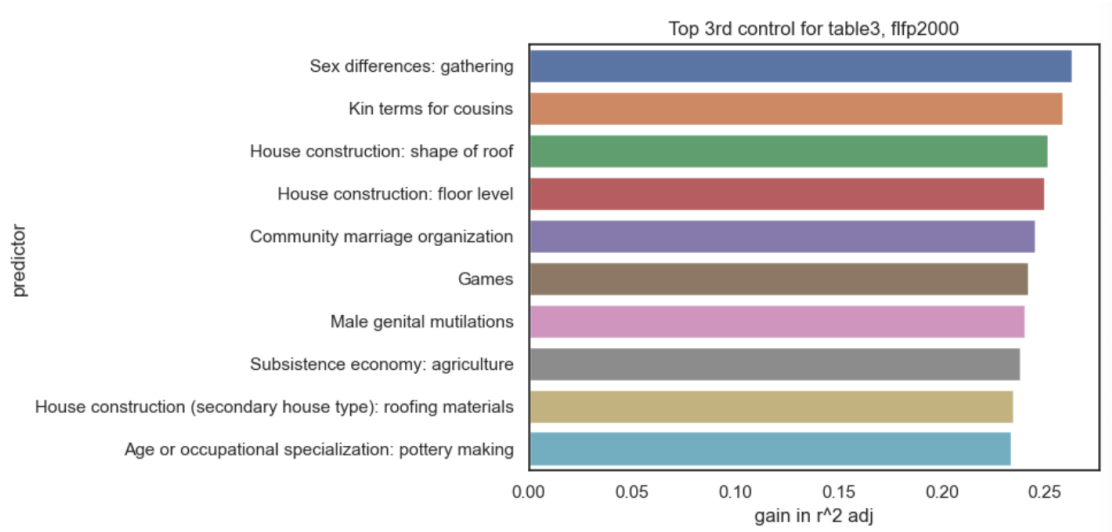


The most interesting historical controls

2nd control for table 3: Animal Husbandry



3rd control for table 3: Sex differences in gathering



Robustness of plough vs female labor participation with new controls

- The effect of the plough is robust to the additional controls found.
- We can see that the power of the plough as predictor increases when the other relevant historical controls are considered.
  - This could be due to i.e. overfitting.

	1st control	1st + 2nd	1st + 2nd + 3rd
Intercept	53.922***	54.826***	53.533***
	(7.928)	(7.734)	(8.600)
agricultural_suitability	11.687***	10.227**	7.734*
	(4.447)	(4.298)	(4.568)
economic_complexity	-0.695	-0.396	-0.204
	(0.915)	(0.922)	(0.910)
large_animals	15.462***	7.766	4.276
	(5.423)	(7.138)	(8.014)
plow	-17.630***	-19.555***	-23.373***
	(4.413)	(3.762)	(3.530)
political_hierarchies	2.658	2.532	4.151**
	(1.992)	(1.840)	(1.828)
tropical_climate	-13.923***	-14.977***	-18.236***
	(3.471)	(3.231)	(3.479)
Observations	128	128	128
R^2	0.409	0.471	0.543
Adjusted R^2	0.358	0.410	0.458
Residual Std. Error	13.701 (df=117)	13.134 (df=114)	12.594 (df=107)
F Statistic	8.929*** (df=10; 117)	9.310*** (df=13; 114)	50.171*** (df=20; 107)
Note:			*p<0.1; **p<0.05; ***p<0.01

THANK YOU

Appendix

Table 1

TABLE I

TRADITIONAL PLOUGH USE AND FEMALE PARTICIPATION IN PRE-INDUSTRIAL AGRICULTURE

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent variable: Traditional participation of females relative to males in the following tasks:						
	Overall agriculture		Land clearance	Soil preparation	Planting	Crop tending	Harvesting
Mean of dep. var.	3.04	2.83	1.45	2.15	2.86	3.16	3.23
Traditional plough agriculture	−0.883***	−1.136***	−0.434**	−1.182***	−1.290***	−1.188***	−0.954***
	(0.225)	(0.240)	(0.197)	(0.320)	(0.306)	(0.351)	(0.271)
Ethnographic controls	yes	yes	yes	yes	yes	yes	yes
Observations	660	124	129	124	131	122	131
Adjusted R-squared	0.13	0.19	0.14	0.10	0.09	0.13	0.16
R-squared	0.14	0.23	0.18	0.14	0.13	0.18	0.20

Notes. The unit of observation is an ethnic group. In column 1, ethnic groups are from the *Ethnographic Atlas*, and in columns 2–7, they are from the *Standard Cross-Cultural Sample*. The dependent variable measures traditional female participation in a particular agricultural activity in the pre-industrial period. The variables take on integer values between 1 and 5 and are increasing in female participation. "Traditional plough use" is an indicator variable that equals one if the plough was traditionally used in pre-industrial agriculture. For the *Ethnographic Atlas*, the mean (and standard deviation) of the traditional plough agriculture variable is 0.186 (0.390), and for the *SCCS* it is 0.234 (0.425); these correspond to the samples from columns 1 and 2, respectively. The same statistics for the other columns are slightly different. "Ethnographic controls" include: the suitability of the local environment for agriculture, the presence of large domesticated animals, the proportion of the local environment that is tropical or subtropical, an index of settlement density, and an index of political development. Finer details about variable construction are provided in the text and appendix. Coefficients are reported with robust standard errors in brackets. Column 1 reports Conley standard errors adjusted for spatial correlation. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

The first principles of causal inference

1. Establish a link between A and B
2. Establish the individual effect between A and B. Deal with confounders (endogeneity) affecting A and B.
    1. Add observed control variables
    2. Absorb unobserved variables
        1. Fixed effects
        2. Instrumental variable analysis

Controlling for confounders

- Means just including them in the regression

Finding data challenges

- For USA we found female labour participation to be:
  - 57.4% on US bureau of labour statistics, 2019,
  - 67.9% in the wordl bank ILO estimate , 2019
  - 69.9% World bank 15-65 years, year 2000 (same as cross country)
  - 59.5% Cross country dataset, year 2000
  - 61% year Population reference bureau, 2000
  - 59.0% World bank, women 15+, year 2000
- Hard to find novel explanatory variables in the existing datasets (as they were explored already in the paper)

Additional stuff

- Children of immigrants – is controlling for a variable(?)
  - Is this just a new dataset that confirms what can be seen with the fixed effects?
  - Fixed effects don't allow you to see the national / continent differences, and this experiment was needed to confirm the effect (small) effect of the host country to these sticky cultural beliefs?
  - They showed that country fixed effects don't make a difference. And they confirmed when they looked at the children of immigrants, that it was more the plough culture that made a difference rather than the country they immigrated to.

Controlling for unobserved confounders

- Fixed effects control (absorb) for time-invariant unobserved confounders
  - "Fixed effects is a method that is used to control for unobserved confounders. The idea behind fixed effects is to include a variable in the analysis that represents the specific unit of observation (such as a person or a company) and to treat this variable as fixed across all observations. In this way, any unobserved factors that are specific to each unit of observation are absorbed into the fixed effects term, and the remaining variation in the outcome variable can be attributed to the variables of interest. This method can be useful in cases where there are many unobserved confounders that are specific to each unit of observation and would be difficult to control for directly."
  - Continent fixed effects
  - Individual country level fixed effects
- Instrumental variable analysis, a.k.a. use an exogenous instrument to estimate the effect of A on B
  - Instrumental variable analysis is a method that is used to control for unobserved confounders. The idea behind instrumental variable analysis is to use an external variable that is related to the exposure of interest (A), but not directly related to the outcome of interest (B), and use it as an "instrument" to estimate the causal effect of A on B. The assumption behind this method is that the instrument only affects the exposure through its relationship with the unobserved confounder, and thus it can be used to estimate the causal effect of A on B while controlling for the unobserved confounder.
  - It's worth noting that the method of instrumental variable analysis is also used when there is a lack of a direct relationship between the exposure and outcome variables, also known as two-stage least squares method.

R^2 shows how much the control variables are enough to explain the outcomes

- When adding the continent fixed effects, which is supposed to inlcude every possible fixed effect, we see we don't gain that much more R^2 --> the control variables capture a significant amount of the fixed variablity

The problem with panel data

- Autocorrelation and other ways that the regression coefficients will be biased and unreliable.

Table III

- Continent fixed effects absorbed the presence of large animals.
  - Large animals were absorbing some effects that were more due to the continent that the countries were present in. Probs. Because large domesticated animals and continent are correlated
  - If you look within a continent, when you add large animals, it doesn't predict an increase in labor force and political positions.
- Robust standard errors $\{n/(n-k)\}u_j^2$
  - as an estimate of the variance of the jth observation, where u_j is the calculated error and n/(n − k) is included to improve the overall estimate's small-sample properties. N is the number of samples, and k is the number of parameters estimated. Heteroskedasticity is a common problem in the social sciences, where it's harder to assume normally distributed errors, due to the unknown numbers of unobserved covariates. Non-normal errors obviously make the standard error (based on the mean) not robust to another (i.e. tailed) distribution, in general causing one to underestimate the error and thus erroneously underestimate p values (error is used to calc p value). This simple correction increases the error proportional to how many k parameters are estimated.