

Geneva Graduate Institute (IHEID)

Econometrics I (EI035), Fall 2024

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Midterm Exam

Monday, 4 November

- You have 1h 30min.
- There are 51 points in total.
- Prepare concise answers.
- State clearly any additional assumptions, if needed.
- For full credit, you need to explain your answers.

Problem 1 (25 points)

Suppose $\mathbb{E}[X] = \theta$ and $\mathbb{V}[X] = \sigma^2$ for some known σ^2 . Suppose we observe n i.i.d. observations of the random variable X , denoted by $\{x_i\}_{i=1}^n$.

- (a) (3 points) Define and derive the Ordinary Least Squares (OLS) estimator of θ , $\hat{\theta}_{OLS}$.
- (b) (4 points) What can you say about the (finite sample) distribution of $\hat{\theta}_{OLS}$? Is $\hat{\theta}_{OLS}$ unbiased?
- (c) (6 points) What is the asymptotic distribution of $\hat{\theta}_{OLS}$? Is $\hat{\theta}_{OLS}$ consistent?
- (d) (6 points) Set up the two-sided t-test with size $\alpha = 0.05$ for testing $\mathcal{H}_0 : \theta_0 = 0$ against $\mathcal{H}_1 : \theta_0 \neq 0$. More concretely, defining the test as

$$\varphi_t = \mathbf{1} \{T(X) < c_\alpha\} ,$$

define the test-statistic $T(X)$ and find the critical value c_α .

Hint: To find c_α , you need to use the definition of a size α -test and the distribution of $T(X)$ under \mathcal{H}_0 . Thereby, you may not know the corresponding finite sample distribution, but you might know the asymptotic distribution, allowing you to construct an asymptotically valid test.

- (e) (6 points) Based on your t-test, find an expression for the 95% confidence interval for θ , $C(X)$. What happens with $C(X)$ as n increases? What happens with $C(X)$ as σ increases? Discuss.

Problem 2 (26 points)

This problem asks you to investigate some results from the paper Alesina, Giuliano & Nunn (2013): “On the Origins of Gender Roles: Women and the Plough,” *Quarterly Journal of Economics*, 128(2), 469-530. We will focus on Tables 3 and 4. For some context, here is the abstract of the paper:

The study examines the historical origins of existing cross-cultural differences in beliefs and values regarding the appropriate role of women in society. We test the hypothesis that traditional agricultural practices influenced the historical gender division of labor and the evolution of gender norms. We find that, consistent with existing hypotheses, the descendants of societies that traditionally practiced plough agriculture today have less equal gender norms, measured using reported gender-role attitudes and female participation in the workplace, politics, and entrepreneurial activities. Our results hold looking across countries, across districts within countries, and across ethnicities within districts. To test for the importance of cultural persistence, we examine the children of immigrants living in Europe and the United States. We find that even among these individuals, all born and raised in the same country, those with a heritage of traditional plough use exhibit less equal beliefs about gender roles today.

For now, we focus on Table 3 (see Fig. 1), which contains 8 different regressions along columns. The regressions are ran using observations for different countries. You can see the description of the variables used in the regressions in the notes at the bottom of the table.

- (a) (3 points) What is an R^2 (R-squared)? What does the value of 0.22 in regression 1 indicate?
- (b) (3 points) The coefficient for the variable “Traditional plough use” in regression 1 is equal to -14.895. How do you interpret this number?
- (c) (4 points) The standard error corresponding to the coefficient mentioned in the previous exercise is given in parentheses below the coefficient. It is equal to 3.318. How do you interpret this number?
- (d) (4 points) Relative to regression 1, regression 2 adds “continent fixed effects”, i.e. a dummy variable for each continent, which shows a 1 if country i is in that particular continent and a 0 otherwise. What does it mean to include such covariates in the regression?

Now focus on Table 4 (see Figs. 2 and 3), which adds two more covariates to each regression from Table 3: the logarithm of income in the year 2000 as well as the squared logarithm of income in the year 2000.

- (e) (6 points) Based on the results in regression 1, what is the expected change (in percentage points) in female labor force participation (in the year 2000) if income (in the year 2000) increases by 5%? Does that effect depend on the level of income in 2000?
- (f) (6 points) Can we credibly interpret the effect of “Traditional plough use” on the share of political positions held by women (in the year 2000) from regression 6 as causal? Discuss.

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*** (3.318)	−15.962*** (3.881)	−16.243*** (3.854)	−17.806*** (4.475)	−2.522 (1.967)	−2.303 (2.353)	−0.736*** (0.084)	−0.920*** (0.100)
<i>Historical controls:</i>								
Agricultural suitability	9.407** (3.885)	9.017** (4.236)	1.514 (5.358)	4.619 (5.836)	1.009 (2.799)	−0.687 (2.925)	0.312** (0.129)	0.325** (0.133)
Tropical climate	−8.644*** (2.698)	−12.389*** (3.302)	−11.091*** (3.608)	−3.974 (5.542)	−7.671*** (2.370)	−5.618** (2.265)	−0.322*** (0.083)	−0.004 (0.102)
Presence of large animals	10.903** (5.032)	2.35 (5.956)	−0.649 (9.130)	4.475 (10.034)	−9.152** (4.052)	−7.338 (4.774)	0.174 (0.111)	0.296** (0.145)
Political hierarchies	−0.787 (1.622)	0.447 (1.624)	1.502 (1.845)	0.52 (1.773)	0.906 (0.740)	0.699 (0.777)	0.080** (0.040)	0.062 (0.043)
Economic complexity	0.170 (0.849)	1.157 (0.859)	1.810* (1.023)	0.517 (1.351)	1.082** (0.491)	0.727 (0.510)	0.048** (0.021)	0.018 (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

Notes. OLS estimates are reported with robust standard errors in brackets. The unit of observation is a country. “Traditional plough use” is the estimated proportion of citizens with ancestors that used the plough in pre-industrial agriculture. The variable ranges from 0 to 1. The mean (and standard deviation) for this variable is 0.522 (0.473); this corresponds to the sample from columns 1 and 2. “Female labor force participation” is the percentage of women in the labor force, measured in 2000. The variable ranges from 0 to 100. “Share of firms with female ownership” is the percentage of firms in the World Bank Enterprise Surveys with some female ownership. The surveys were conducted between 2003 and 2010, depending on the country. The variable ranges from 0 to 100. “Share of political positions held by women” is the proportion of seats in parliament held by women, measured in 2000. The variable ranges from 0 to 100. The number of observations reported for the AES is the average number of observations in the regressions for the three outcomes. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Figure 1: Table 3 from Alesina, Giuliano & Nunn (2013)

TABLE IV
COUNTRY-LEVEL OLS ESTIMATES WITH HISTORICAL AND CONTEMPORARY 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.	51.35		35.17		11.83		2.31	
Traditional plough use	–12.401*** (2.964)	–12.930*** (3.537)	–15.241*** (4.060)	–16.587*** (4.960)	–4.821*** (1.782)	–5.129** (2.061)	–0.743*** (0.080)	–0.845*** (0.091)
<i>Historical controls:</i>								
Agricultural suitability	6.073 (3.696)	7.181* (4.175)	0.803 (5.447)	4.322 (6.071)	2.198 (2.605)	1.081 (2.548)	0.262* (0.139)	0.342** (0.139)
Tropical climate	–9.718*** (2.487)	–10.906*** (3.070)	–10.432*** (3.762)	–3.712 (5.711)	–6.086*** (2.094)	–4.169* (2.396)	–0.362*** (0.084)	–0.06 (0.101)
Presence of large animals	–2.015 (5.372)	–2.166 (6.072)	2.707 (9.745)	5.610 (10.417)	–5.718 (3.565)	–4.688 (4.132)	0.005 (0.121)	0.201 (0.146)
Political hierarchies	0.779 (1.515)	1.181 (1.482)	1.128 (1.941)	0.207 (1.878)	0.744 (0.822)	0.656 (0.807)	0.102** (0.040)	0.070* (0.042)
Economic complexity	1.157 (0.793)	1.411* (0.815)	1.693 (1.129)	0.764 (1.382)	0.454 (0.487)	0.333 (0.502)	0.063*** (0.023)	0.027 (0.026)

Figure 2: First Part of Table 4 from Alesina, Giuliano & Nunn (2013)

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TABLE IV
(CONTINUED)

	(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	Share of firms with female ownership, 2003–2010	Share of political positions held by women in 2000	Average effect size (AES)		
<i>Contemporary controls:</i>								
ln income in 2000	-34.612*** (6.528)	-32.685*** (7.023)	10.766 (9.986)	6.385 (10.482)	-6.530 (4.071)	-6.616 (4.335)	-0.776*** (0.221)	-0.815*** (0.231)
ln income in 2000 squared	2.038*** (0.406)	1.936*** (0.431)	-0.707 (0.688)	-0.523 (0.706)	0.539** (0.271)	0.535* (0.281)	0.051*** (0.015)	0.051*** (0.015)
Continent fixed effects	no	yes	no	yes	no	yes	no	yes
Observations	165	165	123	123	144	144	144	144
Adjusted R-squared	0.37	0.36	0.11	0.13	0.27	0.27	0.26	0.30
R-squared	0.40	0.41	0.16	0.22	0.31	0.34	0.28	0.33

Notes. OLS estimates are reported with robust standard errors in brackets. The unit of observation is a country. "Traditional plough use" is the estimated proportion of citizens with ancestors that used the plough in pre-industrial agriculture. The variable ranges from 0 to 1. The mean (and standard deviation) of this variable is 0.525 (0.472); this corresponds to the sample from columns 1 and 2. "Female labor force participation" is the percentage of women in the labor force, measured in 2000. The variable ranges from 0 to 100. "Share of firms with female ownership" is the percentage of firms in the World Bank Enterprise Surveys with some female ownership. The surveys were conducted between 2003 and 2010, depending on the country. The variable ranges from 0 to 100. "Share of political positions held by women" is the proportion of seats in parliament held by women, measured in 2000. The variable ranges from 0 to 100. The number of observations reported for the AES is the average number of observations in the regressions for the three outcomes. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Figure 3: Second Part of Table 4 from Alesina, Giuliano & Nunn (2013)