Geneva Graduate Institute (IHEID)

Econometrics I (EI035), Fall 2024

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Midterm Exam Solutions

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, $\hat{\theta}_{OLS}$.

Solution:

$$\hat{\theta}_{OLS} := \arg\min_{\theta \in \Theta} \sum_{i=1}^{n} (x_i - \theta)^2 = \arg\min_{\theta \in \Theta} (x - \theta)'(x - \theta) \ . \quad [\mathbf{1p}]$$

Using scalar-notation, we get the First Order Condition (FOC)

$$\begin{aligned} 0 = \frac{\partial}{\partial \theta} \sum_{i=1}^{n} (x_i - \theta)^2 &= -2 \sum_{i=1}^{n} (x_i - \theta) \\ &= -2 \left(\sum_{i=1}^{n} x_i - \sum_{i=1}^{n} \theta \right) \\ &= -2(n\bar{X} - n\theta) \ , \quad [\mathbf{1p}] \end{aligned}$$

implying that

$$\hat{\theta}_{OLS} = \bar{X} \equiv \frac{1}{n} \sum_{i=1}^{n} x_i \ . \quad [\mathbf{1p}]$$

Alternatively, using vector notation:

$$\begin{aligned} 0 = \frac{\partial}{\partial \theta}(x - \theta)'(x - \theta) &= -2i'(x - \theta) \\ &= -2x'i + 2\theta' i \\ &= -2n\bar{X} + 2n\bar{\theta} \ , \end{aligned}$$

where ι is a vector of ones. This implies again $\hat{\theta}_{OLS} = \bar{X}$.

(b) (4 points) What can you say about the (finite sample) distribution of $\hat{\theta}_{OLS}$? Is $\hat{\theta}_{OLS}$ unbiased?

Solution: With the information provided – $\{x_i\}_{i=1}^n$ is an i.i.d. sample of n realizations ofthe RV X with $\mathbb{E}[X] = \theta$ and $\mathbb{V}[X] = \sigma^2$ –, we know the mean and variance of the OLS estimator:

$$\begin{aligned} \mathbb{E}[\hat{\theta}_{OLS}] &= \mathbb{E}\left[\frac{1}{n}\sum_{i=1}^{n} x_i\right] = \frac{1}{n}\mathbb{E}\left[\sum_{i=1}^{n} x_i\right] = \frac{1}{n}\sum_{i=1}^{n} \mathbb{E}[x_i] = \frac{1}{n} n\theta = \theta \ , \quad [\mathbf{1p}] \\ \mathbb{V}[\hat{\theta}_{OLS}] &= \mathbb{V}\left[\frac{1}{n}\sum_{i=1}^{n} x_i\right] = \frac{1}{n^2}\mathbb{V}\left[\sum_{i=1}^{n} x_i\right] = \frac{1}{n^2}\sum_{i=1}^{n} \mathbb{V}[x_i] = \frac{1}{n^2} n\sigma^2 = \frac{\sigma^2}{n} \ . \quad [\mathbf{1p}] \end{aligned}$$

Because $\mathbb{E}[\hat{\theta}_{OLS}] = \theta$, $\hat{\theta}_{OLS}$ is indeed unbiased. $[\mathbf{1p}]$

Unless we make a specific assumption on the distribution of the random sample $\{x_i\}_{i=1}^n$, we cannot determine the exact distribution of the estimator $\hat{\theta}$. For instance, if we assume that $x_i \sim N(\theta, \sigma^2)$, then also $\hat{\theta}$ is normally distributed with the above mean and variance. **[1p]**

(c) (6 points) What is the asymptotic distribution of $\hat{\theta}_{OLS}$? Is $\hat{\theta}_{OLS}$ consistent?

Solution: Given that the sample is i.i.d., we can invoke the WLLN, which states that sample averages converge in probability to the respective population mean:

$$\hat{\theta}_{OLS} = \frac{1}{n}\sum_{i=1}^n x_i \xrightarrow{p} \mathbb{E}[x_i] = \theta \ ,$$

proving that $\hat{\theta}_{OLS}$ is consistent. **[3p]**

Given that the sample is i.i.d., we can invoke the CLT, which states that the difference between the sample average and correspoonding population mean, when standardized by $\sqrt{n}$ converges to a Normal distribution:

$$\sqrt{n}(\frac{1}{n}\sum_{i=1}^n x_i - \mathbb{E}[x_i]) \xrightarrow{d} N(0, \mathbb{V}[x_i]) \ ,$$

i.e.

$$\sqrt{n}(\hat{\theta}_{OLS} - \theta) \xrightarrow{d} N(0, \sigma^2) \ . \quad \textbf{[3p]}$$

(d) (6 points) Set up the two-sided t-test with size $\alpha = 0.05$ for testing $\mathscr{H}_0 : \theta_0 = 0$ against $\mathscr{H}_1 : \theta_0 \neq 0$. More concretely, definining 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 $\mathscr{H}_0$. 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.

Solution The test-statistic of a two-sided t-test for testing whether the true value of θ is equal to $\theta_0 = 0$ is

$$T(x) = \left| \frac{\hat{\theta}_{OLS} - \theta_0}{\sigma/\sqrt{n}} \right| = \left| \frac{\hat{\theta}_{OLS}}{\sigma/\sqrt{n}} \right| \ . \quad \textbf{[2p]}$$

Based on $\sqrt{n}(\hat{\theta}_{OLS} - \theta) \xrightarrow{d} N(0, \sigma^2)$, we can argue that $\hat{\theta}_{OLS} \overset{approx.}{\sim} N(\theta, \sigma^2/n)$ in finite samples. Similarly, under the null hypothesis that $\theta = \theta_0$,

$$\frac{\sqrt{n}}{\sigma}(\hat{\theta}_{OLS} - \theta_0) = \frac{\hat{\theta}_{OLS} - \theta_0}{\sigma/\sqrt{n}} \xrightarrow{d} N(0, 1) \ ,$$

based on which we can argue that $\dfrac{\hat{\theta}_{OLS}-\theta_0}{\sigma/\sqrt{n}} \overset{approx.}{\sim} N(0,1)$ already in finite samples. **[2p]**

(Alternatively, if $\theta=\tilde{\theta}$ is the true value, then we would get

$$\frac{\hat{\theta}_{OLS}-\theta_0}{\sigma/\sqrt{n}} \xrightarrow{d} N(\tilde{\theta}-\theta_0, 1)$$

instead.)

The size of the test is given by the probability of false rejection, i.e. the probability that $\varphi=0$ when the true θ is indeed equal to $\theta_0=0$:

$$\begin{aligned}
\alpha =&\beta(\theta_0)\\
=&\mathbb{P}[\varphi=0|\theta=\theta_0]\\
=&1-\mathbb{P}[\varphi=1|\theta=\theta_0]\\
=&1-\mathbb{P}\left[|T(X)|\leq c_\alpha\right]\\
=&1-\mathbb{P}\left[-c_\alpha \leq \frac{\hat{\theta}_{OLS}-\theta_0}{\sigma/\sqrt{n}} \leq c_\alpha \mid \theta=\theta_0\right]\\
=&1-\mathbb{P}[-c_\alpha\leq Z\leq c_\alpha]\\
=&1-[\Phi(c_\alpha)-\Phi(-c_\alpha)]\\
=&2(1-\Phi(c_\alpha))\ ,
\end{aligned}$$

where Φ is the standard Normal cdf. Under $\alpha=0.05$, we get the critical value $c_\alpha=1.96$. **[2p]**

(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.

Solution: We know this 95% CI is the set of values for θ_0 which we could accept given our estimate $\hat{\theta}_{OLS}$, i.e. it is the set of θ_0s that satisfy

$$-c_{0.05} \leq \frac{\hat{\theta}_{OLS}-\theta_0}{\sigma/\sqrt{n}} \leq c_{0.05}\ . \quad \textbf{[2p]}$$

(1.5p if not commented on what this set represents) This yields

$$C(X) := \{\theta_0\in\Theta|\varphi(x;\theta_0)=1\} = \left[\hat{\theta}_{OLS}-1.96\frac{\sigma}{\sqrt{n}}, \hat{\theta}_{OLS}+1.96\frac{\sigma}{\sqrt{n}}\right]\ . \quad \textbf{[2p]}$$

The width of the CI is increasing in σ and decreasing in n. Both parameters influence the standard error of the estimator $\hat{\theta}$. The higher the population variance σ^2, the higher the uncertainty around the point estimate of θ, *ceteris paribus*. On the other hand, the higher our sample size n, the more precise is our estimator $\hat{\theta}$ and the narrower the resulting CI. [**2p**] **(1p if only stated mathematical result that CI shrinks/widens without intuition)**

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?

Solution: The R^2 is a statistic between 0 and 1 representing the portion of the sum of squares (variance) of the dependent variable y that is explained by the explanatory variables X under a particular model (here the linear regression model). **[1p]** More precisely, we can decompose the dependent variable $y_i = \hat{y}_i + \hat{u}_i$ into the predicted value $\hat{y}_i$ and the sample residual term $\hat{u}_i$. In matrix notation, this is

$$Y = \hat{Y} + \hat{U} \; .$$

Based on this, we define the total sum of squares (SST) of the dependent variable $Y'Y$, the explained sum of squares (SSE) $\hat{Y}'\hat{Y}$ and the sum of squared residuals (SSR) $\hat{U}'\hat{U}$ and one can show that

$$Y'Y = \hat{Y}'\hat{Y} + \hat{U}'\hat{U} \; .$$

The R^2 is then

$$R^2 = \frac{SSE}{SST} = \frac{\hat{y}'\hat{y}}{y'y} = 1 - \frac{SSR}{SST} = 1 - \frac{\hat{u}'\hat{u}}{y'y} \; . \quad \textbf{[1p]}$$

An R^2 of 0.22 implies that 22% of the sum of squares of the dependent variable is explained by the explanatory variables. **[1p] (3p as long as both a general explanation of R^2 (with or without formula) + explanation of the concrete 0.22 in this regression**

were given, -1p if either is missing)

(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?

Solution: To understand the effect, it is important to know the units of the variables *traditional plough use* and *female labor force participation in 2000*. The former is measured in percent, ranging from 0 to 1, the latter in percent, but ranging from 0 to 100. Hence, a 1 unit (or 100 percentage point (pp)) increase in the (estimated) proportion of citizens with ancestors that used the plough in pre-industrial agriculture is associated with a 15 pp decrease in the female labor force participation rate in 2000. **[3p]**

(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?

Solution: The standard error of an estimator $\hat{\beta}_j$ shows how precisely $\hat{\beta}_j$ estimates the true parameter β_j. More precisely, it shows the (estimated) standard deviation of $\hat{\beta}_j$ in repeated sampling. Even more precisely, it shows the number we would get if we were to repeatedly draw different samples from some underlying population, compute our estimate for each of them and compute the standard deviation of these different estimates. **[2p] for what the SE is**

Assuming that the estimator $\hat{\beta}_j$ is normally distributed (which we do based on the result that it is indeed Normally distributed asymptotically), the absolute value of our estimate $\hat{\beta}_j$ divided by its standard error, is equal to the t-statistic for testing whether the true value of β_j is equal to zero. In this case, we get

$$\left|\frac{\hat{\beta}_j}{SE(\hat{\beta}_j)}\right| = \left|\frac{-14.895}{3.318}\right| = 4.489 \ ,$$

which lets us conclude that the true β_j is significantly different from zero at all commonly used significance levels. (Similarly, we could test whether β_j is equal to any other number by subracting this number in the numerator.)

Under the same assumptions, we can construct a 95% CI for the true coefficient β_j based on the point estimate $\hat{\beta}_j$ and its standard error. We get

$$[14.895 - 1.96 \times 3.318 \ \ , \ 14.895 + 1.96 \times 3.318] = [8.268 \ \ , \ 21.522] \ .$$

[2p] for interpretation of what one can do with the SE (no need to mention CI, significance is enough)

(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?

Solution: This means that we include a separate intercept for every continent, accounting for the fact that, for the same level of traditional plough usage, different continents tend to have different female labor force participation rates. To see this, suppose for simplicity that there are only two continents, A and B. Including continent dummies means estimating

$$y_i = \beta_0 + \beta_1 \, \mathbf{1}\{i \text{ is in cont. } B\} + z_i'\gamma + u_i \ ,$$

where z_i are other covariates. Because of multicollinearity, if we have an (unconditional) intercept β_0, we cannot include both continent dummies, but only one of them. Under this specification, the intercept for countries i in continent A is β_0, while that for countries in continent B is $\beta_0 + \beta_1$. (Alternatively, we could drop the constant and include both dummies, leading to the same conclusion that we have separate intercepts for each continent.) **[3p]**

Because we do not interact the variable *traditional plough use* with these continent dummies, we keep the assumption that the effect of traditional plough use on female labor force participation is the same for every continent. We only account for differences in levels across continents. **[1p]**

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 pps) 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?

Solution: We are estimating a regression of the form

$$y_i = \beta_0 + \beta_1 x_i + \beta_2 x_i^2 + z_i'\gamma + u_i \ ,$$

where x_i is the log of income in 2000 and z_i are other covariates. We can write $x_i = \log inc_i$. We get the following marginal effect of increasing x_i on y_i:

$$\frac{\partial y_i}{\partial x_i} = \beta_1 + 2\beta_2 x_i \ .$$

Because $\partial x_i / \partial inc_i = 1/inc_i$, we get the following marginal effect of increasing inc_i on y_i:

$$\frac{\partial y_i}{\partial inc_i} = \frac{\partial y_i}{\partial x_i}\frac{\partial x_i}{\partial inc_i} = (\beta_1 + 2\beta_2 x_i)\frac{1}{inc_i} \quad \text{i.e.} \quad \Delta y_i \approx (\beta_1 + 2\beta_2 x_i)\frac{\Delta inc_i}{inc_i} \ . \quad \textbf{[2p]}$$

Therefore, a 5% increase in inc_i – $\Delta inc_i / inc_i = 0.05$ – is estimated to lead to a change in female labor force participation of $0.05(\hat{\beta}_1 + 2\hat{\beta}_2 x_i) = 0.05(34.61 + 2 \times 2.04 x_i)$ pps. **[2p]** This effect clearly depends on $x_i = \log inc_i$ and therefore inc_i, the level of income in 2000. It is stronger if the latter is higher. **[2p]**

(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.

Solution: The estimator from the linear regression estimates the "true" causal effect of traditional plug use on female labor force participation only if the estimated model is correctly specified **[2p]**. More concretely, this requires that i) indeed female labor force participation y_i is a linear function of traditional plough use and the other included explanatory variables **[1p]** and ii) the resulting error term from such a linear model, $u_i = y_i - x_i'\beta$ (i.e. the part of y_i not accounted for linearly by these explanatory variables), is uncorrelated with these explanatory variables: $\mathbb{E}[x_i' u_i] = 0$. If the error term is correlated with at least one of the regressors, then our estimate of the effect is biased and inconsistent. This happens, for example, if we omitted some variable that affects female labor force participation y_i and is correlated with one of the regressors. It also happens if we measured traditional plough use with an error. **[2p]**

Taken together, the assumptions that the relationship between y_i and x_i is linear, that we did not leave out any relevant variables correlated with x_i and that there are no measurement errors appear quite restrictive. (In particular, as the authors acknowledge in the notes below the tables, the variable *traditional plough use* is estimated and therefore surely measured with error.) This prevents us to attach a causal interpretation to the estimate(s). Instead, we can take them as a partial correlation analysis that suggests that, even if various other explanatory variables are taken into account, there is still a significant (and economically meaningful) correlation between traditional plough use and female labor force participation. **[1p]**

(4p as long as you mentioned at least one of these issues and concluded that we cannot intrpret effect as causal)

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

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

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

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		Average effect size (AES)	
Contemporary controls:								
ln income in 2000	−34.612***	−32.685***	10.766	6.385	−6.530	−6.616	−0.776***	−0.815***
	(6.528)	(7.023)	(9.986)	(10.482)	(4.071)	(4.335)	(0.221)	(0.231)
ln income in 2000 squared	2.038***	1.936***	−0.707	−0.523	0.539**	0.535*	0.051***	0.051***
	(0.406)	(0.431)	(0.688)	(0.706)	(0.271)	(0.281)	(0.015)	(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)