Econ 113
Problem Set 3
Answer Key

June 4, 2014

Problem 1

Using wagepan2.dta from the course website, we will begin our study of panel econometrics by evaluating changes in industries on wage outcomes. Specifically, we will evaluate the following basic regression:

$$log(wage_{it}) = \beta_0 + \beta_{Manu} Manu_{it} + \beta_{Agri} Agri_{it} + u_{it}$$

Here, the natural log of wage in the dataset is already generated with "lwage". $Manu_{it}$ is a dummy variable that identifies whether the individual works in a manufacturing industry, and $Agri_{it}$ identifies whether the individual works in agriculture. If the individual works in neither, you may assume they work in services.

a. Please run this regression using pooled OLS, and interpret β_{Manu} and β_{Agri}.

CODE:
tsset nr year
reg lwage manuf agric

ANSWER:

Source	SS	df	MS
Model	19.6395688	2	9.81978439
Residual	288.279107	1197	.240834676
Total	307.918676	1199	.256812908

Number of obs =	1200
F(2, 1197) =	40.77
Prob > F =	0.0000
R-squared =	0.0638
Adj R-squared =	0.0622
Root MSE =	.49075

lwage	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
manuf	.2244387	.0316147	7.10	0.000	.1624123	.2864652
agric	-.3071753	.0678383	-4.53	0.000	-.4402705	-.17408
_cons	1.58124	.0173615	91.08	0.000	1.547177	1.615302

Holding all else constant, someone working in the manufacturing industry earns, on average, 22.4% more than they would working in the service industry.

Holding all else constant, someone working in the agriculture industry earns, on average, 30.7% less than they would working in the service industry.

b. Suppose that we wish to add individual effects, and we run:

$$log(wage_{it}) = \beta_0 + \beta_{Manu} Manu_{it} + \beta_{Agri} Agri_{it} + \alpha_i + u_{it}$$

Please eliminate the individual effect using first differences, and interpret β_{Manu} and β_{Agri} **precisely**. Please be sure to include all code used to run this regression.

CODE:
gen lwage_diff = D.lwage
gen manuf_diff = D.manuf
gen agric_diff = D.agric
reg lwage_diff manuf_diff agric_diff, noconstant

ANSWER:

Source	SS	df	MS
Model	1.32935425	2	.664677126
Residual	175.374884	1048	.167342446
Total	176.704238	1050	.168289751

Number of obs =	1050
F(2, 1048) =	3.97
Prob > F =	0.0191
R-squared =	0.0075
Adj R-squared =	0.0056
Root MSE =	.40908

lwage_diff	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
manuf_diff	.0853942	.0336366	2.54	0.011	.0193914	.1513969
agric_diff	-.0447453	.0644092	-0.69	0.487	-.1711309	.0816404

The estimates for β_{Manu} and β_{Agri} are .0791 and -.0353. To interpret these **precisely** we need to take the exponential and subtract 1 from each:

$$\hat{\beta}_{Manu} : e^{.0853942} - 1 = .0891 \Rightarrow 8.91\%$$

$$\hat{\beta}_{Agri} : e^{-.0447453} - 1 = -.0438 \Rightarrow -4.38\%$$

Within individuals, the short-run effect of switching industry of employment to manufacturing from the service industry is a wage increase of 8.91%, on average.

Within individuals, the short-run effect of switching industry of employment to agriculture from the service industry is a wage decrease of 4.38%, on average.

c. Please run the regression from 'b' using a fixed effects estimator, and interpret β_{Manu} and β_{Agri} **precisely**.

CODE:
xtreg lwage manuf agric, fe

ANSWER:

```
Fixed-effects (within) regression               Number of obs      =      1200
Group variable: nr                              Number of groups   =       150

R-sq:  within  = 0.0218                         Obs per group: min =         8
       between = 0.1101                                        avg =       8.0
       overall = 0.0625                                        max =         8

                                                F(2,1048)          =     11.68
corr(u_i, Xb)  = 0.1467                         Prob > F           =    0.0000

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       manuf |   .1403634   .0353017     3.98   0.000     .0710932    .2096335
       agric |  -.1301406   .0691586    -1.88   0.060    -.2658458    .0055645
       _cons |     1.59715   .0151627   105.33   0.000     1.567397    1.626903
-------------+----------------------------------------------------------------
     sigma_u |  .36913381
     sigma_e |  .35185917
         rho |  .52394576   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(149, 1048) =     8.59           Prob > F = 0.0000
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The estimates for β_{Manu} and β_{Agri} are .1403 and -.1301. To interpret these **precisely** we need to take the exponential and subtract 1 from each:

$$\hat{\beta}_{Manu} : e^{.1403634} - 1 = .1507 \Rightarrow 15.07\%$$
$$\hat{\beta}_{Agri} : e^{-.1301406} - 1 = -.1220 \Rightarrow -12.2\%$$

Within individuals, working in the agriculture industry is associated with a wage increase of precisely 15.07%, on average, compared to the service industry.

Within individuals, working in the agriculture industry is associated with a wage decrease of precisely 12.2%, on average, compared to the service industry.

d. Given the results in (b) and (c) in comparison with the results in (a), please comment on the relationship of the observed effect α_i to wages and industry choice.

ANSWER:

The coefficients in (a) seem to be of greater magnitude than those in parts (b) and (c). This suggests that failing to correct for differences in α_i across individuals may be biasing the results. In this case, the coefficient $\hat{\beta}_{Manu}$ seems to be larger in part (a) than the other parts, suggesting *upward bias* in the coefficient. If α_i (i.e. ability) is positively related to earnings (i.e. people with higher ability earn higher wages), then α_i and $Manuf_{it}$ have to be **positively correlated** to produce the observed **upward bias**. Therefore, α_i and $Manuf_{it}$ must be positively correlated, suggesting that people with higher ability level (α_i) are more likely to select into jobs in the manufacturing industry.

The same argument can be made for β_{Agri}. Since the estimate in (a) seems to be more negative that the estimates in (b) and (c), the estimate might be subject to *downward bias*. If, again, α_i (i.e. ability) is positively related to earnings (i.e. people with higher ability earn higher wages), then α_i and $Agric_{it}$ have to be **negatively correlated** to produce the observed **downward bias**. Therefore, α_i and $Agric_{it}$ must be negatively correlated, suggesting that people with lower

ability level (α_i) are more likely to select into jobs in the agriculture industry.

e. Please calculate **precisely** the effect on the wage of an individual that moves from agriculture to manufacturing. Please show your work.

ANSWER:

$$ln(wage^{Agr}) = \beta_0 + \beta_{Agr}$$
$$ln(wage^{Man}) = \beta_0 + \beta_{Man}$$

Subtract $ln(wage^{Agr})$ from $ln(wage^{Man})$:

$$\Rightarrow ln(wage^{Man}) - ln(wage^{Agr}) = (\beta_0 + \beta_{Man}) - (\beta_0 + \beta_{Agr})$$

$$ln(\frac{wage^{Man}}{wage^{Agr}}) = \beta_{Man} - \beta_{Agr}$$

$$\frac{wage^{Man}}{wage^{Agr}} = e^{\beta_{Man} - \beta_{Agr}}$$

Subtract $\frac{wage^{Agr}}{wage^{Agr}}$ from both sides to put it in terms of percent change:

$$\frac{wage^{Man}}{wage^{Agr}} - \frac{wage^{Agr}}{wage^{Agr}} = e^{\beta_{Man} - \beta_{Agr}} - 1$$

$$\frac{wage^{Man} - wage^{Agr}}{wage^{Agr}} = e^{\beta_{Man} - \beta_{Agr}} - 1$$

The answer to this depends on which specification you choose to use for estimates for β_{Man} and β_{Agr}. From parts b and c, respectively:
Part b:

$$e^{\hat{\beta}_{Man} - \hat{\beta}_{Agr}} - 1 = e^{.0791 - (-.0353)} - 1 = 0.121 \Rightarrow 21.1\%$$

Part c:

$$e^{\hat{\beta}_{Man} - \hat{\beta}_{Agr}} - 1 = e^{.1404 - (-.1301)} - 1 = 0.311 \Rightarrow 30.1\%$$

Within individuals, moving from the agriculture to the manufacturing industry increases earnings by 21.1% (or 30.1%), on average.