Homework 3 – AK

PROBLEM 1

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

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

```
reg lwage manu agric

      Source |       SS       df       MS              Number of obs =    1200
-------------+------------------------------           F(  2,  1197) =   40.77
       Model |  19.6395688     2  9.81978439           Prob > F      =  0.0000
    Residual |  288.279107  1197  .240834676           R-squared     =  0.0638
-------------+------------------------------           Adj R-squared =  0.0622
       Total |  307.918676  1199  .256812908           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
------------------------------------------------------------------------------
```

For the interpretation, notice that individuals can work in services, manufacture or agriculture. In our regression, since we are including a constant we must omit a dummy variable for working in services. Our interpretations of β_{Manu} and β_{Agri} are going to be relative to working in services.

β_{Manu} : People working in manufacturing on average earn 22.4% higher wages than those working in services.

β_{Agric}: People working in agriculture on average earn 30.7% lower wages than those working in services.

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

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

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

We have a balanced panel of 150 individuals for years 1980 – 1987. To eliminate the individual effects by using first differences, we created three variables: delta_lwage, delta_manu and delta_agric. Each variable captures the difference between the value in t minus the value in t-1. For example, for the variable lwage we did the following:

$\text{delta\_lwage}_t = \text{lwage}_t - \text{lwage}_{t-1}$

We run the following first difference regression:

$\text{delta\_lwage}_t = \beta_0 + \beta_{\text{Manu}}\ \text{delta\_manu}_t + \beta_{\text{Agri}}\ \text{delta\_agric}_t + u$

```
tsset nr year

gen delta_lwage = D.lwage
gen delta_manu = D.manuf
gen delta_agric = D.agric

reg delta_lwage delta_manu delta_agric

      Source |       SS       df       MS              Number of obs =    1050
-------------+------------------------------           F(  2,  1047) =    3.37
       Model |  1.10271509     2  .551357547           Prob > F      =  0.0348
    Residual |  171.329513  1047  .163638503           R-squared     =  0.0064
-------------+------------------------------           Adj R-squared =  0.0045
       Total |  172.432228  1049   .16437772           Root MSE      =  .40452

------------------------------------------------------------------------------
 delta_lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  delta_manu |   .0791101   .0332863     2.38   0.018     .0137947    .1444255
 delta_agric |  -.0352991   .0637207    -0.55   0.580    -.1603339    .0897357
       _cons |   .0621603   .0125019     4.97   0.000     .0376286     .086692
------------------------------------------------------------------------------
```

To compute precise coefficients:

$$\%\Delta\text{delta\_wage} = 100 * \left(e^{0.0791101 * \Delta\text{manuf}} - 1\right) = 8.23\%$$

$$\%\Delta\text{delta\_wage} = 100 * \left(e^{-0.0352991 * \Delta\text{agric}} - 1\right) = -3.47\%$$

β_{Manu} : In the short run, within individuals, working in the manufacturing sector earns 8.23% higher wages than working in services.

β_{Agric}: In the short run, within individuals, working in the manufacturing sector earns 3.47% lower wages than working in services.

c) Please run the regression from 'b' using a fixed effect estimator, and interpret β_{manu} and β_{agric} precisely.

```
xtreg lwage manu agric, fe

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
```

$$\%\Delta \text{wage} = 100 * (e^{0.1403634 * \Delta \text{manuf}} - 1) = 15.07\%$$

$$\%\Delta \text{wage} = 100 * (e^{-0.1301406 * \Delta \text{agric}} - 1) = -12.20\%$$

β_{Manu} : Within individuals, working in the manufacturing sector earns 15.07% higher wages than working in services

β_{Agric}: Within individuals, working in the manufacturing sector earns 12.2% lower wages than working in services.

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.

Individual fixed effects are omitted variables in regression (a). When we include a measure of these fixed effects in regressions (b) and (c) we find that the coefficient on manufacture shrinks while the coefficient on agriculture increases (from a large negative number to a less negative number).

From omitted variable bias, we remember that the direction of the bias depends on two things: correlation of dependent variable and omitted explanatory variable; and, the correlation between the explanatory variable included and the omitted explanatory variable.

Direction of Bias on β_{Manu}

$\text{corr}(\text{lwage}_{it}, \alpha_i) * \text{corr}(\text{manu}_{it}, \alpha_i) = (+)$

It has to be the case that individual fixed effects are positively correlated with manufacturing and that individual fixed effects are positively correlated with lwage, thus giving upward biased results in (a).

Direction of Bias on β_{Agric}

$\text{corr}(\text{lwage}_{it}, \alpha_i) * \text{corr}(\text{agric}_{it}, \alpha_i) = (-)$

It has to be the case that individual fixed effects are negatively correlated with agriculture and individual fixed effects are positively correlated with lwage, thus giving downward biased results in (a).

The difference in coefficients between (b) and (c) comes from the different specifications used. Regression (b) captures only short run effects while regression (c) captures average effects within each individual.

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

$$\ln(\text{wage}_{it}) = \beta_0 + \beta_{\text{Manu}}\text{Manu}_{it} + \beta_{\text{Agri}}\text{Agri}_{it} + \alpha_i + u$$

Notice that β_{manu}captures the relative effect of manufacturing relative to services while β_{agric} captures the effect of agriculture relative to wages. Therefore if we compare $\beta_{manu}$to β_{agric} we will get the effect of switching from agriculture to manufacturing.

Note that the question does not ask for a derivation, so one could simply calculate $\beta_{manu} - \beta_{agri}$, exponentiate, and interpret (which we do at the end). However, to test this with a standard error, we must do the following:

Define $\theta = \beta_{manu} - \beta_{agri}$

$H_0: \theta = 0$

$H_a: \theta \neq 0$

Replace in your equation $\beta_{manu} = \theta + \beta_{agri}$

$$\ln(\text{wage}_{it}) = \beta_0 + (\theta + \beta_{\text{agri}})\text{Manu}_{it} + \beta_{\text{Agri}}\text{Agri}_{it} + \alpha_i + u$$

$$\ln(\text{wage}_{it}) = \beta_0 + \theta \text{Manu}_{it} + \beta_{agri}(\text{Manu}_{it} + \text{Agri}_{it}) + \alpha_i + u$$

```
gen ag_manuf = agric+manuf


xtreg lwage manuf ag_manuf,fe

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 |    .270504   .0709702     3.81   0.000      .131244     .409764
    ag_manuf |  -.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
```

$$\%\Delta\text{wage} = 100 * \left(e^{0.270504 * \Delta\text{manuf}} - 1\right) = 31.06\%$$

Within individuals, switching from agriculture to manufacturing increases wages by 31.06%.