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Question 1)

PGLS Assume Heteroskedasticity.

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. xtgls y x1 x2 x3 x4 x5 x6 x7, igls panels(heteroskedastic) nolog

Cross-sectional time-series FGLS regression

Coefficients:  generalized least squares
Panels:        heteroskedastic
Correlation:   no autocorrelation

Estimated covariances      =       255          Number of obs      =     1,275
Estimated autocorrelations =         0          Number of groups   =       255
Estimated coefficients     =         8          Time periods       =         5
                                                Wald chi2(7)       =   3850.64
Log likelihood             =   519.361          Prob > chi2        =    0.0000
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y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
x1	.0834067	.0045748	18.23	0.000	.0744403	.0923732
x2	.0163976	.0032919	4.98	0.000	.0099456	.0228497
x3	-.3631261	.0505673	-7.18	0.000	-.4622362	-.264016
x4	.3191455	.1093883	2.92	0.004	.1047484	.5335426
x5	-.1093301	.0043601	-25.07	0.000	-.1178758	-.1007844
x6	.1361732	.0275038	4.95	0.000	.0822667	.1900797
x7	-.2282655	.0063087	-36.18	0.000	-.2406303	-.2159007
_cons	-.037658	.0426502	-0.88	0.377	-.1212509	.0459349

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. est store het
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From the table we could see that Log = 519.361

PLS

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. xtgls y x1 x2 x3 x4 x5 x6 x7

Cross-sectional time-series FGLS regression

Coefficients:  generalized least squares
Panels:        homoskedastic
Correlation:   no autocorrelation

Estimated covariances      =         1          Number of obs      =      1,275
Estimated autocorrelations =         0          Number of groups   =        255
Estimated coefficients     =         8          Time periods       =          5
                                                Wald chi2(7)       =     899.95
Log likelihood             =  209.4322          Prob > chi2        =     0.0000
```

y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
x1	.0794732	.0093881	8.47	0.000	.0610728	.0978735
x2	.0183375	.0051421	3.57	0.000	.0082592	.0284158
x3	.0977707	.0526329	1.86	0.063	-.0053879	.2009293
x4	.0873838	.2186064	0.40	0.689	-.3410767	.5158444
x5	-.1076457	.0069214	-15.55	0.000	-.1212114	-.0940801
x6	-.1432493	.0186811	-7.67	0.000	-.1798637	-.106635
x7	-.2712849	.011995	-22.62	0.000	-.2947946	-.2477753
_cons	-.0107965	.0860341	-0.13	0.900	-.1794201	.1578272

```
. est store pgls

. local df = e(N_g)-1

. lrtest het,df(`df')

Likelihood-ratio test                           LR chi2(254)=    619.86
(Assumption: pgls nested in het)                Prob > chi2 =    0.0000
```

From table we obtain $L_R = 209.4322$

From LR-test $= 2(L_{UR} - L_R) \sim \chi^2(d)$

$= 2(519.361 - 209.4322) \sim \chi^2(d)$

$= 619.86$

Which has P-value < 0.05 thus, We reject null hypothesis and There exist significant Heteroskedasticity Problem.

```
. xtreg y x1 x2 x3 x4 x5 x6 x7, fe

Fixed-effects (within) regression               Number of obs      =       1,275
Group variable: crossid                         Number of groups   =         255

R-sq:                                           Obs per group:
     within  = 0.3772                                         min =           5
     between = 0.1103                                         avg =         5.0
     overall = 0.1644                                         max =           5

                                                F(7,1013)          =       87.64
corr(u_i, Xb)  = -0.2003                        Prob > F           =      0.0000

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |  -.1256447   .0180942    -6.94   0.000    -.161151   -.0901384
          x2 |   .0123739    .008023     1.54   0.123    -.0033697    .0281176
          x3 |   .0747825    .039773     1.88   0.060    -.0032643    .1528293
          x4 |   .6493144   .2855092     2.27   0.023     .0890573    1.209572
          x5 |  -.1104883   .0061097   -18.08   0.000    -.1224773   -.0984992
          x6 |  -.1461423   .0141035   -10.36   0.000    -.1738178   -.1184669
          x7 |  -.0951497   .0121853    -7.81   0.000    -.1190611   -.0712383
       _cons |   1.756067   .1658407    10.59   0.000     1.430636    2.081497
-------------+----------------------------------------------------------------
     sigma_u |  .22676694
     sigma_e |  .11725953
         rho |  .78902632   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(254, 1013) = 11.40                     Prob > F = 0.0000
```

FE test $H_0: \gamma_1 = \gamma_2 = \dots = \gamma_{255} = 0$

From $F(254, 1013) = 11.4$ and P-value of 0.00 which is lower than 0.05. We could reject the null hypothesis and conclude that there exist at least one of the alphas is not equal to zero, There for There exist fixed effect and endogineity problem.

Note $\gamma_1 = \alpha_1 - \alpha$

$\gamma_2 = \alpha_2 - \alpha$

$\vdots$

$\gamma_n = \alpha_{nn} - \alpha$

```
. est store fixed

. xtreg y x1 x2 x3 x4 x5 x6 x7, re

Random-effects GLS regression                   Number of obs     =      1,275
Group variable: crossid                         Number of groups  =        255

R-sq:                                           Obs per group:
     within  = 0.3492                                         min =          5
     between = 0.3404                                         avg =        5.0
     overall = 0.3377                                         max =          5

                                                Wald chi2(7)      =     663.43
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000
```

y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
x1	-.0145018	.0133366	-1.09	0.277	-.040641	.0116375
x2	.0146948	.0064463	2.28	0.023	.0020604	.0273292
x3	.0985565	.0399464	2.47	0.014	.020263	.1768501
x4	.4693539	.2493856	1.88	0.060	-.0194329	.9581407
x5	-.1117985	.005959	-18.76	0.000	-.1234779	-.100119
x6	-.1541318	.014125	-10.91	0.000	-.1818163	-.1264472
x7	-.1494529	.0115006	-13.00	0.000	-.1719937	-.1269122
_cons	.7714573	.1226841	6.29	0.000	.5310009	1.011914
sigma_u	.15944933					
sigma_e	.11725953					
rho	.64900604	(fraction of variance due to u_i)				

```
. est store random
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. hausman fixed random
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	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
x1	-.1256447	-.0145018	-.1111429	.0122284
x2	.0123739	.0146948	-.0023208	.0047765
x3	.0747825	.0985565	-.0237741	.
x4	.6493144	.4693539	.1799605	.1390048
x5	-.1104883	-.1117985	.0013102	.0013484
x6	-.1461423	-.1541318	.0079894	.
x7	-.0951497	-.1494529	.0543033	.0040273

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 190.39
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)

.

According to Hausman test with Ho: $\beta_{RE} = \beta_{FE}$, Chi2(7) is equal to 190.39 which has p-value of 0.000 which is lower than 0.05. The null hypothesis is rejected, thus Fixed effect model is more appropriate than random effect model.