1. `. 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
```

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

`. est store het`

`. 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 the result, LR-Chi 2 test equals to 619.86. The p-value of LR-Chi2 equals to 0.0000 which is less than 0.05. So, the null hypothesis is rejected. It means that there exists a significant heteroscedasticity problem in this model.

2.

```
. 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
------------------------------------------------------------------------------

. 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
```

```
. 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

. hausman fixed random

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |    fixed       random       Difference          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)

.
```

From the test, it can see that there are the significant fixed effects since the result from F-test equals to 0.0000 which is less that 0.05. Moreover, the fixed effects model is more appropriated than random effect model. It comes from the result of significant Hausman test which chi2=190.39 and p-value equals to 0.0000 which is less than 0.05. So, the null hypothesis of the test is rejected and it means that the fixed effects model is more appropriated than random effects model.