Thirakhun Wiwatsawatdinont
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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
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. est store het
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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
------------------------------------------------------------------------------

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. est store pgls
```

```
. lrtest het, df(254)

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

As probability or p-value of Prob > χ^2 is < 0.0001 which is lower than 0.05, null hypothesis of heteroscedasticity is rejected, therefore heteroscedasticity is statistically significant.

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
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. 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)
```

With fixed-effects approach, there is a statistical significance over fixed effects. With Hausman method, chi2(7) is 190.39 making Prob>chi2 to be lower than .05 making fixed effects more to be more attractive model.