Thanakrit 6204640087

Assignment 7
Panel Data

The study on capital structure of Thai companies listed in the stock exchange market of Thailand (SET) employs the following regression models:

1. Panel Data Model

$$y_{it} = \alpha + \beta_1 x_{1it} + \beta_2 x_{2it} + \beta_3 x_{3it} + \beta_4 x_{4it} + \beta_5 x_{5it} + \beta_6 x_{6it} + \beta_7 x_{7it} + u_{it} \quad (1)$$

where:
y_{it} = leverage of firm i in year t
x_{1it} = size of firm determined by log of total revenue
x_{2it} = tangibles asset of the firm determined by log of tangible assets plus inventories divided by total book assets
x_{3it} = profitability index determined by return on assets
x_{4it} = non-debt tax shields determined by depreciation divided by total assets
x_{5it} = growth rate of the firm determined by book value of asset plus market value of equity minus book value of equity then divided by book value of asset
x_{6it} = risk of the firm determined by square of deviation from mean of return on asset at period t
x_{7it} = dividend payment equals to 1 if firm paid dividend at period t or equals to 0 if no dividend paid

2. Fixed Effects Model

$$y_{it} = \alpha_i + \beta_1 x_{1it} + \beta_2 x_{2it} + \beta_3 x_{3it} + \beta_4 x_{4it} + \beta_5 x_{5it} + \beta_6 x_{6it} + \beta_7 x_{7it} + u_{it} \quad (2)$$

where:
α_i = Cross-sectional fixed effects

3. Random Effects Model

$$y_{it} = \alpha + \beta_1 x_{1it} + \beta_2 x_{2it} + \beta_3 x_{3it} + \beta_4 x_{4it} + \beta_5 x_{5it} + \beta_6 x_{6it} + \beta_7 x_{7it} + u_{it} \quad (3)$$

and $u_{it} = v_i + \varepsilon_{it}$

where: v_i = Cross-section random effects
ε_{it} = residual terms

From the given data set (`assign7.dta`):

a. Estimate model (1) using Panel Least Squares estimation method and PGLS assuming Heteroskedasticity, and test whether there exists Heteroskedasticity problem.
b. Estimate the above three models including Panel Least Squares model, Fixed effects model, and Random-effects model. Perform fixed effects tests and random effects test, also state null hypothesis of the tests. Then, determine the most appropriated model. Also, give explanation of the choosing criterion (perform the tests), and make interpretation of the estimated models.

From the given data set (`assign7.dta`):

a. Estimate model (1) using Panel Least Squares estimation method and PGLS assuming Heteroskedasticity, and test whether there exists Heteroskedasticity problem.

```
3 . *A*
4 . xtset crossid t
        panel variable:  crossid (strongly balanced)
         time variable:  t, 1 to 5
                 delta:  1 year

5 . 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
------------------------------------------------------------------------------

6 . estimates store hetero

7 . 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
------------------------------------------------------------------------------

 8 . estimates store pgls

 9 . local df = e(N_g) - 1

10 . lrtest hetero . , df(`df')

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

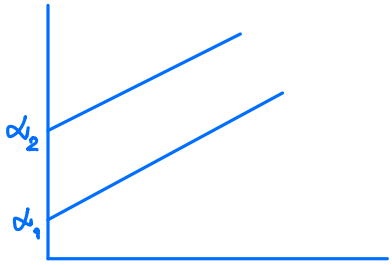
According to the LR test, the null hypothesis which is there is no heteroskedasticity is rejected. It means that there exists significant heteroskedasticity.

b. Estimate the above three models including Panel Least Squares model, Fixed effects model, and Random-effects model. Perform fixed effects tests and random effects test, also state null hypothesis of the tests. Then, determine the most appropriated model. Also, give explanation of the choosing criterion (perform the tests), and make interpretation of the estimated models.

```
12 . *B*
13 . 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
------------------------------------------------------------------------------

14 . 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
```

From the fixed effect test, the null hypothesis ($\alpha_1 = \alpha_2 = \ldots = \alpha_n$) is rejected.

Therefore, there exists significant fixed effect.



```
15 . estimates store fixed

16 . 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)
------------------------------------------------------------------------------

17 . estimates store random

18 . 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)
```

According to the hausman test, H_0 : $\beta_{random} = \beta_{fixed}$ is rejected. Therefore, fixed effect model is most appropiated.

From the fixed test, it is to test wheter there exists a fixed effect, and this test suggests that there is significant fixed effect.

Next, the hausman test is to test wheter it should be randam effect or fixed effect, and the test suggests that there is significant fixed effect.

```
  Estimated covariances      =       255          Number of obs     =      1,275
        name:  <unnamed>
         log:  C:\Users\Chaiyapong M\Desktop\BE\EE426\Assignment 7\Assignment7.smcl
    log type:  smcl
   opened on:  17 Mar 2021, 22:26:37

1 . do "C:\Users\Chaiyapong M\Desktop\BE\EE426\Assignment 7\Assignment7.do"

2 . set more off

3 . *A*
4 . xtset crossid t
          panel variable:  crossid (strongly balanced)
           time variable:  t, 1 to 5
                   delta:  1 year

5 . 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]
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          x1 |   .0834067   .0045748    18.23   0.000     .0744403    .0923732
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          x5 |  -.1093301   .0043601   -25.07   0.000    -.1178758   -.1007844
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       _cons |   -.037658   .0426502    -0.88   0.377    -.1212509    .0459349
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6 . estimates store hetero

7 . 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
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          x5 |  -.1076457   .0069214   -15.55   0.000    -.1212114   -.0940801
          x6 |  -.1432493   .0186811    -7.67   0.000    -.1798637    -.106635
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       _cons |  -.0107965   .0860341    -0.13   0.900    -.1794201    .1578272
------------------------------------------------------------------------------
```

```
 8 . estimates store pgls

 9 . local df = e(N_g) - 1

10 . lrtest hetero . , df(`df')

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

11 .
12 . *B*
13 . 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
------------------------------------------------------------------------------

14 . 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
```

```
15 . estimates store fixed

16 . 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
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          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)
------------------------------------------------------------------------------

17 . estimates store random

18 . 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)

19 .
   end of do-file

20 . log off
       name:  <unnamed>
        log:  C:\Users\Chaiyapong M\Desktop\BE\EE426\Assignment 7\Assignment7.smcl
   log type:  smcl
  paused on:  17 Mar 2021, 22:28:49
-------------------------------------------------------------------------------
```