

Solutions Guideline

Assignment 4

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 (Assignment 4.dta):

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

```
. xtglm 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      =      1275
```

```

Estimated autocorrelations =      0      Number of groups =      255
Estimated coefficients      =      8      Time periods      =      5
Log likelihood              = 519.361    wald chi2(7)        = 3850.64
                                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
```

```
. xtglm 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      =     1275
Estimated autocorrelations =      0      Number of groups    =     255
Estimated coefficients      =      8      Time periods        =      5
Log likelihood              = 209.4322    wald chi2(7)        = 899.95
                                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

```

With LR-chi2 test = 619.86 with p-value of 0.0000<0.05, the null hypothesis of no heteroscedasticity is rejected, thus, there exists significant heteroscedasticity problem.

2. 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.

```
. xtglm 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	=	1275
Estimated autocorrelations	=	0	Number of groups	=	255
Estimated coefficients	=	8	Time periods	=	5
Log likelihood	=	209.4322	Wald chi2(7)	=	899.95
			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	=	1275
Group variable: crossid	Number of groups	=	255
R-sq: within = 0.3772	Obs per group: min	=	5
between = 0.1103	avg	=	5.0
overall = 0.1644	max	=	5
corr(u_i, xb) = -0.2003	F(7,1013)	=	87.64
	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	=	1275
Group variable: crossid	Number of groups	=	255
R-sq: within = 0.3492	Obs per group: min	=	5
between = 0.3404	avg	=	5.0
overall = 0.3377	max	=	5
Random effects u_i ~ Gaussian	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

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sigma_u | .15944933
sigma_e | .11725953
rho     | .64900604   (fraction of variance due to u_i)
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```

```
. est store random
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```
. hausman fixed random
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-----+-----
              Coefficients
              (b)      (B)
              fixed    random    (b-B)      sqrt(diag(V_b-V_B))
              -----+-----
              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
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```

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 fixed effects test, there is the significant fixed effects. According to the significant Hausman test ($\chi^2=190.39$ with p-value of $0.0000 < 0.05$), the null hypothesis of the test is rejected, thus, the fixed effects model is more appropriated than random effects model.