

CH15-6

(f) EXPER 差了 0.0411 最大

Hausman test

$$\text{EXPER} = \frac{-0.0411}{\sqrt{0.033^2 - 0.022^2}} = -1.671$$

$$\text{EXPER}^2 = \frac{0.0011}{\sqrt{0.0011^2 - 0.0007^2}} = 1.296$$

$$\text{south} = \frac{-0.0035}{\sqrt{0.1258^2 - 0.0317^2}} = -0.029$$

$$\text{UNION} = \frac{-0.0205}{\sqrt{0.0312^2 - 0.0245^2}} = -1.061$$

EXPER 在 FE 和 RE 差異最明顯

FE 是基準，RE 是檢驗對象，若 RE 和 FE 差異顯著，表示 RE 估計有偏 → 應用 RE

$$\text{Hausman} = 15.36$$

$$\chi_{0.05}^2 4 = 9.49$$

$$15.36 > 9.49 \Rightarrow \text{拒絕 } H_0$$

⇒ 應用固定效果估計

CH15Q17

(b) $LIQUOR = 0.969 + 0.02657 INCOME$

```
Balanced Panel: n = 40, T = 3, N = 120

Effects:
      var std.dev share
idiosyncratic 0.9640  0.9819 0.571
individual    0.7251  0.8515 0.429
theta: 0.4459

Residuals:
      Min.    1st Qu.    Median    3rd Qu.    Max.
-2.263634 -0.697383  0.078697  0.552680  2.225798

Coefficients:
      Estimate Std. Error z-value Pr(>|z|)
(Intercept) 0.9690324  0.5210052  1.8599 0.0628957 .
income      0.0265755  0.0070126  3.7897 0.0001508 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

95% CI for income coefficient: [0.0128 , 0.0403]

income 對 liquor 支出是正向且顯著

income 95% 區間不含 0 \Rightarrow 拒絕 H_0

\therefore 收入變化會影響酒的花費

(a) 95% 區間有含 0，不拒絕 H_0

\therefore 無法支持

\therefore (a)、(b) 不同

(c)

```
Lagrange Multiplier Test - (Breusch-Pagan)

data: liquor ~ income
chisq = 20.68, df = 1, p-value = 5.429e-06
alternative hypothesis: significant effects
```

拒絕 H_0 ，支持隨機效果存在

應用 random effects 模型

(d) $LIQUOR = 0.9163 + 0.0207 INCOME + 0.00658 INCOMEm$

```
Balanced Panel: n = 40, T = 3, N = 120

Effects:
      var std.dev share
idiosyncratic 0.9640  0.9819 0.571
individual    0.7251  0.8515 0.429
theta: 0.4459

Residuals:
      Min.    1st Qu.    Median    3rd Qu.    Max.
-2.300955 -0.703840  0.054992  0.560255  2.257325

Coefficients:
      Estimate Std. Error z-value Pr(>|z|)
(Intercept) 0.9163337  0.5524439  1.6587 0.09718 .
income      0.0207421  0.0209083  0.9921 0.32117
incomem     0.0065792  0.0222048  0.2963 0.76700
```

$P = 0.169$ (不顯著)

沒有證據顯示 $incomem$ 和個體

隨機效果 u_i 有相關性

可使用 random effects 模型

CH15 Q2o

(d) 大多解釋變數在P隨機效果模型中具顯著性，顯示這些因素和學生的閱讀表現具重要關聯，再來透過 Breush - Pagan LM test $p < 0.05$ 表示存在明顯的學校層級異質性，相較 pooled OLS 模型，更應採用 random effect model

```
call:
plm(formula = readscore ~ small + aide + tchexper + white_asian +
  freelunch + boy, data = pdata, model = "random")

Unbalanced Panel: n = 79, T = 34-137, N = 5766

Effects:
              var std.dev share
idiosyncratic 751.43   27.41 0.829
individual    155.31   12.46 0.171
theta:
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
0.6470  0.7225  0.7523  0.7541  0.7831  0.8133

Residuals:
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-97.483 -17.236  -3.282   0.037  12.803  192.346

Coefficients:
              Estimate Std. Error z-value Pr(>|z|)
(Intercept) 436.126774   2.064782 211.2217 < 2.2e-16 ***
small        6.458722   0.912548   7.0777 1.466e-12 ***
aide         0.992146   0.881159   1.1260  0.2602
tchexper     0.302679   0.070292   4.3060 1.662e-05 ***
white_asian  7.350477   1.431376   5.1353 2.818e-07 ***
freelunch   -14.584332  0.874676 -16.6740 < 2.2e-16 ***
boy         -5.512081   0.727639  -7.5753 3.583e-14 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    6158000
Residual Sum of Squares: 4332100
R-Squared:                0.29655
Adj. R-Squared: 0.29582
Chisq: 493.205 on 6 DF, p-value: < 2.22e-16
```

```
Lagrange Multiplier Test - (Breusch-Pagan)

data:  readscore ~ small + aide + tchexper + white_asian + freelunch + ...
chisq = 6677.4, df = 1, p-value < 2.2e-16
alternative hypothesis: significant effects
```

(e)

```
> print(t_stats)
      aide    tchexper white_asian    freelunch      boy
1.146    0.128    -1.938     1.218    -0.096    NaN
> library(dplyr)
```

boy 的 $Se_{FE}^2 < Se_{RE}^2$

$\Rightarrow \sqrt{\quad}$ 內小於 0

\Rightarrow 不適用

```
Hausman Test

data:  readscore ~ small + aide + tchexper + white_asian + freelunch + ...
chisq = 13.809, df = 6, p-value = 0.03184
alternative hypothesis: one model is inconsistent
```

$\chi^2_{0.95, 6} = 12.59$

13.809 > 12.59 拒絕 H_0 (P隨機效果和解釋變數無關)

應用 固定效果模型

(f)

```
Effects:
             var std.dev share
idiosyncratic 756.11   27.50 0.817
individual    169.40   13.02 0.183
theta:
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
0.6593  0.7327   0.7615  0.7630  0.7892   0.8217

Residuals:
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-98.886 -17.051  -3.166   0.039  12.846  193.321

Coefficients:
              Estimate Std. Error z-value Pr(>|z|) ***
(Intercept)  459.462989  20.529888   22.3802 < 2.2e-16 ***
small        6.637460   0.922068    7.1985 6.090e-13 ***
aide        1.157620   0.889542    1.3014 0.1931
tchexper     0.289286   0.071754    4.0316 5.539e-05 ***
boy         -5.386109   0.735063   -7.3274 2.346e-13 ***
white_asian  8.081423   1.550155    5.2133 1.855e-07 ***
freelunch   -14.699025   0.892109   -16.4767 < 2.2e-16 ***
small_m     -18.410060   22.273923   -0.8265 0.4085
aide_m      16.811358   20.793685    0.8085 0.4188
tchexper_m   1.006007   0.625690    1.6078 0.1079
boy_m       -53.353521   25.221654   -2.1154 0.0344 *
white_asian_m -6.648191    6.320012   -1.0519 0.2928
freelunch_m  -3.318853   8.779553   -0.3780 0.7054
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

total Sum of Squares: 6007200
Residual Sum of Squares: 4281300
R-Squared: 0.28737
Adj. R-Squared: 0.28586
Chisq: 500.306 on 12 DF, p-value: < 2.22e-16
```

只有性別的平均值是顯著的(5%)

和學校的 individual effect 是相關性

⇒ boy 不符 random effect 的外生性假設

應用 FE model , 其它則可用 RE