Examples from B. BALTAGI : *Econometric Analysis of Panel Data*

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1 Introduction

```
> library(plm)
> library(Ecdat)
```

2 Oneway panel

Grunfeld data, used in Baltagi p21–24.

```
> data(Grunfeld)
> Grunfeld = pdata.frame(Grunfeld, firm, year)
> form = inv ~ value + capital
> gow = plm(form, data = Grunfeld, theta = "swar")
> gowt = plm(inv ~ value + capital, effect = "double", data = Grunfeld)
> gowt = plm(inv ~ value + capital, effect = "double", data = Grunfeld,
+     theta = "walhus")
> xt = summary(gow)$CoefTable
> summary(gow$random)


Model formula: inv ~ value + capital

Residuals:
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
-1.78e+02 -1.97e+01  4.69e+00 -4.47e-16  1.95e+01  2.53e+02

            Estimate Std. Error z-value Pr(>|z|)
(intercept) -57.8344    28.8989    -2.0    0.045 *
value         0.1098     0.0105    10.5   <2e-16 ***
capital       0.3081     0.0172    17.9   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Gasoline data, used in Baltagi p. 24

```
> data(Gasoline)
> Gasoline = pdata.frame(Gasoline, country, year)
> form = lgaspcar ~ lincomep + lrpmg + lcarpcap
> plm(form, data = Gasoline)
Model  pooling  :

Model Formula: lgaspcar ~ lincomep + lrpmg + lcarpcap

Coefficients:
(intercept)    lincomep       lrpmg    lcarpcap
      2.391       0.890      -0.892      -0.763

Model  between  :

Model Formula: lgaspcar ~ lincomep + lrpmg + lcarpcap

Coefficients:
(intercept)    lincomep       lrpmg    lcarpcap
      2.542       0.968      -0.964      -0.795

Model  within  :

Model Formula: lgaspcar ~ lincomep + lrpmg + lcarpcap

Coefficients:
lincomep    lrpmg lcarpcap
   0.662   -0.322   -0.640

Model  random  :

Model Formula: lgaspcar ~ lincomep + lrpmg + lcarpcap

Coefficients:
(intercept)    lincomep       lrpmg    lcarpcap
      1.997       0.555      -0.420      -0.607
```

Produ data, used p.25.

```
> data(Produc)
> Produc = pdata.frame(Produc, state, year)
> form = log(gsp) ~ log(pcap) + log(pc) + log(emp) + unemp
> zo <- plm(form, data = Produc, theta = "swar")
> summary(zo)
```

```
             between       bse    within       wse    random   rse
(intercept)  1.589444  0.232980         .         .  2.135411  0.13
log(pcap)    0.179365  0.071972 -0.026150  0.029002  0.004439  0.02
log(pc)      0.301954  0.041821  0.292007  0.025120  0.310548  0.02
log(emp)     0.576127  0.056375  0.768159  0.030092  0.729671  0.02
unemp       -0.003890  0.009908 -0.005298  0.000989 -0.006172 9e-04
```

3 Two–way error component regression model

Grunfeld data, used in Baltagi p.43–46

```
> data(Grunfeld)
> Grunfeld = pdata.frame(Grunfeld, firm, year)
> gtw = plm(inv ~ value + capital, data = Grunfeld, theta = "swar",
+     effect = "double")
> summary(gtw$random)


Model formula: inv ~ value + capital

Residuals:
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
-1.77e+02 -1.98e+01  4.60e+00 -3.54e-16  1.95e+01  2.53e+02

            Estimate Std. Error z-value Pr(>|z|)
(intercept) -57.8654    29.3934   -1.97    0.049 *
value         0.1098     0.0105   10.43   <2e-16 ***
capital       0.3082     0.0172   17.95   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Gasoline data, used in Baltagi p. 24

```
> data(Gasoline)
> Gasoline = pdata.frame(Gasoline, country, year)
> form = lgaspcar ~ lincomep + lrpmg + lcarpcap
> gas = plm(form, data = Gasoline)
```

Produ data, used p.25.

```
> data(Produc)
> Produc = pdata.frame(Produc, state, year)
> form = log(gsp) ~ log(pcap) + log(pc) + log(emp) + unemp
> zo <- plm(form, data = Produc, theta = "swar")
> summary(zo)
```

```
              between       bse    within       wse    random   rse
(intercept)  1.589444  0.232980         .         .  2.135411  0.13
log(pcap)    0.179365  0.071972 -0.026150  0.029002  0.004439  0.02
log(pc)      0.301954  0.041821  0.292007  0.025120  0.310548  0.02
log(emp)     0.576127  0.056375  0.768159  0.030092  0.729671  0.02
unemp       -0.003890  0.009908 -0.005298  0.000989 -0.006172 9e-04
```

4 Test of hypotheses with panel data

4.1 Test for Poolability of the data

```
> data(Grunfeld)
> Grunfeld = pdata.frame(Grunfeld, firm, year)
> form = inv ~ value + capital
> z = nopool(form, data = Grunfeld)
> z = plm(form, data = Grunfeld, np = TRUE)
> summary(z)
```

```
             between      bse   within      wse   random   rse
(intercept)  -8.5271  47.5153        .        . -57.8344 28.90
value         0.1346   0.0287   0.1101   0.0119   0.1098  0.01
capital       0.0320   0.1909   0.3101   0.0174   0.3081  0.02
```

```
> plot(z$nopool)
> pooltest(z)
```

```
        F statistic

data:  z
F = 27.7486, p-value < 2.2e-16
alternative hypothesis: true is stability
```

```
> pooltest(z, effect = T)
```

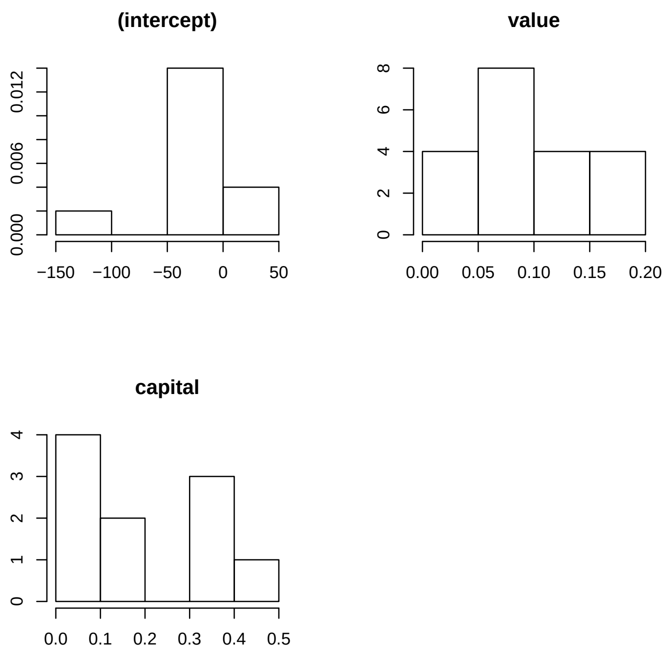
```
        F statistic

data:  z
F = 5.7805, p-value = 1.219e-10
alternative hypothesis: true is stability
```

```
> z = plm(form, data = Grunfeld, effect = "time", np = TRUE)
> pooltest(z, effect = F)
```

```
        F statistic

data:  z
F = 1.1204, p-value = 0.2928
alternative hypothesis: true is stability
```



4.2 Test for individual and time effects

Grunfeld, p. 65

```
> plmtest(gow)


        Lagrange Multiplier Test - individual effects ( Breush-Pagan )

data:  gow
chi2 = 798.1615, df = 1, p-value < 2.2e-16



> plmtest(gow, type = "honda")


        Lagrange Multiplier Test - individual effects ( Honda )

data:  gow
normal = 28.2518, p-value < 2.2e-16
```

```
> plmtest(gow, effect = "time")

        Lagrange Multiplier Test - time effects ( Breush-Pagan )

data:  gow
chi2 = 6.4539, df = 1, p-value = 0.01107


> plmtest(gow, type = "honda", effect = "time")

        Lagrange Multiplier Test - time effects ( Honda )

data:  gow
normal = -2.5404, p-value = 0.002768


> plmtest(gow, effect = "double")

        Lagrange Multiplier Test - two-ways effects ( Breush-Pagan )

data:  gow
chi2 = 804.6154, df = 2, p-value < 2.2e-16


> plmtest(gow, type = "honda", effect = "double")

        Lagrange Multiplier Test - two-ways effects ( Honda )

data:  gow
normal = 18.1806, p-value < 2.2e-16


> plmtest(gow, type = "ghm", effect = "double")

        Lagrange Multiplier Test - two-ways effects ( Gourierroux, Holly and
        Monfort )

data:  gow
chi2 = 798.1615, df = 2, p-value < 2.2e-16
```

```
> plmtest(gow, type = "kw", effect = "double")


        Lagrange Multiplier Test - two-ways effects ( King and Wu )

data:  gow
normal = 21.8322, df = 2, p-value < 2.2e-16
```

```
> pFtest(gow)


        F statistic

data:  data.name
F = 49.1766, p-value < 2.2e-16
alternative hypothesis: true is null.value
```

```
> pFtest(gtw)


        F statistic

data:  data.name
F = 17.4031, p-value < 2.2e-16
alternative hypothesis: true is null.value
```

```
> pFtest(gowt)


        F statistic

data:  data.name
F = 17.4031, p-value < 2.2e-16
alternative hypothesis: true is null.value
```

4.3 Hausman's specification test

Grunfeld, p.71

```
> phtest(gow)
```

```
        Hausman Test

data:  gow
chi2 = 2.3304, df = 2, p-value = 0.3119
```

```
> phtest(gow$between, gow$random)

        Hausman Test

data:  gow$between and gow$random
chi2 = 2.1314, df = 3, p-value = 0.5456
```

Gasoline, p.71-72

```
> phtest(gas)

        Hausman Test

data:  gas
chi2 = 302.8037, df = 3, p-value < 2.2e-16
```

```
> phtest(gas$between, gas$random)

        Hausman Test

data:  gas$between and gas$random
chi2 = 27.4548, df = 4, p-value = 1.608e-05
```

5 Seemingly unrelated regressions with error components

6 Simultaneous equations with error components

Crime in North Carolina, p. 117–121

```
> data(Crime)
> Crime = pdata.frame(Crime, county, year)
> form = log(crmrte) ~ log(prbarr) + log(polpc) + log(prbconv) +
+     log(prbpris) + log(avgsen) + log(density) + log(wcon) + log(wtuc) +
+     log(wtrd) + log(wfir) + log(wser) + log(wmfg) + log(wfed) +
+     log(wsta) + log(wloc) + log(pctymle) + log(pctmin) + region +
+     smsa + factor(year)
> inst = ~log(prbconv) + log(prbpris) + log(avgsen) + log(density) +
+     log(wcon) + log(wtuc) + log(wtrd) + log(wfir) + log(wser) +
+     log(wmfg) + log(wfed) + log(wsta) + log(wloc) + log(pctymle) +
+     log(pctmin) + region + smsa + log(taxpc) + log(mix) + factor(year)
> inst2 = ~log(taxpc) + log(mix)
> endog = ~log(prbarr) + log(polpc)
> cr = plm(form, data = Crime)
> cr1 = plm(form, inst, data = Crime)
> cr3 = plm(form, inst2, endog, data = Crime)
> summary(cr3)
```

```
                between     bse   within      wse   random  rse
(intercept)    -1.97722 4.00078        .        . -0.92679 1.29
log(prbarr)    -0.50295 0.24062 -0.57539  0.80199 -0.42992 0.10
log(polpc)      0.40844 0.19300  0.65741  0.84667  0.44346 0.09
log(prbconv)   -0.52477 0.09995 -0.42308  0.50182 -0.33073 0.05
log(prbpris)    0.18718 0.31829 -0.25022  0.27940 -0.19103 0.04
log(avgsen)    -0.22723 0.17851  0.00909  0.04898 -0.00986 0.03
log(density)    0.22562 0.10247  0.13952  1.02103  0.42452 0.05
log(wcon)       0.31401 0.25910 -0.02873  0.05351 -0.00698 0.04
log(wtuc)      -0.19894 0.19712  0.03913  0.03085  0.04488 0.02
log(wtrd)       0.05356 0.29600 -0.01776  0.04531 -0.00784 0.04
log(wfir)       0.04171 0.30562 -0.00934  0.03655 -0.00388 0.03
log(wser)      -0.13543 0.17365  0.01858  0.03881  0.00552 0.02
log(wmfg)      -0.04200 0.15627 -0.24319  0.41950 -0.20266 0.08
log(wfed)       0.14802 0.32565 -0.45128  0.52703 -0.16915 0.16
log(wsta)      -0.20308 0.29815 -0.01871  0.28076 -0.05804 0.11
log(wloc)       0.04444 0.49436  0.26319  0.31229  0.16636 0.12
log(pctymle)   -0.09472 0.19181  0.35130  1.01077 -0.11854 0.14
log(pctmin)     0.16890 0.05270        .        .  0.18987 0.04
regionwest     -0.20482 0.11384        .        . -0.22726 0.10
regioncentral  -0.17293 0.06671        .        . -0.19315 0.06
smsayes        -0.08050 0.14423        .        . -0.22866 0.12
factor(year)82        .       .  0.03785  0.06169  0.01171 0.03
factor(year)83        .       . -0.04438  0.04238 -0.08301 0.03
factor(year)84        .       . -0.04518  0.05490 -0.10233 0.04
factor(year)85        .       . -0.02093  0.07384 -0.09453 0.05
factor(year)86        .       .  0.00635  0.12803 -0.06896 0.06
factor(year)87        .       .  0.04354  0.21577 -0.03253 0.07
```

Hausman and Taylor estimator, p.129–131

```
> data(Wages)
> Wages = pdata.frame(Wages, 595)
> form = lwage ~ wks + south + smsa + married + exp + I(exp^2) +
+     bluecol + ind + union + sexe + black + ed
> ht = plm(form, ~sexe + black + bluecol + south + smsa + ind,
+     data = Wages, theta = "swar", trinst = "ht")
> summary(ht)
```

```
Model formula: lwage ~ wks + south + smsa + married + exp + I(exp^2) + bluecol +
    ind + union + sexe + black + ed

Residuals:
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
-1.92e+00 -7.07e-02  6.57e-03 -4.09e-17  7.97e-02  2.03e+00

             Estimate Std. Error z-value Pr(>|z|)
(intercept)  2.78e+00   3.08e-01    9.04  < 2e-16 ***
wks          8.37e-04   6.00e-04    1.40    0.163
southyes     7.44e-03   3.20e-02    0.23    0.816
smsayes     -4.18e-02   1.90e-02   -2.21    0.027 *
marriedyes  -2.99e-02   1.90e-02   -1.57    0.116
exp          1.13e-01   2.47e-03   45.78  < 2e-16 ***
I(exp^2)    -4.19e-04   5.46e-05   -7.67  1.7e-14 ***
bluecolyes  -2.07e-02   1.38e-02   -1.50    0.133
ind          1.36e-02   1.52e-02    0.89    0.372
unionyes     3.28e-02   1.49e-02    2.20    0.028 *
sexemale     1.31e-01   1.27e-01    1.03    0.301
blackyes    -2.86e-01   1.56e-01   -1.84    0.067 .
ed           1.38e-01   2.13e-02    6.49  8.5e-11 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

7 Dynamic panel data models

8 Unbalanced panel data

Hedonic, p.173

```
> data(Hedonic)
> Hedonic = pdata.frame(Hedonic, townid)
```

unbalanced panel

```
> form = mv ~ crim + zn + indus + chas + nox + rm + age + dis +
+     rad + tax + ptratio + blacks + lstat
> ba = plm(form, data = Hedonic)
> summary(ba)
```

	between	bse	within	wse	random	rse
(intercept)	9.49e+00	3.41e-01	.	.	9.68e+00	0.21
crim	-2.03e-02	4.88e-03	-6.25e-03	1.04e-03	-7.23e-03	0.00103
zn	9.97e-04	6.46e-04	.	.	3.96e-05	0.00069
indus	-3.86e-03	4.47e-03	.	.	2.08e-03	0.00434
chasyes	3.01e-01	8.28e-02	-4.52e-02	2.99e-02	-1.06e-02	0.03
nox	-1.06e-02	3.32e-03	-5.59e-03	1.35e-03	-5.86e-03	0.00125
rm	1.23e-02	3.47e-03	9.27e-03	1.22e-03	9.18e-03	0.00118
age	1.87e-03	1.40e-03	-1.41e-03	4.86e-04	-9.27e-04	0.00046
dis	-2.15e-01	6.26e-02	8.01e-02	7.12e-02	-1.33e-01	0.05
rad	9.41e-02	2.43e-02	.	.	9.69e-02	0.03
tax	-7.12e-05	1.80e-04	.	.	-3.75e-04	0.00019
ptratio	-1.48e-02	9.20e-03	.	.	-2.97e-02	0.01
blacks	-3.36e-02	3.73e-01	6.63e-01	1.03e-01	5.75e-01	0.10
lstat	-2.98e-01	6.04e-02	-2.45e-01	2.56e-02	-2.85e-01	0.02