[Example13-9] First Difference estimator

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```
load("~/計量経済学演習/R data sets for 5e/crime4.RData")
crime4<-data

library(plm);library(lmtest)

## Loading required package: Formula

## Loading required package: zoo

##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric

crime4.p <- pdata.frame(crime4, index=c("county","year") )
pdim(crime4.p)

## Balanced Panel: n = 90, T = 7, N = 630
```

manually calculate first differences of crime rate

```
crime4.p$dcrmrte <- diff(crime4.p$crmrte)
```

Display selected variables for obs 1-9

```
crime4.p[1:9, c("county","year","crmrte","dcrmrte")]

##      county year    crmrte       dcrmrte
## 1-81      1   81 0.0398849            NA
## 1-82      1   82 0.0383449 -0.0015399978
## 1-83      1   83 0.0303048 -0.0080401003
## 1-84      1   84 0.0347259  0.0044211000
## 1-85      1   85 0.0365730  0.0018470995
## 1-86      1   86 0.0347524 -0.0018206015
## 1-87      1   87 0.0356036  0.0008512028
## 3-81      3   81 0.0163921            NA
## 3-82      3   82 0.0190651  0.0026730001
```

difference の最初は自動で NA になっていることを確認。

manually take difference and estimate FD model with “pooled OLS”"

l は lag ではなく log。要するに log の difference なので%change に変換できていると期待する。(値が小さければ)

あとで階差とる前提で model 作ってるので d81 だけでなく d82 も入れてない。そもそも d81 は無いけど。

```
coeftest( plm(diff(log(crmrte))~d83+d84+d85+d86+d87+diff(lprbarr)+diff(lprbconv)+
                  diff(lprbpris)+diff(lavgsen)+diff(lpolpc),data=crime4.p, model="pooling") )

##
## t test of coefficients:
##
##                   Estimate Std. Error  t value  Pr(>|t|)
## (Intercept)     0.0077134  0.0170579   0.4522   0.65132
## d83            -0.0998658  0.0238953  -4.1793 3.421e-05 ***
## d84            -0.0479374  0.0235021  -2.0397   0.04188 *
## d85            -0.0046111  0.0234998  -0.1962   0.84451
## d86             0.0275143  0.0241494   1.1393   0.25508
## d87             0.0408267  0.0244153   1.6722   0.09508 .
## diff(lprbarr)  -0.3274942  0.0299801 -10.9237 < 2.2e-16 ***
## diff(lprbconv) -0.2381066  0.0182341 -13.0583 < 2.2e-16 ***
## diff(lprbpris) -0.1650463  0.0259690  -6.3555 4.488e-10 ***
## diff(lavgsen)  -0.0217606  0.0220909  -0.9850   0.32505
## diff(lpolpc)    0.3984264  0.0268820  14.8213 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

FD model(automatic way)

```
coeftest( plm(log(crmrte)~d83+d84+d85+d86+d87+lprbarr+lprbconv+
                  lprbpris+lavgsen+lpolpc,data=crime4.p, model="fd") )

##
## t test of coefficients:
##
##                Estimate Std. Error  t value  Pr(>|t|)
## (Intercept)  0.0077134  0.0170579   0.4522 0.6513193
## d83         -0.0998658  0.0238953  -4.1793 3.421e-05 ***
## d84         -0.1478033  0.0412794  -3.5806 0.0003744 ***
## d85         -0.1524144  0.0584000  -2.6098 0.0093152 **
```

```
## d86          -0.1249001  0.0760042  -1.6433 0.1009087
## d87          -0.0840734  0.0940003  -0.8944 0.3715175
## lprbarr      -0.3274942  0.0299801 -10.9237 < 2.2e-16 ***
## lprbconv     -0.2381066  0.0182341 -13.0583 < 2.2e-16 ***
## lprbpris     -0.1650463  0.0259690  -6.3555 4.488e-10 ***
## lavgsen      -0.0217606  0.0220909  -0.9850 0.3250506
## lpolpc        0.3984264  0.0268820  14.8213 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

year dummy の扱いだけ manual と automatic で階差とるか取らないかで違うので coef も違うが、解釈のしようの問題なので no problem。それよりも、year dummy 以外の regressors の coefs が一致してることが重要。