13) Correlated Random Effects (CRE)

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Vella and Verbeek (1998)

$$Log(wage)_{it} = \beta_0 + \beta_1 Union_{it} + X_{it} + u_{it}$$

use wagepan.dta

sum lwage educ black hisp exper married union

Variable	Obs	Mean	Std. Dev.	Min
lwage	4,360	1.649147	.5326094	-3.579079
educ	4,360	11.76697	1.746181	3
black	4,360	.1155963	.3197769	0
hisp	4,360	.1559633	.3628622	0
exper	4,360	6.514679	2.825873	0
married	4,360	.4389908	.4963208	0
union	4,360	.2440367	.4295639	0

Compare OLS, RE, and FE

```
xtset nr year

reg lwage educ black hisp exper expersq married union i.year

estimates store OLS

xtreg lwage educ black hisp exper expersq married union i.year, re

estimates store RE

xtreg lwage educ black hisp exper expersq married union i.year, fe

estimates store FE
```

estimates table OLS RE FE, b(%7.4f) se

Variable	OLS	RE	FE
educ	0.0913	0.0919	(omitted)
	0.0052	0.0107	
black	-0.1392	-0.1394	(omitted)
	0.0236	0.0477	
hisp	0.0160	0.0217	(omitted)
	0.0208	0.0426	
exper	0.0672	0.1058	0.1321
	0.0137	0.0154	0.0098
expersq	-0.0024	-0.0047	-0.0052
	0.0008	0.0007	0.0007
married	0.1083	0.0640	0.0467
	0.0157	0.0168	0.0183
union	0.1825	0.1061	0.0800
	0.0172	0.0179	0.0193

Hausman Test (1978)

$$H = (\hat{\delta}_{FE} - \hat{\delta}_{RE})'[Avar(\hat{\delta}_{FE}) - Avar(\hat{\delta}_{RE})]^{-1}(\hat{\delta}_{FE} - \hat{\delta}_{RE})$$

$H \sim \chi^2_M$, where M is the vector of regressors varying across i and t

Hausman Test has no power under violation of assumption RE.3

hausman FE RE

	Coefficients (b) FE	(B) RE	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
exper	.1321464	.1057545	.0263919	.
expersq	-.0051855	-.0047239	-.0004616	.0001443
married	.0466804	.063986	-.0173057	.0073414
union	.0800019	.1061344	-.0261326	.0073572
year				
1981	.0190448	.040462	-.0214172	.
1982	-.011322	.0309212	-.0422431	.
1983	-.0419955	.0202806	-.0622762	.
1984	-.0384709	.0431187	-.0815896	.
1985	-.0432498	.0578155	-.1010653	.
1986	-.0273819	.0919476	-.1193295	.

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(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 31.71
Prob>chi2 = 0.0004

hausman FE RE, sigmamore

	Coefficients (b) FE	(B) RE	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
exper	.1321464	.1057545	.0263919	.
expersq	-.0051855	-.0047239	-.0004616	.0001533
married	.0466804	.063986	-.0173057	.0074632
union	.0800019	.1061344	-.0261326	.0074922
year				
1981	.0190448	.040462	-.0214172	.
1982	-.011322	.0309212	-.0422431	.
1983	-.0419955	.0202806	-.0622762	.
1984	-.0384709	.0431187	-.0815896	.
1985	-.0432498	.0578155	-.1010653	.
1986	-.0273819	.0919476	-.1193295	.

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(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 26.22
Prob>chi2 = 0.0001

Correlated Random Effects - Mundlak (1978)

$$y_{it} = x_{it}\beta + c_i + u_{it}$$

$$x_{it}\beta = z_i\gamma + w_{it}\delta$$

$$c_i = \psi + \bar{w}_i\xi + \alpha_i$$

$$y_{it} = x_{it}\beta + \bar{w}_i\xi + \alpha_i + u_{it}$$

$$\hat{\beta}_{CRE} = \hat{\beta}_{FE}$$

Create Variables for CRE

egen experbar = mean(exper), by(nr)

egen expersqbar = mean(expersq), by(nr)

egen marriedbar = mean(married), by(nr)

egen unionbar = mean(union), by(nr)

	nr	year	union	unionbar	exper	experbar
1.	13	1980	0	.125	1	4.5
2.	13	1981	1	.125	2	4.5
3.	13	1982	0	.125	3	4.5
4.	13	1983	0	.125	4	4.5
5.	13	1984	0	.125	5	4.5
6.	13	1985	0	.125	6	4.5
7.	13	1986	0	.125	7	4.5
8.	13	1987	0	.125	8	4.5
9.	17	1980	0	0	4	7.5
10.	17	1981	0	0	5	7.5

xtreg lwage educ black hisp exper expersq married union experbar expersqbar marriedbar unionbar i.year , re

lwage	Coef.	Std. Err.	z	P>|z|
educ	.0946036	.0109043	8.68	0.000
black	-.1388124	.0488709	-2.84	0.005
hisp	.0047758	.0426925	0.11	0.911
exper	.1321464	.0098247	13.45	0.000
expersq	-.0051855	.0007044	-7.36	0.000
married	.0466804	.0183104	2.55	0.011
union	.0800019	.0193103	4.14	0.000
experbar	-.1825835	.0512825	-3.56	0.000
expersqbar	.01031	.0032882	3.14	0.002
marriedbar	.0969833	.045084	2.15	0.031
unionbar	.1906747	.0504097	3.78	0.000

Test for Endogeneity

test expersqbar marriedbar unionbar

```
 ( 1)  expersqbar = 0
 ( 2)  marriedbar = 0           chi2(  3) =   26.36
 ( 3)  unionbar = 0           Prob > chi2 =    0.0000
```

test unionbar

```
                               chi2(  1) =   14.31
 ( 1)  unionbar = 0          Prob > chi2 =    0.0002
```

xtreg lwage educ black hisp exper expersq married union experbar expersqbar marriedbar unionbar i.year, re cluster(nr)

lwage	Coef.	Robust Std. Err.	z	P>|z|
educ	.0946036	.0112571	8.40	0.000
black	-.1388124	.0504943	-2.75	0.006
hisp	.0047758	.0386535	0.12	0.902
exper	.1321464	.0120177	11.00	0.000
expersq	-.0051855	.0008109	-6.39	0.000
married	.0466804	.0210207	2.22	0.026
union	.0800019	.0227614	3.51	0.000
experbar	-.1825835	.0467446	-3.91	0.000
expersqbar	.01031	.0028495	3.62	0.000
marriedbar	.0969833	.0448145	2.16	0.030
unionbar	.1906747	.0474693	4.02	0.000

Fully Efficient Test

test expersqbar marriedbar unionbar

```
 ( 1)  expersqbar = 0
 ( 2)  marriedbar = 0
 ( 3)  unionbar = 0

           chi2(  3) =   29.87
         Prob > chi2 =    0.0000
```

test unionbar

```
 ( 1)  unionbar = 0

           chi2(  1) =   16.13
         Prob > chi2 =    0.0001
```