Computer Lab in Economics
Master in International Economics
Panel Data Analysis with Stata

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PANEL DATA ANALYSIS

- A panel data consist in n individuals along t periods:

$$y_{it} = \alpha + x_{it}'\beta + \mu_i + v_{it}$$

i = 1…N
t = 1…T

- μ_i: individual effects (heterogeneity) time-invariant

PANEL DATA ANALYSIS (ESTIMATION METHODS)

- **OLS**, when there is no individual effects, OLS consistent and efficient
- **Fixed effects**: μ_i unobservable and correlated with x_{it}
- **Random effects**: $\mu_i$unobservable and uncorrelated with x_{it}. In that case, the error term includes:

  μ_i:individual effect

PANEL DATA ANALYSIS (ESTIMATION METHODS)

- Before estimate we should fix the panel with the command xtset (o tsset):

  xtset varindiv vartime

- The command xtdescribe offers information about the panel.

- To obtain the descriptive statistics we can use the command xtsum or summarize if we specify one variable in particular.

PANEL DATA ANALYSIS (ESTIMATION METHODS)

Title

[XT] xtreg — Fixed-, between-, and random-effects, and population-averaged linear models

Syntax

GLS random-effects (RE) model

xtreg *depvar* [*indepvars*] [*if*] [*in*] [**, re** *RE_options*]

Between-effects (BE) model

xtreg *depvar* [*indepvars*] [*if*] [*in*] **, be** [*BE_options*]

Fixed-effects (FE) model

xtreg *depvar* [*indepvars*] [*if*] [*in*] [*weight*] **, fe** [*FE_options*]

ML random-effects (MLE) model

xtreg *depvar* [*indepvars*] [*if*] [*in*] [*weight*] **, mle** [*MLE_options*]

Population-averaged (PA) model

xtreg *depvar* [*indepvars*] [*if*] [*in*] [*weight*] **, pa** [*PA_options*]

PANEL DATA ANALYSIS
(Hausman Test)

To determine the estimation method we have available the Hausman test.

In first place, we should sabe the fixed effects estimation:

xtreg depvar invars, fe

estimates store «name»

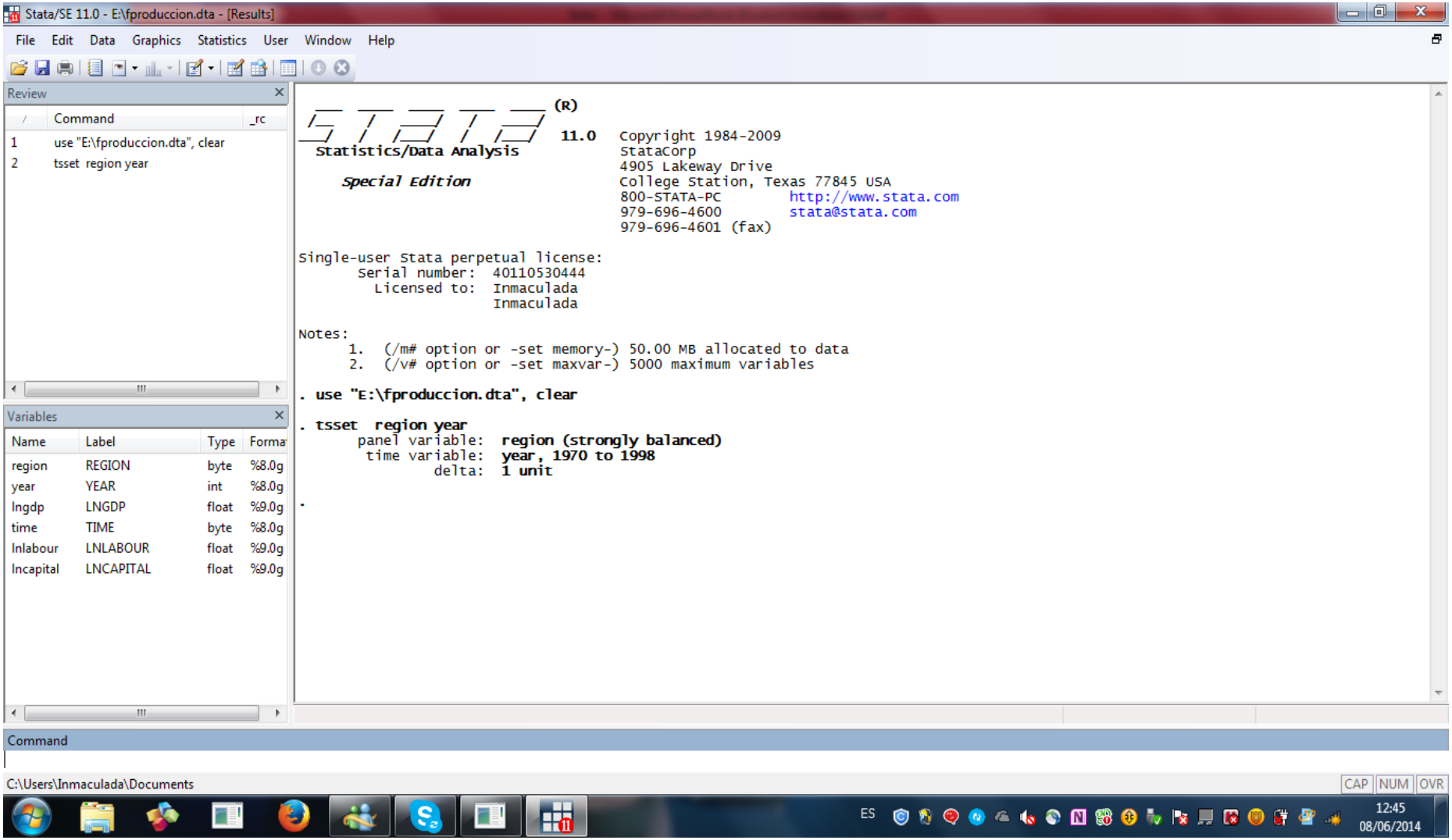
We perform the random effects estimation

xtreg depvar invars, re

To develop the test we must type in command line hausman:

hausman «name»

PANEL DATA ANALYSIS (Example)



PANEL DATA ANALYSIS (Example)

```
. xtreg  lngdp time lnlabour lncapital,fe

Fixed-effects (within) regression               Number of obs      =       551
Group variable: region                          Number of groups   =        19

R-sq:  within  = 0.9718                         Obs per group: min =        29
       between = 0.9954                                        avg =      29.0
       overall = 0.9923                                        max =        29

                                                F(3,529)           =   6084.87
corr(u_i, Xb)  = 0.9387                         Prob > F           =    0.0000
```

lngdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
time	.0137155	.0006289	21.81	0.000	.01248	.014951
lnlabour	.3415174	.023138	14.76	0.000	.2960638	.3869711
lncapital	.4062171	.0199011	20.41	0.000	.3671222	.4453121
_cons	-2.602446	.4105087	-6.34	0.000	-3.408873	-1.796018
sigma_u	.34171011					
sigma_e	.03938228					
rho	.98689143	(fraction of variance due to u_i)				

F test that all u_i=0: F(18, 529) = 155.31 Prob > F = 0.0000

PANEL DATA ANALYSIS (Example)

```
. estimates store fixed

. xtreg  lngdp time lnlabour lncapital,re

Random-effects GLS regression                   Number of obs      =       551
Group variable: region                          Number of groups   =        19

R-sq:  within  = 0.9699                         Obs per group: min =        29
       between = 0.9953                                        avg =      29.0
       overall = 0.9945                                        max =        29

Random effects u_i ~ Gaussian                   Wald chi2(3)       =  20411.71
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
```

lngdp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
time	.0110751	.0005365	20.64	0.000	.0100236	.0121266
lnlabour	.4404544	.0187716	23.46	0.000	.4036628	.477246
lncapital	.487915	.0171822	28.40	0.000	.4542384	.5215915
_cons	-5.163637	.2045575	-25.24	0.000	-5.564562	-4.762712
sigma_u	.09176683					
sigma_e	.03938228					
rho	.84446991	(fraction of variance due to u_i)				

Análisis de Datos de Panel (Example)

```
. hausman fixed
```

	Coefficients (b) fixed	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
time	.0137155	.0110751	.0026404	.0003282
lnlabour	.3415174	.4404544	-.098937	.0135276
lncapital	.4062171	.487915	-.0816978	.0100413

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(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 50.70
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)

In our example, the correct method is fixed effects

PANEL DATA ANALYSIS (Post estimation)

[XT] xtreg postestimation — Postestimation tools for xtreg

Description

The following postestimation commands are of special interest after **xtreg**:

command	description
xttest0	Breusch and Pagan LM test for random effects

The following standard postestimation commands are also available:

command		description
(1)	**estat**	AIC, BIC, VCE, and estimation sample summary
	estimates	cataloging estimation results
	hausman	Hausman's specification test
	lincom	point estimates, standard errors, testing, and inference for linear combinations of coefficients
	lrtest	likelihood-ratio test
	margins	marginal means, predictive margins, marginal effects, and average marginal effects
	nlcom	point estimates, standard errors, testing, and inference for nonlinear combinations of coefficients
	predict	predictions, residuals, influence statistics, and other diagnostic measures
	predictnl	point estimates, standard errors, testing, and inference for generalized predictions
	test	Wald tests of simple and composite linear hypotheses
	testnl	Wald tests of nonlinear hypotheses

PANEL DATA ANALYSIS
(Post estimation, command predict)

After estimation of panel data analysis using the command xtreg, we can use the command predict to obtain linear predictions and the residuals.

For example, to obtain the linear prediction:

predict «variable name», xb

In the same way, we can obtain the residuals and the individual effects:

predict «variable name», e

predict «variable name», u

PANEL DATA ANALYSIS
(Post estimation, command predict)

Syntax for predict

For all but the population-averaged model

predict [*type*] *newvar* [*if*] [*in*] [, *statistic* **nooffset**]

Population-averaged model

predict [*type*] *newvar* [*if*] [*in*] [, *PA_statistic* **nooffset**]

statistic	description
Main	
xb	xb, fitted values; the default
stdp	calculate standard error of the fitted values
ue	u_i + e_it, the combined residual
* **xbu**	xb + u_i, prediction including effect
* **u**	u_i, the fixed- or random-error component
* **e**	e_it, the overall error component

PANEL DATA ANALYSIS
(Estimation methods, command xtregar)

help xtregar dialog: xtregar
also see: xtregar postestimation

Title

[XT] xtregar — Fixed- and random-effects linear models with an AR(1) disturbance

Syntax

GLS Random-effects (RE) model

xtregar *depvar* [*indepvars*] [*if*] [*in*] [, **re** *options*]

Fixed-effects (FE) model

xtregar *depvar* [*indepvars*] [*if*] [*in*] [*weight*] , **fe** [*options*]

options	description
Model	
re	use random-effects estimator; the default
fe	use fixed-effects estimator
rhotype(*rhomethod***)**	specify method to compute autocorrelation; seldom used
rhof(#)	use # for p and do not estimate p
twostep	perform two-step estimate of correlation
Reporting	
level(#)	set confidence level; default is **level(95)**
lbi	perform Baltagi-Wu LBI test
display_options	control spacing and display of omitted variables and base and empty cells
+ **coeflegend**	display coefficients' legend instead of coefficient table

+ **coeflegend** does not appear in the dialog box.
A panel variable and a time variable must be specified; use **xtset**.
indepvars may contain factor variables; see fvvarlist.
depvar and *indepvars* may contain time-series operators; see tsvarlist.
by and **statsby** are allowed; see prefix.
fweights and **aweight**s are allowed for the fixed-effects model with **rhotype(regress)** or **rhotype(freg)**, or with a fixed rho; see weight. Weights must be constant within panel.
See **[XT] xtregar postestimation** for features available after estimation.

PANEL DATA ANALYSIS
(Estimation methods, command xtregar)

```
. xtregar  lngdp time lnlabour lncapital,fe lbi

FE (within) regression with AR(1) disturbances  Number of obs      =       532
Group variable: region                          Number of groups   =        19

R-sq:  within  = 0.6322                         Obs per group: min =        28
       between = 0.9919                                        avg =      28.0
       overall = 0.9829                                        max =        28

                                                F(3,510)           =    292.24
corr(u_i, Xb)  = -0.9324                        Prob > F           =    0.0000
```

lngdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
time	.0052772	.0013275	3.98	0.000	.0026692	.0078852
lnlabour	1.021219	.0480876	21.24	0.000	.9267446	1.115693
lncapital	.2147897	.0455619	4.71	0.000	.1252776	.3043017
_cons	-7.910373	.0654689	-120.83	0.000	-8.038995	-7.781751
rho_ar	.92348725					
sigma_u	.35629782					
sigma_e	.01519371					
rho_fov	.99818485	(fraction of variance because of u_i)				

```
F test that all u_i=0:     F(18,510) =     7.68                 Prob > F = 0.0000
modified Bhargava et al. Durbin-Watson = .22091777
Baltagi-Wu LBI = .29929258
```

PANEL DATA ANALYSIS
(Estimation methods, command xtregar)

```
. xtregar  lngdp time lnlabour lncapital,fe twostep

FE (within) regression with AR(1) disturbances  Number of obs      =       532
Group variable: region                          Number of groups   =        19

R-sq:  within  = 0.7228                         Obs per group: min =        28
       between = 0.9921                                        avg =      28.0
       overall = 0.9874                                        max =        28

                                                F(3,510)           =    443.24
corr(u_i, Xb)  = -0.8481                        Prob > F           =    0.0000
```

lngdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
time	.0101502	.0011803	8.60	0.000	.0078314	.0124691
lnlabour	.928512	.0457961	20.27	0.000	.8385397	1.018484
lncapital	.2136608	.0452267	4.72	0.000	.1248072	.3025144
_cons	-6.867505	.091817	-74.80	0.000	-7.047891	-6.687119
rho_ar	.88954111					
sigma_u	.23843218					
sigma_e	.01549526					
rho_fov	.99579431	(fraction of variance because of u_i)				

F test that all u_i=0: F(18,510) = 14.40 Prob > F = 0.0000

PANEL DATA ANALYSIS
(Estimation methods, command xtregar)

```
. xtregar  lngdp time lnlabour lncapital,re lbi

RE GLS regression with AR(1) disturbances       Number of obs      =       551
Group variable: region                          Number of groups   =        19

R-sq:  within  = 0.9676                         Obs per group: min =        29
       between = 0.9946                                        avg =      29.0
       overall = 0.9938                                        max =        29

                                                Wald chi2(4)       =   7631.28
corr(u_i, Xb)      = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       lngdp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   .0133094   .0009312    14.29   0.000     .0114842    .0151346
    lnlabour |   .5629617   .0290077    19.41   0.000     .5061076    .6198158
   lncapital |   .4263252   .0270399    15.77   0.000     .3733279    .4793225
       _cons |  -5.779074   .2228863   -25.93   0.000    -6.215923   -5.342225
-------------+----------------------------------------------------------------
      rho_ar |  .92348725   (estimated autocorrelation coefficient)
     sigma_u |  .08991628
     sigma_e |  .01762297
     rho_fov |   .9630077   (fraction of variance due to u_i)
       theta |  .66847535
------------------------------------------------------------------------------
modified Bhargava et al. Durbin-Watson = .22091777
Baltagi-Wu LBI = .29929258
```

PANEL DATA ANALYSIS
(Estimation methods, command xtregar)

help xtregar postestimation dialog: predict
also see: xtregar

Title

[XT] **xtregar postestimation** — Postestimation tools for xtregar

Description

The following postestimation commands are available for **xtregar**:

	command	description
(1)	**estat**	AIC, BIC, VCE, and estimation sample summary
	estimates	cataloging estimation results
	hausman	Hausman's specification test
	lincom	point estimates, standard errors, testing, and inference for linear combinations of coefficients
	margins	marginal means, predictive margins, marginal effects, and average marginal effects
	nlcom	point estimates, standard errors, testing, and inference for nonlinear combinations of coefficients
	predict	predictions, residuals, influence statistics, and other diagnostic measures
	predictnl	point estimates, standard errors, testing, and inference for generalized predictions
	test	Wald tests of simple and composite linear hypotheses
	testnl	Wald tests of nonlinear hypotheses

(1) **estat ic** is not appropriate with **xtregar, re**.

PANEL DATA ANALYSIS (Endogeneity)

To constrast endogeneity problems there are different tests. One alternative is the test of Wooldridge (2002), based on the following specification:

$$y_{it} = x_{it}\beta + w_{it+1}\delta + c_i + u_{it}$$

Where w_{it+1} is a subsample of regressors in which we contrast the existence of endogeneity problems. When the associated coefficients are not significant these variables are considered exogenous.

PANEL DATA ANALYSIS (Instrumental variables, command xtivreg)

Title

[XT] xtivreg — Instrumental variables and two-stage least squares for panel-data models

Syntax

GLS random-effects (RE) model

```
xtivreg depvar [varlist_1] (varlist_2 = varlist_iv) [if] [in] [, re
        RE_options]
```

Between-effects (BE) model

```
xtivreg depvar [varlist_1] (varlist_2 = varlist_iv) [if] [in] , be
        [BE_options]
```

Fixed-effects (FE) model

```
xtivreg depvar [varlist_1] (varlist_2 = varlist_iv) [if] [in] , fe
        [FE_options]
```

Fixed-effects (FD) model

```
xtivreg depvar [varlist_1] (varlist_2 = varlist_iv) [if] [in] , fd
        [FD_options]
```

PANEL DATA ANALYSIS (Instrumental variables, command xtivreg)

```
. xtivreg lngdp time lnlabour (lncapital=lncapitaliv),fe

Fixed-effects (within) IV regression            Number of obs      =       532
Group variable: region                          Number of groups   =        19

R-sq:  within  = 0.9692                         Obs per group: min =        28
       between = 0.9952                                        avg =      28.0
       overall = 0.9915                                        max =        28

                                                Wald chi2(3)       =  2.61e+07
corr(u_i, Xb)  = 0.9461                         Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       lngdp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   lncapital |   .3513562   .0217044    16.19   0.000     .3088164    .393896
        time |    .014977   .0006652    22.52   0.000     .0136733    .0162807
   lnlabour |   .3670343   .0239904    15.30   0.000      .320014    .4140546
       _cons |  -2.038384   .4361731    -4.67   0.000    -2.893268   -1.183501
-------------+----------------------------------------------------------------
     sigma_u |  .38584644
     sigma_e |  .03894695
         rho |  .98991408   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(18,510) =   154.64                 Prob > F    = 0.0000
------------------------------------------------------------------------------
Instrumented:   lncapital
Instruments:    time lnlabour lncapitaliv
------------------------------------------------------------------------------

.
```

PANEL DATA ANALYSIS (Instrumental variables, command xtivreg)

```
. hausman fixed
```

	Coefficients (b) fixed	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lncapital	.3513562	.4511102	-.099754	.0116049
time	.014977	.0118393	.0031377	.0003684
lnlabour	.3670343	.477104	-.1100697	.0136906

```
                b = consistent under Ho and Ha; obtained from xtivreg
     B = inconsistent under Ha, efficient under Ho; obtained from xtivreg

  Test:  Ho:  difference in coefficients not systematic

              chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =       60.14
            Prob>chi2 =      0.0000
            (V_b-V_B is not positive definite)
```

PANEL DATA ANALYSIS (Instrumental variables, command xtivreg)

help xtivreg postestimation predict dialogs: re/be/fe first-diff
also see: xtivreg

Title

[XT] xtivreg postestimation — Postestimation tools for xtivreg

Description

The following postestimation commands are available for **xtivreg**:

command	description
estat	VCE and estimation sample summary
estimates	cataloging estimation results
hausman	Hausman's specification test
lincom	point estimates, standard errors, testing, and inference for linear combinations of coefficients
margins	marginal means, predictive margins, marginal effects, and average marginal effects
nlcom	point estimates, standard errors, testing, and inference for nonlinear combinations of coefficients
predict	predictions, residuals, influence statistics, and other diagnostic measures
predictnl	point estimates, standard errors, testing, and inference for generalized predictions
test	Wald tests of simple and composite linear hypotheses
testnl	Wald tests of nonlinear hypotheses

PANEL DATA ANALYSIS (Instrumental variables, command xtivreg)

Syntax for predict

For all but the first-differenced estimator

predict [*type*] *newvar* [*if*] [*in*] [, *statistic*]

First-differenced estimator

predict [*type*] *newvar* [*if*] [*in*] [, *FD_statistic*]

statistic	description
Main	
xb	Z_(it)d, fitted values; the default
ue	u_i + v_it, the combined residual
* **xbu**	Z_(it)d + v_i, prediction including effect
* **u**	u_i, the fixed- or random-error component
* **e**	v_it, the overall error component

PANEL DATA ANALYSIS
(Instrumental variables, command xthtaylor)

It a very useful method when some regressors could be correlated with the random individual effects.

- Time variant exogenous and endogenous regressors.
- Dummies or time invariant regressors exogenous and correlated with the random effects.

Panel Data Analysis with Stata

PANEL DATA ANALYSIS

(Instrumental variables, command xthtaylor)

Title

[XT] xthtaylor — Hausman–Taylor estimator for error-components models

Syntax

xthtaylor *depvar indepvars* [*if*] [*in*] [*weight*] , **endog(***varlist***)** [*options*]

options	description
Main	
noconstant	suppress constant term
* **endog(***varlist***)**	explanatory variables in *indepvars* to be treated as endogenous
constant(*varlist_ti***)**	independent variables that are constant within panel
varying(*varlist_tv***)**	independent variables that are time varying within panel
amacurdy	fit model based on Amemiya and MaCurdy estimator
SE	
vce(*vcetype***)**	*vcetype* may be **conventional**, **bootstrap**, or **jackknife**
Reporting	
level(#)	set confidence level; default is **level(95)**
small	report small-sample statistics

* **endog(***varlist***)** is required.
A panel variable must be specified. For **xthtaylor**, **amacurdy**, a time variable must also be specified. Use **xtset**.
depvar, *indepvars*, and all *varlists* may contain time-series operators; see tsvarlist.
by, **statsby**, and **xi** are allowed; see prefix.
iweights and **fweights** are allowed unless the **amacurdy** option is specified. Weights must be constant within panel; see weight.
See **[XT] xthtaylor postestimation** for features available after estimation.

PANEL DATA ANALYSIS
(Instrumental variables, command xthtaylor)

help xthtaylor postestimation dialog: predict
also see: xthtaylor

Title

[XT] **xthtaylor postestimation** — Postestimation tools for xthtaylor

Description

The following postestimation commands are available for **xthtaylor**:

command	description
estat	VCE and estimation sample summary
estimates	cataloging estimation results
lincom	point estimates, standard errors, testing, and inference for linear combinations of coefficients
margins	marginal means, predictive margins, marginal effects, and average marginal effects
nlcom	point estimates, standard errors, testing, and inference for nonlinear combinations of coefficients
predict	predictions, residuals, influence statistics, and other diagnostic measures
predictnl	point estimates, standard errors, testing, and inference for generalized predictions
test	Wald tests of simple and composite linear hypotheses
testnl	Wald tests of nonlinear hypotheses

PANEL DATA ANALYSIS
(Instrumental variables, command xthtaylor)

Syntax for predict

predict [*type*] *newvar* [*if*] [*in*] [, *statistic*]

statistic	description
Main	
xb	B*x[i,t] + G*z[i] fitted values; the default
stdp	standard error of the fitted values
ue	u[i] + e[i,t], the combined residual
* **xbu**	B*x[i,t] + G*z[i] + u[i], prediction including effect
* **u**	u[i], the random-error component
* **e**	e[i,t], prediction of the idiosyncratic error component

Unstarred statistics are available both in and out of sample; type **predict** ... **if e(sample)** ... if wanted only for the estimation sample. Starred statistics are calculated only for the estimation sample, even when **if e(sample)** is not specified.

PANEL DATA ANALYSIS (Dynamic Models)

To contrast some dynamics we can propose the following specification:

$$Y_{it} = \delta Y_{i,t-1} + X'_{it}\beta + \mu_i + v_{it}$$

Incorporating the lagged dependent variable as an additional regressor. In that case, we should implement an Instrumental Variable (IV) estimation.

PANEL DATA ANALYSIS (Dynamic Models)

In the context of fixed effects, we should estimate eliminating those effects. For this reason, we apply first differences transformation:

$$\Delta Y_{it} = \delta \Delta Y_{i,t-1} + \Delta X'_{it} \beta + \Delta v_{it}$$

Given that the correlation between $\Delta Y_{i,t-1}$ and Δv_{it} yields inconsistencies in OLS estimation, we impose exogeneity in X.

PANEL DATA ANALYSIS (Dynamic Models)

We can apply an IV estimaton. For this, we only need valid instruments: correlated with $\Delta Y_{i,t-1}$ and not with Δv_{it} .

There are estimators that use one instruments, or those based on the Generalized Method of Moments (GMM), that uses all posible instruments..

- Anderson-Hsiao VI: instrument $Y_{i,t-2}$
- Arellano-Bond GMM: instrument for t $Y_{i,1},\ Y_{i,2},...,Y_{i,t-2}$

PANEL DATA ANALYSIS (Dynamic Models, xtabond)

Title

[XT] xtabond — Arellano-Bond linear dynamic panel-data estimation

Syntax

xtabond *depvar* [*indepvars*] [*if*] [*in*] [, *options*]

options	description
Model	
noconstant	suppress constant term
diffvars(*varlist***)**	already-differenced exogenous variables
inst(*varlist***)**	additional instrument variables
lags(*#***)**	use *#* lags of dependent variable as covariates; default is **lags(1)**
maxldep(*#***)**	maximum lags of dependent variable for use as instruments
maxlags(*#***)**	maximum lags of predetermined and endogenous variables for use as instruments
twostep	compute the two-step estimator instead of the one-step estimator
Predetermined	
pre(*varlist***[...])**	predetermined variables; can be specified more than once
Endogenous	
endogenous(*varlist***[...])**	endogenous variables; can be specified more than once

PANEL DATA ANALYSIS (Dynamic Models, xtabond)

```
. xtabond  lngdp time lnlabour lncapital, endog(lncapital)
note: lncapital dropped because of collinearity

Arellano-Bond dynamic panel-data estimation  Number of obs      =       513
Group variable: region                       Number of groups   =        19
Time variable: year
                                             Obs per group: min =        27
                                                            avg =        27
                                                            max =        27

Number of instruments =     409              Wald chi2(4)       =  167620.57
                                             Prob > chi2        =    0.0000
One-step results
```

lngdp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lngdp L1.	.8573716	.0149006	57.54	0.000	.828167	.8865762
lncapital	-.0402074	.0101237	-3.97	0.000	-.0600494	-.0203653
time	.0041541	.0002838	14.64	0.000	.0035979	.0047104
lnlabour	.1384269	.0097896	14.14	0.000	.1192396	.1576142
_cons	.069509	.1527172	0.46	0.649	-.2298112	.3688292

```
Instruments for differenced equation
        GMM-type: L(2/.).lngdp L(2/.).lncapital
        Standard: D.time D.lnlabour D.lncapital
Instruments for level equation
        Standard: _cons
```

PANEL DATA ANALYSIS (Dynamic Models, xtabond)

```
. xtabond  lngdp time lnlabour lncapital, endog(lncapital) twostep
note: lncapital dropped because of collinearity

Arellano-Bond dynamic panel-data estimation  Number of obs          =       513
Group variable: region                       Number of groups       =        19
Time variable: year
                                             Obs per group:    min =        27
                                                               avg =        27
                                                               max =        27

Number of instruments =     409              Wald chi2(4)           =  521497.95
                                             Prob > chi2            =    0.0000
Two-step results
```

lngdp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lngdp L1.	.8580294	.0110551	77.61	0.000	.8363618	.879697
lncapital	-.0419416	.0156428	-2.68	0.007	-.0726009	-.0112823
time	.0042017	.0002998	14.01	0.000	.003614	.0047894
lnlabour	.1378218	.0118064	11.67	0.000	.1146817	.1609619
_cons	.0981878	.3009359	0.33	0.744	-.4916356	.6880113

```
Warning: gmm two-step standard errors are biased; robust standard
         errors are recommended.
Instruments for differenced equation
        GMM-type: L(2/.).lngdp L(2/.).lncapital
        Standard: D.time D.lnlabour D.lncapital
Instruments for level equation
        Standard: _cons
```

PANEL DATA ANALYSIS (Dynamic Models, xtabond)

Title

[XT] xtabond postestimation — Postestimation tools for xtabond

Description

The following postestimation commands are of special interest after **xtabond**:

command	description
estat abond	test for autocorrelation
estat sargan	Sargan test of overidentifying restrictions

The following standard postestimation commands are also available:

command	description
estat	VCE and estimation sample summary
estimates	cataloging estimation results
lincom	point estimates, standard errors, testing, and inference for linear combinations of coefficients
margins	marginal means, predictive margins, marginal effects, and average marginal effects
nlcom	point estimates, standard errors, testing, and inference for nonlinear combinations of coefficients
predict	predictions, residuals, influence statistics, and other diagnostic measures
predictnl	point estimates, standard errors, testing, and inference for generalized predictions
test	Wald tests of simple and composite linear hypotheses
testnl	Wald tests of nonlinear hypotheses

PANEL DATA ANALYSIS
(Dynamic Models, xtabond)

```
. estat abond

Arellano-Bond test for zero autocorrelation in first-differenced errors
```

Order	z	Prob > z
1	-1.2149	0.2244
2	-2.9419	0.0033

```
    H0: no autocorrelation

. estat sargan
Sargan test of overidentifying restrictions
        H0: overidentifying restrictions are valid

        chi2(404)     =  18.94105
        Prob > chi2   =    1.0000
```

- **estat abond**: We reject the null hypothesis in the second case.Therefore, we obtain correlation of second order.
- **estat sargan**: We don´t reject the null hypothesis. For this reason, the model is correct.

TAKE CARE! For autocorrelation of order higher than 1 is convenient to use **xtdpd**, instead of **xtabond**.

PANEL DATA ANALYSIS
(Dynamic Models, xtdpd)

help xtdpd — dialog: xtdpd; also see: xtdpd postestimation

Title

[XT] xtdpd — Linear dynamic panel-data estimation

Syntax

xtdpd *depvar* [*indepvars*] [*if*] [*in*] , **dgmmiv(***varlist* [...]**)** [*options*]

options	description
Model	
* **dgmmiv(***varlist*[...]**)**	GMM-type instruments for the difference equation; can be specified more than once
lgmmiv(*varlist*[...]**)**	GMM-type instruments for the level equation; can be specified more than once
iv(*varlist*[...]**)**	standard instruments for the difference and level equations; can be specified more than once
div(*varlist*[...]**)**	standard instruments for the difference equation only; can be specified more than once
liv(*varlist***)**	standard instruments for the level equation only; can be specified more than once
noconstant	suppress constant term
twostep	compute the two-step estimator instead of the one-step estimator
hascons	check for collinearity only among levels of independent
SE/Robust	
vce(*vcetype***)**	*vcetype* may be **gmm** or **robust**
Reporting	
level(#)	set confidence level; default is **level(95)**
artests(#)	use # as maximum order for AR tests; default is **artests(2)**
display_options	control spacing
+ **coeflegend**	display coefficients' legend instead of coefficient table

* **dgmmiv()** is required.
\+ **coeflegend** does not appear in the dialog box.
A panel variable and a time variable must be specified; use **xtset**; see **[XT] xtset**.
depvar, *indepvars*, and all *varlists* may contain time-series operators; see tsvarlist.
by, **statsby**, and **xi** are allowed; see prefix.
See **[XT] xtdpd postestimation** for features available after estimation.

PANEL DATA ANALYSIS
(Dynamic Models, xtdpd)

```
. xtdpd L(0/2).lngdp time lnlabour lncapital, dgmmiv(lngdp) twostep
note: D.time dropped because of collinearity

Dynamic panel-data estimation                 Number of obs      =       513
Group variable: region                        Number of groups   =        19
Time variable: year
                                              Obs per group:  min =        27
                                                              avg =        27
                                                              max =        27

Number of instruments =    222                Wald chi2(4)       =  158023.29
                                              Prob > chi2        =    0.0000
Two-step results
```

lngdp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lngdp						
L1.	1.558953	.0097436	160.00	0.000	1.539856	1.57805
L2.	-.6808701	.0078211	-87.06	0.000	-.6961991	-.665541
lnlabour	.068652	.0066601	10.31	0.000	.0555985	.0817054
lncapital	.1007266	.0064448	15.63	0.000	.088095	.1133583
_cons	-1.465396	.1115193	-13.14	0.000	-1.683969	-1.246822

```
Warning: gmm two-step standard errors are biased; robust standard
         errors are recommended.
Instruments for differenced equation
        GMM-type: L(2/.).lngdp
Instruments for level equation
        Standard: _cons
```

PANEL DATA ANALYSIS
(Dynamic Models, xtdpd)

Title

[XT] xtdpd postestimation — Postestimation tools for xtdpd

Description

The following postestimation commands are of special interest after **xtdpd**:

command	description
estat abond	test for autocorrelation
estat sargan	Sargan test of overidentifying restrictions

The following standard postestimation commands are also available:

command	description
estat	VCE and estimation sample summary
estimates	cataloging estimation results
lincom	point estimates, standard errors, testing, and inference for linear combinations of coefficients
margins	marginal means, predictive margins, marginal effects, and average marginal effects
nlcom	point estimates, standard errors, testing, and inference for nonlinear combinations of coefficients
predict	predictions, residuals, influence statistics, and other diagnostic measures
predictnl	point estimates, standard errors, testing, and inference for generalized predictions
test	Wald tests of simple and composite linear hypotheses
testnl	Wald tests of nonlinear hypotheses

PANEL DATA ANALYSIS
(Dynamic Models, xtdpd)

```
. estat abond

Arellano-Bond test for zero autocorrelation in first-differenced errors
```

Order	z	Prob > z
1	-4.1582	0.0000
2	-2.9221	0.0035

H0: no autocorrelation

```
.
. estat sargan
Sargan test of overidentifying restrictions
        H0: overidentifying restrictions are valid

        chi2(217)     =  18.7804
        Prob > chi2   =   1.0000
```

PANEL DATA ANALYSIS
(Dynamic Models, xtdpdsys)

Advantages:

It is useful when there are many autoregressive terms. For this reason, introduces moment conditions in GMM estimator.

Inconvenients:

Many freedom degree. So, it is necessary a sample with n large and an small period T.

Panel Data Analysis with Stata

PANEL DATA ANALYSIS

(Dynamic Models, xtdpdsys)

help xtdpdsys — dialog: xtdpdsys; also see: xtdpdsys postestimation

---

Title

[XT] xtdpdsys — Arellano-Bover/Blundell-Bond linear dynamic panel-data estimation

Syntax

xtdpdsys *depvar* [*indepvars*] [*if*] [*in*] [, *options*]

options	description
Model	
noconstant	suppress constant term
lags(#)	use # lags of dependent variable as covariates; default is **lags(1)**
maxldep(#)	maximum lags of dependent variable for use as instruments
maxlags(#)	maximum lags of predetermined and endogenous variables for use as instruments
twostep	compute the two-step estimator instead of the one-step estimator
Predetermined	
pre(*varlist*[...]**)**	predetermined variables; can be specified more than once
Endogenous	
endogenous(*varlist*[...]**)**	endogenous variables; can be specified more than once
SE/Robust	
vce(*vcetype***)**	*vcetype* may be **gmm** or **robust**
Reporting	
level(#)	set confidence level; default is **level(95)**
artests(#)	use # as maximum order for AR tests; default is **artests(2)**
display_options	control spacing
+ **coeflegend**	display coefficients' legend instead of coefficient table

---

+ **coeflegend** does not appear in the dialog box.
A panel variable and a time variable must be specified; use **xtset**; see **[XT] xtset**.
indepvars and all *varlists*, except **pre(***varlist*[...]**)** and **endogenous(***varlist*[...]**)**, may contain time-series operators; see tsvarlist. The specification of *depvar* may not contain time-series operators.
by, **statsby**, and **xi** are allowed; see prefix.
See **[XT] xtdpdsys postestimation** for features available after estimation.

PANEL DATA ANALYSIS
(Dynamic Models, xtdpdsys)

```
. xtdpdsys  lngdp time lnlabour lncapital, endog(lncapital) twostep
note: lncapital dropped because of collinearity

System dynamic panel-data estimation          Number of obs      =       532
Group variable: region                        Number of groups   =        19
Time variable: year
                                              Obs per group:  min =        28
                                                              avg =        28
                                                              max =        28

Number of instruments =    463                Wald chi2(4)       =  340654.99
                                              Prob > chi2        =    0.0000
Two-step results
```

lngdp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lngdp L1.	.9545583	.0095923	99.51	0.000	.9357579	.9733588
lncapital	-.0900015	.0137513	-6.54	0.000	-.1169536	-.0630495
time	.0030957	.0002645	11.71	0.000	.0025773	.003614
lnlabour	.1394301	.0129826	10.74	0.000	.1139846	.1648756
_cons	.0504763	.2950214	0.17	0.864	-.527755	.6287076

```
Warning: gmm two-step standard errors are biased; robust standard
         errors are recommended.
Instruments for differenced equation
        GMM-type: L(2/.).lngdp L(2/.).lncapital
        Standard: D.time D.lnlabour D.lncapital
Instruments for level equation
        GMM-type: LD.lngdp LD.lncapital
        Standard: _cons
```

PANEL DATA ANALYSIS
(Dynamic Models, xtdpdsys)

Title

[XT] xtdpdsys postestimation — Postestimation tools for xtdpdsys

Description

The following postestimation commands are of special interest after **xtdpdsys**:

command	description
estat abond	test for autocorrelation
estat sargan	Sargan test of overidentifying restrictions

The following standard postestimation commands are also available:

command	description
estat	VCE and estimation sample summary
estimates	cataloging estimation results
lincom	point estimates, standard errors, testing, and inference for linear combinations of coefficients
margins	marginal means, predictive margins, marginal effects, and average marginal effects
nlcom	point estimates, standard errors, testing, and inference for nonlinear combinations of coefficients
predict	predictions, residuals, influence statistics, and other diagnostic measures
predictnl	point estimates, standard errors, testing, and inference for generalized predictions
test	Wald tests of simple and composite linear hypotheses
testnl	Wald tests of nonlinear hypotheses

PANEL DATA ANALYSIS
(Dynamic Models, xtdpdsys)

```
. estat abond

Arellano-Bond test for zero autocorrelation in first-differenced errors
```

Order	z	Prob > z
1	-2.516	0.0119
2	-2.9531	0.0031

H0: no autocorrelation

```
. estat sargan
Sargan test of overidentifying restrictions
        H0: overidentifying restrictions are valid

        chi2(458)     =  18.95103
        Prob > chi2   =    1.0000
```