Lab 7: Dynamic Panels Extended

GECO 6281 Advanced Econometrics 1

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Recapitulation Dynamic Panels

Panel Data is observed over time, including a lagged variable or **auto-regressive** term is an intuitive modeling choice.

$$y_t = \alpha + \phi_1 y_{t-1} + \beta x_t + \epsilon_t \text{ autoregressive process}$$
$$y_{i,t} = \alpha_i + \gamma_1 y_{i,t-1} + \beta x_{i,t} + \epsilon_{i,t} \text{ autoregressive panel data}$$

Caution: OLS with a lagged variable and serially correlated errors leads to **inconsistent estimators** (as it does in the non-panel case).

When estimating a dynamic panel using fixed effects, **first differencing** must be used rather than **mean differencing**.

Arellano-Bond instrumentalization allows for efficient FD estimation in a dynamic model. Estimated parameters are consistent for both FE and RE models.

Extending Arellano-Bond 1 (Repetition)

A dynamic panel model can be written in fixed effects.

$$y_{it} = \alpha_i + \sum_{j}^{p} \gamma_i y_{it-j} + x_t' \beta + \epsilon_{it}$$

y can be correlated (1) directly thorugh lags of y ("true state dependency"), (2) directly thorugh x ("observed heterogeneity") or (3) indirectly through individual effects α_i ("unobserved heterogeneity"). Keep in mind that individual effects respond to unobserved characteristics.

Note that mean difference ("within") is inconsistent, as is instrumented mean difference estimation, as mean differences will be correlated with the mean error term.

First Difference estimation is also inconsistent, but instrumented fist difference estimation is permitted.

$$p-1$$

Extending Arellano-Bond 2 (Repetition)

- Anderson-Hsiao: y_{t-2} is uncorrelated with $\Delta\epsilon_{it}$ and can be used as an instrument for Δy_{it-1}
- Arellano-Bond: Adding more lags as instruments makes estimation more efficient
- Using the General Method of Moments (GMM) is even more efficient. Restricting lags in long and narrow samples (large T) increases asymptotic performance. `vce(robust)` includes Windmeijer (2005) robust standard errors.

Extending Arellano-Bond 3 (Repetition 2)

```
. xtabond lwage, lags(2) twostep vce(robust)
```

- You can of course include additional covariates.
- Test whether errors are serially correlated (`estat abond`) and for *overidentifying restrictions* (`estat sargan` but prohibits use of Windmeijer robust standard errors).
- An **overidentifying restrictions test** (eg. Sargan's J-test) tests how many instrumental variables are **exogenous**, ie. uncorrelated with the error term. The test statistic $J \sim \chi^2_{m-k}$ with m the number of instruments, k the number of endogenous covariates, and thus $m - k$ the degree of over-identification.

Extending Arellano-Bond 3

Both Arellano-Bover and Blundell-Bond introduce a restriction $E(\Delta y_{it-1}\epsilon_{it}) = 0$ such that Δy_{it-1} can be introduced as an instrument.

This is a solution for the problem that the pure Arellano-Bond instruments tend to suffer from weak instrumental variable problems.

```
use mus08psidextract.dta, clear
 xtdpdsys lwage, lags(2) twostep
```

Compare Arellano-Bond and Arellano-Bover

```
. quietly xtabond lwage, lags(2) twostep

. estimates store abond2

. quietly xtdpdsys lwage, lags(2) twostep

. estimates store abover1

. esttab abond2 abover1, mtitles("Arellan-Bond" "Arellano-B
```

	Ar.nd	Ar.er
	lwage	lwage
L.lwage	0.610***	0.602***
	(26.70)	(31.48)

Serial Corellation

Both Arellano-Bond and Arellano-Bover/Blundell-Bond methdoologies require the error terms to be serially uncorrelated.

Autocorrelation in ϵ_{it} and ϵ_{it-1} (absent individual effects) would render y_{t-2} be endogenous to v_{it-1}.

This can be tested using `estat abond`.

```
. estat abond //Test for serial correlation of error terms

Arellano-Bond test for zero autocorrelation in first-differ
  +---------------------+
  |Order |  z     Prob > z|
  |------+---------------|
  |   1  |-4.3902  0.0000 |
  |   2  |-2.1733  0.0298 |
  +---------------------+
   H0: no autocorrelation
```

Treating Serial Correlation in the error term

- Include more and earlier lags, the re-do the test
- Model a moving average process in the error term: $v_{it} = \epsilon_{it} + \theta v_{it-1}$
- In STATA, `xtdpd` allows for this (`dpd` denotes "dynamic panel data")

Arellano-Bover in xtdpd

- Reproduce earlier model

```
xtdpd L(0/2).lwage, dgmmiv(lwage) twostep
estimates store ab_alt
xtabond lwage, lags(2) twostep
estimates store ab_ori
```

- Add Moving Average Term by restricting IV lags

```
xtdpd L(0/2).lwage,
dgmmiv(lwage, lagrange(3 4)) twostep
vce(robust) artests(3)
```

Comparison

```
esttab ab_alt ab_ori ab_ma, ///
mtitles("A-Bond 1" "A-Bond 2" "A-Bond MA(1)")
```