MICROECONOMETRICS
CLASS 9B

Wiktor Budziński

SOME COMMENTS

Method	Coef.	Std. Err.	z	P>|z|	[95% C.I.]
Conventional	7.414	1.459	5.083	0.000	[4.555 , 10.273]
Bias-Corrected	7.507	1.459	5.146	0.000	[4.647 , 10.366]
Robust	7.507	1.741	4.311	0.000	[4.094 , 10.919]

SOME COMMENTS

Testing coefficients in the switching regression model

```
Eq4 <- ldrugexp ~ totchr + age + female + blhisp + linc
model5<-selection(Eq3c, list(Eq4, Eq4), data = medexp3, type = 5) # Tobit – 5
summary(model5)
coeftest(model5)
model5$estimate
Vec <-rep(0, 23)
Vec[9] <- 1
Vec[17] <- -1
linearHypothesis(model5, Vec) # totchr
Vec <-rep(0, 23)
Vec[11] <-1
Vec[19] <- -1
linearHypothesis(model5, Vec) # female
```

DYNAMIC PANEL MODELS

Panel models can be useful to study dynamic relationship in the data

The current level of the dependent variable can be a function of its lagged value

$$\begin{cases} y_{it} = \rho y_{it-1} + x_{it}\beta + v_{it} \\ v_{it} = u_i + \varepsilon_{it} \end{cases}$$

Estimation of the autoregressive coefficient in the presence of the error component is non-trivial

- Within model will lead to biased estimates
- Transformed lag is correlated with the error term

$$y_{it} - \bar{y}_i = \rho\left(y_{it-1} - \bar{y}_i\right) + \left(x_{it} - \bar{x}_i\right)\beta + \left(\varepsilon_{it} - \bar{\varepsilon}_i\right)$$

DYNAMIC PANEL MODELS

The usual "*trick*" that is used to obtain unbiased estimates utilizes further lags as instrumental variables for the lag that is endogenous

- In the within-model this cannot be done because every lag is correlated with the dependent variable and therefore is not a valid instrument

For this reason, the first-differences model is used instead:

$$y_{it} - y_{it-1} = \rho\left(y_{it-1} - y_{it-2}\right) + \left(x_{it} - x_{it-1}\right)\beta + \left(\varepsilon_{it} - \varepsilon_{it-1}\right)$$

- Note that the first-difference of the lag is still endogenous
- We lose one observation for each unit
- But now the second lag of y does not directly affect the dependent variable
- It is also a good instrument for the $\Delta y_{it-1} = y_{it-1} - y_{it-2}$

DYNAMIC PANEL MODELS

The model can be estimated with Generalized Method of Moments

- This estimator uses some theoretical assumptions about the moments of the data to derive the parameters
- In this case we have

$$\mathbf{E}\left(z_{it}\Delta\varepsilon_{it}\right)=0$$

- Basically, exogenous variables need to be independent from the (differenced) error terms

Solving this equation for the empirical moments gives us the estimates of the coefficients

- The equation cannot be always solved, so the LHS is often minimized
- This requires specifying a weighting matrix for the minimization problem

DYNAMIC PANEL MODELS

One-step GMM estimator is consistent, but maybe inefficient

- The weighting matrix is defined so that the estimator theoretically would have the smallest variance
- It assumes homoscedastic errors, with limited serial autocorrelation
- Asymptotically inefficient

Two-step GMM estimator is more robust

- It uses residuals from the one-step GMM to define the weighting matrix
- Asymptotically more efficient
- Does not take into account the variation from the residuals unless the Windmeijer (2005) formula is used

DYNAMIC PANEL MODELS

Sargan test is the most relevant test for the dynamic panels

- Similar to one for the 2SLS
- It tests whether the instrumental variables are actually independent from the error terms

It may be also useful to test for the serial autocorrelation

- Autocorrelation of the first order is expected due to first-differences in the model specification
- The second order autocorrelation should be 0

DYNAMIC PANEL MODELS

System GMM estimator utilizes additional conditions for the estimation

It uses the first-differences model as the standard GMM

Additionally, it uses the model in levels

- For this model it utilizes the differenced lags as instruments
- Maybe useful if the instruments in the standard GMM are weak

$$\begin{cases} \mathbf{E}\left(z_{it}\Delta\varepsilon_{it}\right)=0 \\ \mathbf{E}\left(\Delta y_{it-s}\left(u_i+\varepsilon_{it}\right)\right)=0 \end{cases}$$

EXERCISE 1: DYNAMIC PANEL MODELS

1. Analyze the gross output of rice farms in India
2. Estimate one-step and two-step GMM model
   1. Conduct Sargan and serial autocorrelation tests
3. Compare the results with system-GMM
4. Analyze *Sim_examples10*.R to compare the results of OLS, Within model, and GMM under different conditions

SIMULATIONS

Throughout the class we were looking at the results of various simulations to better understand how different models work

- Such "*baby*" Monte Carlo simulations are very useful

Making simulations forces you to think about the assumptions of the given model

- It also provides a convenient framework for analyzing how changing some of these assumptions affects your results

To some extent such simulations are prone to error due to random chance

- To make the inference more robust we usually want to repeat the simulation multiple times and look at the distribution of the outcome
- Such simulation studies are a valid research method and can be published
  - Most often to show that something does not work
  - Sometimes as a weak evidence of something working

SIMULATIONS

Monte Carlo method is a general name for the wide array of techniques employing probabilistic simulations to address issues that are often deterministic in nature

- For example, calculating integrals

They are useful to obtain statistical inference when theoretical properties are unknown

- Often statistical tests are developed under some assumptions that can be not met in practice
- Simulations can be used to obtain more reliable critical values

We can also use them to develop new tests without complex mathematics

Can be also used to verify whether the currently used methods actually work

EXERCISE 2: VOUNG TEST FOR ZIP

1. Replicate the simulation from

Wilson, P. (2015). The misuse of the Vuong test for non-nested models to test for zero-inflation. *Economics Letters*, 127, 51-53.

2. Compare the results with the case of standard non-nested Poisson models

EXERCISE 3: EFFICIENCY OF GMM

1. Employ Monte Carlo simulation to check whether two-step GMM is more efficient than one-step GMM
2. Is two-step estimator more robust when error terms are serially correlated?
   - E.g., follow the AR(1) process

EXERCISE 4: ZERO-INFLATION TEST

1. Employ simulation to test for the zero-inflation in the negative binomial model .