Specification tests o o

E 4160: Econometrics–Modelling and Systems Estimation Computer Class # 6 Ragnar Nymoen

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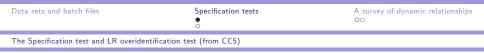
► KeynesID2.fl

This is a batch file that uses the same data set as in *KeynesID1.zip* from computer class 5

Wage2_excel.xls

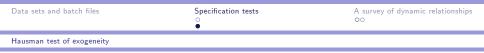
A data set with micro data from USA.

 ADLfromVAR_d.in7/bn7 from computer class 2 (ADLfromVAR_d.zip)



We will use *KeynesID2.fl* to "run trough":

- the Specification test for the validity of the over-identifying instruments in a single equation, estimated by IV, and
- the LR test for the validity of the over-identifying restriction implies by a multi-equation structural model on the reduced form system
- See the last slides of CC5



 In our example, the situation is that we are interested in a theoretical relationship

$$C_i = \theta \, Y_i \tag{1}$$

where θ is the true derivative coefficient.

The motivation of the Hausman-test is that we test

$$H_0$$
: plim($\hat{\theta}_{OLS}$) = plim($\hat{\theta}_{IV}$)

recognizing that $plim(\hat{\theta}_{IV}) = \theta$.

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The test uses the information implied by the statistical model of C and Y under the alternative hypothesis, to test the equivalent H_0

$$\delta = 0$$

in the regression model:

$$C_i = \beta Y_i + \delta \hat{v}_i + \varepsilon_i \tag{2}$$

where \hat{v}_i is the residual from the marginal (reduced form) model of Y_i , for example

$$Y_i = \gamma Z_i + e_i$$

which can only be formulated by specifying the statistical system for C, Y and Z.

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- The Hausman test can be interpreted as a test of Weak Exogeneity.
- The definition of WE is that it allows us to do efficient inference about the *parameter of interest* (θ) by only considering the conditional relationship.
- If the test rejects, the parameter of interest is not "in" the regression model—we need a different statistical model, where the marginal model for Y is allowed to play a role in the estimation of θ.

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Models of the VAR I

Referring back to CC2 we had:

$$y_t = \mu_{yt-1} + \epsilon_{yt} \tag{3}$$

$$x_t = \mu_{xt-1} + \epsilon_{xt} \tag{4}$$

$$\mu_{yt-1} = \mathsf{E}[y_t \mid x_{t-1}, y_{t-1}] = \mu_{y0} + \mathsf{a}_{11}y_{t-1} + \mathsf{a}_{12}x_{t-1} \qquad (5)$$

$$\mu_{xt-1} = \mathsf{E}[x_t \mid x_{t-1}, y_{t-1}] = \mu_{x0} + \mathsf{a}_{21}y_{t-1} + \mathsf{a}_{22}x_{t-1} \qquad (6)$$

$$\begin{pmatrix} \epsilon_{xt} \\ \epsilon_{yt} \end{pmatrix} \sim N\left(\mathbf{0}, \begin{pmatrix} \sigma_x^2 & \omega_{xy} \\ \omega_{xy} & \sigma_y^2 \end{pmatrix}\right).$$
(7)

which is a bivariate VAR with normally distributed errors.

Models of the VAR II

- If μ_{vt-1} and μ_{vt-1} depend on (a vector of) exogenous variables we have an open VAR, also called VAR-X
- We have seen that we can formulate different econometric models of this type of VAR
 - A simultaneous equations model
 - A recursive model
 - A model with a conditional model for y_t and a marginal model for x_t .

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Models of the VAR III

 To review some important concepts and properties, we now choose the conditional model representation, meaning that we have

$$y_t = \beta_0 + \phi_1 y_{t-1} + \beta_1 x_t + \beta_2 x_{t-1} + \varepsilon_t.$$
 (8)

$$x_t = \mu_{x0} + a_{21}y_{t-1} + a_{22}x_{t-1} + \epsilon_{xt}$$
(9)

see CC2 for derivations, in particular:

$$E(\varepsilon_t \epsilon_{xt}) = 0 \Rightarrow E(\varepsilon_t x_t) = 0$$

(8) is often referred to as the Autoregressive Distributed Lag Model (ARDL) for y_t given x_t .

We have that

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Models of the VAR $\ensuremath{\mathsf{IV}}$

- x_t is strictly exogenous
- x_t is weakly exogenous since OLS estimation of (8) efficient.
- x_t is strongly exogenous if a₂₁ = 0 is a valid restriction on the system (one-way Granger Causality)
- x_t is super-exogenous if the parameters of (8) are invariant with respect to structural changes in the marginal model.

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Single equation typology: special cases of ARDL

$\phi_1 = 0$	Distributed lag (DL $y_t = \beta_0 + \beta_1 x_t + \beta_2 x_{t-1} + \varepsilon_t.$ Growth rate (GR)
$\phi_1 = 1$ $\beta_1 + \beta_2 = 0$	$\Delta y_t = \beta_0 + \beta_1 \Delta x_t + \varepsilon_t.$
, 1 . , 2	Random Walk (RW)
$\phi_1 = 1$ $\beta_1 = \beta_2 = 0$	$y_t = \beta_0 + y_{t-1} + \varepsilon_t.$
, 1 , 2	Static model
$\begin{array}{c} \phi_1 = 0 \\ \beta_2 = 0 \end{array}$	$y_t = \beta_0 + \beta_1 x_t + \varepsilon_t.$
	ECM
$ \phi_1 < 1$	$\Delta y_t = \beta_0 + \beta_1 \Delta x_t + (\phi_1 - 1)y_{t-1} + (\beta_1 + \beta_2)x_{t-1}\varepsilon_t.$

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Single equation typology: special cases of ARDL

And many more, including polynomial lag distributions and geometric lag distribution, see EB note DL which can be used to represent longer lags by a small number of parameters.

- ► Note in particular that ECM does not impose any restrictions on ARDL, except |φ₁| < 1 (dynamic stability).</p>
- The partial derivatives

$$\frac{\partial y_t}{\partial x_{t-j}}$$

also called *dynamic multipliers*, or *lag-weights*, are easy to obtain in PcGive after estimation, as are the *long-run multipliers*, as we have seen (for example CC3).

 As all parameters of an econometric model, also dynamic and long-run multipliers can become badly biased if a mis-specified model is estimated.

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Single equation typology: special cases of ARDL

Estimation of correctly specified AR and ARDL models I

Yet another special case: If $\beta_1=\beta_2=0$ is true, then the AR model

$$y_t = \beta_0 + \phi_1 y_{t-1} + \varepsilon_t$$

is correctly specified.

- ► The only caveat is that y_{t-1} is predetermined rater than exogenous.
- OLS estimator of ϕ_1 is consistent but biased in small samples.
- We can check this directly using Monte Carlo Simulation.
- Choose Model category Monte Carlo in the Model Formulation menu.