Macroeconometric modelling

5 Topics in estimation of dynamic models

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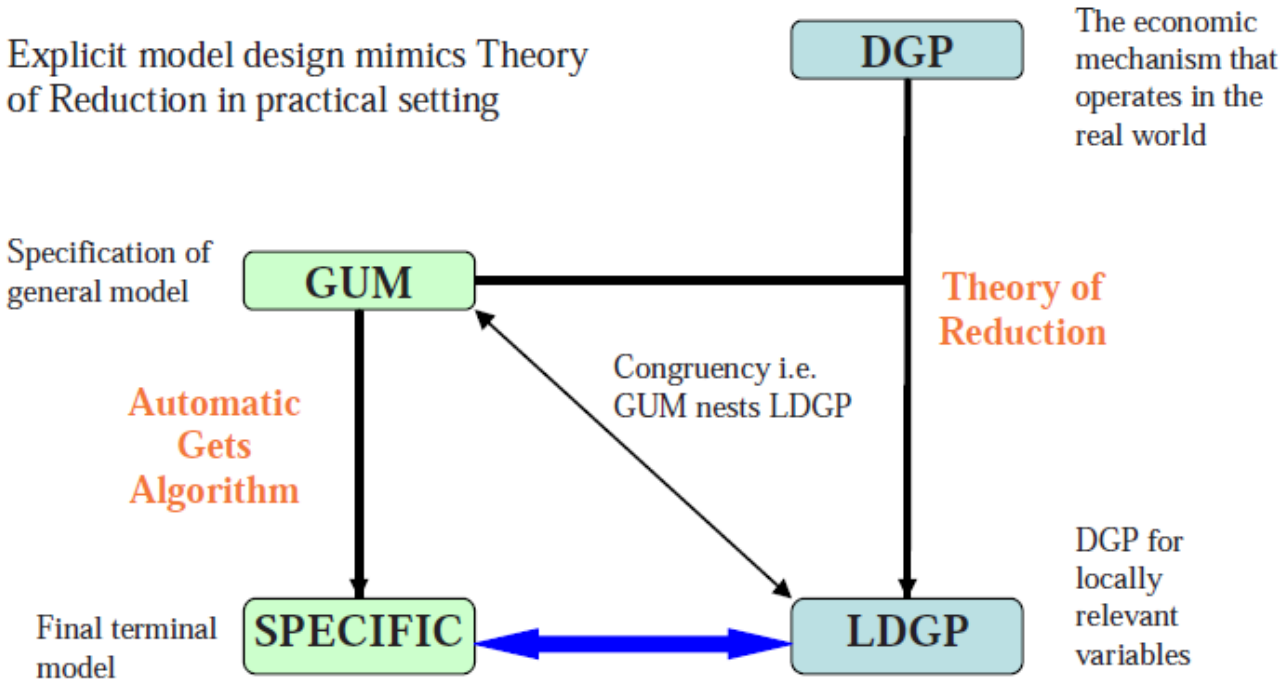
Autometrics

Autometric model selection

Can be very helpful in building a good model.

The structure



Autometrics

The search

See Doornik (2009) for details on this section.

- Start from general statistical system (GUM):
  based (at least) on previous findings and available theory.
- Check GUM captures essential characteristics of data:
  ensures valid inferences.
- Eliminate insignificant variables to reduce complexity:
  diagnostic checks on validity of reductions
  ensures congruence of final model.
- Tree search avoid path-dependence.
- Backtesting restricts information loss to user-determined level.

Autometrics

Econometrics of model selection

Three-stage process:

- Specification of general unrestricted system (GUM).
- Mis-specification testing of the GUM.
- Selection of specific model:
  1. pre-search lag reduction of GUM;
  2. Tree search finds one or more terminal candidate model;
  3. tie-breaker chooses final model.

Autometrics

Specification of GUM

1. Larger GUM: retain more effects.by chance
2. Smaller GUM: omit key variables.
3. Prior analysis is essential:
   relevant variables, functional form, indicators, etc.
4. Previous evidence to ensure encompassing.
5. The less ‘orthogonality’, the more ‘confusion’.
6. Central role for theory in ‘prior simplification’.

Does repeated testing distort selection?

- (a) Severe illness:
  more tests increase probability of correct diagnosis.
- (b) Mis-specification tests:
  if r independent tests τ_j conducted under null
  for small significance level η (critical value c_η):

$$\mathsf{P}(|\tau_j| < c_\eta \mid j = 1, \ldots, r) = (1 - \eta)^r \simeq 1 - r\eta.$$

  More tests increase probability of false rejection.
  Suggests significance level η of 1% or smaller.

Dynamic Econometric model building I

When building a realistic model, the dimension is to big to model as one system. We will therefore typically model blocks of the complete model and then put them together at the end. In one block we are still analyzing the k-dimensional VAR(p) process for $\mathbf{y}_t$, but now augmented with an m-dimensional vector of unmodelled variables $\mathbf{x}_t$:[1]

$$\mathbf{y}_t = \nu + \sum_{i=1}^{p} A_i \mathbf{y}_{t-i} + \sum_{j=0}^{s} B_j \mathbf{x}_{t-j} + \mathbf{u}_t,$$

Dynamic Econometric model building II

Although each model is different, my modelling procedure typically will include the following steps:

1. Run autometrics with dummy saturation to check for outliers, breaks and non-linearities.
2. Add any found dummies to GUM and find common lag length p.— using Autometrics

Dynamic Econometric model building III

3. Estimate and impose overidentified β^* in

$$\Delta \mathbf{y}_t = \nu + \alpha^* \beta^{*\prime} \begin{pmatrix} \mathbf{y} \\ \mathbf{x} \end{pmatrix}_{t-1} + \sum_{i=1}^{p-1} \mathbf{\Gamma}_i \Delta \mathbf{y}_{t-i}$$

$$+ \mathbf{B}_0 \Delta \mathbf{x}_t + \sum_{j=1}^{s-1} \mathbf{\Upsilon}_j \mathbf{x}_{t-j} + \mathbf{u}_t,$$

$$\mathbf{\Gamma}_i = -\left(\mathbf{A}_{i+1} + \cdots + \mathbf{A}_p\right), \; i = 1, \ldots, p-1$$

$$\mathbf{\Upsilon}_j = -\left(\mathbf{B}_{j+1} + \cdots + \mathbf{B}_p\right), \; j = 1, \ldots, s-1$$

Dynamic Econometric model building IV

4. Estimate overidentified general model

$$\mathbf{A}_0\Delta\mathbf{y}_t = \mathbf{A}_0\nu + \mathbf{A}_0\alpha^*\beta^{*\prime}\begin{pmatrix}\mathbf{y}\\ \mathbf{x}\end{pmatrix}_{t-1} + \mathbf{A}_0\sum_{i=1}^{p-1}\mathbf{\Gamma}_i\Delta\mathbf{y}_{t-i}$$
$$+ \mathbf{A}_0\mathbf{B}_0\Delta\mathbf{x}_t + \mathbf{A}_0\sum_{j=1}^{s-1}\mathbf{\Upsilon}_j\mathbf{x}_{t-j} + \mathbf{A}_0\mathbf{u}_t,$$

and test down lag lengths of dynamic terms, starting with the longest lags.

Dynamic Econometric model building V

5. Reformulate as

$$\begin{aligned}
\mathbf{A}_0 \Delta \mathbf{y}_t &= \mathbf{A}_0 \nu + \mathbf{A}_0 \alpha^* \beta^{*\prime} \begin{pmatrix} \mathbf{y}_{t-p} \\ \mathbf{x}_{t-s} \end{pmatrix} \\
&\quad + \mathbf{A}_0 \sum_{i=1}^{p-1} \mathbf{D}_i \Delta \mathbf{y}_{t-i} + \mathbf{A}_0 \sum_{j=0}^{s-1} \mathbf{E}_j \mathbf{x}_{t-j} + \mathbf{A}_0 \mathbf{u}_t, \\
\mathbf{D}_i &= -\left(\mathbf{I}_k - \mathbf{A}_1 - \cdots - \mathbf{A}_i\right), \; i = 1, \ldots, p-1. \\
\mathbf{E}_j &= \left(\mathbf{B}_0 + \cdots + \mathbf{B}_j\right), \; j = 0, \ldots, s-1
\end{aligned}$$

and simplify—the rewards in parsimony can be substantial.

Dynamic Econometric model building VI

Comments:

- Strive for economic interpretation and parsimony.
- Do sensitivity analysis across across sub-samples:
  - model constancy?
  - parameter constancy?
  - ex-post forecasts constancy?

[1] The notation follows Lütkepohl (2005).

References I

Doornik, J. A. (2009).
Autometrics.
In J. L. Castle and N. Shephard (Eds.), *The Methodology and Practise of Econometrics*, Chapter 4, pp. 88–121. Oxford University Press.

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