Alternative Empirical Strategies Revisited

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Empirical Strategies

- Ultimate goal: reliable quantitative answers to substantive economic questions.
- This involves:
  - parameterizing the DSGE model
  - assessing model fit
  - generating quantitative predictions with the model
  - and hopefully attaching some measure of uncertainty / reliability to the predictions

Assessing Absolute Model Fit

- We looked at prior / posterior predictive checks, which tend to be close in spirit to frequentist specification tests.

- Not surprisingly, many frequentist evaluation techniques that were proposed in the literature are based on p-values for various sample characteristics of the data.

- In general, these p-values measure how far transformations of the data fall in the tails of their respective sampling distributions, that are derived from the DSGE models. Examples are Canova, Finn, and Pagan (1994), Christiano and Eichenbaum (1992), Nason and Cogley (1994), Smith (1993), Söderlind (1994), and Canova (1994).

Assessing Absolute Model Fit

- Just keep in mind: p-values are not designed for model comparisons.
- In cases where it is clear from the beginning that the structural models are severely misspecified it is implausible to use sampling distributions as a benchmark, that were derived from misspecified models.

Comparisons with a Reference Model

- Diebold, Ohanian and Berkowitz (1998) essentially ask the question: can we parameterize the DSGE model such that it can match spectral densities of macroeconomic time series estimated with non-parametric methods.

- Since the DSGE model is believed to be misspecified, the behavior of parameter estimators and test statistics is conducted under the sampling distribution obtained from a non-parametric spectral representation of the data.

- One could easily replace the non-parametric spectral estimates that serve as a benchmark with parametric ones: estimate parameters of a VAR and calculate the implied spectral densities.

Comparisons with a Reference Model

- Dejong, Ingram, and Whiteman (1996) propose a Bayesian approach to calibration that can be used if the DSGE model generates a singular probability distributions for the data (because there are fewer shocks than variables).

- A measure of overlap between the posterior distribution of unconditional moments obtained from an estimated VAR and the prior predictive distribution from a structural model is proposed.

- Geweke (1999a) shows that a refinement of the overlap criterion can be interpreted as posterior odds ratio for DSGE models conditional on a reference model. He assumes that DSGE models only claim to describe population characteristics, such as autocorrelations, but not the data itself.

- Again, a VAR serves as a benchmark for the evaluation of the DSGE model as it can provide estimates of population autocovariances.

Comparisons with a Reference Model

- Finally, we can compare DSGE and VAR impulse responses, which brings us back to the minimum distance approach pursued, for instance, by Rotemberg and Woodford (1998), Christiano, Eichenbaum, and Evans (2005):
  - Assume that we know how to identify a monetary policy shock with a structural VAR.
  - Design DSGE models that are "consistent" with VAR identification scheme.
  - Estimate DSGE model parameters by minimizing discrepancy between DSGE model and VAR responses.
  - Assess internal propagation of DSGE model based on its ability to replicate the response to a monetary policy shock.

A Word About Minimum-Distance Approaches

- Say, a are VAR impulse responses, θ are DSGE model parameters, and $g(\theta)$ are IRFs calculated from the DSGE model.

- Minimum Distance Estimation:

$$\min_{\theta \in \Theta} \quad \left\| W_T \left(\hat{a}_T - g\left(\theta\right) \right) \right\|, \tag{1}$$

where $W_T \stackrel{p}{\longrightarrow} W$ and W is non-random.

A Word About Minimum-Distance Approaches

- Asymptotic properties: Suppose $g(\theta) = g(\theta_0) + G(\theta - \theta_0) + small$ and

$$T^{1/2}\left(\hat{a}_T - a_0\right) \Longrightarrow \mathcal{N}(0, \Sigma). \tag{2}$$

  Then $T^{1/2}\left(\hat{\theta}_T - \theta_0\right) \Longrightarrow \mathcal{N}(0, A^{-1}BA^{-1})$, where

$$\begin{aligned} A &= G'W'WG, \\ B &= G'W'W\Sigma W'WG. \end{aligned}$$

- Optimal weight matrix is $W^{o\prime}W^o = \Sigma^{-1}$ and in this case:

$$T^{1/2}\left(\hat{\theta}_T - \theta_0\right) \Longrightarrow \mathcal{N}\left(0, [G'\Sigma^{-1}G]^{-1}\right). \tag{3}$$

A Word About Minimum-Distance Approaches

- Formal analysis is quite tedious. Application in the context of DSGE model are often informal, in particular choice of weight matrix.

- Generalizations to non-stationary time series models in Moon and Schorfheide (Econometric Theory, 2002).

What's Next?

- As many of the approaches involve the use of vector autoregressions as benchmark models we will

- discuss the estimation of structural vector autoregressions

- and finally combine DSGE models and vector autoregressions in a DSGE-VAR framework, which unifies many of the ideas that have been developed in the literature.