Discussion of "GMM with Latent Variables"

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Overview of the Paper

Motivation

Can't always solve to get an analytic expression for the likelihood (e.g. forward-looking models), numerical solutions may be suspect.

Main Idea

Use moment conditions to construct a limited information likelihood and combine with MCMC.

Contribution

General framework for GMM with Latent Variables (Λ) when:

1. Transition density for Λ is known.
2. MCs would identify model parameters were Λ observed.

First Ingredient – Getting a Likelihood from GMM

Limit Distribution for GMM with Λ Known

$$\begin{aligned} Z_T(X,\Lambda,\theta) &= [\Sigma_T(X,\Lambda,\theta)]^{-1/2}\ \sqrt{T}\bar{g}_T(X,\Lambda,\theta) \\ Z_T(X,\Lambda,\theta^o) &\xrightarrow{d} N(0,I) \end{aligned}$$

Treat This as "Exact"

$$p(X|\Lambda,\theta) = p(X,\Lambda,\theta) = \frac{1}{(2\pi)^{M/2}} \exp\left\{-\frac{1}{2} Z_T(X,\Lambda,\theta)' Z_T(X,\Lambda,\theta)\right\}$$

Background

Fisher (1930), Gallant & Hong (2007)

Second Ingredient – MCMC Algorithm

Strategy

Sample $\{\theta^{(i)}, \Lambda^{(i)}\}$ from $p(\theta, \Lambda|X) \propto p(X, \Lambda, \theta)$, discard Λ draws.

Metropolis within Gibbs

"M–Step" Metropolis Algorithm to draw $\theta^{(i)}$ from $p\left(\theta|X, \Lambda^{(i-1)}\right)$ given $\theta^{(i-1)}$

"E–Step" Modified Particle Filter to draw $\Lambda^{(i)}$ from $p\left(\Lambda|X, \theta^{(i)}\right)$ given $\Lambda^{(i-1)}$

Background

Chernozhukov & Hong (2003); Andrieu, Douced & Holenstein (2010)

Examples

1. Stochastic Volatility Model
2. DGSE Model (Del Negro & Schorfheide, 2008)

Many others: Measurement Error, Tobit with Endogeneity, etc.

Choice of Moment Conditions

Distinction between MCs used to identify Λ vs. θ

- "To estimate latent variables, it is not necessary to identify model parameters. Only the latent variables need to be identified."
- "Gibbs draw should evaluate the moments in the Metropolis step accurately; not necessarily approximate the history accurately."

Some Questions and Speculation

Weak Identification?

More of a problem than usual GMM?

Robustness

- MCs contain less information but make fewer assumptions.
- How sensitive are results to the transition density?

Focused Selection?

For some problems getting Λ correct isn't so important. For others (e.g. impulse responses) it's crucial.

- Intentionally mis-specify transition density?
- Local mis-specification?
- Sieve estimate of history of Λ (earlier version of paper).