Quantitative Macroeconomics

Winter 2022/23

Week 10

Willi Mutschler
willi@mutschler.eu

Version: 1.0.0
Latest version available on: GitHub

Contents

1 Inference In SVARs Identified By Exclusion Restrictions

Consider an exactly-identified structural VAR model subject to short- and/or long-run restrictions, where the structural impulse response of variable j to structural shock k at horizon h is denoted as $\theta_{jk,h}$, which we simply denote as θ. We are interested in the distribution of θ, in particular deriving $(1-\gamma)\%$ point-wise confidence intervals given a consistent estimate $\hat{\theta}$ of θ.

1. Consider the asymptotic confidence intervals which are derived using the delta method:
$$\hat{\theta} \pm z_{\gamma/2}\widehat{std}(\hat{\theta})$$
where $z_{\gamma/2}$ denotes the $\gamma/2$ percentile of the standard normal distribution and $\widehat{std}(\hat{\theta})$ a consistent estimate of the standard deviation of θ. Name the assumptions and shortcomings of this approach.

2. Outline the idea and algorithm of the Standard Residual-Based Recursive-Design Bootstrap approach.

3. Name the central idea underlying the Residual-Based Wild Bootstrap.

4. Discuss the choice of significance level γ.

5. Discuss how to draw initial conditions for a resampling method.

6. Given a bootstrap approximation to the distribution of the structural impulse-response function, discuss how to construct bootstrap confidence intervals from this distribution. Particularly, explain
   a) intervals based on bootstrap standard errors
   b) Efron's percentile interval
   c) equal-tailed percentile-t intervals

Readings

- Kilian and Lütkepohl (2017, Ch. 12.1-12.5, 12.9)

2 Bootstrapping Standard Deviations of Structural IRFs

Consider an exactly-identified structural VAR model subject to short- and/or long-run restrictions, where the structural impulse response of variable i to shock j at horizon h are simply denoted as $\theta \equiv \Theta_{ij,h}$. As an exact closed-form solution for the asymptotic standard errors of θ are only available under restrictive assumptions, we will rely on a numerical approximation using a bootstrap approach.

1. Reconsider an exercise (of your choice) from the lecture on SVAR models identified with exclusion restrictions and re-estimate the structural impulse response function.

2. Compute $\widehat{std}(\hat{\theta}^*)$ via a bootstrap approximation by following these steps:

   - Write a function `BootstrapGDP(VAR)` which implements a standard residual-based bootstrap approach using sampling with replacement techniques on the residuals. Furthermore, the initial values should be drawn randomly in blocks. Hint: Use the companion form to do the simulations.
   - Set bootstrap repetitions B equal to 1000 (or higher) and initialize a $K \times K \times H \times B$ array `THETAstar`, where the first dimension corresponds to variable $i = 1, .., K$, the second dimension to shock $j = 1, ..., K$, the third dimension to the horizon of the IRFs $h = 0, .., H$ and the fourth dimension to the bootstrap repetition $b = 1., ..., B$.
   - For $b = 1, ..., B$ do the following (you may also try `parfor` instead of `for` in order to make use of Matlab's parallel computing toolbox if installed):
     - Compute a bootstrap GDP y_t^b using the function `BootstrapGDP(VAR)`.
     - Estimate the reduced-form and structural impulse response function on this artificial dataset with the same methodology, settings and identification restrictions as in the estimation of the original dataset.
     - Store the structural IRFs in `THETAstar` at position `(:,:,:,b)`.
   - Compute the standard deviation of the bootstrap structural IRFs using `std(THETAstar,0,4)`.

3. Plot approximate 68% and 95% confidence intervals for the structural impulse response functions according to the delta method:

$$\hat{\theta} \pm z_{\gamma/2}\widehat{std}(\hat{\theta}^*)$$

   where $z_{\gamma/2}$ is the $\gamma/2$ quantile of the standard normal distribution.

Readings

- Kilian and Lütkepohl (2017, Ch. 12.1-12.5, 12.9)

References

Kilian, Lutz and Helmut Lütkepohl (2017). *Structural Vector Autoregressive Analysis*. Themes in Modern Econometrics. Cambridge: Cambridge University Press. ISBN: 978-1-107-19657-5. DOI: 10.1017/9781108164818.