Precision-based sampling with missing observations

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This presentation

Mash-up of two papers in my dissertation!

Method:

Hauber, P and C. Schumacher (2021). *Precision-based sampling with missing observations: A factor model application*, **Bundesbank Discussion Paper 11/2021**.

Application:

Hauber, P. (2021) *How useful is external information from professional forecasters? Conditional forecasts in large factor models*

Motivation

Essential task in the Bayesian estimation of state space models: drawing from $p(\boldsymbol{\eta}|\mathbf{y}, \Theta)$ where $\boldsymbol{\eta}$ is an unobserved component, $\mathbf{y}$ is data and Θ parameters

Precision-based samplers (Chan and Jeliazkov 2009, **IJMMNO**; McCausland 2012, **JEcmtrics**) exploit the fact the precision matrix of $\boldsymbol{\eta}$ is banded in many macroeconomic application $\rightarrow$ alternative to simulation smoothers that rely on the Kalman filter

Applications in macroeconomics (with complete data) include models of trend inflation (Chan et al. 2013, **JBES**), time-varying Bayesian vector autoregressions (Chan 2020, **JBES**) and factor models (Kaufmann and Schumacher 2017, **JAE**)

Missing observations arise frequently in macroeconomic applications/datasets: different starting dates, different release patterns ("ragged edge"), outliers or mixed frequencies

In our paper, we propose a precision-sampler that can handle (most of these) applications!

Precision-based sampling

Simple example: AR(2)

Precision-based sampling

Computational advantages of a banded precision matrix

The fact that $Q = \Sigma^{-1}$ is banded leads to several numerical advantages that can be exploited wh:

- factoring
- the Cholesky factor L such that $Q = LL'$ "inherits" the bandedness of Q
- solving triangular systems of the form $Lx = b$

```
for i = n:-1:1
    % do something
end
```

```
for i = n:-1:1
    for j = 1:i
        % do something
    end
end
```

Precision-based sampling

Drawing from $p(\eta|\mathbf{y}, \Theta)$

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```
double x, y;
double z, w;
main();
return 0;
```

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Precision-based sampling with missing observations

Drawing from $p(\eta, \mathbf{y}^m | \mathbf{y}^o, \Theta)$

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