DYNARE version 4

Practical issues in DSGE modeling at central banks
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Main goals

- Accelerating Dynare

- Cleaning up code

- Improving access to internal data

- Adding DSGE-VAR analysis

- Adding global sensitivity functions

- Adding general optimal policy routines

- Possibility to write several models in a single *.mod file (steady state model; one country version of a multi-country model + aggregative model)

Accelerating Dynare

- Analytical derivatives

- Kalman filter (state space representation)

- DLLs:

  - Kalman filter

  - Lyapunov equation for unconditional variance computation:

$$
\begin{aligned}
y_t &= \bar{y} + g_y \left(y_{t-1} - \bar{y} \right) g_u u_t \\
\Sigma_y &= g_y \Sigma_y g_y' + g_u \Sigma_u g_u'
\end{aligned}
$$

Analytical derivatives

- Build representation of model equations as tree of elementary tokens

- Apply derivation rules on each token

- Keep a list of already computed tokens and use temporary results instead of recomputing (needs fine tuning)

- Project: local optimization for simplifying some expressions

State space representation

- Earlier wastefull state space representation in Kalman filter: all endogenous variables are part of the state space vector.

- More reasonable state space representation: the state vector is made of only the state variables and the observed variables.

Cleaning up the code

- Eliminating large number of global variables, replaced by

    model parameters vector

    M_: description of the model

    options_: command options

    oo_: output variables (results)

    dr: approximated solution is now part of oo_

- avoid to have different order of model variables in different parts of Dynare (still to be done)

- systematic description of input and output arguments of every function in the toolbox (still to be done)

A timing benchmark

- Smets and Wouters (2002) model in linearized form (no steady state computation)

- SW1:

  - 29 endogenous variables

  - 19 endogenous state variables (6 autocorrelated shocks)

  - 10 shocks

  - 32 estimated parameters

A timing benchmark (continued)

- SW2 (fake 2–country model):
  - 58 endogenous variables
  - 38 endogenous state variables (12 autocorrelated shocks)
  - 20 shocks
  - 64 estimated parameters

- SW3 (fake 3–country model):
  - 87 endogenous variables
  - 57 endogenous state variables (18 autocorrelated shocks)
  - 30 shocks
  - 96 estimated parameters

Comparing three versions

- Dynare version 3 (numerical derivatives, wastefull state space representation in Kalman filter)

- Dynare version 4a (analytical derivatives, wastefull state space representation in Kalman filter)

- Dynare version 4b (analytical derivatives, more reasonable state space representation in Kalman filter)

Two features aren't part of the comparison:

- DLL for the model file

- DLL for the Kalman filter (O. Kamenik)

Timing results

- 2.4 Ghz Pentium IV

- Matlab 7.1 (R14) under Linux

- Computing 900 Metropolis iterations

	v3	v4a	v4b
SW1	196	81	62
SW2	365	251	176
SW3	791	559	339

Computing time in seconds

DSGE–VAR estimation

Method by Del Negro, Schorfheide, Smets and Wouters:

- DSGE model is used as a prior for a BVAR
- λ is called `dsge_prior_weight`
- `options_.varlag` number of lags in VAR

Listening to you . . .

1. Historical decomposition of shocks

2. (Rolling) forecasts (RMSE)

3. Expectation operator (asset pricing models)

4. 3rd order approximation

5. Priors for model comparison

6. Simulations under the prior

Further projects

- Projection methods
- Error analysis
- Optimal policy in general nonlinear models
- Nonlinear estimation

Dynare Conference

- September 4–5, 2006, University Paris 1
- Focus on estimating DSGE models
- All applications of Dynare are welcome

www.dsge.net

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