Introduction to Dynare

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Aims for today's lecture

- Economics
  - Distinguish between exogenous and endogenous variables.
  - Solve and simulate an autoregressive process.
  - Solve the basic RBC model and get impulse response functions.
- Techniques
  - Set up the structure of the `.mod`-file.
  - Implement an economic model in Dynare and simulate it.

Working process and assessment

Continuously working on the seminar is important for success.

- Start by reading carefully your paper.
- First, read the introduction and make sure, you understand the research question.
- For an overview of the RBC literature, read Rebelo (2005).
- Once you understood what your paper is about, go to the model section.

To support your working process,

- you are asked to hand in three **micro-articles**,
- at the end of **weeks 5, 7 and 9** (Sunday, midnight).
- You give a feedback to me, and I will help you with your problems.

Micro-article

Micro-articles: What is this?

- Micro-articles were initially thought as tools for knowledge management.
- They are short documents about the learning process, in which problems and open questions appear.

What is the structure?

1. Header: Guiding Topic/Question/Problem (1 Line).
2. Milestones achieved so far: What have I done? Where do I stand?
3. Main Problem: What did not work? Where do I need help?
4. Next milestones: Which are my next steps in the seminar?

See the template and sample on the webpage.

Evaluation of your work

Presentation

1. Duration: 15 Minutes presentation and 10 Minutes of discussion per student.
2. Criteria: knowledge of the paper, reasoning, structure of the presentation, presentation skills, media

Essay

- Length: 10-12 pages.
- Structure: short description of the model, presentation of the main results, a critical evaluation of the model, and possibilities for future work.
- Criteria: Economic content, reasoning, correctness, originality, individuality, coherence, structure, language.

I also evaluate the working process of the students (quality of Dynare code and micro-articles, presence in sessions).

Questions so far?

INTRODUCTION TO DYNARE

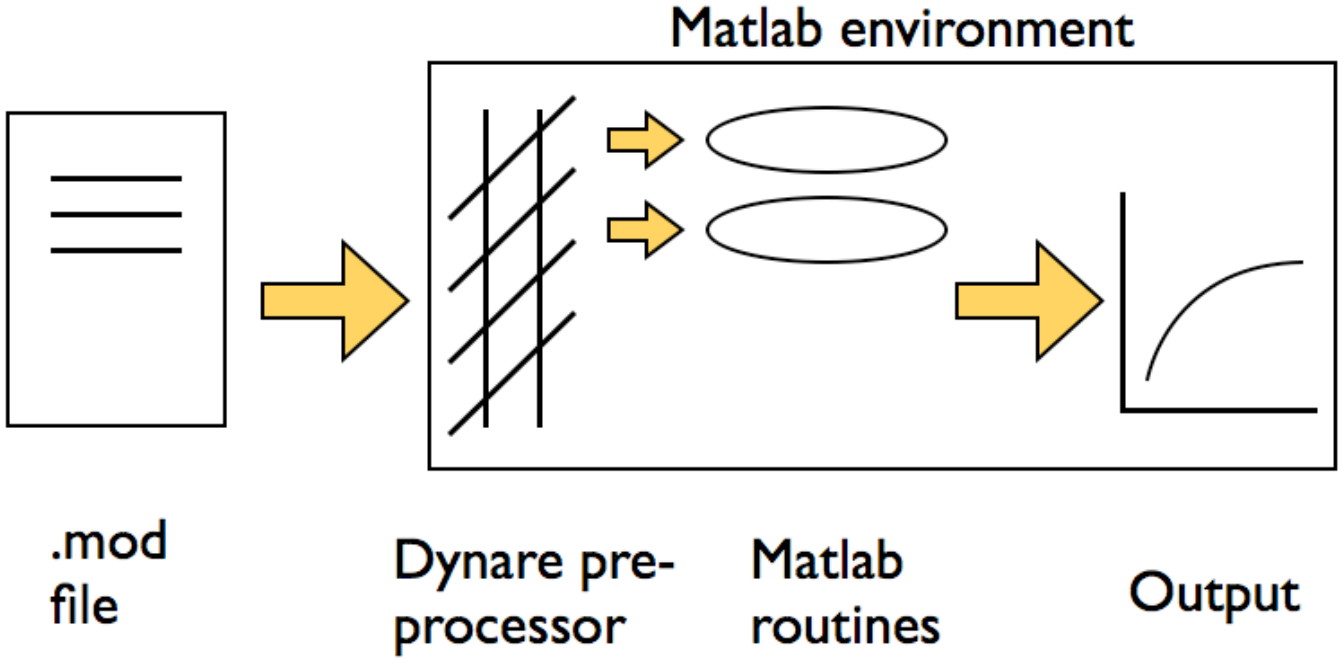
What is Dynare?

- Dynare is a Matlab frontend to solve and simulate dynamic models
- Either deterministic or **stochastic**
- Developed by Michel Juillard at CEPREMAP
- website: `http://www.cepremap.cnrs.fr/dynare/`

How does it work?

- Write the code of the model
- Takes care of parsing the model to Dynare
- Rearrange the model
- Solves the model
- Use the solution to generate some output
- (Can even estimate the model)

How does it Work?



Source: Griffoli (2007)

How to use Dynare?

Structure of the mod file

Preamble
Define variables and parameters

Model
Equations of the Model

Steady State
Compute the Long–Run

Shocks
Define the properties of Shocks

Solution
Compute the Solution and Produce Output

Structure of the mod file: **Preamble**

- **Aim:** Define variables and parameters
- 3 major instructions:
  1. VAR: Define variables
  2. VAREXO: Define (truely) exogenous variables
  3. PARAMETERS: Declare parameters
- assign values to parameters

Structure of the mod file: **Model**

- **Aim:** Define model equations
- 1 major instruction:

```
model;

...

end;
```

- write equations as they appear in *natural* language

Structure of the mod file: **Steady State**

- **Aim:** Compute the long–run of the model
- That is: Where its *deterministic* dynamics will converge
- Why? Because it will take a (non–)linear approximation around this long run
- Structure:

```
initval;

...

end;
steady;
check;
```

Structure of the mod file: **Shocks**

- **Aim:** Define the properties of the exogenous shocks
- Exogenous shocks are gaussian innovations.
- They are assumed to be gaussian with $\mathcal{N}(0, \Sigma)$
- Not so limitative actually
- Structure:

```
shocks;
var ...;
stderr ...;

or

var ... = ...;
end;
```

Structure of the mod file: **Solution**

- Final step: Compute the solution and produce some output
- Solution method
  - Deterministic model: Relaxation method
  - Stochastic model: First or Second order perturbation method
- Then compute some moments and impulse responses.
- Getting solution:

```
stoch_simul(...) ...;
```

Typical Output: ar1.log

```
STEADY-STATE RESULTS:
x        0

EIGENVALUES:
         Modulus             Real        Imaginary
            0.95             0.95                0

There are 0 eigenvalue(s) larger than 1 in modulus
for 0 forward-looking variable(s)

The rank condition is verified.

MODEL SUMMARY

  Number of variables:         1
  Number of stochastic shocks: 1
  Number of state variables:   1
  Number of jumpers:           0
  Number of static variables:  0
```

Typical Output: ar1.log

```
MATRIX OF COVARIANCE OF EXOGENOUS SHOCKS

Variables    e
e            0.000400

POLICY AND TRANSITION FUNCTIONS
                                    x
x(-1)                        0.950000
e                            1.000000

THEORETICAL MOMENTS
VARIABLE    MEAN       STD. DEV.   VARIANCE
x              0.0000     0.0641     0.0041

MATRIX OF CORRELATIONS
Variables    x
x            1.0000

COEFFICIENTS OF AUTOCORRELATION
Order    1       2       3       4       5
x        0.9500  0.9025  0.8574  0.8145  0.7738
```

Learning Dynare

- Best thing to do to learn dynare
- Practice Dynare!
- We will now go from simple to more and more complex models