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Macroeconometrics

Lecture 1 What's macroeconometrics?

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Tomasz Woźniak - short CV

Lived in.

Inowrocław, Poland
Kraków, Poland
Firenze, Italy
Melbourne, Australia

Education.

Ph.D. in Economics at the European University Institute
M.Res. in Economics at the European University Institute
M.S. in IT and Econometrics at the Cracow University of Economics

Tomasz Woźniak - short CV

Research Interests.

Econometrics
Multivariate Time Series Analysis
Bayesian Inference
Economic Forecasting
Causality Analysis

Topics I worked on.

Granger causality for time-varying volatility
how risk associated with one financial asset transmits to another financial asset's risk

Granger causality for state-dependent variables
how variables affect one another in an economy following business cycles

Heteroskedastic models for monetary policy
how to use volatility of variables to estimate the effect of monetary policy on the real economy more precisely

What's macroeconometrics?

Macroeconometrics

Macroeconometrics focuses on developing methodology for empirical macroeconomic research.

Its main objectives include

- verification of economic theories
- forecasting future developments of essential variables
- providing analyses for data-driven decision-making at governing institutions and their stakeholders

It uses dedicated econometric models and procedures that determine the feasibility, robustness, and reliability of the applied research.

Macroeconometrics

The characterization of econometric modeling includes

- System modeling of many variables in one model
- Identification of economically interpretable objects of interest
- Incorporation of economic theory assumptions into econometric model specifications
- Efficient extraction of information from the data implying e.g. modeling unit-root nonstationary variables

Macroeconometrics

Macroeconometrics develops dedicated econometric models and procedures that are data, application, and objective-specific.

The development of these methods makes the empirical research possible and reliable.

Macroeconometrics as a field became highly technical and heavily computational.


macroeconometrics
monetary policy
unobserved component
parallel computing
Minnesota prior
identification
Gibbs sampling
structural shocks
random number generator
Bayes' rule
inverse gamma 2
empirical macro
structural analysis
computational methods
normal distribution
Wishart
Chris Sims
impulse responses
contemporaneous effects
NOWcasting
State-space
Unit-root
SVAR
FED
mcxs
fiscal
time series analysis
fat data
VAR
density forecasting
macroeconomics
nonstationary
BIG DATA
applied econometrics
ECB
RBA
Helmut
posterior distribution
shrinkage
simulation smoother
MCMC
AR(1)
prior
Matrix-variate distributions

Macroeconometrics

This subject prepares the students to develop their own methods which requires:

- knowing the models and their properties
- deriving estimation procedures
- writing computer programs for these procedures and computation of interpretable values
- employing these programs for data analysis

Organisation of the subject

Contact Info

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Lectures

Lectures.

In-person active learning sessions are scheduled on:

Wednesdays 5:45 – 7:15 pm, FBE 221 (Theatre 4)
Thursdays 3:15 – 4:45 pm, FBE 211 (Theatre 2)

Attendance is monitored

Consultations.

Wednesdays 4:30–5:30 pm FBE 350

Assessment

Week	Task	Grade
4	**Test 1:** Concepts and Tools	10%
5	**RP1:** question, data, model, hypothesis	10%
6	**Test 2:** Bayesian Estimation	10%
8	**RP2:** estimation procedure and algorithm	10%
10	**RP3:** empirical analysis	10%
4–10	Learning repository contribution	10%
11	**RP Presentation**	10%
12+	**RP Final report**	30%

RP stands for **R**esearch **P**roject

Learning outcomes

LO1: Develop original econometric methodology for applied macroeconomic analyses

LO2: Propose econometric techniques and models to verify hypotheses that inform fiscal or monetary policy

LO3: Derive Bayesian estimation procedure for the newly proposed macroeconometric model

LO4: Write computer programs in R that implement the derived estimation procedure

LO5: Apply the computer program in the forecasting or structural analyses of Australian macroeconomic data

LO6: Transparently create econometric data analysis using the newly proposed methodology in a fully reproducible report developed collaboratively

Generic skills

GS1: Obtain and format data from the original sources in an automated workflow

GS2: Document the essential data properties and incorporate them in the econometric modelling

GS3: Handle statistical distributions of parameters and forecasted values to make the econometric analysis feasible

GS4: Apply linear algebra operations and basic statistical theory to facilitate model estimation, hypothesis verification, and reliable forecasting

GS5: Create visualisations of data and estimation results that inform economic interpretations

Generic skills

GS6: Use functional programming to implement econometric procedures

GS7: Propose economic interpretations based on the empirical evidence

GS8: Obtaining, providing, and implementing constructive and actionable feedback

GS9: Managing a programming and data analysis project using git and GitHub

GS10: Communicating research outcomes in plain language and using visualisations

Syllabus

Lecture	Topic
	Concepts and Tools
1	What's macroeconometrics?
2	Maximum likelihood estimation
3	Bayesian estimation
4	Numerical optimization and integration
5	Understanding unit-rooters
6	Macroeconometric research themes

Syllabus

Lecture	Topic
	Macroeconomic Forecasting with Fat Data
7	Vector Autoregressions
8	Large Bayesian VARs
9	Forecasting with Bayesian VARs
10	Forecasting with Large Bayesian VARs

Syllabus

Lecture	Topic
	Modeling Effects of Monetary Policy
11	Structural VAR models
12	Structural VAR tools
13	Bayesian estimation of Structural VARs
14	Modeling effects of monetary policy

Syllabus

Lecture	Topic
	Modeling Trend Inflation
15	Unobserved Component models
16	Bayesian estimation using simulation smoother
17	Modeling trend inflation
	Modeling Conditional Heteroskedasticity
18	Stochastic Volatility models
19	Bayesian estimation using auxiliary mixtures
	Topics in Climate Change
20	Forecasting CO_2 Emissions for the 21st Century

Syllabus

Lecture	Topic
	Research Project Presentations
21	Student Presentations
22	Student Presentations
	Lecturer's Research Presentation
23	Robust macroeceonometric modelling
24	`bsvars` package presentation

Introduction to R

The objective of the complementary four sessions is to facilitate the beginning of working with R.

Session 1: **Introduction to R**

Session 2: **Basic programing in R**

Session 3: **Numerical integration**

Session 4: **Numerical optimization**

Session 5: **Quarto documents**

Session 6: **Project development with git and GitHub**

Session 7: **Working with template repository on GitHub**

Research project

Research project

Week	Task	Grade
5	**RP1:** question, data, model, hypothesis	10%
8	**RP2:** estimation procedure and algorithm	10%
10	**RP3:** empirical analysis	10%
11	**RP Presentation**	10%
12+	**RP Final report**	30%

Research project

The report includes:

- a proposal of an original model and a hypothesis to be verified
- derivation and coding of the Bayesian estimation procedure
- empirical investigation answering the proposed hypothesis

Submission format.

- a fully reproducible report generated with **Quarto**
- the report is a website hosted on **GitHub**
- the project is developed collaboratively using management tools git and **GitHub**

Research project

Each of the **PR1–PR3** and the **Presentation** consist of:

Task	Grade
GitHub and Canvas submission	8%
Providing feedback to your peer	1%
Implementing the feedback in your report	1%

Models we are working with

Models we are working with

Vector Autoregressions.

$$y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + \mu_0 + \epsilon_t$$

$$\epsilon_t | Y_{t-1} \sim iid\left(\mathbf{0}_N, \Sigma\right)$$

System modelling – all variables are endogenous

Dynamics – captures system dynamics of the variables

Forecasting – a go to model for predictive applications

Extensions capturing important data features improve forecasting precision

Models we are working with

Structural Vector Autoregressions.

$$
\begin{aligned}
y_t &= A_1 y_{t-1} + \dots + A_p y_{t-p} + \mu_0 + \epsilon_t \\
B\epsilon_t &= u_t \\
u_t | Y_{t-1} &\sim iid\left(\mathbf{0}_N, I_N\right)
\end{aligned}
$$

Structural relationships are explicitly modelled

Economic theory informs identification of structural shocks

Dynamic causal effects can be estimated and interpeted

Policy decision-making is based on evidence provided by SVARs

Models we are working with

Unobserved Component Models.

$$
\begin{aligned}
y_t &= \tau_t + \epsilon_t \\
\tau_t &= \mu + \tau_{t-1} + \eta_t \\
\epsilon_t &= \alpha_1 \epsilon_{t-1} + \cdots + \alpha_p \epsilon_{t-p} + e_t \\
\eta_t | Y_{t-1} &\sim iid\mathcal{N}\left(0, \sigma_\eta^2\right) \\
e_t | Y_{t-1} &\sim iid\mathcal{N}\left(0, \sigma_e^2\right)
\end{aligned}
$$

Trend and cycle decomposition of a variable

Long-run trend is highly-persistent

Oscillating cycle captures short-term dynamics

Inflation trend analysis and output gap estimation are the main applications

Macroeconometrics means cooperation!