

17M025

## Advanced Time Series

Spring Term - 3 ECTS

Elective Course

Prof. Marek Jarocinski

Prof. Gabriel Pérez

Quirós

### Prerequisites to Enroll

TBD

### Overview and Objectives

#### PART 1 (by Marek Jarocinski)

Bayesian Vector autoregressions (VARs) are becoming a standard tool both in the academia and in policy institutions. They are useful for forecasting and for structural analysis. This module starts with an introduction to the Bayesian approach to econometrics and then familiarizes students with the theory and practice of Bayesian VARs. Examples from central banking practice are given throughout the course.

We explain the standard priors for VARs introduced by Sims, Litterman and their coauthors. We run examples implemented in matlab and in Dynare and discuss applications of Bayesian VARs to forecasting. We discuss density forecasts and define the Marginal Likelihood - the basic ingredient in Bayesian model choice. We interpret the Marginal Likelihood and discuss its relation with out-of-sample density forecasting. We finish with applications of conditional forecasting in policy institutions and, time permitting, optional topics such as other priors for VARs, choice of variables and non-gaussian errors.

#### PART 2 (by Gabriel Pérez Quirós)

This part is mainly practical. Econometrics of business cycle. Special attention on forecasting, At the end of this course you should be able to produce forecasts of the most relevant macroeconomic variables using state of the art techniques. These forecasts should be as accurate and precise as the one produced by professional forecasters in the most relevant institutions. We will include a estimation about the current forecast, based on the latest indicator of activity after the coronavirus outbreak.

### Course Outline

#### PART 1

1. Introduction to / refreshment of Bayesian econometrics
  - Likelihood, prior, posterior, posterior simulation
  - Linear regression, prior as additional observationsKoop (2003, Ch.1), Sims (2002)
2. Bayesian VARs
  - Motivation for the standard priors for VARs
  - Minnesota prior, one-unit-root prior, no-cointegration prior

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- Forecasting examples: Medium size VAR, Large VAR, ECB short-term projections Litterman (1986), Sims and Zha (1998), Sims (2006) Banbura et al. (2010), Giannone et al. (2010)

3. Density forecasts and Bayesian model choice  
Koop (2003, Ch.1), Geweke (2005)

4. Unconditional vs conditional forecasting.  
Example: 'missing disinflation' and 'missing inflation' during the Great Recession  
Waggoner and Zha (1999), Bobeica and Jarocinski (2016)

### PART 2

#### Session 1

Model selection: Small scale models; dynamic factor models. Common factors, principal components and Kalman filter. Output gap and coincident indicators.

Nowcasting and real time forecasting. Incorporating real time information in forecasting models. Real-time out-of-sample evaluation of the models. Data revisions and publication lags. Hard indicators vs indicators based on surveys. Non-seasonally adjusted series. Construction of daily business cycle indicators and forecasts with different models.

Midas, Bridge Equations and Mix-Frequency VAR

#### Session 2

Forecasting turning points. Non-linear methods. Markov switching and threshold models, Univariate and multivariate analysis. Dynamic non-linear factor models. Non parametric models. Real-time assessment of recession probabilities with unbalanced information. Leading indicators of turning points. Non-linear real-time models for the US, the Euro-area and other economies. Forecasting stock returns. Forecasting second, third and fourth moments of stock returns. Credit and the business cycle. Forecasting amplitudes, durations, and shapes of recessions and expansions. The role of macroeconomic and financial variables in forecasting amplitudes, durations, and shapes of recessions and expansions. Recent pitfalls in the literature. Real-time tests of structural breaks.

#### Session 3

Forecasting using large scale models. Advantages and disadvantages of large scale models. Principal components. Dynamic principal components.

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### Required Activities

Homeworks will count for 50% of the grade.

### Evaluation

There will be one final exam.

### Competences

- To (be able to) communicate with determination and in the English Language, the results and implications of the required analytical study using a language that the receiver can relate to.
- To work within a heterogeneous team of researchers as economic analyst using specific group techniques.
- To fit in diverse professional environments and varied types of collaborations in different professional projects.
- To possess and understand the knowledge that provides a basis or opportunity to be original in the development and / or application of ideas, often in a research context.
- That students know how to apply the acquired knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.  
  
That the students be able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, include reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.
- That the students be able to communicate their conclusions and the knowledge and the ultimate reasons that sustain them to both, specialized and non-specialized publics in a clear and unambiguous way.
- That students possess the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.
- To identify and apply the insights of the theory, the models, and the analytical tools of modern economy to its global dimension.
- Understand and apply the economic theory of macroeconomic models and financial markets.

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- To understand and apply the quantitative methods used to solve complex problems of the economy.
- To evaluate, with theoretical and quantitative instruments, the complex realities of the economy to understand the way it works.

### Learning Outcomes

- Applies econometric techniques for an applied analysis of financial market policies.
- Applies numerical calculation methods and simulation techniques for macroeconomic problems and design of financial policy evaluation.
- Empirically characterizes relevant phenomena from the macroeconomic point of view.

### Materials

#### PART 1

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### PART 2

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