Introduction to Multiple Time Series Analysis: Syllabus with Extended Information

1 Introductory Remarks

The course will provide an introduction to multiple time series analysis with a focus on impulse response analysis using vector autoregressive (VAR) models. We start with a short introduction of univariate time series concepts and then turn to the VAR model framework and estimation. Then, we look into structural VAR (SVAR) models that are commonly applied for impulse response analysis, i.e., the analysis of the effects of so-called structural shocks that are (economically) interpretable. We deal with basic identification schemes to recover the structural shock(s) of interest. We also look into forecast error variance and historical decompositions. The lectures are accompanied by tutorial sessions that deal with some algebraic issues and, in particular, empirical applications. 'Introduction to Multiple Time Series Analysis' complements well the course 'Time Series and Forecasting' but it can also be taken independently without any problems.

We will focus on the (S)VAR tools and their application as well as the interpretation of empirical results. We will not dive into statistical details like, e.g., asymptotic properties of estimators or statistics. As this is an introductory course we also have to take a number of shortcuts. However, I will mention what additional steps would have to be taken or which additional issues would have to be considered whenever appropriate.

At the end of the course we will discuss one or two related empirical research papers if time permits. I expect you to read them in advance. Moreover, the lecture will be accompanied by tutorial sessions in which we discuss empirical and methodological problems. For solving the empirical problems we are using R programs.

2 Grading

Grading will be based on an written exam (90 minutes) that counts 70% and two assignments with two to three problems that, together, count 30% for the final grade.

3 Course Outline

1. Introduction and Overview (**KL**: Sect. 1.1), **SW**: Sect. 15.1),
2. Univariate time series concepts and AR model (**SW**: Sects. 15.2-15.3, 15.6-15.7; **KL**: Sect. 2.1)
    - Time series data, stochastic processes, and time series models
    - Time series concepts: transformations, polynomials, stationarity, autocorrelation
    - Stable AR models

3. Stable vector autoregressive (VAR) processes (**SW**: Sect. 17.1, **E**: Sects. 10.5-10.6, **KL**: Sects. 2.2-2.3, 2.6.2-2.6.3, 2.7.1)
    - Model representation and properties
    - Estimation
    - Model selection and diagnostics
4. Structural VAR model and identification (**E**: Sects. 10.10-10.14, **KL**: Sects. 4.1, 7.6, Ch. 8, Sect. 9.1-9.2.1, 10.1, (15.2))
    - Model framework and identification problem
    - Short-run restrictions
    - Long-run restrictions
    - if time permits: Proxy-SVARs and external instruments
5. SVAR tools (**E**: Sects. 10.7, 10.9, **KL**: Sects. 4.1, 4.2-4.3, 12.1, (12.2), (15.2))
    - Impulse response analysis
    - Confidence intervals for impulse responses
    - Forecast error variance decomposition and historical decomposition
6. Empirical Papers
    - Stock, J.H. and Watson, M.W. (2001). Vector Autoregressions, Journal of Economic Perspectives 15(4): 101-115
    - Blanchard, O.J. and Quah, D. (1989). The Dynamic Effects of Aggregate Demand and Supply Disturbances, American Economic Review 79 (4): 655-673

4 Literature

In the syllabus above, I have provided you with the relevant sections of the textbooks we rely on in this course. Sections given in parentheses refer to the additional material that we may cover if time permits. In the following, I comment on the textbooks.

The main reference for the course is Kilian and Lütkpepohl (2018), (**KL**), which extensively deals with structural VAR analysis. Eventually, we just draw upon a small part of this textbook. The textbook is actually tailored to graduate students. So, if you find it difficult at first reading you may consult the mentioned sections of Stock and Watson (2019), (**SW**), and Enders (2015), (**E**) before turning back to Kilian and Lütkepohl (2018). Chapter 2 of Kilian and Lütkpepohl (2018) contains a concise description of VAR models. If you like, you can read the whole chapter rather than only the listed subsections. The material on SVAR models, the different identification schemes, and the SVAR tools is somewhat spread across the book. However, I have collected the relevant sections to help you finding the material we discuss. Note that we will proceed in a slightly different way than the book. To be precise, we will first discuss

the identification problem and the identification schemes before we turn to the SVAR tools. I will generally use the notation from the textbook but deviate with respect to the so-called contemporaneous impact matrix. We use B instead of B_0^{-1} as done in the book.

If you feel comfortable with Kilian and Lütkpepohl (2018) you could skip the stated sections of Stock and Watson (2019) and Enders (2015) regarding Parts 3 to 5 of the course. However, you should consult Stock and Watson (2018) for Part 2 on univariate time series concepts since Kilian and Lütkpepohl (2018) does not contain much in this regard.

In case you would like to know more about the econometric and statistical background of multiple time series analysis you could consult Lütkepohl (2005). However, it is really just an optional reference that you could skip completely.

I have listed the empirical papers at the end of the course. It might be that I draw upon them already earlier when introducing the methods. I let you know in this case.

Both Kilian and Lütkepohl (2018) and Stock and Watson (2019) are available online via the University Library. You should also be able to download the two papers.

References

Enders, W. (2015), *Applied Econometric Time Series*, 2nd ed., Wiley. (**E**)

Kilian, L. and Lütkepohl, H. (2018), Structural Vector Autoregressive Analysis, Cambridge University Press. (**KL**)

Lütkepohl, H. (2005), *New Introduction to Multiple Time Series Analysis*, Springer.

Stock, J.H. and Watson, M.W. (2019), Introduction to Econometrics, Pearson Education Ltd.. (**SW**)