Academic Year	2024-2025
Subject	Dynamic Connectedness
Instructor	Andrea Cipollini and Fabio Parla
Date	Third and fourth week of September
Course description	The topic of dynamic connectedness based on the Diebold and Yilmaz approach has a wide range of applications from financial to macro time series data and is based on indices of total and directional connectedness that allow to measure how a country/market/financial institution contributes and is vulnerable to systemic risk. In this course, we will first introduce the Vector Autoregressive model and the concepts of impulse response function and forecast error variance decomposition. Then, we will focus on the connectedness analysis proposed by Diebold & Yilmaz (2012, 2014) and based on the generalized forecast error variance decomposition. Finally, we will discuss two applications of the DY connectedness approach using large VAR models (Bayesian VAR and LASSO VAR).
Learning Objectives	Students should be able to: • Construct the forecast error variance decomposition based on both the reduced and structural form of VAR. • Build the static and dynamic measures of connectedness proposed by Diebold & Yilmaz (2012, 2014). • Perform the DY connectedness analysis using both relatively small-scale and large VARs.
Suggested readings	• Banbura, M., Giannone, D. & Reichlin, L. (2010). "Large Bayesian vector auto regressions". *Journal of Applied Econometrics (25) 71-92*. • Demirer, M., Diebold, F. X., Liu, L., & Yilmaz, K. (2018). "Estimating global bank network connectedness". *Journal of Applied Econometrics, 33(1), 1-15*. • Diebold, F. X., & Yilmaz, K. (2012). "Better to give than to receive: Predictive directional measurement of volatility spillovers". *International Journal of Forecasting, 28(1), 57-66*. • Diebold, F. X., & Yilmaz, K. (2014). "On the network topology of variance decompositions: Measuring the connectedness of financial firms". *Journal of Econometrics, 182(1), 119-134*. • Greenwood-Nimmo, M., Nguyen, V. H., & Shin, Y. (2021). "Measuring the Connectedness of the Global Economy". *International Journal of Forecasting, 37(2), 899-919*. • Pesaran, H. H., & Shin, Y. (1998). "Generalized impulse response analysis in linear multivariate models". *Economics Letters, 58(1), 17-29*. • Teaching materials provided during the lectures

Course Activity (hrs)	15 hrs
Credits	2
Assessment Method	Written report on a scientific paper and/or a dataset as agreed with the instructor.
Teaching Methods	Each day consists of a lecture ad a practical session using R.
Calendar	September 2024
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Syllabus	1. **A recap on Vector Autoregression, VAR:** (4 hours) 1.1 VAR Estimation, VMA, Impulse Response Function (IRF) and Forecast Error Variance Decomposition (FEVD). R examples: estimation of a VAR model; construction of IRF and FEVD. 2. **Networks for Time Series based on VAR** (6 hours) 2.1 Generalized IRF and generalized FEVD (Pesaran & Shin, 1998). 2.2 The Diebold & Yilmaz (2012, 2014) static and dynamic connectedness measures: the connectedness table. 2.3 The Greenwood-Nimmo, Nguyen & Shin (2021) connectedness measures. 2.4 DY connectedness measures based on generalized FEVD and on structural VAR (literature overview). 2.5 Brief overview of other approaches: Granger Network and NETS (network estimation for time series). R examples: construction of the generalized IRF and the generalized FEVD; construction of the DY static and dynamic (through rolling window estimation) measures of connectedness based on both structural and reduced form VAR. 3 **Connectedness measures using large VARs** (5 hours) 3.1 Bayesian VAR: Minnesota prior, Natural conjugate prior, Gibbs sampling for Bayesian VAR 3.2 LASSO VAR R example: construction of the DY connectedness measures obtained by estimating Bayesian VAR (e.g. Banbura, Giannone, & Reichlin, 2010) and LASSO VAR (Demirer, Diebold, Liu, & Yilmaz, 2018).

Practical sessions	R codes with examples will be provided. Lab exercises will use several datasets. The R codes will perform the estimation of VARs (frequentist estimation), the construction of orthogonalized and generalized forecast error variance decomposition, and the associated DY connectedness measures. Moreover, the R codes will perform the construction of the DY connectedness measures obtained through the estimation of large VARs using shrinkage techniques (i.e., Bayesian VAR with dummy observations and LASSO VAR).