

Applied macroeconometrics, Spring 2024

Fabio Canova
CEMFI

Outline

This course covers applied methods used in macroeconomics and finance to extract output gaps and to separate trend and cycles; to measure the effect of permanent and transitory shocks on domestic and international variables; to deal with large data (assets, consumers, firms, sectors, etc.) and to study networks interconnections. It also provides an introduction to the estimation of Dynamic Stochastic General Equilibrium (DGSE) models.

It is assumed participants are familiar with the following topics:

- (a) Representative agent models used in dynamics macroeconomics.
- (b) Basic statistics and theoretical econometric tools.
- (c) Working knowledge of Matlab/ Dynare programming language.

The lectures are based on my book: Methods for Applied Macroeconomic Research, Princeton University Press, 2007 and on additional material. Lecture notes will be posted together with homeworks and practice activities. Other useful books are

J. Hamilton, Time series analysis, Princeton University Press, 1994

L. Kilian and H. Lutkepohl, Structural Vector Autoregressive Analysis, Cambridge University Press, 2017.

Grading

Students will be graded according to the following scheme: presentations count 10 percent of the grade; homeworks count 30 percent of the grade. The final reproduction project (one page outline due by May 16, 2024, max 10 pages paper ' due end of June 2024) counts for the remaining 60 percent of the grade.

Program

Part I: Applied time series methods

09/04/2024: Refresher of univariate time series models. Stationary and ergodicity.

11/04/2024: Autocovariances of AR and ARMA models. Covariance generating function. Invertibility. Examples.

11/04/2024 Introduction to Hitchhiker guide to empirical macroeconomics. Slides and video presentations can be found at:

<https://sites.google.com/view/fabio-canova-homepage/home/empirical-macro-toolbox>

16/04/2024: ML estimation of AR(1) (conditional and unconditional), AR(p) and ARMA(p,q). Properties of ML estimators and tests.

Homework 1 due.

18/04/2024: Introduction to multivariate time series models. Wold theorem. Causality and exogeneity.

18/04/2024: Estimation and inference in classical VARs.

23/04/2024: Shock identification and estimation procedures.

25/04/2024: Bayesian methods for time series. Bayesian VARs
25/04/2024: Priors for VARs and impulse responses. Forecasting and large VARs.

30/04/2024: Paper presentations
02/05/2024: Paper presentations (2 sessions)

Papers for presentation:

- i) Giannone, D., Lenza, M. and Primiceri, G. (2019). Priors for the long run. *Journal of the American Statistical Association*, 114, 565-580.
- ii) Canova, F., Kozielky, A. and Piffer, M. (2023). Flexible prior beliefs on impulse responses in Bayesian vector autoregressive models, manuscript
- iii) Chan, J (2022). Asymmetric conjugate priors for large Bayesian VARs, *Quantitative Economics*, 13, 1145-1169.
- iv) Jarocinski, M. (2023). Estimating the Fed's unconventional monetary policy, ECB manuscript.
- v) Beaudry, P., Collard, F., Feve, P., Guay A. and Portier, F. (2022). Dynamic Identification in VARs, CEPR working paper 17726.
- vi) Lutz K., Plante, M. and Richter, A. (2022). Macroeconomic responses to uncertainty shocks. The perils of recursive orderings, CEPR working paper 17698.
- vii) Altavilla, C., Brugnolini, L., Gurkaynak, R., Motto, R., and Ragusa, G. (2019). Measuring euro area monetary policy. *Journal of Monetary Economics*, 108: 162–179.
- viii) Buda, G., Carvalho, V., Corsetti, G., Duarte, J., Hansen, S., Ortiz, A., Rodrigo, T., and Rodriguez Mora, J. (2023). Short and Variable lags. Robert Schuman Centre for Advanced Studies Research Paper No. 22.
- ix) Cloyne, J., Ferreira, C., and Surico, P. (2020). Monetary policy when households have debt: New evidence on the transmission mechanism. *Review of Economic Studies*, 87(1): 102–129.
- x) Krishnamurthy, A., and Vissing-Jorgensen, A. (2011). The effects of quantitative easing on interest rates: Channels and implications for policy. *Brookings Papers on Economic Activity*, 215–265
- xi) Baumeister, C. and Hamilton, J. (2015). Sign Restrictions, Structural Vector Autoregressions, and Useful Prior Information. *Econometrica* 83(5): 1963—1999
- xii) Arias, J, Rubio, J. and Waggoner, D. (2022) Uniform prior for Impulse responses, Emory University, manuscript.

07/05/2024: Local projections.

09/05/2024: Small sample issues. Asymmetric local projections.

09/05/2024: Cross sectional local projections.

Readings (VARs and LPs):

- Miranda Agrippino, S. and Ricco, G. (2018) Bayesian Vector autoregression, hal-03458277.
- Karadi, P. and M. Jarocinski (2020). Deconstructing Monetary Policy Surprises: The role of information shocks. *American Economic Journal: Macroeconomics*, 12(2), 1-43
- Antolin Diaz, J. and J. Rubio Ramirez (2018). Narrative sign restrictions for VARs. *American Economic Review*, 108, 2802-2829.
- Canova, F. and F. Ferroni (2022) Mind the gap! Stylized Dynamic Facts and Structural Models, *American Economic Journal*, 14(4), 104-135
- Bergholt, D., Canova, F., Furlanetto, F. Maffei-Faccioli, N and Ulvedal, P. (2023) What drives the recent surge in inflation? The historical decomposition rollercoaster, manuscript.
- Keweloh, S. (2021). A Generalized Method of Moments Estimator for Structural Vector Autoregressions Based on Higher Moments. *Journal of Business & Economic Statistics* 39.3, 772–782.

Lanne, M., Meitz, M., and Saikkonen, P. (2017). Identification and Estimation of Non-Gaussian Structural Vector Autoregressions, *Journal of Econometrics*, 196, pp. 288-304.

Stock, J. and M. Watson (2018). Identification and Estimation of Dynamic Causal Effects in Macroeconomics Using External Instruments. *Economic Journal*, 128, 917-947.

Cloyne, J., O. Jorda and A. Taylor (2023) State dependent local projections: understanding impulse response heterogeneity, CEPR working paper 17903

F. Canova (2022) Should we trust cross-sectional multiplier estimates?, forthcoming, *Journal of Applied Econometrics*, https://drive.google.com/file/d/1T7Fd7-7y34Di_7dbaovVULhvMEJYM_XT/view?usp=sharing.

Bruns, M. and Lutkepohl, H. (2022) Comparison of local projection estimator for proxy vector autoregression, *Journal of Economic Dynamics and Control*, 134, 1-17.

Plagborg-Moller, M. and C. Wolf (2020). Local projections and VARs estimate the same impulse responses. *Econometrica*, 89, 955-980.

14/05/2024. Network analysis and estimation of large scale models.

Homework 2 due.

16/05/2024 Factor models.

16/05/2024 FAVARs. Some nonlinear models (TVAR, Markov switching, Threshold VARs).

Readings:

Stock, J. and M. Watson (2016). Dynamic Factor Models, Factor-Augmented Vector Autoregressions, and Structural Vector Autoregressions in Macroeconomics. *Handbook of Macroeconomics*, volume 2, 415-525

Gudmundson, G and C. Brownlees (2021). Detecting groups in large VARs, forthcoming, *Journal of Econometrics*.

De Paula, A. (2017). Econometrics of Network Models. in *Advances in Economics and Econometrics: Theory and Applications*, ed. by B. Honore, A. Pakes, M. Piazzesi, and L. Samuelson, Cambridge University Press.

Hallin, M. and Liska, R. (2011). Dynamic factors in the presence of blocks. *Journal of Econometrics*, 163, 29-41.

Born, B., Muller, G., Schularik, M. and P. Sedlacek (2019) The cost of economic nationalism: evidence from the brexit experiment, *Economic Journal*, 129, 2722-2744.

Canova, F. and Perez Forero, F. (2023). Does the monetary policy transmission depends on the level of inflation?, manuscript

Debortoli, D., Forni, M., Gambetti, L. and Sala, L. (2020). Asymmetric Effects of Monetary Policy Easing and Tightening. BSE, working Papers 1205.

Chen, C. and Lee, J. (1995). Bayesian inference of threshold autoregressive models. *Journal of Time Series Analysis*, 16 (5), 483-492.

21/05/2024 Introduction to trend and cycle decompositions. Burns and Mitchell approach. Frequency domain decomposition methods.

23/05/2024: MA filters (the Hodrick and Prescott, band pass, wavelet). Hamilton filter, Unobservable component models.

23/05/2024 VAR methods. Collection of cyclical facts. Interpretation problems.

Readings:

J. Hamilton (2018). Why you should never use the Hodrick and Prescott Filter, *Review of Economics and Statistics*, 100(5), 831-843..

C. Chang, K. Chen, D. Waggoner and T. Zha (2015). Trend and cycles in China economy, NBER

macroeconomic annual, 30(1),1-84.

F. Canova (2022) FAQ: How to I estimate the output gap? <https://sites.google.com/view/fabio-canova-homepage/home/current-research>

M. Del Negro, D. Giannone, M. Giannoni and A. Tambalotti (2019) Global trends in interest rates, *Journal of International Economics*, 118, 248-262.

Part II: Structural estimation and inference in representative agents DSGE models.

28/05/2024 Perturbation methods for DSGE.

Homework 3 due.

30/05/2023 Calibration of DSGE. Examples.

30/05/2023 GMM and SMM estimation of DSGE. Examples.

Readings:

K. Judd (1996) Approximation, Perturbation and Projection methods in economic analysis, in *Handbook of Computational Economics*, Volume I, Edited by H.M. Amman, D.A. Kendrick and J. Rust, Elsevier Science .

G. Imbens (2002) Generalized Method of Moments and Empirical Likelihood, *Journal of Business and Economic Statistics*, 20(4),493-506.

F. Ruge Murcia (2011) GMM estimation of DSGE models. *Handbook of Empirical Macroeconomics*, edited by N. Hashimzade and M. Thornton, Edward Elgar Publishing.

F. Ruge Murcia (2012) Estimating nonlinear DSGE models by the simulated method of moments: With an application to business cycles, *Journal of Economic Dynamics and control*, 36(6), 914-938.

04/06/2024 State space models, the Kalman filter and the EM algorithm

06/06/2024 ML estimation of DSGE. Examples

06/06/2024 Markov Chain Monte Carlo methods, Particle filters and SMC.

Readings:

Van Ravenzwaaij, D., Cassey, P. , Brown , S. (2018) A simple introduction to Markov Chain Monte-Carlo sampling,<https://link.springer.com/article/10.3758/s13423-016-1015-8>

Doucet A. and Johansen, A. (2011) A Tutorial on Particle Filtering and Smoothing: Fifteen years later, https://www.stats.ox.ac.uk/~doucet/doucet_johansen_tutorialPF2011.pdf

Speekenbrink M. (2016) A Tutorial on particle filteres and SMC, manuscript

F. Ruge Murcia (2007) Methods to estimate DSGE models, *Journal of Economic Dynamics and control*, 31, 2599-2636.

11/06/2024 Bayesian estimation of DSGE models (I)

Homework 4

13/06/2024 Bayesian estimation of DSGE models (II)

13/06/2024 Practical DSGE models for policy analyses

Readings:

Herbst, E. and F. Schorfheide (2016) *Bayesian Inference for DSGE Models*, Princeton University Press.

Canova (2014) Bridging DSGE Models and the Raw Data. *Journal of Monetary Economics*, 67, 1-15.

Canova and Matthes (2021) Dealing with misspecification in macroeconometric models (with C. Matthes), *Quantitative Economics*, 12, 313-350.

Potential final reproduction projects (only suggestions, you can choose others):

- i) Ramey, V. A. and S. Zubairy (2018). Government spending multipliers in good times and in bad: evidence from us historical data. *Journal of Political Economy* 126(2), 850–901
- ii) Alessandri, P. and H. Mumtaz (2019). Financial regimes and uncertainty shocks. *Journal of monetary economics* 101, 31–46.
- iii) Debortoli, D., J. Galí, and L. Gambetti (2019). On the Empirical (Ir)Relevance of the Zero Lower Bound Constraint, NBER macro annual 2019, see also comment by M. Watson
- iv) Ascari, G., Friis, P., Florio, A. and Gobbi, A. (2023) Fiscal foresight and the effects of government spending: It’s all in the monetary fiscal mix”. In: *Journal of Monetary Economics* 134. 1–15.
- v) Schuler, Y. S., Hiebert, P. P., and Peltonen, T. A. (2020). Financial Cycles: Characterisation and Real-Time Measurement. *Journal of International Money and Finance*, 100(1).
- vi) Basu, S. and Bundick, B. (2017). Uncertainty shocks in a model of effective demand. *Econometrica*, 85(3):937–958.
- vii) Jurado, K., Ludvigson, S. C., and Ng, S. (2015). Measuring uncertainty. *American Economic Review*, 105(3):1177–1216.
- viii) Bachmann, R. and Bayer, C. (2013). ‘wait-and-see’ business cycles? *Journal of Monetary Economics*, 60(6):704–719.
- ix) Angeletos, G.-M., F. Collard, and H. Dellas (2020). Business-cycle anatomy. *American Economic Review* 110 (10), 3030–70.
- x) Barnichon, R. and C. Matthes (2018). Functional Approximation of Impulse Responses. *Journal of Monetary Economics* 99, 41–55.
- xi) Jarocinski, M. and P. Karadi (2020). Deconstructing Monetary Policy Surprises— The Role of Information Shocks. *American Economic Journal: Macroeconomics* 12 (2), 1–43.
- xii) Canova, F. (2007). G-7 inflation forecasts: Random walk, phillips curve or what else? *Macroeconomic Dynamics*, 11 (1), 1–30.
- xiii) Kaplan, G., Moll, B., and Violante, G. (2018) Monetary policy according to HANK. *American Economic Review*, 108(3): 697–743.
- xiv) Tenreyro, S., and Thwaites, G. (2016). Pushing on a string: US monetary policy is less powerful in recessions. *American Economic Journal: Macroeconomics*, 8(4): 43–74.
- xv) Coibion, O., Y. Gorodnichenko, and M. Ulate (2018). The cyclical sensitivity in estimates of potential output. *Brookings Papers on Economic Activity*.
- xvi) Gabaix, X. (2020). A behavioral New Keynesian model. *American Economic Review*, 110(8), 2271-2327.