

**Kiel Institute for the world economy, September 2018**  
**Time series tools for the study of monetary policy transmission**  
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**Outline**

The course presents a self contained exposition of methods needed to undertake analyses and forecasts of monetary policy with reduced form and semi-structural time series methods. The lectures are based on chapters 3,4,8 of my book: *Methods for Applied Macroeconomic Research*, Princeton University, Press, 2007 and on additional material.

**Program**

September 24, 2018 Morning(9:00-12:00 with coffee break) Vector autoregressions (VARs), structural VARs, Identification issues.  
 September 24, 2018 Afternoon (14:00-15:30) Matlab practice and exercises.  
 September 25, 2018 Morning (9:00-12:00 with coffee break) Problems with VAR analyses, Local projections and IV approaches to identification. Introduction to Bayesian VARs.  
 September 25, 2018 Afternoon (14:00-15:30) Matlab practice and exercises.  
 September 26, 2018 Morning (9:00-12:00 with coffee break) Factor models and FAVARs.  
 September 26, 2018 Afternoon (14:00-15:30) Matlab practice and exercises.  
 September 27, 2018 Morning (9:00-12:00 with coffee break) Detrending, cyclical dynamics and computation of gaps.  
 September 27, 2018 Afternoon (14:00-15:30) Matlab practice and exercises.  
 September 28, 2018 Morning (9:00-12:00 with coffee break) Forecasting methods.

**Preliminary readings**

It would be useful if participants familiarize themselves with the basic time series material and with Matlab programming language prior to the course. The following can help:

- J. Hamilton, 1994. *Time series analysis*, chapters 2, 3 and 10.
- Canova, F. , 2015. *Introduction to Matlab programming*, manuscript.

**Reading list**

**1) VARs, Structural VARs, local projections.**

- Hamilton, J., (1994). *Time Series Analysis*, Princeton University Press, Chapter 11.
- Killian, L. (2012). *Structural Vector Autoregressions*, University of Michigan, manuscript.

- Canova, F., (1995). VAR Models: Specification, Estimation, Inference and Forecasting”, in H. Pesaran and M. Wickens (eds.), *Handbook of Applied Econometrics*, Ch.2 , Blackwell.
- Blanchard, O. and Quah, D. (1989). The Dynamic Effect of Aggregate Demand and Supply Disturbances. *American Economic Review*, 79, 655-673.
- Uhlig, H. (2005). What are the Effects of Monetary Policy? Results from an agnostic Identification procedure. *Journal of Monetary Economics*, 52, 381-419.
- Canova, F. and De Nicolo, G. (2002). Money Matters for Business Cycle Fluctuations in the G7. *Journal of Monetary Economics*, 49, 1131-1159.
- Erceg, C., Guerrieri, L. and Gust, C. (2005). Can long run restrictions identify technology shocks?, *Journal of the European Economic Association*, 3, 1237-1278.
- Faust, J. and Leeper, E. (1997). Do Long Run Restrictions Really Identify Anything? *Journal of Business and Economic Statistics*, 15, 345-353.
- Canova, F. and Pina, J. (2005). Monetary Policy Misspecification in VAR models, in Diebolt, C. and Kyrtsov, C. (eds.), *New Trends In Macroeconomic*, Springer Verlag.
- Sims, C. and Zha, T. (1999). Error Bands for Impulse Responses. *Econometrica*, 67, 1113-1155.
- Chari, V.V., Kehoe, P. and McGrattan, E. (2008). Are structural VAR with Long Run restrictions useful for developing Business Cycle Theory, *Journal of Monetary Economics*, 55, 1337-1352.
- Fernandez Villaverde, J. Rubio Ramirez , J., Sargent, T. and Watson, M. (2007). The ABC and D for understanding VAR. *American Economic Review*, 97, 1021-1026.
- Canova, F. and Paustian, M. (2011). Business cycle measurement with some theory. *Journal of Monetary Economics*, 58, 345-361.
- Fry, R. and Pagan, A. (2011). Sign restrictions in structural vector autoregressions: A Critical Review, *Journal of Economic Literature*, 48, 938-960.
- Robertson, J. and Tallman, E. (1999). 'Vector Autoregressions: Forecasting and Reality”, *Federal Reserve Bank of Atlanta, Economic Review*, First quarter, 4-18.
- Waggoner, D. and Zha, T. (1999). Conditional Forecasts in Dynamic Multivariate Models, *Review of Economics and Statistics*, 81, 1-14.

- Altavilla, C., Canova, F. and M. Ciccarelli (2018). Mending the broken link: Bank lending rates and unconventional monetary policy. CEPR working paper 11584.
- Barnichon, R. and C. Brownlees (2016). Impulse Response Estimation by Smooth Local Projections. CEPR Discussion paper 11726.
- Faust, J., Rogers, J.H., Swanson, E., and J.H. Wright (2003). Identifying the Effects of Monetary Policy Shocks on Exchange Rates Using High Frequency Data. *Journal of the European Economic Association*, 1, 1031-57.
- Gertler, M. and P. Karadi (2015). Monetary Policy Surprises, Credit Costs, and Economic Activity. *American Economic Journal: Macroeconomics*, 7, 44-76.
- Gurkaynak, R.S., Sack, B., and E. Swanson (2005). The sensitivity of long-term interest rates to economic news: Evidence and implications for macroeconomic models. *American Economic Review*, 95, 425-436.
- Jorda, O. (2005) Estimation and Inference of Impulse Responses by Local Projections. *American Economic Review*, 95, 161-182.
- Kuttner, K.N. (2001). Monetary policy surprises and interest rates: Evidence from the Fed funds futures market. *Journal of Monetary Economics*, 47, 523-544.
- Ramey, V. (2016). Macroeconomic Shocks and their Propagation, in *Handbook of Macroeconomics*, Vol. 2A. Amsterdam: Elsevier, 71-162.
- Romer, C. D. and D.H. Romer (2004). A New Measure of Monetary Shocks: Derivation and Implications. *American Economic Review*, 94, 1055-1084.
- Sims, C.A. (1980). Macroeconomics and Reality. *Econometrica* 48, 1-48.
- Stock, J. and M. Watson (2017). Identification and estimation of dynamic causal effects in macroeconomics. NBER working paper 24216.

## 2) Factor models, FAVARs.

- Anderson T. W. (2003). *An Introduction to Multivariate Statistical Analysis*, 3rd edition, Wiley.
- Sargent T. and Sims C. (1977). Business Cycle Modeling Without Pretending to Have Too Much a Priori Theory, in C. Sims (ed.), *New Methods of Business Cycle Research*. Minneapolis: Federal Reserve Bank of Minneapolis.
- Quah, D. and Sargent, T. (1993). A dynamic index model for large cross sections. In J. H. Stock and M. W. Watson, Eds, *Business Cycles, Indicators, and Forecasting*, N.B.E.R. and University of Chicago Press, Chicago.

- Chamberlain G., and Rothschild, M. (1983). Arbitrage, factor structure and mean variance analysis in large asset markets, *Econometrica*, 51, 1305-1324.
- Schneeweiss H. and Mathes H. (1995). Factor Analysis and Principal Components, *Journal of Multivariate Analysis*, 55, 105-124.
- Stock, J. and Watson, M. (2002). Macroeconomic Forecasting Using Diffusion Indexes. *Journal of Business and Economic Statistics*, 20, 147-162.
- Forni, M., Hallin, M., Lippi, M. and Reichlin, L. (2000). The generalized dynamic factor model: identification and estimation. *The Review of Economics and Statistics*, 82, 540-554.
- Forni, M., D. Giannone, M. Lippi and L. Reichlin (2009). Opening the Black Box: Structural Factor Models with Large Cross-Sections, *Econometric Theory*, 25, 1319-1347.
- Bunburra, M., Giannone, D. and Riechlin, L. 2010. Large Bayesian VARs. *Journal of Applied econometrics*, 25, 71-92.

### 3) Detrending and gap computations

- Baxter, M. and King, R., (1999), "Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series", *Review of Economics and Statistics*, 81, 575-593.
- Beveridge, S. and Nelson, C., (1981), "A New Approach to Decomposition of Economic Time Series into Permanent and Transitory Components with Particular Attention to the Measurement of the Business Cycle", *Journal of Monetary Economics*, 7, 151-174.
- Bry, G. and Boschen, C. (1971) *Cyclical analysis of time series: Selected Procedures and Computer Programs*, New York, NBER
- Canova, F., (1998), "Detrending and Business Cycle Facts", *Journal of Monetary Economics*, 41, 475-540.
- Canova, F., (1999), "Reference Cycle and Turning Points: A Sensitivity Analysis to Detrending and Dating Rules", *Economic Journal*, 109, 126-150.
- Canova, F., (2012), "Bridging DSGE models and the data", manuscript.
- Canova, F., and Ferroni, F. (2011), "Multiple filtering device for the estimation of DSGE models", *Quantitative Economics*, 2, 37-59.

- Christiano, L. and J. Fitzgerald (2003) The Band Pass Filter, *International Economic Review*, 44, 435-465.
- Cogley, T. and Nason, J., (1995), "The Effects of the Hodrick and Prescott Filter on Integrated Time Series", *Journal of Economic Dynamics and Control*, 19, 253-278.
- Harvey, A. and Jeager, A., (1993), "Detrending, Stylized Facts and the Business Cycles", *Journal of Applied Econometrics*, 8, 231-247.
- Hodrick, R. and Prescott, E., (1997), "Post-War US Business Cycles: An Empirical Investigation", *Journal of Money Banking and Credit*, 29, 1-16.
- King, R. and Rebelo, S., (1993), "Low Frequency Filtering and Real Business Cycles", *Journal of Economic Dynamics and Control*, 17, 207-231.
- King, R. Plosser, C., Stock, J. and Watson, M. (1991) "Stochastic Trends and Economic Fluctuations", *American Economic Review*, 81, 819-840.
- Pagan, A. and Harding, D. (2002), "Dissecting the Cycle: A Methodological Investigation", *Journal of Monetary Economics*, 49, 365-381.
- Ravn, M and Uhlig, H. (2002), On adjusting the HP filter for the frequency of Observations, *Review of Economics and Statistics*, 84, 371-375.

#### 4) Forecasting

- Adolfson, M., Andersson, M., Linde' J and Villani, M. (2007). Modern Forecasting Models in Action: Improving Macroeconomic Analyses at Central Banks, *International Journal of Central Banking*, 3(4), 111-144.
- Adolfson, M., Lindé, J. and M. Villani (2007). Forecasting performance of an open economy DSGE model *Econometric Reviews*, 26 (2-4), 289-328.
- Amisano, G. and R. Giacomini (2007) Comparing Density Forecasts via Weighted Likelihood Ratio Tests, *Journal of Business and Economic Statistics*, 25, 177-190.
- Amisano, G. and J. Geweke (2011). Optimal prediction pools. *Journal of Econometrics*, 164, 130-141.
- Amisano, G. and J. Geweke (2013). Predictions using several macroeconomic models, ECB working paper 1537.

- Atkenson, A. and L. Ohanian (2001) Are Phillips Curves useful for forecasting inflation? Federal Reserve Bank of Minneapolis Quarterly Review 25(1), 2–11.
- Billio, M. Casarin. R, Ravazzolo, F. and H. van Dijk (2013). Time varying combination of predictive densities using nonlinear filtering. *Journal of Econometrics*, 177, 213-232.
- Canova, F. (2007) Forecasting inflation: random Walk, Phillips curve, what else? *Macroeconomic Dynamics*, 11, 1-30.
- D’Agostino, A., Gambetti, L and D. Giannone (2013). Macroeconomic Forecasting and Structural Change, *Journal of Applied Econometrics*, 28(1), 82-101.
- Dawid, A. (1984). Statistical theory: The Prequential Approach, *Journal of the Royal Statistical Society, Series A*, 147, 278-292.
- Del Negro, M. and F. Schorfheide (2012). DSGE model based forecasting in *Handbook of Economic Forecasting*, vol 2, edited by G. Elliot and A. Timmerman, Elsevier.
- Del Negro, M., Hasegawa, F. Schorfheide (2014). Dynamic prediction pools: an investigations of financial frictions and forecasting performance, Federal Reserve Bank of New York, staff report 695.
- Diebold, F.X., Gunther, T. and A. Tay (1998). Evaluating Density Forecasts, with Applications to Financial Risk Management. *International Economic Review*, 39, 863-883.
- Diebold, F.X., Tay, A. and K. Wallis (1999). Evaluating Density Forecasts of Inflation: The Survey of Professional Forecasters, in R. Engle and H. White (eds.), *Festschrift in Honor of C.W.J. Granger*, 76-90. Oxford: Oxford University Press.
- Diebold, F.X. and R. Mariano (1995). Comparing Predictive Accuracy. *Journal of Business and Economic Statistics*, 13, 253-265
- Edge, R. and R. Gurkaynak (2011). How useful are DSGE models forecast. *Brookings Papers of Economic Activity*, 41, 209-249.
- Elliot, G. and Timmerman, A. (2005) Optimal forecast combination under regime switching. *International Economic Review*, 46(4), 1081-1102.
- Gerard, A and K. Nimark (2010) Combining Multivariate Density Forecasts Using Predictive Criteria, Bank of Australia, manuscript.

- Geweke, J. and G. Amisano (2014). Analysis of Variance for Bayesian Inference, *Econometric Reviews*, 33(1-4), 270-288.
- Giacomini, R. and H. White(2006). Tests of Conditional Predictive Ability, *Econometrica*, 74(6), 1545-1578.
- Gurkaynak,R. Kisacikoglu and B. Rossi (2013) Do DSGE Models Forecast More Accurately Out-of-Sample than VAR Models?, in T. Fomby, L. Kilian, A. Murphy (eds) VAR models in macroeconomics: new developments and applications, *Advances in Econometrics*, 28, 27-80.
- Hall S. and J. Mitchell (2007). Combining density forecast. *International Journal of Forecasting* 23, 1-13.
- Karlsson, S. (2012).Forecasting with Bayesian Vector Autoregression, *Handbook of Economic Forecasting*, vol 2, edited by G. Elliot and A. Timmerman, Elsevier.
- Kilian, L. and Baumeister, C. (2014). Real time analysis of oil price risk using forecast scenarios, *IMF economic Review*, 62(1), 119-145
- Koop G. and D. Korobilis (2011). Forecasting inflation using dynamic model averaging. *International Economic Review*, 53, 868-886.
- Jarocinski M. (2010). Conditional forecasts and uncertainty about forecast revisions in VARs. *Economic Letters*, 108, 257-259.
- Rapach, D, J. Strauss, and G Zhou (2010). Out of sample equity premium prediction: combination forecasts and link to the real economy. *Review of Financial Studies*, 23(2), 821-862.
- Rossi, B. and T. Sekhposyan (2014). Evaluating predictive densities of US output growth and inflation in a large macroeconomic data set, *International Journal of Forecasting*, 30(3), 662-682.
- Stiglitz, (2015). Toward a general theory of deep downturns. NBER working paper 21444.
- Stock, J. and M. Watson (2007) Why has U.S. inflation become harder to forecast? *Journal of Money Credit and Banking*, 39(7), 3-33.
- Stock, J. and M. Watson (2004). Combination Forecasts of Output Growth in a Seven-Country Data Set, *Journal of Forecasting*, 23(6), 405-430.

- Waggoner D. and Zha, T. (1999). Conditional forecasts in dynamic multivariate models. *The Review of Economics and Statistics* 81, 639–651.
- Waggoner D. and Zha, T. (2012). Confronting model misspecification in macroeconomics. *Journal of Econometrics*, 146, 329-343.
- West, K and M. McCracken, (1998). Regression-Based Tests of Predictive Ability, *International Economic Review*, 39(4), 817-40.
- Wolters, M. (2011). Forecasting under Model Uncertainty. Goethe University, manuscript.