JEM017 - Business Cycles Theory

Lecturers
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Description
In this course, students learn how to use the methods of current macroeconometrics. We start with isolation of trends and cycles, and with modelling univariate time series. More advanced topics, i.e., spectral analysis, filters, regime-shift models and state-space models, follow. The second part of the semester is devoted to multivariate models, forecasting, and identification of causal relationships in macroeconomics. We cover the recently developed approaches to identification such as external instruments in VAR or high frequency identification as well.
Over the semester, students are expected to apply the methods in regular problem sets, and to present their results in the seminars. Problem sets shall be written in R and delivered as Jupyter notebooks. Sample R-codes are provided.
Moodle Site: http://dl1.cuni.cz/course/view.php?id=880

Literature
We provide most of the necessary information in our presentations and in sample codes. If needed, we encourage students to consult in the following textbooks and in articles mentioned in the syllabus.
Enders, W.: *Applied Econometric Time Series*, 3rd ed., Wiley, 2009
Kilian, L., & Lütkepohl, H.: *Structural Vector Autoregressive Analysis.* Cambridge: Cambridge University Press, 2017. http://www-personal.umich.edu/~lkilian/book.html.
Lütkepohl, H.: *New Introduction to Multiple Time Series Analysis*. Springer, 2005.
Kočenda, E., Černý, A.: *Elements of Time Series Econometrics: An Applied Approach*, Karolinum 2007
Ramey, V. A. (2016). Macroeconomic shocks and their propagation. In *Handbook of Macroeconomics* (Vol. 2, pp. 71-162). Elsevier.

Course requirements:
Problem sets and presentations 60%, Midterm 20%, Final exam 20%.
Problem sets: 10 points for each problem set at maximum. Late submission/returned PS -1 points.
Presentation: 10 points (2-3 presentations per semester).
About 10 problem sets shall be expected. It is necessary to have at least 50% of points of each problem set to pass the course.
Midterm: written exam.
Final exam: presentation of selected problem set and written exam.

Grading scale: 100 - 91 A; 90 - 81 B; 80 - 71 C; 70 - 61 D ; 60 - 51 E; 50 - 0 F

Schedule: Wednesday, 15:30 – 16:50 (lecture), 17:00-18:20 (seminar), room 601

Content

1. Introduction to the course. Study requirements.
Assignment: Linear and polynomial trends. Sensitivity of estimated cyclical components on method.

2. Stationary linear models
AR, MA, ARMA models and their properties. Stationarity: economic and econometric interpretation, unit-root tests. (Enders, Ch. 2)
Assignment: Estimation of ARMA model of selected real-world time series.

Perron, Pierre. "The great crash, the oil price shock, and the unit root hypothesis." Econometrica: Journal of the Econometric Society (1989): 1361-1401

3. Nonstationary models, unit-root tests under structural instability; seasonality.
(Enders, Ch. 4)
Assignment: The power of ADF test – Monte Carlo simulation.

4. Introduction to spectral analysis.
Time domain and frequency domain. Spectrum, periodogram and Fourier analysis of signal.

5. Filters and identification of business cycles.
Review of spectral analysis. Filters and their properties. Moving averages as filters. Hodrick-Prescott filter and other commonly used filters, seasonal adjustment methods. Data revisions and end-sample bias of filters.
Assignment: Estimation of spectrum of real GDP and of log differences of real GDP. Extraction of the cyclical component using Hodrick-Prescott filter, Baxter-King filter, and the Hamilton's (2018) filter.

Stock, J.H. Watson, M.W.: Business cycles fluctuations and U.S. macroeconomic time series. In: Taylor, J.B., Woodford, M. (eds): *Handbook of Macroeconomics*, Vol. 1, Elsevier, 1999
Hodrick, Robert; Prescott, Edward C. (1997). "Postwar U.S. Business Cycles: An Empirical Investigation". Journal of Money, Credit, and Banking. 29 (1): 1–16.
Baxter, M., & King, R. G. (1999). Measuring business cycles: approximate band-pass filters for economic time series. Review of economics and statistics, 81(4), 575-593.
Hamilton, J. D. (2018). Why you should never use the Hodrick-Prescott filter. Review of Economics and Statistics, 100(5), 831-843.

6. Kalman filter and state-space models.
State space models. Kalman recursions. Applications in econometrics: ARMA models as state-space models. Models with time-varying parameters, factor models, stochastic volatility. (Lütkepohl, Ch. 18)
Assignment: Local-level model with and without MLE estimation of parameters.

Laubach, Thomas, and John C. Williams. 2003. "Measuring the Natural Rate of Interest," Review of Economics and Statistics, 85(4), November, 1063-1070.

7. Classical business cycles analysis: turning points, non-linear models and leading indicators.
Recession dating procedures. Classical cycles vs. Growth cycles. Nonlinear models - threshold and Markov switching regressions. Forecasting turning points. (Enders, Ch. 7 for nonlinear models)
Assignment: Identification of turning points, estimation of TAR and Markov-switching model.

Stock, J.H. Watson, M.W.: Business cycles fluctuations and U.S. macroeconomic time series. In: Taylor, J.B., Woodford, M. (eds): *Handbook of Macroeconomics*, Vol. 1, Elsevier, 1999
Canova, F. (1998). Detrending and business cycle facts: A user's guide. Journal of Monetary Economics, 41(3), 533-540.
Aruoba, S.B., Diebold, F.X. and Scotti, C. (2009), "Real-Time Measurement of Business Conditions," Journal of Business and Economic Statistics 27:4 (October 2009), pp. 417-27.
Andrews, D. W., & Ploberger, W. (1994). Optimal tests when a nuisance parameter is present only under the alternative. Econometrica: Journal of the Econometric Society, 1383-1414.
Luukkonen, R., Saikkonen, P., & Teräsvirta, T. (1988). Testing linearity against smooth transition autoregressive models. Biometrika, 75(3), 491-499.

8. VAR models
Estimation, post-estimation diagnostics and forecasting. (Kilian-Lütkepohl, Ch. 2, 4)
Assignment: Estimation of monetary VAR for a country of interest, impulse responses, forecast error variance decompositions, historical decompositions and predictions.

9. Identification in VAR models.
Recursive identification, structural VARs, sign-restrictions and narrative approach. (Kilian-Lütkepohl, Ch. 7, 8, 10, 13; Ramey, 2016)
Assignment: Estimate SVAR model and VAR with sign restrictions. Compare the impulse responses.

Christiano, L. J., Eichenbaum, M., & Evans, C. L. (1999). Monetary policy shocks: What have we learned and to what end?. Handbook of macroeconomics, 1, 65-148.
Borys, M. M., Horváth, R., & Franta, M. (2009). The effects of monetary policy in the Czech Republic: an empirical study. Empirica, 36(4), 419.
Cushman, D. O., & Zha, T. (1997). Identifying monetary policy in a small open economy under flexible exchange rates. Journal of Monetary economics, 39(3), 433-448.
Blanchard, O. J., & Quah, D. (1989). The dynamic effects of aggregate demand and aggregate supply. The American Economic Review, 79(4), 655-73.
Romer, C. D., & Romer, D. H. (2010). The macroeconomic effects of tax changes: estimates based on a new measure of fiscal shocks. American Economic Review, 100(3), 763-801.
Aldasoro, I., & Unger, R. (2017). External financing and economic activity in the euro area-why are bank loans special?.

10. VARs with non-stationary variables. Cointegration.
(Kilian-Lütkepohl, Ch. 3, 19; Ramey, 2016)
Assignment: Estimate the VECM model, compare the impulse responses and forecasts with VAR model.

Juselius, K. The Cointegrated VAR Model: Methodology and Applications (Advanced Texts in Econometrics), 2007, ch. 10
Juselius, M., Borio, C., Disyatat, P., & Drehmannb, M. (2017). Monetary Policy, the Financial Cycle, and Ultra-Low Interest Rates. International Journal of Central Banking.
Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of applied econometrics, 16(3), 289-326.

11. Bayesian VARs and large VARs.
Introduction to Bayesian estimation: Prior, likelihood and posterior. Priors for VAR models. Big Data in Macroeconometrics: FAVAR and alternatives. (Kilian-Lütkepohl, Ch. 5., 16)
Assignment: Estimate BVAR with reasonable priors. Compare the results with simple VAR.

Koop, G., & Korobilis, D. (2010). Bayesian multivariate time series methods for empirical macroeconomics. Foundations and Trends® in Econometrics, 3(4), 267-358.
Bernanke, B. S., Boivin, J., & Eliasz, P. (2005). Measuring the Effects of Monetary Policy: A Factor-Augmented Vector Autoregressive (FAVAR) Approach. The Quarterly Journal of Economics, 120(1), 387-422.
Bańbura, M., Giannone, D., & Reichlin, L. (2010). Large Bayesian vector auto regressions. Journal of Applied Econometrics, 25(1), 71-92.
Garratt, A., Lee, K., Pesaran, M. H., & Shin, Y. (2012). Global and national macroeconometric modelling: a
long-run structural approach. Oxford University Press.

12. Recent approaches to identification.
Local projections. External instruments (proxy SVAR), high-frequency identification and other alternatives. (Kilian-Lütkepohl, Ch. 6.3, 15 , 17; Ramey, 2016)

Mertens, K., & Ravn, M. O. (2013). The dynamic effects of personal and corporate income tax changes in the United States. American Economic Review, 103(4), 1212-47.
Gertler, M., & Karadi, P. (2015). Monetary policy surprises, credit costs, and economic activity. American Economic Journal: Macroeconomics, 7(1), 44-76.
Ramey, V. A. (2011). Identifying government spending shocks: It's all in the timing. The Quarterly Journal of Economics, 126(1), 1-50.

Nakamura, E., & Steinsson, J. (2014). Fiscal stimulus in a monetary union: Evidence from US regions. American Economic Review, 104(3), 753-92.
Nakamura, E., & Steinsson, J. (2018). Identification in macroeconomics. Journal of Economic Perspectives, 32(3), 59-86.