

**Empirical methods in macroeconomics and forecasting in time series analysis**  
**Barbara Rossi, Fall 2011**  
**Course description**

This course examines the models and statistical techniques used to study time series data with a special emphasis to applications in macroeconomics. The course has three specific objectives. The first is to equip students who anticipate using time series data in their Ph.D. research with the tools they need for state-of-the-art empirical research. The second objective is to lay out the econometric theory of time series analysis, with an emphasis on recent developments. The third objective is to analyze selected recent works in theoretical macroeconomic modeling with an emphasis on their empirical implications and analysis.

The course is built so that for each topic the econometric tool is presented first, followed by the relevant empirical applications. Among the topics, the course will cover:

- i) Time series models with latent variables and applications to leading indicators and the business cycle
- ii) Vector Auto-Regressions and impulse responses, with applications to monetary policy analysis and the dynamics of aggregate demand and supply shocks
- iii) Modeling and inference in persistent time series, with applications to trends and random walks, and price convergence
- iv) Forecasting and structural breaks, and applications to the Phillips curve and the Term Structure as predictors of future GDP growth and inflation dynamics

There will be various problem sets during the course, plus a final project.

This course may be used toward minor certification in either Macro or Econometrics (not both).

Here is a link to an overview and motivation for the course:

<http://econ.duke.edu/~brossi/RossiFieldDay.pdf>

## Preliminary reading list and references

### General References:

*H is Hayashi, Econometrics, Princeton University Press<sup>1</sup>*

*Hamilton, Time Series Econometrics, Princeton University Press*

*Canova, Fabio, Methods for Applied Macroeconomic Research, Princeton University Press*

*White, H. (1994), Estimation, Inference and Specification Analysis, New York: Cambridge University Press (optional)*

*White, H. (2001), Asymptotic Theory for Econometricians, San Diego: Academic Press (optional)*

**Important:** *this syllabus is preliminary and the contents of the course may change during the semester – please come to classes to keep up with the contents!*

**Mark your calendars!** *There will be a special Macro-International-Applied workshop at a date TBA, and the students taking this course are expected to participate. I will keep you posted! This activity is really part of the course and will help you integrate with the research done in the time-series / applied macro literature! And they will be fun!*

### - 1. Introduction: An overview of the time series properties of macro data

- Econometric theory: Correlation and basics of time series
  - Chp 6 Hayashi
  - Baxter and King, [“Measuring the Business Cycle: Approximate Band-Pass filters for Economic Time Series”](#), *Review of Economics and Statistics* 1999.
- Application: Description of time series data
  - Stock and Watson, “Business Cycle Fluctuations in US Macroeconomic Time Series”, in: Taylor,-John-B.; Woodford, Michael, eds. *Handbook of macroeconomics*. Volume 1A. Handbooks in Economics, vol. 15. Amsterdam; New York and Oxford: Elsevier Science, North-Holland, 1999; 3-64, available at: <http://www.nber.org/papers/w6528>
  - Stock and Watson, [“Has the Business Cycle changed? Evidence and explanations”](#), *mimeo*
  - Burnside, Craig (1998) “Detrending and Business Cycle Facts: A Comment,” *Journal of Monetary Economics*, 41, 513-532.
  - Canova, Fabio (1998a) “Detrending and Business Cycle Facts,” *Journal of Monetary Economics*, 41, 475-512.

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<sup>1</sup> Hayashi is not among the requested book available at the Duke University Store, as it is a required reference for the first year PhD sequence in Econometrics

- Goal: Learn how to estimate Business Cycles, interpret data, learn about Great Moderation phenomenon
- Handouts: <http://econ.duke.edu/~brossi/econ327handout1.pdf>  
<http://econ.duke.edu/~brossi/econ327handout2.pdf>

## - 2. Vector Autoregressions

- Econometric theory: Estimation and inference, Identification and interpretation of Impulse response functions and variance decomposition
  - Chp 6 Hayashi, Hamilton
  - Watson, [\*Vector Autoregressions\*](#), *Handbook of Econometrics* Volume 4, Elsevier
  - L. Kilian (1998), [\*Small Sample Confidence Intervals for IRFs\*](#), *Review of Economics and Statistics*
  - Pesavento and Rossi (2006), [\*Impulse Response Confidence Intervals for Persistent Data: What Have We Learned?\*](#), *Journal of Economic Dynamics and Control*
- Economic applications: monetary policy analysis and productivity shocks
  - Christiano, Eichenbaum and Evans, [\*Monetary Policy Shocks: What Have We Learned and to What End?\*](#) in: Taylor, John B.; Woodford, Michael, eds. *Handbook of macroeconomics*. Volume 1A. Handbooks in Economics, vol. 15. Amsterdam; New York and Oxford: Elsevier Science, North-Holland, 1999; 65-148
  - J. Fernandez-Villaverde, J. Rubio-Ramirez, T. Sargent, [\*A, B, C's \(and D\)'s For Understanding VARs\*](#), *American Economic Review*
  - L. Christiano, M. Eichenbaum, Robert Vigfusson, [\*Assessing Structural VARs\*](#)
  - Chari, Kehoe, McGrattan, [\*A critique of structural VARs using business cycle theory\*](#)
  - Christiano, Eichenbaum, Evans, [\*Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy\*](#), *Journal of Political Economy*. February 2005; 113(1): 1-45
  - Hall, Inoue, Nason and Rossi, Optimal IRF matching estimation, *mimeo*
  - Kilian, L., “Structural Vector Autoregressions”, forthcoming in *Handbook of Research Methods and Applications on Empirical Macroeconomics*.
- Goal: Estimate VARs and Impulse Responses, IRF confidence bands, estimate structural VARs. Learn about IRF matching estimation techniques.
- Handouts: <http://econ.duke.edu/~brossi/econ327handout3.pdf>  
<http://econ.duke.edu/~brossi/econ327handout4.pdf>  
<http://econ.duke.edu/~brossi/econ327handout5.pdf>

## - 3. Modeling and inference in persistent time series

- Econometric theory: Univariate tests for unit roots

- chp. 9 H,
- Stock, J.H. (1994) "[Unit Roots, Structural Breaks and Trends](#)", in Engle, R. and D. McFadden, *Handbook of Econometrics*, Vol. 4.
- Elliott, Rothemberg, and Stock (1996), Efficient Tests for Unit Roots, *Econometrica*
- Stock, J.H. (1991), "[Confidence intervals for the largest autoregressive root in U.S. macroeconomic time series](#)"
- Ng and Perron (2001), "Lag length selection and the construction of unit root tests with good size and power", *Econometrica*
- o Economic applications: Does PPP hold?
  - Rossi, B. (2005), "[Confidence intervals for half-life deviations from PPP](#)", *Journal of Business and Economic Statistics*
- o Goal: Learn to test for unit roots and construct confidence intervals for the largest root, understand the PPP debate
- o Econometric theory: Multivariate tests for unit roots and cointegration
  - chp. 10 H
  - Watson, M. (1994), "Vector Autoregressions and Cointegration", in: Engle, Robert F.; McFadden, Daniel L., eds. *Handbook of econometrics*. Volume 4.. Handbooks in Economics, vol. 2. Amsterdam; London and New York: Elsevier, North-Holland; 2843-2915
- o Economic applications: Is the technology driven real business cycle model dead? Continuing the debate...
  - Galí, J. (1999). "Technology, Employment, and the Business Cycle: Do Technology Shocks Explain Aggregate Fluctuations?" *American Economic Review*. Available at: <http://www.econ.upf.edu/crei/people/gali/publications.html>
  - Galí J. and P. Rabanal (2005), Technology Shocks and Aggregate Fluctuations: How Well Does the RBC Model Fit Post-War US Data?, *NBER Macroeconomics Annual*
  - Francis, Neville and Valerie Ramey (2003). "Is the technology-driven real business cycle model dead? Shocks and aggregate fluctuations revisited." *Journal of Monetary Economics*
  - [Christiano Eichenbaum and Vigfusson, "What Happens After A Technology Shock?"](#), mimeo
  - Rossi and Pesavento (2005)," [Do technology shocks drive hours up or down? A little evidence from an agnostic procedure](#)", *Macroeconomic Dynamics 2005*
  - King, Plosser, Stock and Watson (1991), Stochastic Trends and Economic Fluctuations, *The American Economic Review*, Vol. 81, No. 4. (Sep., 1991), pp. 819-840
- o Goal: Test for cointegration, understand the Technology Shock debate
- o Handouts: <http://econ.duke.edu/~brossi/econ327handout7.pdf>
- **4. Structural breaks and model selection with instabilities**

- Econometric theory: tests for structural breaks
  - Andrews, D.W.K. (1993), "Tests for Parameter Instability and Structural Change with Unknown Change Point", *Econometrica* 61, 821-856.
  - Bai, Jushan; Perron, Pierre (1998), Estimating and Testing Linear Models with Multiple Structural Changes, *Econometrica*; 66(1): 47-78
  - Bai, Jushan (1997), Estimating Multiple Breaks One at a Time, *Econometric-Theory*; 13(3): 315-52
  - Rossi, B. (2005), Optimal tests for nested model selection in the presence of underlying parameter instability, *Econometric Theory*
  - Elliott and Muller (2006), Optimally testing general breaking processes in linear time series models, *Review of Economic Studies*
  - Giacomini and Rossi (2006), Non-nested model selection in unstable environments, *mimeo*
- Economic applications: Empirical evidence on structural breaks and their implications for an analysis of NAIRU, technology and monetary policy shocks
  - Stock and Watson (1996), [Evidence on Structural Instability in Macroeconomic Time Series Relations](#), *Journal of Business and Economic-Statistics*. January 1996; 14(1): 11-30
  - Estrella, A. and G. A. Hardouvelis (1991), "[The Term Structure as a Predictor of Real Economic Activity](#)", *The Journal of Finance* 46(2), 555-576.
  - J. Fernald (2004), "[Trend Breaks, Long Run Restrictions, and the Contractionary Effects of Technology Shocks](#)", *Journal of Monetary Economics*
  - Clarida, R., J. Gali and M. Gertler (2000), "[Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory](#)", *Quarterly Journal of Economics*, pp. 147-180.
  - Staiger, D., J. H. Stock, and M. W. Watson (1997), "[The NAIRU, Unemployment and Monetary Policy](#)", *Journal of Economic Perspectives* 11, p. 33-51.
- Goal: Learn how to test for structural breaks, understand the stability of monetary policy reaction function debate
- Handouts: <http://econ.duke.edu/~brossi/econ327handout6.pdf>

## - 5. Forecasting

- Econometric theory: tests for equal and absolute predictive ability, forecast densities
  - West, K. (2006), "Forecast Evaluation", *Handbook of Economic Forecasting* Vol. 1, Elsevier.
  - Clark and McCracken, "Advances in Forecast Evaluation", *Handbook of Economic Forecasting* Vol. 2, forthcoming.
  - Rossi, B. (2011), "Advances in Forecasting under Model Instabilities", *Handbook of Economic Forecasting* Vol. 2, forthcoming.

- West, K. (1996), "[Asymptotic Inference about Predictive Ability](#)", *Econometrica* 64(5), 1067-1084.
  - Diebold, F and J. Lopez (1006), "Forecast Evaluation and Combination," in G.S. Maddala and C.R. Rao (eds.), *Handbook of Statistics*, 241-268, Amsterdam: North-Holland. With J. Lopez.
  - Corradi, V. and N. Swanson (2001), "Predictive Density Evaluation", *Handbook of Economic Forecasting* Vol. 1, Elsevier
  - Giacomini, R. and B. Rossi (2010), "[Forecast Comparisons in Unstable Environments](#)", *Journal of Applied Econometrics* 25(4), April 2010, 595-620.
  - A. Timmermann (2005), "[Forecast Combinations](#)", *Handbook of Forecasting Vol. 1*
  - G. Elliott (2005), "[Forecasting with trending variables](#)", *Handbook of Forecasting Vol. 1*
  - H. White (2005), "[Forecasting with Nonlinear Models](#)", *Handbook of Forecasting Vol. 1*
- o Economic applications: forecasting inflation and GDP growth by using the term structure
    - Giacomini R. and B. Rossi (2005), "[How stable is the forecasting performance of the yield curve for output growth?](#)", *Oxford Bulletin of Economics and Statistics* 68(s1), December 2006, 783-795
    - Rossi, B and T Sekhposyan (2010), "[Have Models' Forecasting Performance Changed Over Time, and When?](#)", *International Journal of Forecasting* 26(4).
    - Giacomini R. and B. Rossi (2011), "Forecasting in Macroeconomics, forthcoming in: *Handbook of Research Methods and Applications on Empirical Macroeconomics*.
    - Clark, T. and M. McCracken (2005), "The Power of Tests of Predictive Ability in the Presence of Structural Breaks", *Journal of Econometrics*. January; 124(1): 1-31
    - Stock and Watson (2002), "Macroeconomic Forecasting Using Diffusion Indexes", *Journal of Business and Economic Statistics*. 20(2): 147-62
  - o Goal: Learn how to make and evaluate forecasts
  - o Handouts: <http://econ.duke.edu/~brossi/econ327handout8.pdf>

## - 6. Structural estimation of Macroeconomic models

- o Econometric theory: GMM estimation (with some references to MLE and Bayesian estimation)
  - Hayashi, chp. 3
  - Burnside, Craig, [Craig's notes on GMM estimation](#)
  - Canova, Fabio, *Methods for Applied Macroeconomic Research*
  - David De Jong, [Structural Macroeconometrics](#)
- o Economic applications

- Burnside, Eichenbaum and Rebelo, [Labor Hoarding and the Business Cycle](#), *Journal of Political Economy* 101(2), 1993, 245-73.
  - Nason and Cogley, [Output Dynamics in RBC Models](#), *American Economic Review* 1995
  - M. Del Negro, F. Schorfheide, F. Smets, R. Wouters (2005), [On the Fit and Forecasting Performance of New-Keynesian Models](#)
  - o Goal: Learn how to estimate structural macro models and understand the lack of propagation debate in the 1990s
- **7. Time series models with latent variables** (if time permits)
- o Econometric theory: Linear models, the Kalman Filter, and Regime Switching models
    - Hamilton
    - Muller and Petalas, Efficient estimation of the parameter path in unstable time series models, *Review of Economic Studies*
    - Kim and Nelson, State space models with regime switching, MIT press
  - o Economic applications: Leading indicators
    - Marcellino, "Leading Indicators", *Handbook of Forecasting* Vol. I, Elsevier
    - Stock and Watson, New Indexes of Coincident and Leading Economic Indicators, in: Blanchard, Olivier Jean; Fischer, Stanley, eds. *NBER macroeconomics annual*: 1989. Cambridge, Mass. and London: MIT Press 1989; 351-94
  - o Goal: Learn how to estimate unobserved components models and regime switching and learn about the literature on Leading Indicators