Rome Economics Doctorate
Macroeconometrics (18 hours)
Syllabus, Spring 2026

Instructor: Alessandro Casini
Email: alessandro.casini@uniroma2.it
Office Hour: by appointment

Objectives: The aim of the course is to cover a wide range of time series econometrics techniques that have proved to be useful in applied macroeconomics and finance and to ensure that the student acquires knowledge of the relevant concepts necessary to be able to understand the empirical and theoretical econometric literature in the leading journals. We introduce the notion of causality and identification problems in dynamic time series models used in macroeconomics and finance and we study popular identification strategies employed in empirical work. We review the standard theory of stationary stochastic processes. Time series models to be studied include simultaneous stochastic equations, (structural) vector autoregressions, local projections, unit roots cointegration, and structural breaks models. We discuss the estimation of heterogeneous agent models. In order to understand nonstationary models we study some basic concepts for continuous time processes to introduce the Wiener process and the functional central limit theorem.

Prerequisites: First-year PhD Econometric course, or equivalent.

Grading: Problem sets will account for 40% of the final grade. There will be an empirical project or replication exercise that accounts for 60% of the final grade.

Textbooks and Notes: There is no required textbook for the course. Lecture slides will be provided. Attached to this syllabus is a list of optional readings that are useful for a deeper understanding of the material in the first half of the course. Some students might find it useful to have a textbook as an additional reference. Good reference books include:

1. Brockwell, P. J., and Davis, R. A. (1991). Time Series: Theory and Methods. 2nd edition, Springer. (Beautiful mathematical treatment of the classic theory of covariance stationary time series, but not aimed at economists.)

2. Davidson, J. (1994). Stochastic Limit Theory. Oxford University Press. (Thorough, technical treatment of stochastic limit theory for dependent data.)

3. Hamilton, J. D. (1994). Time Series Analysis. Princeton University Press. (Comprehensive reference for time series econometrics methods developed before the mid-1990s.)

4. Kilian, L., and Lütkepohl, H. (2017). Structural Vector Autoregressive Analysis. Cambridge University Press. (Recent reference on SVAR methods.)

Course Outline: The following outline is preliminary:

1. Causality and identification in macroeconomics and finance.
   (a) Dynamic causal effects.
   (b) Causal inference in dynamic time series models.
   (c) Exogenous versus endogenous variation.
   (d) Strong versus weak identification
2. Review of stationary models.
   (a) Strict/covariance stationarity, projection.
   (b) Lag operators, linear filters, VARMA.
   (c) Wold decomposition.
   (d) Likelihood factorization, maximum likelihood estimation.
   (e) Bayesian VARs.
   (f) Model selection.
3. Causal identification in macroeconomics.
   (a) SVMA, SVAR, relationship with structural models.
   (b) Invertibility, recoverability.
   (c) Identification through exclusion restrictions.
   (d) Local Projection versus VAR estimation of impulse responses.
   (e) Identification using instruments/proxies, SVAR-IV, LP-IV.
   (f) Partial identification through sign/magnitude restrictions.
   (g) Identification through non-Gaussianity/heteroskedasticity.
   (h) High-frequency identification and event-studies.
   (i) Nonlinear models.
4. Estimation of heterogeneous agent models.
   (a) Challenges when combining micro and macro data.
   (b) Moment matching.
   (c) Likelihood inference.
5. Inference with weakly dependent data.
   (a) Central Limit Theorem, martingale difference sequences, mixing.

   (b) Applications to GMM, moment matching.

   (c) Bootstrap.

   (d) Weak identification (time permitting).

6. Functional Central Limit Theorem.

   (a) Testing and estimation of structural breaks.

7. Non-stationary models.

   (a) I(1) processes, Beveridge-Nelson decomposition, VARIMA.

   (b) Spurious regression.

   (c) Bayesian vs. frequentist perspective.

   (d) Frequentist asymptotics for unit roots, local-to-unity.

   (e) Cointegration, VECM.

   (f) Detrending.

   (g) Long-run inference (time permitting).

Optional Reading List

Introductory readings are listed first and marked with a star (*). Other readings are included for your reference. Original contributions are not always cited when good survey references are available. The reading list is preliminary and may change without warning.

Causal identification in macroeconomics

Casual inference in dynamic time series setting

Angrist, J. D., O. Jordà, and G. M. Kuersteiner (2018): "Semiparametric Estimates of Monetary Policy Effects: String Theory Revisited," *Journal of Business and Economic Statistics*, 36(3), 371–387.

Angrist, J. D., and G. M. Kuersteiner (2011): "Causal Effects of Monetary Shocks: Semiparametric Conditional Independence Tests with a Multinomial Propensity Score," *Review of Economics and Statistics*, 93(3), 725–747.

Bojinov, I., A. Rambachan, and N. Shephard (2021): "Panel Experiments and Dynamic Causal Effects: A Finite Population Perspective," *Quantitative Economics*, 12(4), 1171–1196.

Bojinov, I., and N. Shephard (2019): "Time Series Experiments and Causal Estimands: Exact Randomization Tests and Trading," *Journal of the American Statistical Association: Theory and Methods*, 114(528), 1665–1682.

(*) Casini, A. and A. McCloskey (2024): "Identification, Estimation and Inference of in High-Frequency Event Studies," arXiv preprint arXiv:2406.15667.

(*) Kolesár, M. and M. Plagborg-Møller (2025): "Dynamic Causal Effects in a Nonlinear World: the Good, the Bad, and the Ugly," *Journal of Business and Economic Statistics*, forthcoming.

(*) Rambachan, A., and N. Shephard (2021): "When Do Common Time Series Estimands Have Nonparametric Causal Meaning?," Review of Economic Studies, forthcoming.

White, H. (2006): "Time-Series Estimation of the Effects of Natural Experiments," *Journal of Econometrics*, 135(1-2), 527–566.

Applications

Berger, D., I. Dew-Becker, and S. Giglio (2019): "Uncertainty Shocks as SecondMoment News Shocks," *The Review of Economic Studies*, 87(1), 40–76.

Bauer, M. D. and E. T. Swanson (2022): "A Reassessment of Monetary Policy Surprises and High-Frequency Identification," *NBER Macroeconomics Annual*, volume 37.

Kanzig, D. (2021): "The Macroeconomic Effects of Oil Supply News: Evidence from OPEC Announcements," *American Economic Review*, 111(4), 1092–1125).

Kanzig, D. R. (2022): "The Unequal Economic Consequences of Carbon Pricing," Unpublished Manuscript, London Business School.

Piffer, M. and M. Podstawski (2018): "Identifying Uncertainty Shocks Using the Price of Gold," *Economic Journal*, 128, 3266–3284.

Swanson, E. T. (2021): "Measuring the Effects of Federal Reserve Forward Guidance and Asset Purchases on Financial Markets," *Journal of Monetary Economics*, 118, 32–53.

Exclusion restrictions, instruments/proxies

(*) Stock, J. H., and M. W. Watson (2018). "Identification and Estimation of Dynamic Causal Effects in Macroeconomics Using External Instruments." *Economic Journal* 128(610), 917–948.

Kilian and Lütkepohl: chapters 4, 7–12, 15.

Barnichon, R., and C. Brownlees, C. (2019). "Impulse Response Estimation By Smooth Local Projections," *Review of Economics and Statistics* 101(3), 522–530.

Blanchard, O., and D. Quah (1989). "The Dynamic Effects of Aggregate Demand and Supply Disturbances," *American Economic Review* 79(4), 655–673.

Jordà, O. (2005). "Estimation and Inference of Impulse Responses by Local Projections," *American Economic Review* 95(1), 161–182.

Li, D., M. Plagborg-Møller and C. K. Wolf(2023). "Local Projections vs. VARs: Lessons From Thousands of DGPs," *Journal of Econometrics*, 244(2), 105722.

McKay, A., and Wolf, C. K. (2023). "What Can Time Series Regressions Tell Us About Policy Counterfactuals?" *Econometrica* 91(5), 1695–1725

Montiel Olea, J. L., J. H. Stock and M. W. Watson (2021). "Inference in SVARs Identified with External Instruments," *Journal of Econometrics* 225(1), 74–87.

Plagborg-Møller, M. (2019). "Bayesian Inference on Structural Impulse Response Functions," *Quantitative Economics* 10(1), 145–184.

Plagborg-Møller, M., and C. K. Wolf (2021). "Local Projections and VARs Estimate the Same Impulse Responses." *Econometrica* 89(2), 955–980.

Rubio-Ramírez, J. F., D. F. Waggoner and T. Zha (2010). "Structural vector autoregressions: Theory of identification and algorithms for inference," *Review of Economic Studies* 77(2), 665–696.

Sims, C. A. (1980). "Macroeconomics and Reality," *Econometrica* 48(1), 1–48.

Uhlig, H. (2005). "What are the effects of monetary policy on output? Results from an agnostic identification procedure," *Journal of Monetary Economics* 52(2), 381–419.

Invertibility, recoverability

Chahrour, R., and Jurado, K. (2021). "Recoverability and Expectations-Driven Fluctuations," *Review of Economic Studies* 89(1), 214–239.

Fernández-Villaverde, J., J. F. Rubio-Ramírez, T. J. Sargent and M. W. Watson (2007). "ABCs (and Ds) of Understanding VARs," *American Economic Review* 97(3), 1021–1026.

Forni, M., L. Gambetti, and L. Sala (2019). "Structural VARs and noninvertible macroeconomic models," *Journal of Applied Econometrics* 34(2), 221–246.

Lippi, M., and L. Reichlin (1994). "VAR analysis, nonfundamental representations, Blaschke matrices," *Journal of Econometrics* 63(1), 307–325.

Plagborg-Møller, M., and C. K. Wolf (2022). "Instrumental Variable Identification of Dynamic Variance Decompositions." *Journal of Political Economy* 130(8), 2164–2202.

Sign/magnitude restrictions

(*) Baumeister, C., and J. D. Hamilton (2015). "Sign Restrictions, Structural Vector Autoregressions, and Useful Prior Information," *Econometrica* 83(5), 1963–1999.

Gafarov, B., M. Meier, and J. L. Montiel Olea (2018). "Delta-Method Inference for a Class of Set-Identified SVARs," *Journal of Econometrics* 203(2), 316–327.

Giacomini, R., and Kitagawa, T. (2021). "Robust Bayesian Inference for Set-Identified Models," *Econometrica* 89(4), 1519–1556.

Wolf, C. K. (2020). "SVAR (Mis)Identification and the Real Effects of Monetary Policy," *American Economic Journal: Macroeconomics* 12(4), 1–32.

Identification through non-Gaussianity/heteroskedasticity

Angelini, G., E. Bacchiocchi, G. Caggiano, and L. Fanelli (2018): "Uncertainty Across Volatility Regimes," *Journal of Applied Econometrics* 34(3), 437–455.

Bacchiocchi, E., E. Castelnuovo, and L. Fanelli (2018): "Give me a Break! Identification and Estimation of the Macroeconomics Effects of Monetary Policy Shocks in the U.S." *Journal of Macroeconomics*, 22(6), 1613–1651.

Carriero, A., T. E. Clark, and M. Marcellino (2019): "Using time-varying volatility for identification in Vector Autoregressions: An application to endogenous uncertainty" *Journal of Econometrics* 225 (1), 47-73

Montiel Olea, J. L., M. Plagborg-Møller and , E. Qian (2022): "SVAR Identification From Higher Moments: Has the Simultaneous Causality Problem Been Solved?" *AEA Papers and Proceedings* 112, 481–485.

Kilian and Lütkepohl: chapter 14.

Gouriéroux, C., A. Monfort and J.-P. Renne (2017): "Statistical inference for independent component analysis: Application to structural VAR models," *Journal of Econometrics* 196(1), 111–126.

Gouriéroux, C., A. Monfort and J.-P. Renne (2020): "Identification and Estimation in Non-Fundamental Structural VARMA Models," *Review of Economic Studies* 87(4), 1915–1953.

Lanne, M., and H. Lutkepohl (2008): "Identifying Monetary Policy Shocks via Changes in Volatility," *Journal of Money, Credit and Banking* 40(6), 1131–1149.

Lewis, D. J. (2021): "Identifying Shocks via Time-Varying Volatility," *Review of Economics Studies*, 88(6), 3086–3124.

Lutkepohl, H., and T. Schlaak (2018): "Choosing Between Different Time-Varying Volatility Models for Structural Vector Autoregressive Analysis," *Oxford Bulletin of Economics and Statistics*, 80(4), 715–735.

(*) Rigobon, R. (2003): "Identification Through Heteroskedasticity," *Review of Economics and Statistics* 85(4), 777–792.

Primiceri, G. E. (2005): "Time Varying Structural Vector Autoregressions," *Review of Economic Studies*, 72(3), 821–852.

Sims, C. A., and T. Zha (2006): "Were There Regime Switches in U.S. Monetary Policy?" *American Economic Review*, 96(1), 54–81.

Nonlinear models

Angrist, J. D., O. Jordà, G. M. Kuersteiner (2018): "Semiparametric Estimates of Monetary Policy Effects: String Theory Revisited," *Journal of Business and Economic Statistics* 36(3), 371–387.

Angrist, J. D., and J.-S. Pischke (2009): "Mostly Harmless Econometrics," Princeton University Press. Chapter 3.

Casini, A. and A. McCloskey (2024): "Identification and Estimation of Causal Effects in High-Frequency Event Studies," arXiv preprint arXiv:2406.15667.

Gallant, A. R., P. E. Rossi, and G. Tauchen (1993): "Nonlinear dynamic structures," *Econometrica* 61(4), 871–907.

Gonçalves, S., A. M. Herrera, L. Kilian, and E. Pesavento (2023): "State-dependent local projections," Jounrnal of Econometrics, 244(2) 105702.

Koop, G., M. H. Pesaran and S. M. Potter (1996): "Impulse response analysis in nonlinear multivariate models." Journal of Econometrics 74(1), 119–147.

Rambachan, A., and N. Shephard (2021): "When Do Common Time Series Estimands Have Nonparametric Causal Meaning?," Unpublished Manuscript, Department of Economics, Harvard University.

Applications

* Ramey, V. A. (2016): "Macroeconomic Shocks and Their Propagation." In *Handbook of Macroeconomics*, Volume 2A, edited by Taylor, J. B., and Uhlig, H., Elsevier, chapter 2, 71–162.

Forni, M., L. Gambetti, M. Lippi and L. Sala (2017): "Noisy News in Business Cycles." *American Economic Journal: Macroeconomics* 9(4), 122–152.

Gertler, M., and P. Karadi (2015): "Monetary Policy Surprises, Credit Costs, and Economic Activity." *American Economic Journal: Macroeconomics* 7(1), 44–76.

Mertens, K., and M. O. Ravn (2010): "Measuring the Impact of Fiscal Policy in the Face of Anticipation: A Structural VAR Approach." *Economic Journal* 120(544), 393–413.

Mertens, K., and M. O. Ravn (2013): "The Dynamic Effects of Personal and Corporate Income Tax Changes in the United States." *American Economic Review* 103(4), 1212–1247.

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.

Identification of monetary policy and high-frequency identification

Inoue A., and B. Rossi (2019): "The Effects of Conventional and Unconventional Monetary Policy: A New Approach," Journal of International Economics 118, 419–447.

Winkelmann, L., M. Bibinger and T. Linzert (2015): "ECB Monetary Policy Surprises: Identification Through Cojumps in Interest Rates," *Journal of Applied Econometrics*.

(*) Nakamura, E. and J. Steinsson (2018): "High Frequency Identification of Monetary Non-Neutrality: The Information Effect," *Quarterly Journal of Economics*, 133, 1283– 1330.

Bianchi F., T. Kind, H. Kung (2020): "Threats to Central Bank Independence: High-Frequency Identification with Twitter," Journal of Monetary Economics, 135, 37-54.

Lewis D., (2019): "Announcement-Specific Decompositions of Unconventional Monetary Policy Shocks and Their Macroeconomic Effects," Review of Economics and Statistics, forthcoming.

High-Frequency Event studies

Cochrane, J. H. and M. Piazzesi (2002): "The Fed and Interest Rates - A High-Frequency Identification," *American Economic Review* 92, 90–95.

Bugni, F. A. and J. Li (2020): "Permutation-based Tests for Discontinuities in Event Studies," Quantitative Economics 14 (2023), 37–70.

Casini, A. and A. McCloskey (2024): "Identification, Estimation and Inference of in High-Frequency Event Studies," arXiv preprint arXiv:2406.15667.

(*) Nakamura, E. and J. Steinsson (2018): "Identification in Macroeconomics," *Journal of Economic Perspectives*, 32, 59–86.

Stationary models

Models, prediction, estimation

(*) Hayashi: chapters 6.16.4.

(*) Kilian and Lütkepohl: chapters 2.1–2.5.

Brockwell and Davis: chapters 1.1–1.5, 2.1–2.9, 3.1–3.5, 5.1–5.5, 5.7, 11.1–11.4.

Hamilton: chapters 2–4, 10–12.

Herbst and Schorfheide: chapters 3.1–3.2.

Kilian and Lütkepohl: chapters 2, 5.

Giannone, D., M. Lenza and G. E. Primiceri (2015): "Prior Selection for Vector Autoregressions." *Review of Economics and Statistics* 97(2), 436–451.

Model selection

(*) Kilian and Lütkepohl: chapter 2.6.

Brockwell and Davis: chapter 9.

Claeskens, G., and N. L. Hjort (2008): Model Selection and Model Averaging. Cambridge University Press. Chapters 1–4.

Geweke, J., and R. Meese (1981): "Estimating regression models of finite but unknown order," *International Economic Review* 22(1), 55–70.

Hansen, B. E. (2005): "Challenges for Econometric Model Selection," *Econometric Theory* 21(1), 60–68.

Leeb, H., and B. M. Pötscher (2005): "Model Selection and Inference: Facts and Fiction." *Econometric Theory* 21(01), 21–59. Sections 1–2.

Applications

(*) Stock, J. H., and M. W. Watson (2017): "Twenty Years of Time Series Econometrics in Ten Pictures," *Journal of Economic Perspectives* 31(2), 59–86.

Bernanke, B. S., and , K. N. Kuttner (2005): "What Explains the Stock Market's Reaction to Federal Reserve Policy?" *Journal of Finance* 60(3), 1221–1257.

Sims, C. A. (1972): "Money, Income, and Causality," *American Economic Review* 62(4), 540–552.

Stock, J. H., and M. W. Watson (2003): "Forecasting Output and Inflation: The Role of Asset Prices," *Journal of Economic Literature* 41(3), 788–829.

Estimating heterogeneous agent models

(*) Winberry, T. (2018). "A Method for Solving and Estimating Heterogeneous Agent Macro Models," *Quantitative Economics* 9(3), 1123–1151.

Ahn, S., G. Kaplan, B. Moll, T. Winberry, and C. K. Wolf, (2017): "When Inequality Matters for Macro and Macro Matters for Inequality," *NBER Macroeconomics Annual* 2017, edited by Eichenbaum, M., and Parker, J. A., chapter 1, 1–75.

Auclert, A., B. Bardóczy, M. Rognline, and L. Straub, L. (2021). "Using the SequenceSpace Jacobian to Solve and Estimate Heterogeneous-Agent Models," *Econometrica* 89(5), 2375–2408.

Chang, M., X. Chen, and F. Schorfheide (2023): "Heterogeneity and Aggregate Fluctuations," Manuscript, University of Pennsylvania.

Cocci, M. D., and M. Plagborg-Møller (2024): "Standard Errors for Calibrated Parameters," The Review of Economic Studies, forthcoming.

Hahn, J., G. Kuersteiner, and M. Mazzocco (2020). "Estimation with Aggregate Shocks," Review of Economic Studies 87(3), 1365–1398.

Liu, L., and M. Plagborg-Møller (2023): "Full-Information Estimation of Heterogeneous Agent Models Using Macro and Micro Data," *Quantitative Economics* 14(1), 2023, 1–35.

Spectral analysis

Representation theory and inference

(*) Hamilton: chapter 6.

Brockwell and Davis: chapters 4, 10.1–10.5, 11.6.

Berk, N. (1974): "Consistent Autoregressive Spectral Estimates," *Annals of Statistics* 2(3), 489–502.

Hannan, E. J. (1970): Multiple Time Series. John Wiley and Sons. Chapters III.2–3, III.5. Applications

Dew-Becker, I., and S. Giglio (2016): "Asset Pricing in the Frequency Domain: Theory and Empirics," *Review of Financial Studies* 29(8), 2029–2068.

King, R. G., and M. W. Watson (1996): "Money, Prices, Interest Rates and the Business Cycle," *Review of Economics and Statistics* 78(1), 35–53.

Qu, Z., and D. Tkachenko (2012): "Frequency Domain Analysis of Medium Scale DSGE Models with Application to Smets and Wouters (2007)," In Advances in Econometrics, Volume 28: DSGE Models in Macroeconomics – Estimation, Evaluation and New Developments, edited by Balke, N., Canova, F., Milani, F., and Wynne, M. A., Emerald Group Publishing, 319–385.

Sala, L. (2015): "DSGE Models in the Frequency Domain," *Journal of Applied Econometrics* 30(2), 219–240.

Sargent, T. J., and P. Surico (2011): "Two Illustrations of the Quantity Theory of Money: Breakdowns and Revivals," *American Economic Review* 101(1), 109–128.

Watson, M. W. (1993): "Measures of Fit for Calibrated Models," *Journal of Political Economy* 101(6), 1011–1041.

Inference with weakly dependent data

Theory

(*) Hayashi: chapters 2, 6.5–6.6.

Brockwell and Davis: chapters 6–7.

Davidson: chapters 13–14, 24.

Hamilton: chapter 7.

GMM, moment matching

(*) Hayashi: chapters 7.1–7.4.

Hansen, L. P., J. Heaton and A. Yaron (1996): "Finite-Sample Properties of Some Alternative GMM Estimators," *Journal of Business and Economic Statistics* 14(3), 262–280.

Hansen, L. P., and J. J. Heckman (1996): "The empirical foundations of calibration," *Journal of Economic Perspectives* 10(1), 87–104.

Hansen, L. P., and K. Singleton (1991): "Computing Semiparametric Efficiency Bounds for Linear Time Series Models," In Nonparametric and semiparametric methods in econometrics and

statistics: Proceedings of the Fifth International Symposium in Economic Theory and Econometrics, edited by Barnett, W. A., Powell, J., and Tauchen, G. E., Cambridge University Press, chapter 15, 388–411.

Kydland, F., and E. Prescott (1996). "The Computational Experiment: an Econometric Tool." *Journal of Economic Perspectives* 10(1), 69–85.

Nakamura, E., and J. Steinsson (2018). "Identification in Macroeconomics," *Journal of Economic Perspectives* 32(3), 59–86.

Newey, W. K., and D. L. McFadden (1994). "Large sample estimation and hypothesis testing." In Handbook of Econometrics, Volume IV, edited by Engle, R. F., and

McFadden, D. L., Elsevier, chapter 36, 2111–2245.

Bootstrap

(*) Kilian and Lütkepohl: chapters 12.1–12.5.

Brüggemann, R., C. Jentsch and C. Trenkler (2016): "Inference in VARs with Conditional Heteroskedasticity of Unknown Form," *Journal of Econometrics* 191(1), 69–85.

Gonçalves, S., and L. Kilian (2004): "Bootstrapping Autoregressions with Conditional Heteroskedasticity of Unknown Form," *Journal of Econometrics* 123(1), 89–120.

Horowitz, J. L. (2001): "The Bootstrap." In Handbook of Econometrics, Volume 5, edited by Heckman, J. J., and Leamer, E., Elsevier, chapter 52, 3159–3228.

Kilian, L. (1998): "Small-sample Confidence Intervals for Impulse Response Functions," *Review of Economics and Statistics* 80(2), 218–230.

Weak identification

(*) Andrews, I., J. H. Stock and L. Sun (2019): "Weak Instruments in Instrumental Variables Regression: Theory and Practice," *Annual Review of Economics* 11(1), 727–753.

Kleibergen, F., and S. Mavroeidis (2009): "Weak Instrument Robust Tests in GMM and the New Keynesian Phillips Curve," *Journal of Business and Economic Statistics* 27(3), 293–339. With comments and rejoinder.

Applications

Christiano, L., M. Eichenbaum and C. Evans (2005). "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy." *Journal of Political Economy* 113(1), 1–45.

Hansen, L. P., and K. J. Singleton (1982). "Generalized Instrumental Variable Estimation of Nonlinear Rational Expectation Models," *Econometrica* 50(5), 1269–1286.

Mankiw, N. G., Reis, R., and Wolfers, J. (2004). "Disagreement about Inflation Expectations," In NBER Macroeconomics Annual 2003, Volume 18, edited by Gertler, M., and Rogoff, K., National

Bureau of Economic Research, 209–248.

Mavroeidis, S., M. Plagborg-Møller and J. H. Stock (2014): "Empirical Evidence on Inflation Expectations in the New Keynesian Phillips Curve," *Journal of Economic Literature* 52(1), 124–188.

Functional Central Limit Theorem

Abstract theory

Davidson: chapters 26–30.

Andrews, D. W. K. (1994): "Empirical process methods in econometrics." In Handbook of Econometrics, Volume IV, edited by Engle, R. F., and McFadden, D. L., Elsevier, chapter 37, 2247–2294.

Hall, P., and C. C. Heyde (1980): Martingale Limit Theory and Its Application. Academic Press. Chapter 4.

Phillips, P. C. B., and V. Solo (1992). "Asymptotics for Linear Processes," *Annals of Statistics* 20(2), 971–1001.

Structural breaks

Andrews, D. W. K., (1993): "Tests for Parameter Instability and Structural Change with Unknown Change Point," *Econometrica* 61(4), 821–856.

Andrews, D. W. K. and W. Ploberger (1994). "Optimal Tests When a Nuisance Parameter is Present Only Under the Alternative," *Econometrica* 62(6), 1383–1414.

Bai, J. (1997): "Estimation of a Change Point in Multiple Regression Models," *Review of Economics and Statistics* 79(4), 551–563.

Bai, J. (1997): "Estimating multiple breaks one at a time," *Econometric Theory* 13(3), 315–352.

Bai, J., and P. Perron (1998): "Estimating and Testing Linear Models with Multiple Structural Changes," *Econometrica* 66(1), 47–78.

Bai, J., and P. Perron (2003): "Computation and Analysis of Multiple Structural Change Models," *Journal of Applied Econometrics* 18, 1–22.

Elliott, G., and U. K. Müller (2006): "Efficient Tests for General Persistent Time Variation in Regression Coefficients," *Review of Economic Studies* 73(4), 907–940.

Elliott, G., Müller, U. K., and M. W. Watson (2015): "Nearly Optimal Tests When a Nuisance Parameter Is Present Under the Null Hypothesis," *Econometrica* 83(2),

771–811.

Müller, U. K. and P.-E. Petalas (2010): "Efficient Estimation of the Parameter Path in Unstable Time Series Models," *Review of Economic Studies* 77(4), 1508–1539.

Nyblom, J. (1989): "Testing for the Constancy of Parameters Over Time," *Journal of the American Statistical Association* 84(405), 223–230.

Stock, J. H. (1994): "Unit roots, structural breaks and trends," In Handbook of Econometrics, Volume 4, edited by Engle, R. F., and McFadden, D. L., Elsevier, chapter 46, 2739–2841. Sections 2.2 and 5.

Applications

(*) Hansen, B. E. (2001). "The New Econometrics of Structural Change: Dating Breaks in U.S. Labor Productivity," *Journal of Economic Perspectives* 15(4), 117–128.

Stock, J. H., and M. W. Watson (1996): "Evidence on Structural Instability in Macroeconomic Time Series Relations," *Journal of Business and Economic Statistics* 14(1), 11–30.

Non-stationary models

Unit roots

(*) Hayashi: chapter 9.

Hamilton: chapters 15–17.

Beveridge, S., and Nelson, C. R. (1981). "A New Approach to Decomposition of Economic Time Series into Permanent and Transitory Components with Particular Attention to Measurement of the 'Business Cycle'." *Journal of Monetary Economics* 7(2), 151–174.

Dou, L., and U. K. Müller (2021): *Econometrica* 89(4), 1825–1854.

Elliott, G., T. J. Rothenberg and J. H. Stock (1996): "Efficient Tests for an Autoregressive Unit Root," *Econometrica* 64(4), 813–836.

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