Course Structure and Standard Syllabus

Course Topic: General Macroeconomic Analysis

Course Title: Macroeconometric Forecasting and Analysis (MFA)

Objectives: This two-week course aims at providing government and related officials a rigorous foundation in the estimation of macro-econometric models and their application for forecasting and policy analysis in central banks, ministries and public research institutions. Participants will work together in groups to undertake a number of hands-on estimation and forecasting exercises.

By the end of the course participants should be able to:

- Understand the underpinnings of a number of model specifications.
- Use EViews software to apply modeling techniques to country data and replicate results from a variety of important published research papers.
- Apply the techniques learned to country cases from their region to forecast and analyze a policy issue.
- Bring applicable econometric tools, implemented in the EVIEWS econometric package, back home that can quickly be applied to their own work or research projects as well as to those of others that need to be understood or reviewed.

Topics:

1. Stationary VARs, structural VARs and their application I: short-run restrictions
2. Modeling of non-stationary variables, forecasting with VECMs
3. Structural VARs and their application II: long-run and other restrictions
4. Forecasting with VAR extensions: FAVARs
5. Conditional forecasting with VARs in small open economies
6. Estimation of and forecasting with Bayesian VARs
7. State-space models and the Kalman Filter
8. Forecast Combination
9. Univariate and multivariate models of volatility and their application
10. Final Project: application of models for policy analysis and forecasting in selected countries

Prerequisites

The course is targeted to staff economists involved in developing macro-econometric models and forecasting for the analysis, design and implementation of macroeconomic policy. Participants should have an advanced degree in economics or equivalent experience and background in econometrics. They should also be comfortable using EViews for econometric applications. The online Macroeconomic Forecasting (MF.x) course is **strongly recommended** as a prerequisite, completing it will be considered an advantage in the applicant selection process. Participants are

expected to complete the EViews component of MF.x prior to the start of the course in case they are not already experienced EViews users.

Performance Evaluation

Two multiple-choice tests will be given, one at the beginning and one at the end of the course. Performance in these tests will be recorded in participants' evaluations.

Team

Charis Christofides (lead), Adina Popescu, Christian Johnson, and Mikhail Pranovich (JVI).

Reviewers

- Internal: Sam Ouliaris, Sunil Sharma (RES).
- External: Massimiliano Marcellino (Bocconi University).

Timetable

- Lectures to be completed by end-April, 2016.
- First delivery at the JVI, May, 2016.
- China August, 2016 offering, to be based on Chinese data.
- Morocco offering, November, 2016.

Introductory Lecture: Overview of the Macroeconomic Forecasting course

Lecture 0.5 hours	L-0	**1. Structure of the Course** 2. A short introduction to the design of the course, its main elements, and objectives.

References

List of references: Not Applicable

UNIT 1: Stationary VARs, structural VARs and their application I: short-run restrictions

Lecture 1.5 hours Part1	L-1	1. Introduction in SVAR: identification problem 2. Choleski decomposition and short-run SVAR restrictions 3. Impulse responses
Workshop 1.5 hours Part2	W-1	• Evaluating effect of monetary policy shocks in "Choleski-ordered" SVARs and SVARs with the "institutionally-implied" short-run restrictions

References

- Sims, C. (1992). "Interpreting the Macroeconomic Time Series Facts: the Effects of Monetary Policy," *European Economic Review*, pp. 975-1000.
- Bernanke, B. and I. Mihov (1995). "Measuring Monetary Policy," NBER, WP/5145.
- Blanchard, O. and R. Perotti (2002), "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output," *The Quarterly Journal of Economics*, pp. 1329-68.
- Canova, F. (2007): Methods for Applied Macroeconomic Research, Princeton University Press.

UNIT 2: Modeling of non-stationary variables, forecasting with VECMs

Lecture 3 hours	L-2	1. Testing variables for integration 2. Testing for cointegration and estimating VECMs
Workshop 3 hours	W-2	• Estimating long-run macroeconomic equilibrium relationships. Forecasting with VECMs

References

- Johansen, S., 1988, "Statistical Analysis of Cointegration Vectors," *Journal of Economic Dynamics and Control*, Vol. 12, No. 2–3, pp. 231–254.
- Hamilton, J. D., 1994, "TS Analysis," Princeton University Press, Chapters 15–19, pp. 435–629.
- Martin, V. L., A. S. Hurn and D. Harris (2013), "Econometric Modeling with Time Series:

Specification, Estimation and Testing," Chapters 16–18, pp. 612–749.
- Ghysels, E., and Massimiliano Marcellino, 2015, *"Forecasting Book,"* Chapter 7.

UNIT 3: Structural VARs and their application for policy analysis II: long-run and other restrictions

Lecture 1.5 hours Part 1	L-3	1. Identifying Structural VARs using long-run restrictions 2. Other restrictions
Workshop 1.5 hours \Part 2	W-3	• The SVAR for evaluating effects of fiscal policy. Studying the effects of supply and demand shocks in the SVAR with long-run restrictions. Tri-variate SVAR with sign restrictions.

References

- Blanchard, O. and D. Quah (1989). "The Dynamic Effects of Aggregate Demand and Supply Disturbances," *American Economic Review*, pp. 655-73.
- Fry, R. and A. Pagan (2011). "Sign Restrictions in Structural Vector Autoregressions: A Critical Review," *Journal of Economic Literature*, 49, pp. 938-60.
- Ouliaris, S. *et al* (2015). "Quantitative Macroeconomic Modeling with SVARs", *Ch.6-7*.

UNIT 4: VAR extensions II: FAVARs

Lectures 3.0 hours Part1	L-4, L-5	**1. Basics of factor models** 2. Small and large scale; selection of number of factors 3. Estimation, forecasting with FAVAR **4. Extensions** 5. Unbalanced datasets; I(1) variables; nonlinearities
Workshops 3.0 hours Part2	W-4, W-5	• Estimating FAVARs on several macro-financial datasets (monthly industrial production; quarterly GDP growth; monthly inflation). Examples from both industrial and emerging economies.

References

- Bernanke, B., Boivin, J., and P. S. Eliasz, 2005, "Measuring the Effects of Monetary Policy: A Factor-augmented Vector Autoregressive (FAVAR) Approach," *The Quarterly Journal of Economics*, MIT Press, vol. 120(1), pp. 387-422.
- Stock, J. H. and M. W. Watson, 2005, "Implications of Dynamic Factor Models for VAR Analysis," *NBER Working Papers* 11467, National Bureau of Economic Research, Inc.
- Fernald, J., M. M. Spiegel, E. T. Swanson, 2014: "Monetary policy effectiveness in China: Evidence from a FAVAR model," *Journal of International Money and Finance*, Elsevier, vol. 49(PA), pages 83-103.

UNIT 5: Conditional forecasting with VARs in small open economies

Lecture 1.5 hours Part1	L-6	1. Conditional forecasting using VARs 2. Incorporating external forecasts and scenario analysis
Workshop 1.5 hours Part2	W-6	• Conditional forecasting and scenario analysis with a VAR model for a small open economy

References

- Waggoner D.F., and T. Zha, 1999, "Conditional forecasts in dynamic multivariate models," *The Review of Economics and Statistics*, 81:4, pp. 639-651.

UNIT 6: Estimation of and forecasting with Bayesian VARs

Lecture 3 hours Part1	L-7	1. Introduction to Bayesian econometrics, estimation of linear regression models 2. Activity: exercise on Bayesian estimation of moments of normal distribution 3. Estimating BVARs with analytical Minnesota and DSGE-VAR priors 4. Review of empirical results on BVARs forecasting performance
Workshop 3 hours Part2	W-7	• Estimating BVARs with Minnesota, Normal-Wishart priors and DSGE-VAR priors. Forecasting macroeconomic variables with BVARs

References

- Andrea Carriero, A., T. Clark and M. Marcellino, 2011, "Bayesian VARs: specification choices and forecast accuracy," *Journal of Applied Econometrics*, 30: pp46–73.
- Litterman, R. B., 1986, "Forecasting with Bayesian Vector Autoregressions—Five Years of Experience," *Journal of Business & Economic Statistics*, 4, 1, pp. 25–38.
- Del Negro, M., and F. Schorfheide, 2004, "Priors from General Equilibrium Models for VARs," *International Economic Review*, 45, 2, pp. 643–73.
- Del Negro, M., and F. Schorfheide, 2007, "Bayesian Macroeconometrics," prepared for the Handbook of Bayesian Econometrics.
- Giannone, D., Lenza, M. and G. Primiceri, 2015, "Prior Selection for Vector Autoregressions," *The Review of Economics and Statistics*, 97(2), pp. 436-451.

UNIT 7: State-Space Models and the Kalman Filter

Lecture 3 hours Part1	L-8	1. State-space representation 2. The Kalman filter 3. Maximum likelihood estimation and Kalman smoothing
Workshop 3 hours Part2	W-8	• Application of state-space models: estimating business condition index, forecasting the yield curve, estimating equilibrium interest rate • Output gap estimation (e.g., HP filter, multivariate filter)

References

- Aruoba, S.B., Diebold, F.X. and C. Scotti, 2009, "Real-Time Measurement of Business Conditions," *Journal of Business and Economic Statistics*, 27:4, pp. 417–27.
- Diebold, F. X. and C. Li, 2006, "Forecasting the Term Structure of Government Bond Yields," *Journal of Econometrics*, 130, pp. 337–364.
- Laubach, T., and J. C. Williams, 2003, "Measuring the Natural Rate of Interest," *Review of Economics and Statistics*, vol. 85, no. 4, pp. 1063–1070.
- Ghysels, E., and Massimiliano Marcellino, 2015, *"Forecasting Book,"* Chapter 12.

UNIT 8: Forecast Combination

Lecture 1.5 hours Part1	L-9	1. Motivation for combining forecasts 2. Implementation issues 3. Methods to assign weights
Workshop 1.5 hours Part2	W-9	• Application of combination techniques to forecasting of macroeconomic variables

References

- Clemen, R., 1985, "Combining Forecasts: A Review and Annotated Bibliography," *International Journal of Forecasting*, Vol. 5, No. 4, pp. 559–583.
- Stock, J., and M. Watson, 2004, "Combination Forecasts of Output Growth in a Seven-Country Data Set," *Journal of Forecasting*, Vol. 23, Issue 6, pp. 405–30.
- Timmermann, A., 2006, "Forecast Combinations," in Handbook of Economic Forecasting, Volume I, ed. by G. Elliott, C. W.J. Granger, and A. Timmermann (Amsterdam: Elsevier), Chapter 4.

UNIT 9: Univariate and multivariate models of volatility and their application

Lecture 3 hours Part1	L-10	1. Estimating univariate volatility models (ARCH, GARCH) and their descendants (TARCH, EGARCH) 2. Estimating multivariate volatility models 3. Background for the workshop: Value-at-Risk analysis
Workshop 1.5 hours Part2	W-10	• Estimation of univariate and multivariate GARCH models. Forecasting with GARCH models, application of MVGARCH to Value-at-Risk analysis • Volatility impact on first moment prediction

References

- Bollerslev, T., 1986, "Generalized Autoregressive Conditional Heteroskedasticity," *Journal of Econometrics*, Vol. 31, No. 3, pp. 307–327.
- Andersen, T., Bollerslev, T., Diebold, F. and P. Labys, 2003, "Modeling and Forecasting Realized Volatility," *Econometrica*, Volume 71, Issue 2, pp. 579–625.

UNIT 10: Final Project: application of models for policy analysis and forecasting in selected countries

Workshop 10.5 hours Part1	O-1	• Projects: Participants will be provided (and encouraged to bring their own) datasets for a number of selected countries from the region and apply models taught in the course to forecast inflation or another key macro variable (single equation, factor, Kalman Filter, combination).
Workshop 3 hours Part2	O-2	• Project presentations: groups present and discuss results of their projects in a plenary session

References

List of references: Not Applicable

MFA -- Summary of Time Allocation

	TOPICS	HOURS
	Lectures	
L-0	***Intro***	0.5
L-1	***Structural VARs and their application for policy analysis I: short-run restrictions***	1.5
L-2	***Modeling of non-stationary variables, forecasting with VECMs***	3
L-3	***Structural VARs and their application for policy analysis II: long-run and other restrictions***	1.5
L-4	***Forecasting with VAR extensions II: FAVAR, Basics of factor models***	1.5
L-5	***Forecasting with VAR extensions II: FAVAR, Extensions***	1.5
L-6	***Conditional forecasting with VARs in small open economies***	1.5
L-7	***Estimation of and forecasting with Bayesian VARs***	3
L-8	***State-Space Models and Kalman Filtration***	3
L-9	***Forecast Combination***	1.5
L-10	***Univariate and multivariate models of volatility and their application***	3
	Workshops	
W-1	***Structural VARs and their application for policy analysis I: short-run restrictions***	1.5
W-2	***Modeling of non-stationary variables, forecasting with VECMs***	3
W-3	***Structural VARs and their application for policy analysis II: long-run and other restrictions***	1.5
W-4	***Forecasting with VAR extensions II: FAVARs, Basics of factor models***	1.5
W-5	***Forecasting with VAR extensions II: FAVARs, Extensions***	1.5
W-6	***Conditional forecasting with VARs in small open economies***	1.5
W-7	***Estimation of and forecasting with Bayesian VARs***	3
W-8	***State-Space Models and Kalman Filtration***	3
W-9	***Forecast Combination***	1.5
W-10	***Univariate and multivariate models of volatility and their application***	1.5
	Other	
O-0	***Quizzes, Administrative presentations***	2.5
O-1	***Participant Presentations - Prep***	10.5
O-2	***Participant presentations***	3
	Summary	
L's		21.5
W's		19.5
O's		16
TOTAL		**57**