

**Symposium on Forecasting and Empirical Methods in Macroeconomics and Finance: Editors' Introduction**



Francis X. Diebold; Kenneth D. West

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**SYMPOSIUM ON FORECASTING AND EMPIRICAL METHODS  
IN MACROECONOMICS AND FINANCE**

**EDITORS' INTRODUCTION<sup>†</sup>**

BY FRANCIS X. DIEBOLD AND KENNETH D. WEST

*University of Pennsylvania, and N.B.E.R., U.S.A.  
University of Wisconsin, and N.B.E.R., U.S.A.*

This special issue of the *International Economic Review* includes fourteen papers on forecasting and empirical methods in macroeconomics and finance, plus a comment and rejoinder on one paper. All papers went through the usual rigorous refereeing and editorial process, and all reflect the *IER*'s ongoing commitment to publish high-quality econometric and empirical work. Some of the papers were first presented at conferences hosted by the National Bureau of Economic Research, generously funded by the National Science Foundation and by the Economic Fluctuations Program of the National Bureau of Economic Research. Many of the papers, in contrast, were standard *IER* submissions that fit naturally in the symposium.

These are exciting times in time-series econometrics, driven by recent and complementary advances in econometric theory and computational capability, as well as important substantive advances in empirical macroeconomics and finance. The papers both reflect that excitement and fuel it, covering a wide range of topics, including forecasting, volatility modeling, vector autoregressions, dynamic factor structure, regime switching, Bayesian methods, rational expectations modeling, unit roots and persistence, instrumental-variables estimation, long memory, aggregation, continuous-time methods, and much else. For purposes of this introductory overview, we have partitioned the papers into six groups: forecast evaluation, structural vector

<sup>†</sup> E-mail: [fdiebold@mail.sas.upenn.edu](mailto:fdiebold@mail.sas.upenn.edu); [kdwest@facstaff.wisc.edu](mailto:kdwest@facstaff.wisc.edu)

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autoregressions, dynamic factor models, rational expectations models, persistence, and instrumental-variables estimation. Many of the papers, however, make several contributions simultaneously, so that any such grouping is somewhat arbitrary. Moreover, concerns related to *forecasting* run throughout most of the papers.

Forecasting is central to economics. It is important in its own right—predicting next quarter's GDP, or interest rate term structure, for example—and methods of evaluating the adequacy of various types of forecasts are therefore of intrinsic interest. Forecasting is also an important model evaluation tool; out-of-sample forecast evaluation analysis is often the most effective way to detect in-sample overfitting due to repeated use of a limited body of data, which leads to models that forecast poorly despite the superficial appearance of good fit.

Hence we begin with the forecast evaluation group, which contains four papers, all of which provide tools to facilitate or improve the evaluation of forecasts. In "Regression Based Tests of Predictive Ability," Kenneth D. West and Michael W. McCracken propose simple regression tests for evaluating the accuracy of point forecasts. Possible measures of accuracy include unbiasedness and ability to encompass an alternative model. The methods are designed to be directly applicable to forecasts that rely on estimated regression parameters, which arise frequently in empirical macroeconomics and finance.

The remaining papers in the forecasting group can be motivated with reference to the time varying volatility that characterizes high-frequency financial data, although all have results applicable to a wide range of nonfinancial data and models. In "Evaluating Interval Forecasts," Peter F. Christoffersen argues that in the presence of conditional heteroskedasticity, unconditional calibration of interval forecasts (for example, the ability to be right 95% of the time, using 95% confidence intervals) is a weak standard. He defines and shows how to assess the stronger property of conditional calibration. This allows one to see, for example, whether a procedure correctly allows for narrower confidence intervals when conditional variances are smaller. Christoffersen illustrates his methods using interval forecasts of daily asset returns.

In "Evaluating Density Forecasts, with Applications to Financial Risk Management," Francis X. Diebold, Todd A. Gunther, and Anthony S. Tay argue that although density forecasts (forecasts stated as complete densities rather than simply 'best guesses' or confidence intervals) feature prominently in applications to financial risk management and elsewhere, appraisal of such forecasts has been hampered by lack of effective tools. Hence they develop a framework for rigorously assessing the adequacy of density forecasts under minimal assumptions, and they illustrate their methods by applying them to a variety of density forecasts involving both simulated and actual U.S. equity returns.

In "Answering the Skeptics: Yes, Standard Volatility Models Do Provide Accurate Forecasts," Torben G. Andersen and Tim Bollerslev reinterpret the findings of several recent studies that document small correlations between GARCH volatility forecasts and the realized squares of financial asset returns. They show that such small correlations are to be expected, and in particular, that they do not necessarily imply that GARCH volatility forecasts are in any sense poor. The problem, as they make clear, is not with GARCH and related models, but rather with the use of

squared returns to proxy for realized volatility. An important byproduct of the Andersen and Bollerslev study, driven by the theory of continuous-time diffusion processes, is the insight that superior measures of realized volatility can be constructed by *averaging* high-frequency intra-period squared returns.

The structural vector autoregression group begins with Glenn D. Rudebusch's "Do Measures of Monetary Policy in a VAR Make Sense?" It is together with a comment by Christopher A. Sims, and a rejoinder by Rudebusch. Structural vector autoregression techniques, which were pioneered by Sims, have become a mainstay in the evaluation of monetary policy. Rudebusch argues that this literature has become complacent and self-referential (our words, not his!), and that comparison of its results with those of other approaches reveals fragile and implausible results. Sims disagrees, and each concludes that the other does not understand the argument being made. We have followed what we believe to be the most productive strategy, letting both authors state their views concisely, and encouraging readers to make up their own minds.

In the second paper in the structural vector autoregression group, "Bayesian Methods for Dynamic Multivariate Models," Christopher A. Sims and Tao Zha show how to generate Bayesian confidence intervals for forecasts from structural vector autoregressions with an informative prior distribution. Their methods are computationally feasible even in large models with 'unruly' terms such as dummy variables, and they should be of direct help in quantifying forecast uncertainty in large structural vector autoregressions with priors motivated by economic theory.

Dynamic factor models facilitate parsimonious modeling of sets of variables subject to common, but unobservable, shocks. The two papers in the dynamic factor models group contribute to the development of that idea. In "An Econometric Characterization of Business Cycle Dynamics With Factor Structure and Regime Switching," Marcelle Chauvet uses new econometric methods to estimate a dynamic factor model with a common factor that switches between 'expansion' and 'contraction' regimes. Such regime-switching dynamic factor models are difficult to estimate, and therefore have been subject to little formal econometric analysis. Chauvet finds that the regime-switching dynamic factor model fits the data well, and she uses her estimates to construct improved indexes of coincident and leading economic indicators.

In the second paper in the dynamic factor models group, "Bayesian Leading Indicators: Measuring and Predicting Economic Conditions in Iowa," Christopher Otrok and Charles H. Whiteman perform a Bayesian analysis of a single-regime dynamic factor model. Previous theoretical and empirical developments used classical (i.e., non-Bayesian) methods; the Otrok and Whiteman analysis exploits recent developments in Markov chain Monte Carlo methods to provide a Bayesian analysis with a number of interesting features, including the provision of exact posterior density forecasts of the common factor. Otrok and Whiteman illustrate their methods with an application to monitoring and forecasting economic conditions in Iowa.

Linear rational expectations models are central to macroeconomics and finance. The first of the two papers in the rational expectations models group is "The Solution of Singular Linear Difference Equations Under Rational Expectations," by

Robert G. King and Mark W. Watson. Many macroeconomic and financial models involve identities, which imply that the relevant vector difference equation is singular in a certain precise sense. King and Watson characterize existence of stable solutions to such systems using a canonical variables transformation, which separates dynamics associated with stable and unstable eigenvalues. The King and Watson results are effectively an extension of the popular Blanchard and Kahn canonical variable approach to the singular case, and they complement earlier extensions of other solution methods to the singular case, such as those based on undetermined coefficients and martingale methods.

The second paper on rational expectations modeling, "Decision Making In the Presence of Heterogeneous Information and Social Interactions," by Michael Binder and M. Hashem Pesaran, considers the problem of solving linear rational expectations models when agents have private information. Computation of rational expectations equilibria in such environments is complicated by the fact that agents are forced to forecast the forecasts of others in order to make their decisions. Binder and Pesaran develop a solution method under the plausible assumption that each agent's expectations about the expectations of others depend only on public information, which they apply to a model of strategic complementarity in capital accumulation, yielding the important insight that informational heterogeneity can strengthen economic propagation mechanisms.

We now turn to a group of three papers on persistence in economic and financial time series. Many of the fluctuations that arise in economic and financial data exhibit persistence: that is, deviations from the mean or trend level often persist for considerable lengths of time. For example, business cycle expansions and contractions display substantial persistence, as do asset return volatilities. The three papers in the persistence group work to deepen our understanding of persistence and provide tools for its measurement and modeling.

In the first paper, "Long Memory and Aggregation in Macroeconomic Time Series," Marcus J. Chambers shows how aggregation of short-memory series can result in highly-persistent, long-memory aggregates. He considers both spatial and temporal aggregation, in both discrete and continuous time, and he characterizes the conditions under which aggregation will and will not increase persistence. Chambers illustrates his theoretical results using six U.K. macroeconomic series, all of which he finds to be fractionally integrated.

The second paper in the persistence group is "Additional Tests for a Unit Root Allowing for a Break in the Trend Function at an Unknown Time," by Timothy J. Vogelsang and Pierre Perron. Their results are relevant to the still-vigorous debate on whether macroeconomic data are better modeled as having unit roots—a very special type of long memory—or as stationary around deterministic terms such as time trends. In making such assessments it is often important to allow for the possibility of breaks in the trend, because trend breaks can be easily misinterpreted as unit roots. Perron and Vogelsang contribute to an ongoing research program that attempts to do so; they present new asymptotic theory and simulation evidence on unit root tests that allow for a trend break at an unknown time.

The third persistence paper is motivated by the importance for financial and other applications of the dynamics of the conditional mean—of the level or square of a

stock return, for example. Moreover, and perhaps counterintuitively, it is possible for the conditional mean to show great persistence (that is, high positive serial correlation), even if the actual variable shows little persistence. Hence, in "Conditional Means of Time Series Processes and Time Series Processes for Conditional Means," Gabriele Fiorentini and Enrique Sentana develop tools for estimating and comparing the persistence of shocks to variables and their conditional means. They work in general vector linear systems, and their results also cover conditional variances, which are of course conditional means of squares of zero-mean variables. Fiorentini and Sentana apply their methods to U.S. stock market data.

The symposium's final topic, instrumental-variables estimation, consists of a one-paper critical mass by Eric Zivot, Richard Startz, and Charles R. Nelson. A pervasive issue in macroeconomic modeling is finding instruments that are both valid and relevant. Instruments that seem likely to satisfy the condition of zero correlation with the disturbance (that is, valid instruments) often have a low correlation with endogenous right-hand-side variables (that is, they appear weak, or irrelevant). In such cases, conventional asymptotic theory often supplies a poor approximation to actual finite sample behavior. In "Valid Confidence Intervals in the Presence of Weak Instruments," Eric Zivot, Richard Startz, and Charles Nelson use simulation methods to evaluate alternative methods of inference in instrumental variables regressions with weak instruments. They show that the performance of different methods varies greatly, and their analysis yields sharp and practical guidelines that researchers can use in their own applications.

In closing, we thank the *IER* for the opportunity to produce this symposium. Throughout, the task was a pleasure. We hope that the *IER*'s readers will find the papers as stimulating as we do, and agree with us, moreover, that the symposium's depth and breadth extend well beyond the sum of its parts.