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SPECIAL ISSUE OF *ECONOMETRIC THEORY* ON BOOTSTRAP AND NUMERICAL METHODS IN TIME SERIES: GUEST EDITORS' INTRODUCTION

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1. BACKGROUND

This special issue of *Econometric Theory* collects papers presented at the Second Annual Conference of the Granger Centre for Time Series Econometrics, held at the University of Nottingham on September 10 and 11, 2008. Reflecting the fact that bootstrap and other numerical methods, including Monte Carlo simulation and simulation-based inference, are fast becoming essential tools in modern-day time series analysis the conference was run under the theme "Bootstrap and Numerical Methods in Time Series."

Eighteen papers were presented at the conference, 10 of which were in contributed sessions and eight in keynote invited sessions. The keynote speakers at the conference were Peter Boswijk (Universiteit van Amsterdam), Jörg Breitung (University of Bonn), Valentina Corradi (University of Warwick), Russell Davidson (McGill University), Silvia Gonçalves (Université de Montréal), Patrik Guggenberger (UCLA), Javier Hidalgo (LSE), and Tim Vogelsang (Michigan State University). The conference program can be obtained from the conference Web site at http://www.nottingham.ac.uk/economics/grangercentre/conf2008.

We are very grateful to Peter Phillips for accepting our proposal for this special issue of *Econometric Theory* comprised of papers from the 2008 Conference of the Granger Centre for Time Series Econometrics. We thank all of the conference delegates who contributed their papers to this special issue. We are also extremely grateful to those individuals who agreed to serve as referees for the papers submitted to this special issue, especially in light of the fast turnaround times we asked for on their reviews. To protect their identities, they are not listed here but will be included in the general list of referees for *Econometric Theory* that appears annually in the journal. Our conference would not have been possible without the generous financial support provided by the University of Nottingham, to which we are extremely grateful. Address correspondence to Robert Taylor, Nottingham School of Economics, University of Nottingham, University Park, Nottingham, NG7 2RD, United Kingdom; e-mail: Robert.Taylor@nottingham.ac.uk.

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An invitation was made to all speakers at the conference to contribute their papers. A total of 10 submissions were received. As special issue editors we adopted the usual editorial procedures and standards of *Econometric Theory*. Six papers survived the reviewing and revision process. These appear in this issue in the order of their final acceptance dates.

2. CONTENTS

The opening paper of this special issue is written by Thomas Flury and Neil Shephard. Starting from the observation provided by Andrieu, Doucet, and Holenstein (2009) that likelihood inference can be based on an unbiased simulation-based estimator (the example of which the authors focus their attention on is the particle filter) of the likelihood when it is used inside a Metropolis–Hastings algorithm, they show, in the context of four well known static and dynamic economic models, how to carry out Bayesian analysis using a simulated likelihood. Specifically, they consider the estimation of a standard cross-sectional probit model, a linear Gaussian time series model, a simple stochastic volatility model, and a stochastic general equilibrium model. The use of simulated maximum likelihood (SML) as the basis for approximate maximum likelihood estimate is now relatively commonplace in econometrics, and SML estimators are known to have a number of shortcomings. Therefore this work is both timely and important for practitioners. The method advanced by Flury and Shephard provides a simple yet powerful generalization of Kalman filter–based approaches, the use of the latter being constrained to linear Gaussian state space models.

In the second paper, Giuseppe Cavaliere, David Harvey, Stephen Leybourne, and Robert Taylor analyze unit root tests that allow for a break in trend at an unknown time, and the innovations to the unit root process are allowed to have nonstationary volatility. With respect to other features of the time series, these unit root tests are very robust. Cavaliere et al. take as the starting point the trend break robust unit root tests recently proposed by Harris, Harvey, Leybourne, and Taylor (HHLT) (2009). The HHLT tests have asymptotically pivotal null distributions when the innovations are stationary. Cavaliere et al. show that although nonstationary volatility does not invalidate the HHLT test, it does make the asymptotic null distribution nonpivotal. They formally show that the wild bootstrap can be used to obtain asymptotically valid critical values in the presence of nonstationary volatility. Finite-sample simulations show that the wild bootstrap indeed delivers robustness to nonstationary volatility in practice.

In a related paper, Özgen Sayginsoy and Timothy Vogelsang consider the problem of testing for a shift in the trend function of a time series at an unknown time. Their approach is based on ordinary least squares (OLS) estimates of the trend function and nonparametric kernel heterostedasticity and autocorrelation consistent (HAC) robust standard errors. Using the fixed-b asymptotic approximation of Kiefer and Vogelsang (2005) in conjunction with the scaling approach of Vogelsang (1998) they develop tests that are robust to strong serial correlation,

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including $I(1)$ behavior, in the errors. Implementing these tests requires choices for the kernel and bandwidth, and the authors give concrete recommendations for these in such a way that asymptotic integrated power is maximized when the data are trend stationary across a range of trend break specifications. Finite-sample simulations for a feasible version of the data dependent bandwidth rule suggest that the proposed tests work well in practice, closely following the predictions from the asymptotic analysis, and are competitive with other available trend break tests.

In the fourth paper, Patrick Marsh provides new optimal unit root test procedures based on critical values obtained from a feasible saddlepoint approximation to their distribution. Refining approximations obtained previously by Lieberman (1994) and Marsh (1998), feasible unit root tests are obtained by plugging in a suitable consistent estimator of the underlying covariance structure. Suitable estimators include the autoregressive spectral density estimator obtained from an augmented Dickey–Fuller regression. Marsh therefore widens the applicability of the saddlepoint approximation while also providing a fully feasible alternative to the established method of obtaining approximate critical values via numerical approximation of the limiting forms of the statistics. Direct finite-sample numerical comparisons with this benchmark method show that the saddlepoint provides more consistently accurate inference over a range of simple models and sample sizes and with no loss of power.

In the next paper, Sílvia Gonçalves proposes a bootstrap method for panel data linear regression models with individual fixed effects. The method, which consists of applying a standard moving blocks bootstrap (e.g., Künsch, 1989) to the vector containing all the individual observations at each point in time, is shown to be robust to heteroskedasticity and to weak serial dependence (mixing) and either strong or weak cross-sectional dependence of unknown form under the assumption that the cross-sectional dimension is a nondecreasing function of the time series dimension, as the latter diverges. The large-sample behavior of both the fixed effects estimator and its bootstrap analogue are explored and are shown to have convergence rates that depend on the degree of cross-section dependence in the panel. Nonetheless, Gonçalves shows that the studentized statistics can be computed without reference to the degree of cross-section dependence. Simulation results are provided that suggest that the block bootstrap can display better finite-sample properties than competitors based on the normal approximation or on fixed-b asymptotic theory.

Finally, in the last paper of this special issue, Miguel Delgado, Javier Hidalgo, and Carlos Velasco analyze bootstrap versions of omnibus specification tests of the null hypothesis that a time series is in the class of stationary and invertible fractionally integrated autoregressive moving average (ARFIMA) processes. The class of specification tests they consider go back to Bartlett (1954) and are functionals of sums of ratios between the sample periodogram and the parametric spectral density as implied by the ARFIMA model under the null. Because of the need to estimate ARFIMA parameters when implementing the tests, the

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asymptotic null distribution is nonpivotal, thus motivating the use of the bootstrap to obtain asymptotically valid critical values. The bootstrap they consider is essentially a parametric bootstrap with resampling from residuals of the fitted ARFIMA model. An alternative testing approach is to apply a transformation recently proposed by Delgado, Hidalgo, and Velasco (2005) that leads to an asymptotically pivotal null distribution. Having a pivotal asymptotic limit opens the door for the bootstrap to be more accurate in finite samples, and so Delgado et al. establish the validity of the bootstrap applied to the transformed statistic. Finite-sample simulations show that the two bootstrap procedures perform well in practice.

REFERENCES

Andrieu, C., A. Doucet, & R. Holenstein (2009) Particle MCMC (with discussion). *Journal of the Royal Statistical Society, Series B*, forthcoming.

Delgado, M.A., J. Hidalgo, & C. Velasco (2005) Distribution free goodness-of-fit tests for linear processes. *Annals of Statistics* 33, 2568–2609.

Bartlett, M.S. (1954) Problèmes de l'analyse spectral des séries temporelles stationnaires. *Publ. Inst. Statist. Univ. Paris III-3*, 119–134.

Harris, D., D.I. Harvey, S.J. Leybourne, & A.M.R. Taylor (2009) Testing for a unit root in the presence of a possible break in trend. *Econometric Theory* 25, 1545–1588.

Kiefer, N.M. & T.J. Vogelsang (2005) A new asymptotic theory for heteroskedasticity-autocorrelation robust tests. *Econometric Theory* 21, 1130–1164.

Künsch, H.R. (1989) The jackknife and the bootstrap for general stationary observations. *Annals of Statistics* 17, 1217–1241.

Lieberman, O. (1994) Saddlepoint approximations to the distribution of a ratio of quadratic forms in normal variables. *Journal of the American Statistical Association* 89, 924–928.

Marsh, P. (1998) Saddlepoint approximations for non-central quadratic forms. *Econometric Theory* 14, 539–559.

Vogelsang, T.J. (1998) Trend function hypothesis testing in the presence of serial correlation. *Econometrica* 65, 123–148.

https://doi.org/10.1017/S0266466610000587 Published online by Cambridge University Press