ESSAYS IN HONOR OF JOON Y. PARK

Econometric Theory

Edited by Yoosoon Chang, Sokbae Lee and J. Isaac Miller

ADVANCES IN ECONOMETRICS

VOLUME 45A

ESSAYS IN HONOR OF JOON Y. PARK

ADVANCES IN ECONOMETRICS

Series editors: Thomas B. Fomby, R. Carter Hill, Ivan Jeliazkov, Juan Carlos Escanciano, Eric Hillebrand, Daniel L. Millimet and Rodney Strachan

Recent Volumes:

Volume 25	Nonparametric Econometric Methods – Edited by Qi Li and Jeffrey S. Racine
Volume 26	Maximum Simulated Likelihood Methods and Applications – Edited by R. Carter Hill and William Greene
Volume 27A	Missing Data Methods: Cross-sectional Methods and Applications – Edited by David M. Drukker
Volume 27B	Missing Data Methods: Time-series Methods and Applications – Edited by David M. Drukker
Volume 28	DSGE Models in Macroeconomics: Estimation, Evaluation and New Developments – Edited by Nathan Balke, Fabio Canova, Fabio Milani and Mark Wynne
Volume 29	Essays in Honor of Jerry Hausman – Edited by Badi H. Baltagi, Whitney Newey, Hal White and R. Carter Hill
Volume 30	30th Anniversary Edition – Edited by Dek Terrell and Daniel Millmet
Volume 31	Structural Econometric Models – Edited by Eugene Choo and Matthew Shum
Volume 32	VAR Models in Macroeconomics – New Developments and Applications: Essays in Honor of Christopher A. Sims – Edited by Thomas B. Fomby, Lutz Kilian and Anthony Murphy
Volume 33	Essays in Honor of Peter C. B. Phillips – Edited by Thomas B. Fomby, Yoosoon Chang and Joon Y. Park
Volume 34	Bayesian Model Comparison – Edited by Ivan Jeliazkov and Dale J. Poirier
Volume 35	Dynamic Factor Models – Edited by Eric Hillebrand and Siem Jan Koopman
Volume 36	Essays in Honor of Aman Ullah – Edited by Gloria Gonzalez-Rivera, R. Carter Hill and Tae-Hwy Lee
Volume 37	Spatial Econometrics – Edited by Badi H. Baltagi, James P. LeSage and R. Kelley Pace
Volume 38	Regression Discontinuity Designs: Theory and Applications – Edited by Matias D. Cattaneo and Juan Carlos Escanciano
Volume 39	The Econometrics of Complex Survey Data: Theory and Applications – Edited by Kim P. Huynh, David T. Jacho-Chávez and Guatam Tripathi
Volume 40A	Topics in Identification, Limited Dependent Variables, Partial Observability, Experimentation, and Flexible Modelling Part A – Edited by Ivan Jeliazkov and Justin L. Tobias
Volume 40B	Topics in Identification, Limited Dependent Variables, Partial Observability, Experimentation, and Flexible Modelling Part B – Edited by Ivan Jeliazkov and Justin L. Tobias
Volume 41	Essays in Honor of Cheng Hsiao – Edited by Tong Li, M. Hashem Pesaran and Dek Terrell
Volume 42	The Econometrics of Networks – Edited by Áureo de Paula, Elie Tamer and Marcel-Cristian Voia
Volume 43A	Essays in Honor of M. Hashem Pesaran: Prediction and Macro Modeling – Edited by Alexander Chudik, Cheng Hsiao and Allan Timmermann
Volume 43B	Essays in Honor of M. Hashem Pesaran: Panel Modeling, Micro Aplications, and Econometric Methodology – Edited by Alexander Chudik, Cheng Hsiao and Allan Timmermann
Volume 44A	Essays in Honour of Fabio Canova Part A – Edited by Juan J. Dolado, Luca Gambetti and Christian Matthes
Volume 44B	Essays in Honour of Fabio Canova Part B – Edited by Juan J. Dolado, Luca Gambetti and Christian Matthes

ADVANCES IN ECONOMETRICS VOLUME 45A

ESSAYS IN HONOR OF JOON Y. PARK: ECONOMETRIC THEORY

EDITED BY

YOOSOON CHANG
Indiana University, USA

SOKBAE LEE
Columbia University, USA

And

J. ISAAC MILLER
University of Missouri, USA

United Kingdom – North America – Japan
India – Malaysia – China

Emerald Publishing Limited
Howard House, Wagon Lane, Bingley BD16 1WA, UK

First edition 2023

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-1-83753-209-4 (Print)
ISBN: 978-1-83753-208-7 (Online)
ISBN: 978-1-83753-210-0 (Epub)

ISSN: 0731-9053 (Series)

ISOQAR certified Management System, awarded to Emerald for adherence to Environmental standard ISO 14001:2004.

Certificate Number 1985
ISO 14001

INVESTOR IN PEOPLE

CONTENTS

LIST OF CONTRIBUTORS

Chafik Bouhaddioui	United Arab Emirates University, UAE
Jean-Marie Dufour	McGill University, Canada
Jiti Gao	Monash University, Australia
Nikolay Gospodinov	Federal Reserve Bank of Atlanta, USA
Uwe Hassler	Goethe-Universität Frankfurt, Germany
Javier Hidalgo	London School of Economics, UK
Kohtaro Hitomi	Kyoto Institute of Technology, Japan
Mehdi Hosseinkouchack	EBS Universität, Germany
Hsein Kew	Monash University, Australia
Jiwoong Kim	University of South Florida, USA
Kun Ho Kim	Concordia University, Canada
Yun-Yeong Kim	Dankook University, South Korea
Hira L. Koul	Michigan State University, USA
Heejun Lee	Brown University, USA
Jungyoon Lee	University of London, Royal Holloway, UK
Han-Ying Liang	Tongji University, China
Yingqian Lin	Shanghai University of Finance and Economics, China
Alex Maynard	University of Guelph, Canada
Keiji Nagai	Yokohama National University, Japan
Yoshihiko Nishiyama	Kyoto University, Japan
Elena Pesavento	Emory University, USA
Peter C. B. Phillips	Yale University, USA; University of Auckland, New Zealand; Singapore Management University, Singapore; and University of Southampton, UK
Myung Hwan Seo	Seoul National University, South Korea
Yu Shen	Tongji University, China
Yixiao Sun	University of California, San Diego, USA
Masaya Takano	McGill University, Canada

Junfan Tao Kyoto University, Japan
Yundong Tu Peking University, China
Qiying Wang The University of Sydney, Australia
Xiaohu Wang Fudan University, China
Weilin Xiao Zhejiang University, China
Jun Yu Singapore Management University, Singapore
Ying Zhou Monash University, Australia

INTRODUCTION

Volume 45 of *Advances in Econometrics* honors Professor Joon Y. Park, who has made numerous and substantive contributions to the field of econometrics over a career spanning four decades since the 1980s and counting. Volume 45 consists of 28 chapters and is in fact split between two volumes with the first focusing on econometric theory and the second focusing on econometric applications. These papers have been contributed by Joon's friends, colleagues, coauthors, former students, and even his dissertation advisor, Professor Peter C. B. Phillips, and the volume is edited by his wife and most frequent collaborator, Professor Yoosoon Chang, and two of his former students.

In the typical fashion of *Advances in Econometrics*, the papers were to be submitted in early 2021 after a conference in Joon's honor in April 2020, which would have nearly coincided with his 65th birthday. Of course, the COVID-19 pandemic forced much of the world into lockdown in April 2020, so plans changed. Papers were still submitted in 2021, but the conference was delayed and, as of this writing, is scheduled for September 29–30, 2023, in Bloomington, Indiana, which Joon and Yoosoon have called home for nearly 15 years.

We introduce the 13 chapters of the first volume, which are loosely grouped into three sections that are closely related to Professor Park's contribution to the theoretical analysis of time series and particularly related to the research of the first two or so decades of his career.

After graduating from Yale under the supervision of Professor Phillips, Joon's early work in the late 1980s and 1990s focused on nonstationary time series and particularly on cointegration and common stochastic trends, where some of his most highly cited contributions were made. These include foundational work on regressions with nonstationary series (Park & Phillips, 1988, 1989); the variable addition test for cointegration (Park, 1990), which remains one of the most highly cited papers in *Advances in Econometrics*; and perhaps his most well-known contribution to the field on canonical cointegrating regressions (CCR)[1] (Park, 1992).

Shifting his research, Park published a series of papers in the late 1990s and 2000s on nonlinear transformations of unit root processes, which introduce nontrivial obstacles in the form of nonstandard rates of convergence and limiting distributions. One could say that his work helped to redefine *nonstandard* in the sense that up to this point, nonstandard typically meant rate-T with limiting Dickey–Fuller type distributions. The rates of convergence in these papers generally involve powers of the sample size other than ½ or 1, and the limits usually include nonlinear functions of stochastic integrals and/or Brownian local times. Park's most well-cited contributions to the study of nonlinear transformation of nonstationary series are Park and Phillips (1999, 2001), but his work

on nonlinearity has also spilled over into time-varying coefficients (Park & Hahn, 1999), instrumental variables (Chang et al., 2004), functional coefficients (Cai et al., 2009), and other areas.

Following the themes of nonstationarity and nonlinearity, the papers in this volume are grouped as follows: (I) nonstationarity, unit roots, and fractional noise; (II) nonlinearity; and (III) inference and prediction using models with trending series.

Part I: Nonstationarity, Unit Roots, and Fractional Noise

A contribution by Peter C. B. Phillips, not only Joon's dissertation advisor but also longtime editor of *Econometric Theory*, appropriately opens the volume on econometric theory and the section on nonstationarity, unit roots, and fractional noise. Specifically, his article "Discrete Fourier Transforms of Fractional Processes With Econometric Applications" presents an exact representation of the discrete Fourier transform in terms of the component data, which he finds to be particularly useful for analyzing the asymptotic behavior of the periodogram when the memory parameter exceeds the threshold for stationarity. He shows that smoothed periodogram spectral estimates remain consistent for frequencies away from the origin as long as the memory parameter is strictly less than unity.

Also studying fractional noise, Xiaohu Wang, Weilin Xiao, and Jun Yu contribute the article "Asymptotic Properties of the Least Squares Estimator in Local to Unity Processes With Fractional Gaussian Noises." They derive the asymptotic properties of the autoregressive parameter in local to unity processes with errors generated as fractional Gaussian noise with the Hurst parameter over the interval (0,1). The rates of convergence are standard rate-T over the upper half of this interval, but nonstandard and dependent of the Hurst parameter over the lower half. They derive limiting distributions over this interval that are new to the literature except at 1/2.

Critical to ascertaining stationarity or lack thereof are unit root tests. In their contribution, "Powerful Self-normalizing Tests for Stationarity Against the Alternative of a Unit Root," Uwe Hassler and Mehdi Hosseinkouchack introduce a new and powerful tool to address this well-known problem. Specifically, they propose a family of tests for stationarity against a local unit root that builds on the Karhunen–Loève expansions of the limiting CUSUM process under the null hypothesis and a local alternative. They find that the proposed tests are more powerful than the classic KPSS test.

Also on the topic of testing for unit roots, Kohtaro Hitomi, Keiji Nagai, Yoshihiko Nishiyama, and Junfan Tao contribute "A Sequential Test for a Unit Root in Monitoring a p-th Order Autoregressive Process." They study unit root tests for autoregressive processes of order p under sequential sampling schemes using stopping times based on the observed Fisher information. They derive the joint limit of the test statistics and the stopping time under the null and local alternatives, which are nonstandard.

Part II: Nonlinearity

As we mentioned, both cointegration and functional coefficients are areas in which Professor Park has made contributions to the literature. Han-Ying Liang, Yu Shen, and Qiying Wang contribute to the volume and this literature with "Functional-coefficient Cointegrating Regression With Endogeneity." As the title suggests, they explore nonparametric estimation of cointegrating regression models with functional coefficients and where the structural equation errors are serially dependent and the regressor is endogenous. In this context, they show the self-normalized local kernel and local linear estimators to be asymptotically normal.

In "A Specification Test Based on Convolution-type Distribution Function Estimates for Non-linear Autoregressive Processes," Kun Ho Kim, Hira L. Koul, and Jiwoong Kim develop a test for a parametric specification of the autoregressive function of a given stationary autoregressive time series. Their test is based on the integrated square difference between the empirical distribution function estimate and a convolution-type distribution function estimate of the stationary distribution function obtained from the autoregressive residuals.

Yingqian Lin and Yundong Tu contribute "Transformation Models With Cointegrated and Deterministically Trending Regressors," which contains important and interesting extensions of the statistical foundation for the nonlinear cointegrated models pioneered by Park and his coauthors. For a general transformation model with a time trend, stationary regressors, and unit root regressors, they estimate the transformation parameter and other model parameters by minimizing the concentrated loss function, and they obtain the asymptotic distributions of the proposed estimators.

The threshold model has been frequently used to model the nonlinearity of time series. Park and Shintani (2016) examine testing issues surrounding threshold effects and unit roots. In "Minimax Risk in Estimating Kink Threshold and Testing Continuity," Javier Hidalgo, Heejun Lee, Jungyoon Lee, and Myung Hwan Seo derive a risk lower bound in estimating the threshold parameter without knowing whether the threshold regression model is continuous or not. They show that the bound goes to zero as the sample size grows only at the cube root rate. Motivated by this finding, they develop a continuity test for the threshold regression model and a bootstrap to compute its p-values.

Part III: Inference and Prediction Using Models With Trending Series

Articles in the final section of this volume deal with models containing stochastic and/or deterministic trends, as do many of Professor Park's papers, from his earliest work on cointegration (Park & Phillips, 1988, 1989) and his widely cited CCR paper (Park, 1992) through his more recent work, such as that on estimating stochastic trends in state-space models (Chang et al., 2009).

In the first of these, "Semiparametric Independence Tests Between Two Infinite-order Cointegrated Series," Chafik Bouhaddioui, Jean-Marie Dufour, and Masaya Takano propose a semiparametric approach for testing independence

between two cointegrated vector autoregressive series of infinite order. The residual-based tests allow for computational simplicity and weak assumptions on the form of the underlying process. The authors derive the asymptotic distributions of the test statistics under the null hypothesis and establish consistency of the tests against fixed alternatives of serial cross-correlation of unknown form.

Nikolay Gospodinov, Alex Maynard, and Elena Pesavento contribute "Inference in Conditional Vector Error Correction Models With a Small Signal-to-Noise Ratio," in which they study vector error correction models when the error correction term is characterized simultaneously by high persistence (near-unit-root behavior) and very small (near zero) variance. The importance of these features lies in the fact that conventional cointegration tests may fail to detect cointegration. The authors develop asymptotic theory for the parameter estimators for unconditional and conditional vector error correction models with these features.

Yixiao Sun, in his contribution entitled "Some Extensions of Asymptotic F and t Theory in Nonstationary Regressions," extends the asymptotic theory for F- and t-tests to linear regression models where the regressors could contain deterministic trends, unit-root processes, and near-unit-root processes. The tests themselves are implemented in the usual ways, but approximations to the limiting distributions are more accurate than the more commonly used chi-squared and normal approximations.

The last two contributions focus on predictive models with nonstationary series. Ying Zhou, Hsein Kew, and Jiti Gao contribute "Non-stationary Parametric Single-index Predictive Models: Simulation and Empirical Studies." Their model is designed to handle a wide variety of nonlinear relationships between the regressand and a single-index component containing either the cointegrated predictors or the non-cointegrated predictors. They introduce a new estimation procedure and investigate its finite-sample properties.

We opened the volume with a contribution from Joon's advisor, so it seems appropriate to close the volume with a contribution from one of his many students. In "Best Linear Prediction in Cointegrated Systems," Yun-Yeong Kim introduces the best linear predictor with the asymptotic minimum mean squared forecasting error among linear predictors of variables in cointegrated systems with unknown error specification. He suggests a switching predictor that automatically selects the random walk or cointegration model according to the size of the estimated autocorrelation coefficient estimated from the residuals.

We hope you enjoy reading "Essays in Honor of Joon Y. Park: Econometric Theory" and learning about the advances in econometrics made by the authors as much as we have!

NOTE

1. In case you have ever wondered… yes, Joon has always been a fan of the music of Credence Clearwater Revival, also abbreviated as CCR!

ADDITIONAL REFERENCES

Cai, Z., Li, Q., & Park, J. Y. (2009). Functional-coefficient models for nonstationary time series data. *Journal of Econometrics*, *148*, 101–113.

Chang, Y., Miller, J. I., & Park, J. Y. (2009). Extracting a common stochastic trend: Theory with some applications. *Journal of Econometrics*, *150*, 231–247.

Chang, Y., Park, J. Y., & Phillips, P. C. B. (2004). Nonlinear instrumental variable estimation of an autoregression. *Journal of Econometrics*, *118*, 219–246.

Park, J. Y. (1990). Testing for unit roots and cointegration by variable addition. In G. F. Rhodes & T. B. Fomby (Eds.), *Advances in econometrics* (pp. 107–133). JAI Press.

Park, J. Y. (1992). Canonical cointegrating regressions. *Econometrica*, *60*, 199–143.

Park, J. Y., & Hahn, S. B. (1999). Cointegrating regressions with time varying coefficients. *Econometric Theory*, *15*, 664–703.

Park, J. Y., & Phillips, P. C. B. (1988). Statistical inference in regressions with integrated processes: Part 1. *Econometric Theory*, *4*, 468–497.

Park, J. Y., & Phillips, P. C. B. (1989). Statistical inference in regressions with integrated processes: Part 2. *Econometric Theory*, *5*, 95–131.

Park, J. Y., & Phillips, P. C. B. (1999). Asymptotics for nonlinear transformations of integrated time series. *Econometric Theory*, *15*, 269–298.

Park, J. Y., & Phillips, P. C. B. (2001). Nonlinear regressions with integrated time series. *Econometrica*, *69*, 117–161.

Park, J. Y., & Shintani, M. (2016). Testing for a unit root against transitional autoregressive models. *International Economic Review*, *57*(2), 635–664.