

Analysis of Panel Data, Fourth Edition

Now in its fourth edition, this comprehensive introduction to fundamental panel data methodologies provides insights on what is most essential in panel literature. A capstone to the 40-year career of a pioneer of panel data analysis, this new edition's primary contribution will be the coverage of advancements in panel data analysis, a statistical method widely used to analyze two- or higher-dimensional panel data. The topics discussed in early editions have been reorganized and streamlined to comprehensively introduce panel econometric methodologies useful for identifying causal relationships among variables, supported by interdisciplinary examples and case studies. This book, to be featured in Cambridge's Econometric Society Monographs series, has been the leader in the field since the first edition. It is essential reading for researchers, practitioners, and graduate students interested in the analysis of microeconomic behavior.

Cheng Hsiao is Professor of Economics at the University of Southern California.

Econometric Society Monographs Series

Editors:

Andrea Prat, Columbia University
 Stéphane Bonhomme, University of Chicago

The Econometric Society is an international society for the advancement of economic theory in relation to statistics and mathematics. The Econometric Society Monograph series is designed to promote the publication of original research contributions of high quality in mathematical economics and theoretical and applied econometrics.

Books in the Series

- C. Hsiao, *Analysis of Panel Data: 4th edn*, 2022
 D. M. Kreps, *The Black–Scholes–Merton Model as an Idealization of Discrete-Time Economies*, 2019
 W. Thomson, *How to Divide When There Isn't Enough: From Aristotle, the Talmud, and Maimonides to the Axiomatics of Resource Allocation*, 2019
 O. Compte & A. Postlewaite, *Ignorance and Uncertainty*, 2018
 I. Molchanov & F. Molinari, *Random Sets in Econometrics*, 2018
 B. Honoré, A. Pakes, M. Piazzesi, & L. Samuelson (eds.), *Advances in Economics and Econometrics: Eleventh World Congress, Vols. I & II*, 2017
 S. Maurer, *On the Shoulders of Giants: Colleagues Remember Suzanne Scotchmer's Contributions to Economics*, 2017
 C. P. Chambers & F. Echenique, *Revealed Preference Theory*, 2016
 J.-F. Mertens, S. Sorins, & S. Samir, *Repeated Games*, 2015
 C. Hsiao, *Analysis of Panel Data: 3rd edn*, 2014
 C. Cameron & P. Trivedi, *Regression Analysis of Count Data, 2nd edn*, 2013
 A. Harvey, *Dynamic Models for Volatility and Heavy Tails, with Applications to Financial and Economic Time Series*, 2013
 D. Acemoglu, M. Arellano, & E. Dekel (eds.), *Advances in Economics and Econometrics: Theory and Applications, Tenth World Congress, Vols. I, II, & III*, 2013
 M. Fleurbaey & F. Maniquet, *A Theory of Fairness and Social Justice*, 2011
 R. Vohra, *Mechanism Design: A Linear Programming Approach*, 2011
 K. Samphantharak & R. Townsend, *Households as Corporate Firms: An Analysis of Household Finance Using Integrated Household Surveys and Corporate Financial Accounting*, 2009
 I. Gilboa, *Theory of Decision under Uncertainty*, 2009
 F. Vega-Redondo, *Complex Networks*, 2007
 R. Blundell, W. Newey, & T. Persson, (eds.), *Advances in Economics and Econometrics: Theory and Applications, Ninth World Congress, Vols. I, II, & III*, 2006
 J. Roemer, *Democracy, Education, and Equality*, 2006
 C. Blackorby, W. Bossert, & D. Donaldson, *Population Issues in Social Choice Theory, Welfare Economics and Ethics*, 2005
 R. Koenker, *Quantile Regression*, 2005
 C. Hsiao, *Analysis of Panel Data, 2nd ed.*, 2003
 M. Dewatripont, L. P. Hausen, & S. J. Turnovsky (eds.), *Advances in Economics and Econometrics: Theory and Applications, Eighth World Congress, Vols. I, II, & III*, 2003
 E. Ghysels, N. Swanson, & M. Watson (eds.), *Essays in Econometrics: Collected Papers of Clive W. J. Granger, Vols. I & II*, 2001
 S. Strøm (ed.), *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*, 1999
 A. C. Cameron & P. K. Trivedi, *Regression Analysis of Count-Data*, 1998
 D. Jacobs, E. Kalai, & M. Kamien (eds.), *Frontiers of Research in Economic Theory: The Nancy L. Schwartz Memorial Lectures*, 1998
 D. M. Kreps & K. F. Wallis (eds.), *Advances in Economics and Econometrics: Theory and Applications, Seventh World Congress, Vols. I, II, & III*, 1997

Continued on page following the index

Analysis of Panel Data

Fourth Edition

Cheng Hsiao

University of Southern California



CAMBRIDGE
UNIVERSITY PRESS

CAMBRIDGE UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre,
New Delhi – 110025, India

103 Penang Road, #05–06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of
education, learning, and research at the highest international levels of excellence.

www.cambridge.org

Information on this title: www.cambridge.org/9781316512104

DOI: 10.1017/9781009057745

© Cheng Hsiao 1986, 2003, 2014, 2022

This publication is in copyright. Subject to statutory exception
and to the provisions of relevant collective licensing agreements,
no reproduction of any part may take place without the written
permission of Cambridge University Press.

First edition published 1986

Second edition 2003

Third edition 2014

Fourth edition 2022

A catalogue record for this publication is available from the British Library.

ISBN 978-1-316-51210-4 Hardback

ISBN 978-1-009-06075-2 Paperback

Cambridge University Press has no responsibility for the persistence or accuracy of
URLs for external or third-party internet websites referred to in this publication
and does not guarantee that any content on such websites is, or will remain,
accurate or appropriate.

To my parents,

Tseng Hsiao and Y. N. Shu Hsiao

and my family,

Amy Meiyun, Irene C., Allen C., Michael C. and Wendy C. Hsiao

Contents

<i>List of Figures</i>	<i>page</i> xiii
<i>List of Tables</i>	xv
<i>Preface to the Fourth Edition</i>	xviii
1 Introduction	1
1.1 Introduction	1
1.2 Advantages of Panel Data	4
1.3 Challenges to Panel Data Analysis	8
1.4 Outline of the Monograph	12
2 Linear Static Models with Additive Effects	15
2.1 Introduction	15
2.2 Fixed-Effects Models: Dummy-Variable Approach	18
2.3 Random-Effects Models: Variance-Components Models	22
2.4 Fixed Effects or Random Effects	29
2.5 Tests for Misspecification	37
2.6 Models with Time- and/or Individual-Invariant Explanatory Variables and both Individual- and Time-Specific Effects	38
2.7 Analysis of Covariance Tests for the Presence of Individual- or Time- Specific Effects	43
2.8 Heteroscedasticity and Autocorrelation	50
2.9 Models with Arbitrary Error Structure: Chamberlain π -Approach	54
Appendix 2A: Consistency and Asymptotic Normality of the Minimum-Distance Estimator	59
Appendix 2B: Characteristic Vectors and the Inverse of the Variance-Covariance Matrix of a Three-Component Model	61
3 Dynamic Models with Additive Specific Effects	63
3.1 Introduction	63
3.2 The Least Squares and the Least Squares Dummy Variable (Covariance) Estimator	64
3.3 Method of Moments Estimator	67
3.4 The Quasi-Likelihood Approach for Random-Effects Models	75
3.5 The Likelihood Approach-Fixed-Effects Models	85

x	Contents	
	3.6 Relations between the Likelihood Based Estimator and the GMM	89
	3.7 Estimation of Dynamic Models with Arbitrary Serial Correlations in the Residuals	95
	3.8 Models with Both Individual- and Time-Specific Additive Effects	96
	Appendix 3A: Derivation of the Asymptotic Covariance Matrix of the Feasible MDE	101
	Appendix 3B: Large N and T Asymptotics	102
4	Simultaneous-Equations Models	107
	4.1 Introduction	107
	4.2 Joint Generalized Least Squares Estimation Technique	110
	4.3 Estimation of Structural Equations	114
	4.4 Triangular System	121
	Appendix 4A: The Determinant and Inverse of the Triangular System Covariance Matrix	131
5	Dynamic System	133
	5.1 Introduction	133
	5.2 Panel Vector Autoregressive Models	134
	5.3 Cointegrated Panel Models and Vector Error Correction	142
	5.4 Unit Root and Cointegration Tests	148
	5.5 Dynamic Simultaneous Equation Models	157
6	Discrete Data	165
	6.1 Introduction	165
	6.2 Qualitative Response Models for Cross-Sectional Data	165
	6.3 Panel Parametric Approach to Static Models with Heterogeneity	170
	6.4 Semiparametric Approach to Static Models	180
	6.5 Dynamic Models	183
	6.6 Alternative Approaches for Identifying Dynamic Dependence	203
7	Limited Dependent and Sample Selection Models	214
	7.1 Cross-Sectional Data Approach	214
	7.2 A Sample Selection Example: Nonrandomly Missing Data in a Panel	223
	7.3 Tobit Models with Random Individual Effects	229
	7.4 Fixed-Effects Estimator	230
	7.5 An Example: Housing Expenditure	241
	7.6 Dynamic Tobit Models	244
8	Some Nonlinear Models	251
	8.1 Duration Model	251
	8.2 Count Data Model	262
	8.3 Nonparametric Models	268
9	Miscellaneous Topics	273
	9.1 Quantile Regression Analysis	273

Contents	xi
9.2 Simulation Methods	276
9.3 Data with Multilevel Structures	281
9.4 Errors of Measurement	283
9.5 Estimating Distributed Lags in Short Panels	288
9.6 Rotating or Randomly Missing Data	297
9.7 Pseudo Panels (or Repeated Cross-Sectional Data)	302
9.8 Discretizing Unobserved Heterogeneity	305
10 Interactive Effects Models	307
10.1 Introduction	307
10.2 Fixed-Effects Linear Static Models	309
10.3 Fixed-Effects Linear Dynamic Models	315
10.4 Models with Mixed Fixed and Random Effects	323
10.5 Quantile Models	328
10.6 Factor Dimension Determination	330
11 Spatial Models and Tests for Cross-Sectional Dependence	339
11.1 Introduction – Weak or Strong Cross-Correlations	339
11.2 The Basic Formulation on Spatial Weight Matrix and Spatial (Dependence) Coefficients	341
11.3 Spatial Error Models	343
11.4 Spatial Regressive Models	346
11.5 Some Extensions	348
11.6 Mixed Spatial and Factor Process	351
11.7 Cross-Sectional Dependence Tests	354
12 Program Evaluation Using Panel Data	361
12.1 Introduction	361
12.2 Cross-Sectional Data Approach	362
12.3 Panel Data Approach	368
12.4 Some Examples	374
12.5 Multiple Treated Units	381
12.6 Simulating or Ranking Program Outcomes with Different Policy Options	384
13 Variable Coefficients Models	389
13.1 Introduction	389
13.2 Coefficients that Vary over Cross-Sectional Units	391
13.3 Coefficients that Vary over Time and Cross-Sectional Units	401
13.4 A Mixed Fixed- and Random-Coefficients Model	407
13.5 Dynamic Random-Coefficients Models	414
13.6 An Example: Liquidity Constraints and Firm Investment Expenditure	418
13.7 Coefficients that Vary over Time	422
13.8 Coefficients that Are Functions of Other Exogenous Variables	428
13.9 Correlated Random-Coefficients Models	431
Appendix 13A: Combination of Two Normal Distributions	438

xii	Contents	
14	Big Data Analytics	440
14.1	Machine Learning Algorithms	440
14.2	Inference with High-Dimensional Data	442
14.3	Inference for Low-Dimensional Parameters in the Presence of High-Dimensional Data	446
14.4	Prediction	453
	<i>References</i>	469
	<i>Author Index</i>	498
	<i>Subject Index</i>	502

Figures

1.1	Homogeneous slope, heterogeneous intercept, a	page 9
1.2	Homogeneous slope, heterogeneous intercept, b	9
1.3	Homogeneous slope, heterogeneous intercept, c	9
1.4	Heterogeneous slope and intercept, a	10
1.5	Heterogeneous slope and intercept, b	10
1.6	Earning and Education	12
6.1	Male dynamic response path for the health shock that leads to activity limiting (ALC = 1) vs. not (ALC = 0).	204
6.2	Male dynamic response path for the health shock that leads to activity limiting (ALC = 1) vs. not (ALC = 0).	205
7.1	Density of y^* censored or truncated at 0.	217
7.2	Distribution of y and y^* under symmetric trimming.	218
7.3	Probability density of u_{it} .	232
7.4	Conditional densities of y_{i1}^* and y_{i2}^* given $(x_{i1}, x_{i2}, \alpha_i)$, assuming $\Delta \mathbf{x}_i' \boldsymbol{\beta} < 0$.	232
7.5	Conditional densities of y_{i1}^* and y_{i2}^* given $(x_{i1}, x_{i2}, \alpha_i)$, assuming $\Delta \mathbf{x}_i' \boldsymbol{\beta} > 0$.	233
7.6	The distribution of (y_{i1}^*, y_{i2}^*) assuming $\Delta \mathbf{x}_i' \boldsymbol{\beta} < 0$. $A_1 = \{(y_{i1}^*, y_{i2}^*) : y_{i1}^* > -\Delta \mathbf{x}_i' \boldsymbol{\beta}, y_{i2}^* > y_{i1}^* + \Delta \mathbf{x}_i' \boldsymbol{\beta}\}$, $A_2 = \{(y_{i1}^*, y_{i2}^*) : y_{i1}^* \leq -\Delta \mathbf{x}_i' \boldsymbol{\beta}, y_{i2}^* > 0\}$, $B_1 = \{(y_{i1}^*, y_{i2}^*) : y_{i1}^* > -\Delta \mathbf{x}_i' \boldsymbol{\beta}, 0 < y_{i2}^* < y_{i1}^* + \Delta \mathbf{x}_i' \boldsymbol{\beta}\}$, $B_2 = \{(y_{i1}^*, y_{i2}^*) : y_{i1}^* > -\Delta \mathbf{x}_i' \boldsymbol{\beta}, y_{i2}^* \leq 0\}$.	233
7.7	The distribution of (y_{i1}^*, y_{i2}^*) assuming $\Delta \mathbf{x}_i' \boldsymbol{\beta} > 0$. $A_1 = \{(y_{i1}^*, y_{i2}^*) : y_{i1}^* > 0, y_{i2}^* > y_{i1}^* + \Delta \mathbf{x}_i' \boldsymbol{\beta}\}$, $A_2 = \{(y_{i1}^*, y_{i2}^*) : y_{i1}^* \leq 0, y_{i2}^* > \Delta \mathbf{x}_i' \boldsymbol{\beta}\}$, $B_1 = \{(y_{i1}^*, y_{i2}^*) : y_{i1}^* > 0, \Delta \mathbf{x}_i' \boldsymbol{\beta} < y_{i2}^* < y_{i1}^* + \Delta \mathbf{x}_i' \boldsymbol{\beta}\}$, $B_2 = \{(y_{i1}^*, y_{i2}^*) : y_{i1}^* > 0, y_{i2}^* \leq \Delta \mathbf{x}_i' \boldsymbol{\beta}\}$.	234
7.8	$\gamma > 0, \gamma y_{i0}^* - \boldsymbol{\beta}' \Delta \mathbf{x}_{i2} > 0$.	245
7.9	$\gamma > 0, \gamma y_{i0}^* - \boldsymbol{\beta}' \Delta \mathbf{x}_{i2} < 0$.	246
8.1	Parameter estimates for the forward default intensity function	261
8.2	Lehman Brothers' term structure of forward and cumulative default probabilities	262
12.1	Actual and AICC predicted real GDP growth rate from 1993Q1 to 2003Q4	375
12.2	AICC – Actual and counterfactual real GDP growth rate from 2004Q1 to 2008Q1	376
12.3	Actual and AIC predicted real GDP growth rate from 1993Q1 to 2003Q4	377
12.4	AIC – Actual and counterfactual real GDP growth rate from 2004Q1 to 2008Q1	378
12.5	Difference between the actual and counterfactual cigarette consumption in the treatment period	380

xiv	List of Figures	
12.6	The impact of China’s high speed rail projects on the per capita growth rate of some Chinese cities	382
12.7	Counterfactual number of infected and active cases for Germany and UK.	
	Counterfactual number of infected and active cases for Germany and UK	387
14.1	Comparison of aggregation of the stock price changes of top 15 US companies	459
14.2	Relative maximum likelihood for the parameters δ_1	466

Tables

1.1	The span and sample sizes of the National Longitudinal Surveys	<i>page 2</i>
2.1	Least-squares estimates of elasticity of Minnesota farm production function based on alternative assumptions	17
2.2	Characteristics of firms grouped on the basis of the firm constant	17
2.3	Wage equations (dependent variable: log wage)	30
2.4	Covariance tests for homogeneity	47
3.1	Simulation results for the biases of the MLEs for dynamic random-effects models	82
3.2	Various estimates of the parameters of Balestra and Nerlove's demand-for-gas model (3.4.24) from the pooled sample, 1957–1962.	84
3.3	Monte Carlo design	92
3.4	Bias of estimators ($T = 5$ and $N = 50$)	92
3.5	Root mean square error ($T = 5$ and $N = 50$)	93
3.6	GMM with many IVs	93
3.7	Simple IV	94
3.8	Fully fledged MLE	94
3.9	Asymptotic properties of the likelihood based estimator and methods of moment estimator for dynamic models	95
6.1	Average values of β for the fixed-effects probit model	176
6.2	Monte Carlo results for first-order Markov process	188
6.3	Estimates of employment models for women aged 45–59 in 1968	196
6.4	Comparisons of employment models using run data: Women aged 45–59 in 1968	199
6.5	Estimates of brand choices using various approaches (standard errors in parentheses)	201
6.6	Maximum-likelihood estimators of dynamic model with random effects	202
6.7	Maximum-likelihood estimators of dynamic model with fixed effects (bandwidth parameter = 8)	203
7.1	Parameter estimates of the earnings-function structural model with and without a correction for attrition	228
7.2	Estimation results for the budget share equations without correction for selection (standard errors in parentheses)	242
7.3	Estimation results for the budget share equations using panel data models taking selection into account (standard errors in parentheses)	243
7.4	Estimates of AR(1) coefficients of log real annual earnings (in thousands)	248

xvi **List of Tables**

8.1	Total number of active firms, defaults/bankruptcies, and other exits for each year over the sample period 1991–2011	259
10.1	Simulation results for β_1 and β_2 of DGP 1	320
10.2	Simulation results for β_1 and β_2 of DGP 2	321
10.3	Simulation results for ρ and β of DGP 4	322
10.4a	Average number of factors selected during replications for case 1 with three factors	335
10.4b	Percentage of correctly estimating the number of factors for Case 1 with three factors	336
10.5a	Average number of factors selected during replications for case 3 with three factors	337
10.5b	Percentage of correctly estimating the number of factors for Case 3 with three factors	338
11.1	Common correlated effects estimation	359
12.1	AICC selected model using data for the period 1993Q1–2003Q4	374
12.2	Treatment effect for economic integration 2004Q1–2008Q1 based on AICC selected model	375
12.3	AIC selected model using data for the period 1993Q1–2003Q4	376
12.4	AIC – Treatment effect for economic integration 2004Q1–2008Q1 based on AIC selected model	377
12.5	Comparison of the actual and counterfactual cigarette consumption	379
12.6	Comparison of the actual and counterfactual personal healthcare expenditures	381
13.1	Long-haul regression coefficients	412
13.2	Bias of the short-run coefficient $\bar{\gamma}$ short-run coefficients, bias	417
13.3	Individual firm regressions (percentage of firms with significant coefficients) regression coefficients! individual firm regressions individual firm regression coefficients	419
13.4	Coefficient heterogeneity: slope estimates at first and third quartiles across a sample of 561 firms coefficient heterogeneity heterogeneity! coefficients	420
13.5	Variable intercept estimation of models for less- and more capital-intensive firms variable intercept model! capital-intensive firms capital-intensive firms! variable intercept model	420
13.6	Estimation of mixed fixed- and random-coefficient models for less- and more-capital-intensive firms mixed fixed and random coefficient models! capital-intensive firm estimations capital-intensive firms! mixed fixed and random coefficient estimation	421
13.7	Prediction Comparison of Fixed-Coefficients and Mixed Fixed and Random-Coefficients Models for Less- and More-Capital-Intensive fixed-coefficient model! prediction comparison, mixed fixed and random-coefficients models Firms mixed fixed and random coefficient models! fixed-coefficient comparisons, capital-intensive firms fixed-coefficient models! mixed fixed and random model comparisons, capital-intensive firms capital-intensive firms! fixed-coefficient vs. mixed fixed and random coefficient comparisons (Recursive Predictive Density)	422
14.1	Estimation results of b_1 and b_2 for (14.3.21)	451
14.2	Estimation results of b_1 and b_2 for (14.3.23)	451
14.3	Estimation of β_x for the effects of 401(k) eligibility on net financial assets	452

List of Tables	xvii
14.4 Estimation of β_x for the effects of unemployment insurance bonus on unemployment duration	452
14.5 Root-mean-square prediction error of log kilowatt-hours (one-period-ahead forecast)	462
14.6 Root-mean-square prediction error of log kilowatts (one-period-ahead forecast)	462
14.7 Least squares estimation of aggregate money demand function	463
14.8 Random-coefficient estimates of Japan prefecture money demand equation	463
14.9 Error sum of squares (ESS) and predicted error sum of squares (PES) for disaggregate and aggregate data	464

Preface to the Fourth Edition

This is a substantially revised and expanded version of *Analysis of Panel Data* that considers new advancements in panel data analysis and streamlines and reorganizes topics discussed in earlier editions. The aim of this monograph remains the same: to comprehensively introduce panel econometric methodologies that are useful for identifying causal relationships among variables of interest to empirical investigators. Some empirical examples are also provided to give readers a perspective of the development of the field in the last half-century.

We start with modeling unobserved heterogeneity in additive forms for linear static and dynamic models, static and dynamic systems in structural and reduced forms, qualitative choice, limited dependent models, and some nonlinear models such as duration, count data, and nonparametric models. We then move to more complicated approaches to modeling unobserved heterogeneity, such as factor approach, spatial approach, and varying parameter models. We conclude with a chapter on the challenges of big data analytics to panel data analysis. However, no single monograph can cover the enormous contributions to panel data analysis. I apologize for the omissions.

I would like to thank Fatima Perez for patiently typing numerous versions of the manuscript, Dongwook Kim for carefully checking for errors, and China National Science Foundation grants 71631004 and 72033008 for partial research support. Comments by Xiaoyi Han on recent advances in spatial models, Cynthia Yang on stochastic SIR models, and Yuwei Xie on the big data approach to predictions are also much appreciated. I would also like to thank Robert Dreesen for support of this project, Laura Simmons for coordinating the production process, Matthew Van Atta for excellent copy editing, and the typesetting team led by Matthew Rohit Jayakumarxavier for their outstanding work; the journals *Computational Statistics*, *Econometrica*, *Econometrics Review*, the *Journal of the American Statistical Association*, the *Journal of Applied Econometrics*, the *Journal of Business and Economic Statistics*, and the *Journal of Econometrics*; the University of Chicago Press; and J.J. Heckman, D. McFadden, C. Manski, M.H. Pesaran, and C. Yang for their permissions to reproduce some of the materials published here.

I have received immeasurable help and support throughout my academic career from my family, teachers, colleagues, and students. I am grateful to my parents, Teng Hsiao and Y.N. Shu Hsiao, for providing a loving and safe environment during the tumultuous years of growing up; Leong Tan and Margaret Tan for giving a warm family environment to me as a lonely foreign student; Frank and Cynthia Kozin for advancing my understanding of mathematics in my youth; Helen Tu for typing up hundreds of job application letters; and the rest of my family members for their understanding and emotional support. I would like to thank Takeshi Amemiya and T.W. Anderson for being my lifelong mentors in

Preface to the Fourth Edition

xix

econometrics, and Dennis J. Aigner for his continuous support. I have also benefitted enormously from interactions with colleagues, collaborators, and friends, Jane Ayers, Pietro Balestra, Michael Binder, Badi Baltagi, Richard Blundell, Georges Bressons, Zongwu Cai, Luke M.W. Chan, Songnian Chen, H.S. Ching, In Choi, Hsinhsin Chou, Gregory Chow, Kannika Damronplasit, Hiroshi Fujiki, Ronald Gallant, Li Gan, Jiti Gao, John Geweke, John C. Ham, Toshihiko Hayashi, Yongmiao Hong, Arie Kapteyn, Xiao Ke, Kenneth C.W. Keng, Jae-Young Kim, Roger Klein, Roger Koenker, Chungming Kuan, Naoto Kunitomo, Ekaterini Kyriazidou, Lawrence J. Lau, Lungfei Lee, Lingfeng Li, Qi Li, Tong Li, Chongming Lin, Echu Liu, Esfandier Maasoumi, Jacques Mairesse, Michael McAleer, Roger H. Moon, Kimio Morimuni, Dean Mountain, Fred Nold, Jeffrey Nugent, Mario Tello Pacheco, Euston Quah, Scott Parris, Isabelle Perrigne, M. Hashem Pesaran, Dale J. Poirer, Geert Ridder, Peter M. Robinson, Patrick Seveste, Yan Shen, Baohong Sun, Kamil Tahmiscioglu, Derek Terrell, Kai Y. Tsui, Quang Vuong, Shui Ki Wan, Cindy SH Wang, Liqun Wang, Tongsan Wang, Yuenkang Wang, Thomas J. Wansbeek, Thomas Wilson, Zhiye Xiao, Fengbei Yau, Eden Yu, Shihti Yu, Arnold Zellner, Xueyen Zhao, and Qiankun Zhou. To all of them, I am eternally grateful.

