

Contents

<i>Preface to the Third Edition</i>	<i>page</i> xvii
<i>Preface to the Second Edition</i>	xix
<i>Preface to the First Edition</i>	xxi
1 Introduction	1
1.1 Introduction	1
1.2 Advantages of Panel Data	4
1.3 Issues Involved in Utilizing Panel Data	10
1.3.1 Unobserved Heterogeneity across Individuals and over Time	10
1.3.2 Incidental Parameters and Multidimensional Statistics	13
1.3.3 Sample Attrition	13
1.4 Outline of the Monograph	14
2 Homogeneity Tests for Linear Regression Models (Analysis of Covariance)	17
2.1 Introduction	17
2.2 Analysis of Covariance	18
2.3 An Example	24
3 Simple Regression with Variable Intercepts	31
3.1 Introduction	31
3.2 Fixed-Effects Models: Least-Squares Dummy Variable Approach	34
3.3 Random Effects Models: Estimation of Variance- Components Models	39
3.3.1 Covariance Estimation	40
3.3.2 Generalized Least-Squares (GLS) Estimation	41
3.3.3 Maximum-Likelihood Estimation	45

x	Contents	
3.4	Fixed Effects or Random Effects	47
3.4.1	An Example	47
3.4.2	Conditional Inference or Unconditional (Marginal) Inference	48
3.5	Tests for Misspecification	56
3.6	Models with Time- and/or Individual-Invariant Explanatory Variables and Both Individual- and Time-Specific Effects	58
3.6.1	Estimation of Models with Individual-Specific Variables	58
3.6.2	Estimation of Models with Both Individual and Time Effects	61
3.7	Heteroscedasticity and Autocorrelation	64
3.7.1	Heteroscedasticity	64
3.7.2	Models with Serially Correlated Errors	65
3.7.3	Heteroscedasticity Autocorrelation Consistent Estimator for the Covariance Matrix of the CV Estimator	68
3.8	Models with Arbitrary Error Structure – Chamberlain π -Approach	69
	Appendix 3A: Consistency and Asymptotic Normality of the Minimum-Distance Estimator	75
	Appendix 3B: Characteristic Vectors and the Inverse of the Variance–Covariance Matrix of a Three-Component Model	77
4	Dynamic Models with Variable Intercepts	80
4.1	Introduction	80
4.2	The CV Estimator	82
4.3	Random-Effects Models	84
4.3.1	Bias in the OLS Estimator	85
4.3.2	Model Formulation	86
4.3.3	Estimation of Random-Effects Models	89
4.3.4	Testing Some Maintained Hypotheses on Initial Conditions	106
4.3.5	Simulation Evidence	107
4.4	An Example	108
4.5	Fixed-Effects Models	111
4.5.1	Transformed Likelihood Approach	112
4.5.2	Minimum Distance Estimator	114
4.5.3	Relations between the Likelihood-Based Estimator and the GMM	116
4.5.4	Issues of Random versus Fixed-Effects Specification	119

Contents	xi
4.6 Estimation of Dynamic Models with Arbitrary Serial Correlations in the Residuals	121
4.7 Models with Both Individual- and Time-Specific Additive Effects	122
Appendix 4A: Derivation of the Asymptotic Covariance Matrix of Feasible MDE	129
Appendix 4B: Large N and T Asymptotics	130
5 Static Simultaneous-Equations Models	136
5.1 Introduction	136
5.2 Joint Generalized Least-Squares Estimation Technique	140
5.3 Estimation of Structural Equations	144
5.3.1 Estimation of a Single Equation in the Structural Model	144
5.3.2 Estimation of the Complete Structural System	149
5.4 Triangular System	152
5.4.1 Identification	153
5.4.2 Estimation	155
5.4.3 An Example	162
Appendix 5A	164
6 Variable-Coefficient Models	167
6.1 Introduction	167
6.2 Coefficients that Vary over Cross-Sectional Units	170
6.2.1 Fixed-Coefficient Model	170
6.2.2 Random-Coefficient Model	172
6.3 Coefficients that Vary over Time and Cross-Sectional Units	180
6.3.1 The Model	180
6.3.2 Fixed-Coefficient Model	182
6.3.3 Random-Coefficient Model	183
6.4 Coefficients that Evolve over Time	186
6.4.1 The Model	186
6.4.2 Predicting β_t by the Kalman Filter	188
6.4.3 Maximum-Likelihood Estimation	191
6.4.4 Tests for Parameter Constancy	192
6.5 Coefficients that Are Functions of Other Exogenous Variables	193
6.6 A Mixed Fixed- and Random-Coefficients Model	196
6.6.1 Model Formulation	196
6.6.2 A Bayes Solution	198
6.6.3 Random or Fixed Differences?	201
6.7 Dynamic Random-Coefficients Models	206
6.8 Two Examples	212

xii	Contents	
	6.8.1	Liquidity Constraints and Firm Investment Expenditure 212
	6.8.2	Aggregate versus Disaggregate Analysis 217
	6.9	Correlated Random-Coefficients Models 220
	6.9.1	Introduction 220
	6.9.2	Identification with Cross-Sectional Data 221
	6.9.3	Estimation of the Mean Effects with Panel Data 223
		Appendix 6A: Combination of Two Normal Distributions 228
7		Discrete Data 230
	7.1	Introduction 230
	7.2	Some Discrete-Response Models for Cross-Sectional Data 230
	7.3	Parametric Approach to Static Models with Heterogeneity 235
	7.3.1	Fixed-Effects Models 236
	7.3.2	Random-Effects Models 242
	7.4	Semiparametric Approach to Static Models 246
	7.4.1	Maximum Score Estimator 247
	7.4.2	A Root- N Consistent Semiparametric Estimator 249
	7.5	Dynamic Models 250
	7.5.1	The General Model 250
	7.5.2	Initial Conditions 252
	7.5.3	A Conditional Approach 255
	7.5.4	State Dependence versus Heterogeneity 261
	7.5.5	Two Examples 264
	7.6	Alternative Approaches for Identifying State Dependence 270
	7.6.1	Bias-Adjusted Estimator 270
	7.6.2	Bounding Parameters 274
	7.6.3	Approximate Model 276
8		Sample Truncation and Sample Selection 281
	8.1	Introduction 281
	8.2	An Example – Nonrandomly Missing Data 292
	8.2.1	Introduction 292
	8.2.2	A Probability Model of Attrition and Selection Bias 292
	8.2.3	Attrition in the Gary Income-Maintenance Experiment 296
	8.3	Tobit Models with Random Individual Effects 298
	8.4	Fixed-Effects Estimator 299
	8.4.1	Pairwise Trimmed Least-Squares and Least Absolute Deviation Estimators for Truncated and Censored Regressions 299

Contents	xiii
8.4.2 A Semiparametric Two-Step Estimator for the Endogenously Determined Sample Selection Model	311
8.5 An Example: Housing Expenditure	313
8.6 Dynamic Tobit Models	317
8.6.1 Dynamic Censored Models	317
8.6.2 Dynamic Sample Selection Models	324
9 Cross-Sectionally Dependent Panel Data	327
9.1 Issues of Cross-Sectional Dependence	327
9.2 Spatial Approach	329
9.2.1 Introduction	329
9.2.2 Spatial Error Model	332
9.2.3 Spatial Lag Model	333
9.2.4 Spatial Error Models with Individual-Specific Effects	334
9.2.5 Spatial Lag Model with Individual-Specific Effects	335
9.2.6 Spatial Dynamic Panel Data Models	336
9.3 Factor Approach	337
9.4 Group Mean Augmented (Common Correlated Effects) Approach to Control the Impact of Cross-Sectional Dependence	342
9.5 Test of Cross-Sectional Independence	344
9.5.1 Linear Model	344
9.5.2 Limited Dependent-Variable Model	348
9.5.3 An Example – A Housing Price Model of China	350
9.6 A Panel Data Approach for Program Evaluation	352
9.6.1 Introduction	352
9.6.2 Definition of Treatment Effects	352
9.6.3 Cross-Sectional Adjustment Methods	354
9.6.4 Panel Data Approach	359
10 Dynamic System	369
10.1 Panel Vector Autoregressive Models	370
10.1.1 “Homogeneous” Panel VAR Models	370
10.1.2 Heterogeneous Vector Autoregressive Models	377
10.2 Cointegrated Panel Models and Vector Error Correction	379
10.2.1 Properties of Cointegrated Processes	379
10.2.2 Estimation	381
10.3 Unit Root and Cointegration Tests	386
10.3.1 Unit Root Tests	386
10.3.2 Tests of Cointegration	394
10.4 Dynamic Simultaneous Equations Models	397
10.4.1 The Model	397

xiv	Contents	
	10.4.2 Likelihood Approach	398
	10.4.3 Method of Moments Estimator	401
11	Incomplete Panel Data	403
	11.1 Rotating or Randomly Missing Data	403
	11.2 Pseudo-Panels (or Repeated Cross-Sectional Data)	408
	11.3 Pooling of Single Cross-Sectional and Single Time Series Data	411
	11.3.1 Introduction	411
	11.3.2 The Likelihood Approach to Pooling Cross-Sectional and Time Series Data	413
	11.3.3 An Example	416
	11.4 Estimating Distributed Lags in Short Panels	418
	11.4.1 Introduction	418
	11.4.2 Common Assumptions	419
	11.4.3 Identification Using Prior Structure on the Process of the Exogenous Variable	421
	11.4.4 Identification Using Prior Structure on the Lag Coefficients	425
	11.4.5 Estimation and Testing	428
12	Miscellaneous Topics	430
	12.1 Duration Model	430
	12.2 Count Data Model	438
	12.3 Panel Quantile Regression	445
	12.4 Simulation Methods	448
	12.5 Data with Multilevel Structures	453
	12.6 Errors of Measurement	455
	12.7 Nonparametric Panel Data Models	461
13	A Summary View	464
	13.1 Benefits of Panel Data	464
	13.1.1 Increasing Degrees of Freedom and Lessening the Problem of Multicollinearity	464
	13.1.2 Identification and Discrimination between Competing Hypotheses	465
	13.1.3 Reducing Estimation Bias	467
	13.1.4 Generating More Accurate Predictions for Individual Outcomes	468
	13.1.5 Providing Information on Appropriate Level of Aggregation	468
	13.1.6 Simplifying Computation and Statistical Inference	469

Cambridge University Press

978-1-107-03869-1 - Analysis of Panel Data: Third Edition

Cheng Hsiao

Table of Contents

[More information](#)

Contents	xv
13.2 Challenges for Panel Data Analysis	469
13.2.1 Modeling Unobserved Heterogeneity	469
13.2.2 Controlling the Impact of Unobserved Heterogeneity in Nonlinear Models	470
13.2.3 Modeling Cross-Sectional Dependence	471
13.2.4 Multidimensional Asymptotics	472
13.2.5 Sample Attrition	472
13.3 A Concluding Remark	473
<i>References</i>	475
<i>Author Index</i>	507
<i>Subject Index</i>	513