
Contents

<i>Preface to the Second Edition</i>	<i>page</i> xiii
<i>Preface to the First Edition</i>	xv
Chapter 1. Introduction	1
1.1 Advantages of Panel Data	1
1.2 Issues Involved in Utilizing Panel Data	8
1.2.1 Heterogeneity Bias	8
1.2.2 Selectivity Bias	9
1.3 Outline of the Monograph	11
Chapter 2. Analysis of Covariance	14
2.1 Introduction	14
2.2 Analysis of Covariance	15
2.3 An Example	21
Chapter 3. Simple Regression with Variable Intercepts	27
3.1 Introduction	27
3.2 Fixed-Effects Models: Least-Squares Dummy-Variable Approach	30
3.3 Random-Effects Models: Estimation of Variance-Components Models	34
3.3.1 Covariance Estimation	35
3.3.2 Generalized-Least-Squares Estimation	35
3.3.3 Maximum Likelihood Estimation	39
3.4 Fixed Effects or Random Effects	41
3.4.1 An Example	41
3.4.2 Conditional Inference or Unconditional (Marginal) Inference	43
3.4.2.a Mundlak's Formulation	44
3.4.2.b Conditional and Unconditional Inferences in the Presence or Absence of Correlation between Individual Effects and Attributes	46

3.5 Tests for Misspecification	49
3.6 Models with Specific Variables and Both Individual- and Time-Specific Effects	51
3.6.1 Estimation of Models with Individual-Specific Variables	51
3.6.2 Estimation of Models with Both Individual and Time Effects	53
3.7 Heteroscedasticity	55
3.8 Models with Serially Correlated Errors	57
3.9 Models with Arbitrary Error Structure – Chamberlain π Approach	60
Appendix 3A: Consistency and Asymptotic Normality of the Minimum-Distance Estimator	65
Appendix 3B: Characteristic Vectors and the Inverse of the Variance–Covariance Matrix of a Three-Component Model	67
 Chapter 4. Dynamic Models with Variable Intercepts	69
4.1 Introduction	69
4.2 The Covariance Estimator	71
4.3 Random-Effects Models	73
4.3.1 Bias in the OLS Estimator	73
4.3.2 Model Formulation	75
4.3.3 Estimation of Random-Effects Models	78
4.3.3.a Maximum Likelihood Estimator	78
4.3.3.b Generalized-Least-Squares Estimator	84
4.3.3.c Instrumental-Variable Estimator	85
4.3.3.d Generalized Method of Moments Estimator	86
4.3.4 Testing Some Maintained Hypotheses on Initial Conditions	90
4.3.5 Simulation Evidence	91
4.4 An Example	92
4.5 Fixed-Effects Models	95
4.5.1 Transformed Likelihood Approach	96
4.5.2 Minimum-Distance Estimator	98
4.5.3 Relations between the Likelihood-Based Estimator and the Generalized Method of Moments Estimator (GMM)	99
4.5.4 Random- versus Fixed-Effects Specification	101
4.6 Estimation of Dynamic Models with Arbitrary Correlations in the Residuals	103
4.7 Fixed-Effects Vector Autoregressive Models	105
4.7.1 Model Formulation	105
4.7.2 Generalized Method of Moments (GMM) Estimation	107

4.7.3 (Transformed) Maximum Likelihood Estimator	109
4.7.4 Minimum-Distance Estimator	109
Appendix 4A: Derivation of the Asymptotic Covariance Matrix of the Feasible MDE	111
Chapter 5. Simultaneous-Equations Models	113
5.1 Introduction	113
5.2 Joint Generalized-Least-Squares Estimation Technique	116
5.3 Estimation of Structural Equations	119
5.3.1 Estimation of a Single Equation in the Structural Model	119
5.3.2 Estimation of the Complete Structural System	124
5.4 Triangular System	127
5.4.1 Identification	127
5.4.2 Estimation	129
5.4.2.a Instrumental-Variable Method	130
5.4.2.b Maximum-Likelihood Method	133
5.4.3 An Example	136
Appendix 5A	138
Chapter 6. Variable-Coefficient Models	141
6.1 Introduction	141
6.2 Coefficients That Vary over Cross-Sectional Units	143
6.2.1 Fixed-Coefficient Model	144
6.2.2 Random-Coefficient Model	144
6.2.2.a The Model	144
6.2.2.b Estimation	145
6.2.2.c Predicting Individual Coefficients	147
6.2.2.d Testing for Coefficient Variation	147
6.2.2.e Fixed or Random Coefficients	149
6.2.2.f An Example	150
6.2.3 Coefficients That Vary over Time and Cross-Sectional Units	151
6.3.1 The Model	151
6.3.2 Fixed-Coefficient Model	153
6.3.3 Random-Coefficient Model	153
6.3.4 Coefficients That Evolve over Time	156
6.4.1 The Model	156
6.4.2 Predicting β_t by the Kalman Filter	158
6.4.3 Maximum Likelihood Estimation	161
6.4.4 Tests for Parameter Constancy	162
6.3.5 Coefficients That Are Functions of Other Exogenous Variables	163
6.6 A Mixed Fixed- and Random-Coefficients Model	165
6.6.1 Model Formulation	165
6.6.2 A Bayes Solution	168
6.6.3 An Example	170

6.6.4 Random or Fixed Parameters	172
6.6.4.a An Example	172
6.6.4.b Model Selection	173
6.7 Dynamic Random-Coefficient Models	175
6.8 An Example – Liquidity Constraints and Firm Investment Expenditure	180
Appendix 6A: Combination of Two Normal Distributions	185
Chapter 7. Discrete Data	188
7.1 Introduction	188
7.2 Some Discrete-Response Models	188
7.3 Parametric Approach to Static Models with Heterogeneity	193
7.3.1 Fixed-Effects Models	194
7.3.1.a Maximum Likelihood Estimator	194
7.3.1.b Conditions for the Existence of a Consistent Estimator	195
7.3.1.c Some Monte Carlo Evidence	198
7.3.2 Random-Effects Models	199
7.4 Semiparametric Approach to Static Models	202
7.4.1 Maximum Score Estimator	203
7.4.2 A Root- N Consistent Semiparametric Estimator	205
7.5 Dynamic Models	206
7.5.1 The General Model	206
7.5.2 Initial Conditions	208
7.5.3 A Conditional Approach	211
7.5.4 State Dependence versus Heterogeneity	216
7.5.5 Two Examples	218
7.5.5.a Female Employment	218
7.5.5.b Household Brand Choices	221
Chapter 8. Truncated and Censored Data	225
8.1 Introduction	225
8.2 An Example – Nonrandomly Missing Data	234
8.2.1 Introduction	234
8.2.2 A Probability Model of Attrition and Selection Bias	235
8.2.3 Attrition in the Gary Income-Maintenance Experiment	238
8.3 Tobit Models with Random Individual Effects	240
8.4 Fixed-Effects Estimator	243
8.4.1 Pairwise Trimmed Least-Squares and Least-Absolute-Deviation Estimators for Truncated and Censored Regressions	243
8.4.1.a Truncated Regression	243
8.4.1.b Censored Regressions	249
8.4.2 A Semiparametric Two-Step Estimator for the Endogenously Determined Sample Selection Model	253

8.5 An Example: Housing Expenditure	255
8.6 Dynamic Tobit Models	259
8.6.1 Dynamic Censored Models	259
8.6.2 Dynamic Sample Selection Models	265
 Chapter 9. Incomplete Panel Data	268
9.1 Estimating Distributed Lags in Short Panels	268
9.1.1 Introduction	268
9.1.2 Common Assumptions	270
9.1.3 Identification Using Prior Structure of the Process of the Exogenous Variable	271
9.1.4 Identification Using Prior Structure of the Lag Coefficients	275
9.1.5 Estimation and Testing	277
9.2 Rotating or Randomly Missing Data	279
9.3 Pseudopanels (or Repeated Cross-Sectional Data)	283
9.4 Pooling of a Single Cross-Sectional and a Single Time-Series Data Set	285
9.4.1 Introduction	285
9.4.2 The Likelihood Approach to Pooling Cross-Sectional and Time-Series Data	287
9.4.3 An Example	288
 Chapter 10. Miscellaneous Topics	291
10.1 Simulation Methods	291
10.2 Panels with Large N and T	295
10.3 Unit-Root Tests	298
10.4 Data with Multilevel Structures	302
10.5 Errors of Measurement	304
10.6 Modeling Cross-Sectional Dependence	309
 Chapter 11. A Summary View	311
11.1 Introduction	311
11.2 Benefits and Limitations of Panel Data	311
11.2.1 Increasing Degrees of Freedom and Lessening the Problem of Multicollinearity	311
11.2.2 Identification and Discrimination between Competing Hypotheses	312
11.2.3 Reducing Estimation Bias	313
11.2.3.a Omitted-Variable Bias	313
11.2.3.b Bias Induced by the Dynamic Structure of a Model	315
11.2.3.c Simultaneity Bias	316
11.2.3.d Bias Induced by Measurement Errors	316

11.2.4 Providing Micro Foundations for Aggregate Data Analysis	316
11.3 Efficiency of the Estimates	317
<i>Notes</i>	319
<i>References</i>	331
<i>Author Index</i>	353
<i>Subject Index</i>	359