

Principles of Econometrics

A Modern Approach Using EViews

Sankar Kumar Bhaumik

OXFORD
UNIVERSITY PRESS

Contents

Lists of Tables, Figures, and Screenshots

Preface

1. Scope and Methodology of Econometrics

- 1.1 What is Econometrics?/1
- 1.2 Brief History of Econometrics/3
- 1.3 Methodology of Econometrics/4
 - Hypothesis/5
 - Model Specification/5
 - Estimation/6
 - Verification or Inference/6
 - Forecasting and Policy Formulation/6
- 1.4 Necessary Assumptions for Estimation/7
 - Probability Distribution of YJ8
- 1.5 Data for Econometric Analysis/8
 - Cross-Sectional Data/8
 - Time Series Data/9
 - Panel Data/9
 - Experimental and Non-experimental Data/9
 - Sources of Data/10
- 1.6 About EViews Software Package/10
 - A Glimpse of the Main Window of EViews 8/12
- 1.7 Questions/12

2. The Simple Linear Regression Model

- 2.1 Definition/15
- 2.2 Specification and Assumptions/16
- 2.3 OLS Estimation/18
- 2.4 Properties of OLS Regression Line/20
- 2.5 Properties of Estimators/24
 - Small Sample Properties/24
 - Large Sample or Asymptotic Properties/25

Contents

- 2.6 Properties of OLS Estimators/26
 - Unbiasedness of β /27
 - Linearity of β /28
 - Minimum Variance or Bestness for β /28
- 2.7 Statistical Inference in SLRM/30
 - Hypothesis Testing/31
 - One-Tailed Test/33
 - Confidence Intervals/34
 - The p -value Approach/34
- 2.8 Measuring Goodness of Fit/35
- 2.9 Analysis of Variance on OLS Regression/36
- 2.10 Some Relations in the Context of SLRM/37
 - Relation between Regression Slope and Correlation Coefficient/37
 - Relation between F -statistic and r^2 /37
 - Relation between F and t^2 /38
 - Relation between r^2 and f -statistic/39
- 2.11 Regression without Intercept Term/39
 - Hypothesis Testing/40
 - Goodness of Fit/41
- 2.12 Reverse Regression/41
 - An Important Result/42
- 2.13 Outliers/42
- 2.14 Estimation of SLRM Using EViews/43
 - Presentation of Regression Results/44
 - Interpretation of Regression Results/46
- 2.15 Questions and Assignments/46

The Multiple Linear Regression Model

- 3.1 Definition/55
- 3.2 Specification and Assumptions/56
- 3.3 OLS Estimation/56
- 3.4 Properties of OLS Estimators/58
- 3.5 Measuring Goodness of Fit/58
- 3.6 Some Problems of Inference in MLRM/62
 - Testing Significance of Individual Regression Coefficients/63
 - Testing the Overall Significance of Regression/63
 - Testing Relevance of an Additional Explanatory Variable/65
 - Testing Validity of Linear Equality Restriction/66

- 3.7 The Likelihood Ratio, Wald, and Lagrange Multiplier Tests/68
- 3.8 Implications of Some Frequently Observed Cases in MLRM/70
- 3.9 Multiple Regression Exercises Using EViews/70
 - Steps in EViews/71
 - Omitted Variable Test /73
 - Redundant Variable Test /74
 - The Wald Test of Coefficient Restrictions **III**
- 3.10 Questions and Assignments/77
- Appendix 3.1: The General Linear Model/82
 - BLUE Properties/86
- Appendix 3.2: Maximum Likelihood Estimation Method/89

4. Heteroskedasticity

92

- 4.1 Definition/92
 - Sources of Heteroskedasticity/93
- 4.2 Consequences of Heteroskedasticity/95
 - Unbiasedness/96
 - Bestness/96
 - Consistency/97
- 4.3 Detection of Heteroskedasticity/98
 - Graphical Approach/98
 - Algebraic Tests/99
 - Breusch-Pagan-Godfrey Test/99
 - Glejser Test/100
 - Goldfeld-Quandt Test/100
 - Whites Test/101
- 4.4 Remedial Measures/102
 - Measures Based on a Specific Idea about the Form of Heteroskedasticity/102
 - Generalized Least Squares/102
 - Weighted Least Squares/104
 - Heteroskedasticity-Consistent Estimator/105
 - General Measures/105
- 4.5 Applications Using EViews/106
 - Tests of Heteroskedasticity/106
 - Estimation of White's Heteroskedasticity-Consistent Standard Errors/110
 - Weighted Least Squares Estimation/111

4.6	Questions and Assignments/112	
	Appendix 4.1: Effect of Heteroskedasticity on the Variance-Covariance Matrix of Disturbance Term of the General Linear Model/117	
5.	Autocorrelation	119
5.1	Definition/119	
	Sources of Autocorrelation/120	
5.2	Specification of Autocorrelation Relationship/120	
5.3	Consequences of Autocorrelation/123	
	Unbiasedness/124	
	Bestness/125	
	Consistency/125	
5.4	Tests for Autocorrelation/126	
	Graphical Approach/126	
	Durbin-Watson (1951) Test/127	
	Theil-Nagar Correction to Durbin-Watson cf-statistic/129	
	Durbin's (1970) fo-test/129	
	Breusch-Godfrey Lagrange Multiplier Test/130	
5.5	Remedial Measures /131	
	When the Value of ρ Is Known/131	
	When the Value of ρ Is Unknown/132	
	Cochrane-Orcutt Iterative Procedure/132	
	Hildreth-Lu Search Procedure/133	
	Heteroskedasticity and Autocorrelation Consistent (HAC) Standard Errors/133	
5.6	Applications Using EViews/134	
	The Durbin-Watson Test/134	
	The Breusch-Godfrey (BG) Test/134	
	Estimation of Model Using the Iterative Method/135	
	OLS Regression with HAC Standard Errors/138	
5.7	Questions and Assignments/138	
	Appendix 5.1: Effect of Autocorrelation on the Variance-Covariance Matrix of Disturbance Term of the General Linear Model/142	
6.	Multicollinearity	144
6.1	Definition/144	
	Sources of Multicollinearity/145	

Contents

- 6.2 Consequences of Multicollinearity/145
 - Case I: Absence of Multicollinearity ($r^*_2 = 0$)/147
 - Case II: Perfect Multicollinearity ($r^*_2 = 1$)/147
 - Case III: Imperfect Multicollinearity ($r^*_2 < 1$)/148
- 6.3 Tests for Multicollinearity/149
 - Correlation Analysis/149
 - Kleins Rule of Thumb/150
 - Variance-Inflation Factor (VIF)/150
 - Tolerance (TOL)/151
 - Condition Number (CN)/152
- 6.4 Remedial Measures/153
 - Increasing Sample Size/153
 - Transformation of Variables/153
 - Using Extraneous Estimate/153
 - Dropping Variables/153
 - Other Methods/156
- 6.5 Multicollinearity Tests Using EViews/156
 - Correlation Matrix/157
 - Computation of VIFs/159
 - Coefficient Variance Decomposition/159
 - An Illustration Using Indian Data/160
- 6.6 Questions and Assignments/163

Dummy Variables

- 7.1 Definition/167
- 7.2 Simple Regression Model with Dummy Variable/167
 - Dummy Variables for Multiple Categories/168
 - Important Points to Remember/169
- 7.3 Interaction Dummy/170
- 7.4 Comparing Two Regressions/171
 - Illustrative Examples/176
 - The Chow Test in EViews/183
- 7.5 Models with Dummy Dependent Variable/184
 - Linear Probability Model (LPM)/185
 - Logit Model/188
 - Probit Model/192
 - Comparison between Logit and Probit Models/193
 - The Problem of Disproportionate Sampling/194

Contents

- 7.6 Measuring Goodness of Fit/194
 - Effrons R^2 /195
 - McFadden's Pseudo- R^2 /195
- 7.7 Examining the Overall Significance of Regression/196
- 7.8 Estimation of Logit and Probit Models Using EViews/196
 - Steps/196
 - An Illustration/197
 - Computation of Marginal Effects/198
- 7.9 Questions and Assignments/200

Distributed Lag Models

- 8.1 Definition and Specification/207
- 8.2 Geometric Lag Approach/208
- 8.3 Estimation of Geometric Lag Model: The Koyck Method/208
 - Advantages of the Koyck Method/209
 - Problems of the Koyck Method/209
 - Median and Mean Lags in Koyck Model/211
 - Short-Run and Long-Run Multipliers/212
- 8.4 Adaptive Expectations Model/212
 - Estimation of AEM/213
 - The Other Problem of AEM/214
- 8.5 Partial Adjustment Model/215
- 8.6 Almon's Polynomial Lag Model/216
 - Merits and Demerits of the Almon Approach/219
- 8.7 Applications Using EViews/219
 - Estimation of the Koyck Model/219
 - Interpretation of Results of the Koyck Model/220
 - Estimation of Partial Adjustment Model/222
 - Interpretation of Results of Partial Adjustment Model/224
- 8.8 Questions and Assignments/225

Panel Data Regression Models

- 9.1 Definition and Usefulness/228
 - Types of Panel Data/229
 - Usefulness of Panel Data/229
- 9.2 Panel Data Models/232
 - The Constant Coefficients Model (CCM)/232
 - The Fixed-Effects Model/233
 - The Random Effects Model/238

Contents

- 9.3 Choosing between FEM and REM: The Hausman Test/240
- 9.4 Estimation of Panel Regression Models Using EViews/241
 - Organizing Data/241
 - Importing Data from Excel Worksheet/241
 - Resetting the Workfile Structure/241
 - Estimating Panel Regression Models/241
 - Obtaining Series for Fixed/Random Effects/245
 - Choosing between OLS Model and Fixed Effects Model:
Fixed Effects Testing/245
 - Estimating Random Effects Model/245
 - Choosing between Fixed Effects Model and Random
Effects Model/245
- 9.5 Interpretation of Panel Regression Results/245
- 9.6 Questions and Assignments/249

10. Time Series Econometrics

- 10.1 Background/258
- 10.2 Some Important Concepts/259
 - Stochastic Process/259
 - Stationary Stochastic Process/259
 - Purely Random or White Noise Stochastic Process/261
 - Non-stationary Stochastic Process or Random Walk/261
 - Random Walk without Drift/261
 - Random Walk with Drift/262
 - Unit Root Stochastic Process/263
- 10.3 Tests for Stationarity/264
 - Graphical Approach/264
 - Autocorrelation Function (ACE) and Correlogram/264
 - Unit Root Test/265
 - Dickey-Fuller (1979) Test/266
 - Augmented Dickey-Fuller (ADF) Test/267
 - Phillips-Perron (PP) Test/268
 - Sources of Non-stationarity/270
 - Limitations of Unit Root Test/272
- 10.4 Spurious Regression Problem/272
 - How to Avoid Spurious Regression Problem?/272

- 10.5 Cointegration and Error Correction Mechanism/273
 - Engle-Granger (EG) Cointegration Test/274
 - Error Correction Mechanism (ECM)/275
- 10.6 ARIMA Forecasting/276
 - AR, MA, and ARMA Modelling of Time Series Data/277
 - The Box-Jenkins (Bj) Methodology/280
 - Steps in BJ Methodology/282
 - Merit and Demerit of the BJ Methodology/283
- 10.7 Vector Autoregressive (VAR) Model/283
 - Specification of the VAR Model/284
 - Estimation of the VAR Model/284
 - Forecasting with VAR/285
 - Vector Error Correction Model/285
 - Impulse Response Analysis/286
 - Variance Decomposition/286
 - Merits and Demerits of VAR/287
- 10.8 Causality Tests/288
 - Granger Causality Test/288
 - Sims Causality Test/290
 - Granger Causality in VAR/290
- 10.9 ARCH/GARCH for Modelling Volatility/291
 - The ARCH Model/292
 - The GARCH Model/293
- 10.10 Applications Using EViews/294
 - Stationarity Tests/294
 - Estimation of Cointegrating Regression and the ECM/299
 - ARIMA (BJ) Forecasting/302
 - Evaluation of Forecasts/308
 - Estimation of VAR Model/310
 - Testing Granger Causality in VAR Model/313
 - Usefulness of Estimated VAR Model/314
 - Forecasting with VAR Model/320
 - Testing of ARCH Effect/321
 - Graphical Presentation of Volatility Clustering/321
 - Estimation of ARCH Model/329
 - Estimation of GARCH Model/331
- 10.11 Questions and Assignments/332

11. Simultaneous Equations System	338
11.1 Single Equation versus Simultaneous Equations System/338	
Features of Simultaneous Equations System/338	
An Example of Simultaneous Equations System (SES)/339	
Simultaneous versus Recursive Systems/339	
11.2 OLS Estimation of SES: Consequence of Ignoring Simultaneity/340	
11.3 Structural and Reduced Form Equations/341	
11.4 Identification Problem/343	
Rules of Identification/346	
An Application of Rules of Identification/348	
11.5 Estimation of Simultaneous Equations System/349	
Indirect Least Squares (ILS)/350	
Two-Stage Least Squares (2SLS)/352	
11.6 Application of 2SLS Using EViews/353	
Interpretation of Results/356	
11.7 Questions and Assignments/358	
Appendix 11.1: Algebraic Derivation of Rules of Identification/363	
General Appendix: Review of Some Statistical Concepts	367
Statistical Tables	383
References	394
Index	399
About the Author	412