Preface

There is no doubt that the environment is one of the greatest challenges faced by policymakers today. The key issues addressed by environmental sciences are often empirical. In many instances, very detailed, sizable datasets are available. Researchers in this field, including those in academe, research bodies, and government agencies, should have a solid understanding of the econometric tools best suited for analysis of these data.

Of course, there exist complex and expensive physical models of the environment that deal with many of the problems addressed in this book, such as pollution, temperature, greenhouse gas emissions, and sea levels to name but a few. However, it is becoming increasingly clear, through the increased involvement of econometricians in environmental issues that reduced-form models have a role to play not only in modeling environmental phenomena but also in producing point and density forecasts. In short, successful environmental modeling does not necessarily require a structural model, but it does require that the econometrics underlying the reduced-form approaches is competently done. This provides the essential raison d'être for the book.

This book is designed to introduce environmental researchers to a broad range of econometric techniques that can be effectively applied to environmental data. The study of environmental issues is inherently interdisciplinary, encompassing the physical sciences, economics, sociology, political science, and public health. Researchers in these fields are likely to have some statistical training, and an understanding of basic statistical concepts is presumed. The development of modern econometrics, coupled with increasing computational capability to process sizable datasets, has broadened our ability to study environmental data using powerful analytical and graphical tools.

Although our focus is on applied econometric techniques appropriate for the analysis of environmental data, we expect this book to be widely used. We believe that the potential audience includes economists at the undergraduate, graduate, and professional levels in academia, research institutes, consulting firms, government agencies, and international organizations. Our approach provides a gentle introduction to the most widely used econometric tools, which should serve to address the needs of those who may have only seen econometrics at an undergraduate level, such as those in public policy programs. We not only emphasize how to fit models in Stata but also highlight the need for using a wide range of diagnostic tests to validate the results of estimation and subsequent policy conclusions. This emphasis on careful, reproducible research should be appreciated by academic and non-academic researchers who are seeking to produce credible, defensible conclusions about key issues in environmental science.

Although appendix A provides a brief guide to using Stata effectively, thus book assumes that the reader is familiar with Stata's command line interface and elementary concepts of Stata programming such as do-files and data management facilities. An understanding of basic linear regression techniques will also be helpful but is not essential, because the book covers the basic building blocks of modern econometrics. More advanced econometric methods are also introduced, interspersing presentation of the underlying theory with clear examples of their employment on environmental data. In contrast with many existing econometric textbooks that deal mainly with the theoretical properties of estimators and test statistics, this book addresses the implementation issues that arise in the computational aspects of applied econometrics. The computer code that is provided will also help to bridge the gap between theory and practice so that the reader, as a result, can build on the code and tailor it to more challenging applications.

Organization

Although not specifically designated as such, the material presented in this book falls naturally into two parts. Chapters 1 to 8 provide a first course in applied environmental econometrics. These chapters cover the basic building blocks upon which the rest of the book is based, including the usual regression framework taught in standard econometric courses but always related to the modeling of environmental data. Chapter 2 describes the workhorse of applied econometrics, the linear regression model, while chapter 3 covers additional important estimation methods beyond the simple least-squares method. Chapter 4 extends the single-equation model to include dynamic components, while chapter 5 considers multiple time-series models, particularly vector autoregression and structural vector autoregression. The next two chapters develop the tools to deal with nonstationary data. Chapter 6 presents a range of tests for nonstationarity, known as unit-root tests. Chapter 7 discusses the extension of nonstationarity to deal with multiple time series and the idea of cointegrated systems. The last chapter in the first part of the book is chapter 8, which deals with forecasting methods and evaluation of forecast accuracy. Our philosophy is to make the treatment accessible by avoiding, wherever possible, the use of matrix algebra and potentially confusing notation. Where the use of this kind of notation is unavoidable, our intention is to provide as much intuition as possible.

The second part of the book comprises chapters 9 to 15 and relates to important econometric methods that may be of particular interest to empirical environmental studies. These chapters could form the core of a second course in applied environmental econometrics, and the level of difficulty steps up slightly. The first three chapters deal with techniques aimed at dealing with the nonlinear behavior that characterizes many environmental data series. Consequently, chapter 9 presents unobserved component models that decompose a given time series into its unobserved components, chapter 10 covers models that exhibit fundamental nonlinearity in mean, such as threshold models and Markov switching models, and chapter 11 deals with models that are nonlinear in variance and display what is known as volatility clustering. The remaining four

chapters are perhaps best described as topics in applied environmental econometrics. Chapter 12 illustrates selected models for longitudinal data, taking advantage of the multiple measurements of environmental series, such as climate conditions. Chapter 13 is concerned with models for data that are measured at different geographical locations and covers the estimation of models that are characterized by spatial effects. Chapter 14 presents a selection of limited dependent variable models, focusing on the modeling of willingness to pay for environmental preservation and mitigation. Chapter 15 presents models of fractional integration and cointegration, which were first studied in hydrology and biological processes.

The Stata code and datasets to reproduce all the examples in the book are available from a companion website. One of the features of this book is that each chapter has several nontrivial exercises that not only reinforce the material covered in the chapter but also extend it. Code to solve the exercises at the end of each chapter is also available.