1 Introduction

Nigar Hashimzade and Michael A. Thornton

This volume is part of the new series of Handbooks of Research Methods and Applications in the Social Sciences, compiled under the editorship of Mark Casson. While these Handbooks engage with general issues of research methodology, their primary focus is on the practical issues surrounding best-practice techniques and real world applications.

This Handbook provides a systematic account of a range of research methods in empirical macroeconomics. It is intended as a reference for graduate students and researchers interested in exploring new methodologies, but could also be deployed as a graduate text. The Handbook concentrates on the most important issues, models and techniques for research in macroeconomics. Each chapter highlights the key methodologies and their empirical application in an accessible way. The chapters are largely self-contained, and some background and key statistical concepts and methods are reviewed in the opening chapter. Given the breadth and the significance of the topics covered in the Handbook, no single chapter could claim to be comprehensive, but the chapters include the key references for each topic and provide a sound guide for further reading.

Distinctive features of the Handbook are:

- coverage of a wide range of methodologies from the well-established to relatively recent advances;
- a particular focus on examples illustrating the application of these methodologies to macroeconomic problems and datasets;
- the availability of resources and computer programs through a supporting website.

The opening chapter of the Handbook introduces the reader to the basic theoretical concepts of stochastic processes and stationarity. The chapter also presents a number of univariate and multivariate models that are useful for the analysis of macroeconomic data, and describes three most commonly used estimation methods: method of moments, generalized method of moments, and maximum likelihood. These models and estimation methods are further developed in greater detail with examples of application in later chapters. The first three sections of the volume set out a general theoretical framework, while also covering some important examples from macroeconomic research, whereas the remaining three sections focus on practical applications, providing further theoretical background where needed. Part I of the Handbook (Chapters 3, 4 and 5) describes the specific properties of macroeconomic data that require modelling and analysis differing from that typically applied in other fields of economics and the social sciences. The decomposition of a time series into trends and cycles, and the identification of unit roots, structural breaks and various non-linearities are presented in Chapters 3 and 4,
whereas Chapter 5 introduces the theory of filtering, or isolating the components of data that are of particular interest (the signal), whilst removing the unwanted components (the noise).

Part II (Chapters 6 to 13) presents a number of fundamental models for macroeconomic data analysis. A detailed treatment of the vector autoregressive (VAR) modelling technique, from model specification and estimation to the structural analysis and forecasting, is given in Chapter 6. Chapter 7 introduces the concept of cointegration and describes the error correction approach to the modelling of non-stationary data. A set of threshold type regime switching models are described in Chapter 8; this approach is relevant when it can be assumed that the model parameters change once an economy experiences a change in regime, for example, following a policy intervention, while remaining constant within each regime. Econometric tests for instability in parameters and in the functional form of a model are presented in Chapter 9. Dynamic panel data models, introduced in Chapter 10, provide the advantage of accounting for heterogeneity across, say, countries, as well as for the dynamic nature of the relationships between economic variables. An overview of the dynamic factor analysis of large macroeconomic panel datasets is given in Chapter 11. Modelling data that exhibit conditional heteroskedasticity is commonly associated with the financial data analysis; Chapter 12 shows how this framework can be usefully applied to study the links between uncertainties in macroeconomic variables. Chapter 13 concludes this section by addressing a fundamental issue of temporal aggregation in time series and discussing, in particular, the implications of temporal aggregation in macroeconomic data for testing popular macroeconomic theories.

Part III (Chapters 14 to 17) presents the theoretical frameworks for estimation and evaluation of macroeconometric models. Chapter 14 describes in detail the generalized method of moments (GMM), arguably the most convenient and general way of estimation of an economic model that can be equally applied in a variety of frameworks. Maximum likelihood (ML) estimation and inference is presented in Chapter 15, as part of a detailed treatment of state space models in macroeconomics. Chapter 16 introduces Bayesian methods, as an alternative to the GMM and the ML estimation that has been gaining popularity in applied macroeconomic research with the development of powerful computers. Often researchers in empirical macroeconomics are interested in selecting, among competing models, the one that generates the most accurate forecast of the future values of economic variables. A review of traditional and modern methods of evaluation of the accuracy of forecasts, which are robust to instabilities, is provided in Chapter 17, along with the macroeconomic applications.

Part IV (Chapters 18 to 21) gives a detailed exposition of one important application of the theoretical and empirical methods developed in the previous sections, the dynamic stochastic general equilibrium (DSGE) framework. Currently, this framework is, perhaps, the most widely employed by academics and practitioners in the field of macroeconomics. Chapter 18 presents the building blocks of the New Keynesian (NK) DSGE model and describes how the Bayesian estimation methodology is applied in this framework. Chapter 19 provides a discussion of model comparison and validation, as well as the application of this framework for policy analysis. The application of two estimation methodologies for the DSGE models, Bayesian estimation and the GMM estimation, with an extension to the simulated method of moments (SMM), are developed.
in greater detail in Chapters 20 and 21, using an alternative version of the NK DSGE model.

Part V (Chapters 22 and 23) presents the application of the VAR as an alternative methodology for the macroeconomic modelling and policy analysis. Chapter 22 develops the structural VAR approach, presenting various methods for identification and discussing the relationship between the structural VAR and the DSGE framework. A number of examples of macroeconomic policy analysis in the VAR framework are developed in Chapter 23.

Part VI (Chapters 24 and 25), the final section of the volume, is dedicated to the calibration, simulation and estimation of macroeconomic models. Chapter 24 gives a detailed and careful description of the procedure for calibration and simulation using the neoclassical growth model as an example. Chapter 25 introduces Dynare, software (http://www.dynare.org) widely used for the simulation and estimation of macroeconomic models of the DSGE type, with detailed instruction from installation to writing a code for Bayesian estimation for a simple real business cycle model using macroeconomic data for the US.

Each chapter in this volume is an original contribution by a leading authority in the field.