

# Estimating Macroeconomic Models: A Likelihood Approach

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This paper shows how particle filtering facilitates likelihood-based inference in dynamic macroeconomic models. The economies can be non-linear and/or non-normal. We describe how to use the output from the particle filter to estimate the structural parameters of the model, those characterizing preferences and technology, and to compare different economies. Both tasks can be implemented from either a classical or a Bayesian perspective. We illustrate the technique by estimating a business cycle model with investment-specific technological change, preference shocks, and stochastic volatility.

## 1. INTRODUCTION

This paper shows how particle filtering facilitates likelihood-based inference in dynamic equilibrium models. The economies can be non-linear and/or non-normal. We describe how to use the particle filter to estimate the structural parameters of the model, those characterizing preferences and technology, and to compare different economies. Both tasks can be implemented from either a classical or a Bayesian perspective. We illustrate the technique by estimating a business cycle model with investment-specific technological change, preference shocks, and stochastic volatility. We highlight three results. First, there is strong evidence of stochastic volatility on U.S. aggregate data. Second, two periods of low and falling aggregate volatility, from the late 1950's to the late 1960's and from the mid 1980's to today, were interrupted by a period of high and rising aggregate volatility from the late 1960's to the early 1980's. Third, variations in the volatility of preferences and investment-specific technological shocks account for most of the variation in the volatility of output growth over the last 50 years.

Likelihood-based inference is a useful tool to take dynamic equilibrium models to the data (An and Schorfheide, 2007). However, most dynamic equilibrium models do not imply a likelihood function that can be evaluated analytically or numerically. To circumvent this problem, the literature has used the approximated likelihood derived from a linearized version of the model, instead of the exact likelihood. But linearization depends on the accurate approximation of the solution of the model by a linear relation and on the shocks to the economy being distributed normally. Both assumptions are problematic.

First, the impact of linearization is grimmer than it appears. Fernández-Villaverde, Rubio-Ramírez and Santos (2006) prove that second-order approximation errors in the solution of the model have first-order effects on the likelihood function. Moreover, the error in the approximated likelihood gets compounded with the size of the sample. Period by period, small errors in the policy function accumulate at the same rate at which the sample size grows. Therefore,

# Estimating Dynamic Economic Models With Non Parametric

**Tao Wei**



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**Applied Nonparametric Econometrics** Daniel J. Henderson, Christopher F. Parmeter, 2015-01-12 The majority of empirical research in economics ignores the potential benefits of nonparametric methods while the majority of advances in nonparametric theory ignore the problems faced in applied econometrics This book helps bridge this gap between applied economists and theoretical nonparametric econometricians It discusses in depth and in terms that someone with only one year of graduate econometrics can understand basic to advanced nonparametric methods The analysis starts with density estimation and motivates the procedures through methods that should be familiar to the reader It then moves on to kernel regression estimation with discrete data and advanced methods such as estimation with panel data and instrumental variables models The book pays close attention to the issues that arise with programming computing speed and application In each chapter the methods discussed are applied to actual data paying attention to presentation of results and potential pitfalls

*Applied Bayesian Modelling* Peter Congdon, 2014-05-23 This book provides an accessible approach to Bayesian computing and data analysis with an emphasis on the interpretation of real data sets Following in the tradition of the successful first edition this book aims to make a wide range of statistical modeling applications accessible using tested code that can be readily adapted to the reader's own applications The second edition has been thoroughly reworked and updated to take account of advances in the field A new set of worked examples is included The novel aspect of the first edition was the coverage of statistical modeling using WinBUGS and OPENBUGS This feature continues in the new edition along with examples using R to broaden appeal and for completeness of coverage

[Analysis of Panel Data](#) Cheng Hsiao, 2022-07-07 Now in its fourth edition this comprehensive introduction of fundamental panel data methodologies provides insights on what is most essential in panel literature A capstone to the forty year career of a pioneer of panel data analysis this new edition's primary contribution will be the coverage of advancements in panel data analysis a statistical method widely used to analyze two or higher dimensional panel data The topics discussed in early editions have been reorganized and streamlined to comprehensively introduce panel econometric methodologies useful for identifying causal relationships among variables supported by interdisciplinary examples and case studies This book to be featured in Cambridge's Econometric Society Monographs series has been the leader in the field since the first edition It is essential reading for researchers practitioners and graduate students interested in the analysis of microeconomic behavior

**Inferences from Parametric and Non-parametric Covariance Matrix Estimation Procedures** Wouter J. Den Haan, Andrew T. Levin, 1996 In this paper we propose a parametric spectral estimation procedure for constructing heteroskedasticity and autocorrelation consistent HAC covariance matrices We establish the consistency of this procedure under very general conditions similar to those considered in previous research and we demonstrate that the parametric estimator converges at a faster rate than the kernel based estimators proposed by Andrews and Monahan 1992 and Newey and West 1994 In finite samples our Monte Carlo

experiments indicate that the parametric estimator matches and in some cases greatly exceeds the performance of the prewhitened kernel estimator proposed by Andrews and Monahan 1992 These simulation experiments illustrate several important limitations of non parametric HAC estimation procedures and highlight the advantages of explicitly modeling the temporal properties of the error terms Wouter J den Haan Andrew Levin Depa **Handbook of Production Economics** Subhash C. Ray, Robert G. Chambers, Subal C. Kumbhakar, 2022-06-02 This three volume handbook includes state of the art surveys in different areas of neoclassical production economics Volumes 1 and 2 cover theoretical and methodological issues only Volume 3 includes surveys of empirical applications in different areas like manufacturing agriculture banking energy and environment and so forth **Journal of Economic Dynamics & Control** ,2003 **Semiparametric Dynamic Panel Data Model** Subodh Kumar, 2000 **Principles and Challenges of Fundamental Methods in Veterinary Epidemiology and Economics** Salome Dürr, Victoria J. Brookes, Andres M. Perez, 2021-08-09 **Chaos and Non-linear Models in Economics** John Creedy, Vance Martin, 1994 Non linear models are increasingly being applied to phenomena that are otherwise very difficult to model such as financial markets economic growth agricultural price cycles business cycles diffusion processes and overlapping generation models Chaos and Non Linear Models in Economics makes important advances in the theory and application of non linear modelling accessible to advanced students The contributions to this volume include both introductory chapters which review the fundamental theoretical and statistical characteristics of non linear models and keep the use of mathematics to a minimum and chapters which introduce more sophisticated techniques

**Journal of the American Statistical Association** ,2007 A scientific and educational journal not only for professional statisticians but also for economists business executives research directors government officials university professors and others who are seriously interested in the application of statistical methods to practical problems in the development of more useful methods and in the improvement of basic statistical data *ASSP Spectrum Estimation Workshop II* IEEE Acoustics, Speech, and Signal Processing Society, 1983 **Reviews in Public Health Expenditure and Performance** Hai Fang, 2025-04-11 Effective allocation and utilization of resources are fundamental to achieving optimal public health outcomes Health economics provides valuable insights into how financial resources are allocated across different healthcare sectors and their subsequent effects on health indicators and health related quality of life By conducting in depth reviews of existing research and policy evaluations on public health expenditure and their performance this Research Topic aims to shed light on best practices challenges and innovative approaches to optimize public health expenditure for maximum impact Potential topics for review articles may include but are not limited to Review of health economic evaluation methods applied to public health interventions including cost effectiveness cost benefit cost utility analyses and budget impacts Assessment of the relationship between public health expenditure and health outcomes including the impact on disease prevention healthcare access and quality of life Evaluation of health financing systems and their influence on healthcare equity and

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**Journal of Economic Literature** ,1994 ASSP Spectrum Estimation Workshop ,1983 **Econometric Analysis of Panel Data** Badi H. Baltagi,1995 This text provides students with a comprehensive assessment of the latest panel data techniques especially for serial correlation heteroscedasticity simultaneous equations dynamic models and incomplete panels The author proceeds from single to simultaneous equation methods

**Genetic Programming 1997** John R. Koza,1997 *Non-linearities Over the Business Cycles* Pablo Mejía Reyes,2001 **SSRI Reprint Series** University of Wisconsin--Madison. Social Systems Research Institute, **Intelligent Systems for Finance and Business** Suran Goonatilake,Philip C. Treleaven,1995 Intelligent Systems for Finance and Business Edited by Suran Goonatilake and Philip Treleaven A new generation of computing methods commonly known as intelligent systems are now beginning to be successfully applied in a variety of business and financial modelling tasks and in many cases are outperforming traditional statistical techniques Intelligent Systems for Finance and Business provides comprehensive coverage of the latest intelligent systems including genetic algorithms neural networks fuzzy logic expert systems rule induction genetic programming case based reasoning and intelligent hybrid systems The authors clearly illustrate theories with practical case studies drawn from a wide variety of business sectors such as credit evaluation direct marketing insider dealing detection insurance fraud detection insurance claims processing financial trading portfolio management economic modelling Written by leading professionals from the US Europe and Asia who have developed intelligent systems to tackle some of the most challenging problems in finance and business this book will be a valuable source of information for traders analysts researchers and computing personnel in investment banking retailing marketing financial services insurance and regulation

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