

Financial Econometrics

Second edition

Peijie Wang

Routledge Advanced Texts in Economics and Finance

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Financial Econometrics

Set against a backdrop of rapid expansions of interest in the modelling and analysis of financial data and the problems to which they are applied, this textbook, now in its second edition, offers an overview and discussion of the contemporary topics surrounding financial econometrics, covering all major developments in the area in recent years in an informative and succinct way

Extended from the first edition of mainly time series modelling, the new edition also takes in discrete choice models, estimation of censored and truncated samples, as well as panel data analysis that has witnessed phenomenal expansion in application in finance and financial economics since the publication of the first edition of the book. Virtually all major topics on time series, cross-sectional and panel data analysis have been dealt with. Subjects covered include

- unit roots, cointegration and other comovements in time series
- time varying volatility models of the GARCH type and the stochastic volatility approach
- analysis of shock persistence and impulse responses
- Markov switching
- present value relations and data characteristics
- state space models and the Kalman filter
- frequency domain analysis of time series
- limited dependent variables and discrete choice models
- truncated and censored samples
- panel data analysis

Refreshingly, every chapter has a section of two or more examples and a section of empirical literature, offering the reader the opportunity to practise right away the kind of research going on in the area. This approach helps the reader develop interest, confidence and momentum in learning contemporary econometric topics.

Graduate and advanced undergraduate students requiring a broad knowledge of techniques applied in the finance literature, as well as students of financial economics engaged in empirical enquiry, should find this textbook to be invaluable.

Peijie Wang is Professor of Finance at IESEG School of Management, Catholic University of Lille. He is author of *An Econometric Analysis of the Real Estate Market* (Routledge 2001) and *The Economics of Foreign Exchange and Global Finance*.

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Financial Econometrics, second edition

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Acknowledgements

The idea of updating this book in contemporary financial econometrics, as of writing the first edition of the book, developed from my experience of advising doctoral and masters students in their research, to provide them with up-to-date and accessible materials either as research tools or as the advancement of the subject itself. Providing up-to-date materials requires updating the book at an interval within which substantial advancements, either in theory or application or both, have taken place.

Since the publication of the first edition of the book, great interest has been shown in discrete choice models, estimation of censored and truncated samples and panel data analysis, and in particular, these models' application in finance and financial economics. Therefore, the new edition of the book has included these models and methods, extending the first edition in which the covered topics were mainly on time series modelling. However, this task has been proven neither easy nor straightforward, and has involved much work and rework on the manuscript. It is not an exaggeration to say that this new edition of the book may never have been completed without the support and encouragement from Rob Langham, the Routledge economics editor, with whom many consultations have taken place at various stages of the development of the book. I am particularly grateful to Tom Sutton, whose excellent, efficient and effective editorial work ensures that the new edition maintains the same high standard as the first edition, while facing a more challenging operation in pooling many diverse and interwoven topics together.

During the writing of this edition of the book, I received fantastic support from many individuals whom I have worked with in this period. A few of my colleagues also made helpful comments on a range of my written material related to the book. I would like to express my gratitude to them, including Yun Zhou, Pingshun Zhang, Habibah Tolos, Duanduan Song, Frank McDonald, Benedicto Lukanima, Andrea de Laine, Trefor Jones, Jinying Hu and Alan Benson. They have contributed to the new edition of the book from various perspectives.

In the meantime, I would like to thank once again those who contributed to the first edition of the book, especially my former colleagues Bob Ward and James Freeman, and Stuart Hey, Terry Clague and Heidi Bagtazo of Routledge. It was

the quality and appeal of the first edition that made the book evolve into a new edition.

Finally, I thank the production and marketing teams of Routledge who bring the book to the reader.

PJW

January 2008

Preface

This book focuses on econometric models widely and frequently used in the examination of issues in financial economics and financial markets, which are scattered in the literature yet to be integrated into a single-volume, multi-theme, and empirical research-oriented text. The book, providing an overview of contemporary topics related to the modelling and analysis of financial data, is set against a backdrop of rapid expansions of interest in both the models themselves and the financial problems to which they are applied. Extended from the first edition of mainly time series modelling, the new edition also takes in discrete choice models, estimation of censored and truncated samples, as well as panel data analysis that has witnessed phenomenal expansion in application in finance and financial economics since the publication of the first edition of the book. Virtually all major topics on time series, cross-sectional and panel data analysis have been dealt with.

We assume that the reader has already had knowledge in econometrics and finance at the intermediate level. So basic regression analysis and time series models such as the OLS, maximum likelihood and ARIMA, while being referred to from time to time in the book, are only briefly reviewed but are not brought up as a book topic; nor the concept of market efficiency and models for asset pricing. For the former, there are good books such as *Basic Econometrics* by Gujarati (2002), *Econometric Analysis* by Greene (2008), and *Introduction to Econometrics* by Maddala (2001); and for the latter, the reader is recommended to refer to *Principles of Corporate Finance* by Brealey, Myers and Allen (2006), *Corporate Finance* by Ross, Westerfield and Jaffe (2008), *Investments* by Sharpe, Alexander and Bailey (1999), *Investments* by Bodie, Kane and Marcus, (2008), and *Financial Markets and Corporate Strategy* by Grinblatt and Titman (2002).

The book has two unique features – every chapter (except the first three introductory chapters and the final chapter) has a section of two or more examples and cases, and a section of empirical literature, offering the reader the opportunity to practice right away the kind of research in the area. The examples and cases, either from the literature or of the book itself, are well executed, and the results are explained in detail in plain language. This would, as we hope, help the reader gain interest, confidence, and momentum in learning contemporary econometric topics. At the same time, the reader would find that the way of implementation

and estimation of a model is unavoidably influenced by the view of the researcher on the issue in a social science subject; nevertheless, for a serious researcher, it is not easy to make two plus two equal to any desired number she or he wants to get. The empirical literature reviewed in each chapter is comprehensive and up to date, exemplifying rich application areas at both macro and micro levels limited only by the imagination of human beings. The section demonstrates how a model can and should match practical problems coherently and guide the researcher's consideration on the rationale, methodology and factors in the research. Overall, the book is methods, models, theories, procedures, surveys, thoughts and tools.

To further help the reader carry out an empirical modern financial econometrics project, the book introduces research tools and sources of information in the final chapter. These include on-line information on, and the websites for, the literature on research in financial economics and financial markets; commonly used econometric software packages for time series, cross-sectional and panel data analysis; professional associations and learned societies; and international and national institutions and organisations. A website link is provided whenever it is possible. The provision is based on our belief that, to perfect an empirical study, one has to understand the wider background of the business environment, market operations and institutional roles, and to frequently upgrade and update the knowledge base which is nowadays largely through internet links.

The book can be used in graduate programmes in financial economics, financial econometrics, international finance, banking and investment. It can also be used as doctorate research methodology materials and by individual researchers interested in econometric modelling, financial studies, or policy evaluation.

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1 Stochastic processes and financial data generating processes

1.1. Introduction

Statistics is the analysis of events and the association of events, with a probability. Econometrics pays attention to economic events, the association between these events, and between these events and human beings' decision-making – government policy, firms' financial leverage, individuals' investment/consumption choice, and so on. The topics of this book, financial econometrics, focus on the variables and issues of financial economics, the financial market and the participants.

The financial world is an uncertain universe where events take place every day, every hour, and every second. Information arrives randomly and so do the events. Nonetheless, there are regularities and patterns in the variables to be identified, effect of a change on the variables to be assessed, and links between the variables to be established. Financial econometrics attempts to perform the analysis of these kinds through employing and developing various relevant statistical procedures.

There are generally three types of economic and financial variables – the rate variable, the level variable and the ratio variable. The first category measures the speed at which, for example, wealth is generated, or savings are made, at one point of time (continuous time) or in a short interval of time (discrete time). The rate of return on a company's stock or share is a typical rate variable. The second category works out the amount of wealth, such as income and assets, being accumulated over a period (continuous time) or in a few of short time intervals (discrete time). A firm's assets and a country's GDP are typical level variables, though they are different in a certain sense in that the former is a stock variable and the latter is a flow variable. The third category consists of two sub-categories, one is the type I ratio variable or the component ratio variable, and the other is the type II ratio, the contemporaneous relativity ratio variable. The unemployment rate is rather a ratio variable, a type I ratio variable, than a rate variable. The exchange rate is more precisely a typical type II ratio variable instead of a rate variable. This classification of variables does not necessarily correspond to the classification of variables into flow variables and stock variables in economics. For example, we will see in Chapter 8 that both income and value should behave similarly in terms