

Preface

I feel obliged to say something in the preface, in an attempt to help the reader love the book, regardless of whether he/she chooses to read the book fortunately or unfortunately. This preface contains five parts. Let me start in the first part about my beloved physics.

Physical Methods Make Physics Mature

From Aristotle (384–322 B.C.) to the time before G. Galilei (February 15, 1564–January 8, 1642), physics was developed mainly on the basis of empirical analysis (observations), which offered correlations (namely relationships involving dependence). Owing to G. Galileo, the situation was significantly changed because he brought controlled experiments into the research of physics. This approach directly reveals cause and effect, which represents a deeper understanding than the correlation brought by empirical analysis. Next, it was I. Newton (December 25, 1642–March 20, 1726) who realized the necessity of introducing the tool of theoretical analysis (based on mathematics) to generalize the results obtained from both empirical analysis and controlled experiments. As a result, physics developed much faster than before, and currently physics has already become a mature discipline.

Physical Methods Might Help Econophysics to Grow Up

The historical route of developing physics sheds light on how to develop econophysics (even though econophysics is only a branch of physics, at least to physicists like me). In fact, if we compare physics with econophysics, we can find a similar route. In the mid-1990s, econophysics got its own name and started to board the stage of history as a new research direction (certainly, I also agree that researches within the scope of econophysics appeared much earlier than the

mid-1990s, but at that time, the word “econophysics” was not yet coined). Since then, studies on econophysics have been mainly based on empirical analysis (as well as agent-based simulations, especially after the birth of the minority game in 1997 [1]; these simulations are used to understand empirical observations). Since the last decade, the situation has been updated by introducing controlled experiments into econophysics, say, the study of the minority game [2–4], political exchange for election outcome prediction [5, 6], the market-directed resource-allocation game [7–10], and a laboratory stock market [11]. In the early stage of introducing controlled experiments [2–4], controlled human experiments (which will be simply called “controlled experiments” throughout this book) were purely performed to yield new results. However, such human experiments often have unavoidable limitations such as specific subjects with specific identities in specific avenues at specific time. Thus, it becomes somehow difficult to generalize the results obtained from controlled experiments. To overcome these limitations and also to achieve more results (that cannot even be obtained from pure human experiments due to the lack of resources like time, money, and/or human subjects), since 2009 [7], my group has introduced a combination method of empirical analysis, controlled experiments, and theoretical analysis (based on agent-based simulations and/or analytical theory) [7–10] into the research of econophysics. Owing to the big success of the combination approach in physics, we expect more from the combination method in the field of econophysics. Because controlled experiments play the most important role in the combination approach, I call the econophysics related to the controlled experiments as *Experimental Econophysics*, which is the topic of this book.

To benefit the reader, a few well-known scholars have published several elegant English monographs on econophysics:

- R.N. Mantegna and H.E. Stanley, *An Introduction to Econophysics*, Cambridge University Press (2000);
- N.F. Johnson, P. Jefferies, and P.M. Hui, *Financial Market Complexity*, Oxford University Press (2003);
- J. Voit, *The Statistical Mechanics of Financial Markets* (3rd edition), Springer (2005);
- D. Challet, M. Marsili, and Y.-C. Zhang, *Minority Games: Interacting Agents in Financial Markets*, Oxford University Press (2005).

However, these monographs have not touched the field of experimental econophysics. So, the present book in your hand would be the first English monograph on *Experimental Econophysics*. I hope it will help to foster the development of econophysics, at least to some extent.

Peer Responses to Experimental Econophysics

What is experimental econophysics in the eyes of econophysicists? I prefer to answer this question as below.

From May 31 to June 2, 2014, I attended the International Conference on Econophysics (ICE2014) in Shanghai, China. During the ICE2014, I presented an invited talk, entitled “Experimental Econophysics: A laboratory market for modeling real stock markets.” The talk presented both my key thoughts on experimental econophysics and the content of Chap. 3 of this book. Surprisingly, the audience appreciated this talk very much, and evoked much stronger repercussions than what I had expected. As a result, during or after my talk, many scholars (including Prof. R.N. Mantegna of the University of Palermo in Italy) had great interest to discuss with me the controlled experiments conducted by my group. In particular, on June 4, 2014, Prof. D. Sornette of ETH Zurich in Switzerland, who is both a chairman of ICE2014 and a leading worldwide expert in the field of econophysics, also emailed me:

“I like very much your presentation at ICE2014. I would be glad if you could send me your presentation in pdf format. I would also appreciate receiving your papers that you listed, especially the ones on your lab experiments.”

Such peer appreciation implies that experimental econophysics, coined by me, has had a good start. Nevertheless, a good start does not mean a good ending; to achieve the latter, we must do much better.

Who Should Read This Book?

One of my dreams, which are genuine dreams beyond reality, is to let this book attract a huge number of readers. So, the dream is as follows.

On one hand, everyone who has an interest in physics should read this book because it guides him/her to know how to develop statistical physics into the field of economics or finance.

On the other hand, everyone who has an interest in economics or finance should read this book because it helps him/her know of economic or financial problems from a different perspective.

The word “everyone” appearing in the above two paragraphs should include undergraduate students, graduate students, teachers in universities, and researchers in universities, institutes or industries, who are working in the field related to physics, economics/finance, complexity science, artificial intelligence, management science, sociology, ecology, or evolutionary biology.

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- Chapter 7: Dr. Y. Liang and Mr. K.N. An;
- Chapter 9: Mr. X.H. Li, Mr. G. Yang, and Mr. K.N. An;
- Chapter 12: Ms. L. Liu;
- Bibliography: Mr. G. Yang.

Besides, I have completed the other chapters according to the articles published by my group. So, I must also thank all the other group members who coauthored these articles. In addition, all my current group members have also helped to look over the whole book and relay to me many constructive comments and suggestions, which are appreciated very much. Below is the name list of my current group members: Dr. X.W. Meng, Miss T. Qiu, Mr. G. Yang, Mr. X.H. Li, Miss L. Liu, Mr. C.G. Zhu, Mr. X.Y. Shen, Mr. G.X. Nie, Mr. H.S. Zhang, Mr. K.N. An, Miss Y.X. Chen, Mr. C. Xin, Miss F.F. Gu, and Mr. Q. Ji.

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