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刘超 著

# 系统科学金融理论

THE FINANCIAL THEORY OF  
SYSTEMS SCIENCE



科学出版社

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The Financial Theory of Systems Science

刘超著

科学出版社

北京

## 内 容 简 介

现代金融理论、行为金融理论研究范式的不足以及经济金融系统运行中产生的重大现实问题，迫使金融理论的研究范式必须发生根本性变革。系统科学是研究复杂系统的一般属性、系统生成、演化、转化、涌现、协同与控制的一般规律的学科，重要的是系统科学不仅能够揭示系统规律认知系统，而且能够在认知系统的基础上控制系统。本书以系统科学为基础，采用系统科学的方法论和范式，包括非线性科学(耗散结构、协同、突变、分形、混沌理论)、系统动力学和复杂性科学(复杂适应性、复杂自适应性临界、复杂网络、综合集成理论)，构建了较为完善的系统科学金融理论体系，包括其构成、科学基础、核心思想、内涵、研究方法、适用研究对象、特点等，并对金融系统进行应用研究。

本书是多学科交叉研究的结果，具有极强的前沿性、普适性、包容性和可拓展性，代表未来金融理论的发展方向。

本书适合从事经济学、金融学、管理科学、社会学、系统工程等相关领域的管理者、高校教师、研究生及其他科研人员使用，也可作为教材或参考书使用。

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# 序

自 20 世纪 70 年代以来，经济全球化、金融国际化已经成为世界经济与金融发展的主要趋势之一。金融是经济的核心，金融系统的高度开放性不仅提高了金融资源在全球范围内的配置效率，也相应扩大了金融风险在全球各个经济体之间的传导效应。随着经济系统的生产、交换、分配、消费等各环节金融化进程的发展，经济资源通过金融系统进行跨时空配置的需求增加，而这种多维度、跨时空资源配置需要通过金融系统同层次之间、不同层次之间、各层次与环境之间的复杂非线性交互作用实现，金融系统的非线性、动力学、复杂性特征愈发明显，金融系统运行和演化机制日益复杂化。因此，建立在有效市场假说基础上的金融理论以及以心理学为基础的行为金融理论因研究范式的缺陷难以全面系统地刻画金融系统的非线性和复杂性等特性本质，不能有效地揭示金融系统的演化、运行规律，也难以指导金融系统的优化控制。尤其是近年来金融危机频发，经济与金融系统出现的若干重大问题迫切需要我们提出新的研究范式和建立新的金融理论体系。

金融系统具有多层次性、非线性、复杂性等特点，面临环境和政策变量等的扰动与约束。金融系统的波动源于金融系统内同层次之间、不同层次之间、各层次与环境之间的交互作用。因此，必须要用系统论的思想来指导金融理论的研究与金融系统的实践，实现从局部到整体、静态到动态、线性到非线性、均衡到非均衡、开环到闭环、国内到国际的转变。

该书的作者在分析了现代金融理论、行为金融理论的研究范式缺陷的基础上，提出了构建系统科学金融理论的研究思路，将系统科学中的非线性科学(耗散结构理论、协同理论、突变理论、分形理论、混沌理论)、系统动力学和复杂性科学(复杂适应性理论、复杂自适应临界性理论、复杂网络理论、综合集成理论)理论和方法运用到对金融系统的研究中，构建了一个系统科学金融理论体系，明确了系统科学金融理论的三个理论支柱(非线性金融理论、系统动力学金融理论和复杂性金融理论)，并对三者进行了比较，阐述了它们之间的逻辑关系，然后应用上述三个理论的研究方法以及计算机仿真技术，对相关金融问题进行了定性定量相结合的研究。系统科学金融理论吸取了多个学科的研究方法论，具有包容性、前沿性、普适性和可拓展性。

作为 2008 年美国金融海啸后的新金融理论研究的一个尝试，该书的作者建立的系统科学金融理论体系，无疑有着非常积极的现实意义和理论价值。相信该书的出版将会推动新的金融理论的研究与创新，也会推动系统科学在经济学等社会科学领域的研究与发展。

中国系统工程学会理事长

国际知识与系统科学学会理事长 汪寿阳

第三世界科学院院士

2013 年初夏于北京

# Preface

Since 1970s, economic globalization and financial internationalization have become one of the main economic and financial development trends in the world. Finance is the core of economy, and the highly opened financial system not only improves the allocation efficiency of financial resources across the world, but also expands the conductibility of financial risk among worldwide economies accordingly. With the financialisation of economic system's production, exchange, distribution and consumption, there is an increasing need in the allocation requirement of economic resources across space and time through the financial system. Multidimensional resource allocation across space and time needs to be achieved through the complicated nonlinear interaction in same levels of the financial system, among different levels, between every level and the whole environment. The financial system's nonlinear, dynamic and complex features have become more obvious and its operation and evolution mechanism have turned out to be increasingly complicated. Therefore, because of the defects of research paradigm, financial theory based on the efficient market hypothesis and behavioral financial theory based on psychology are difficult to comprehensively and systematically describe the features of the financial system such as its nonlinear and complex characteristics and cannot effectively reveal its evolution and operation rules. And it is hard for financial theory and behavioral financial theory to guide the optimization and control of the financial system. Particularly, since financial crisis occurs frequently in recent years, some major problems in the economic and financial system urgently require us to put forward the new research paradigm and establish a new system of financial theory.

The financial system has multidimensional, nonlinear and complex features. Also it is interfered and constrained by environmental and policy variables. Fluctuations of the financial system are caused by interactions in same levels of the financial system, among different levels, between every level and the whole environment. Therefore, we must do the research of financial theory and implement the practice of the financial system under the idea of systems theory in order to achieve the transformations from part to whole, static to dynamic, linear to the nonlinear, equilibrium to disequilibrium, open loop to closed-loop, the domestic to the international.

On the basis of analysis on the research paradigm of defects of the modern financial theory and the behavioral finance theory, this author puts forward a research thought of

constructing system science financial theory. With the use of the theory and method of nonlinear science (dissipative structure, collaboration, mutation, fractal and chaos theory), systematic dynamics and complex science (complex adaptive theory and complex adaptive critical theory and complex network theory, the integrated theory) in the study of the financial system, the author builds the system science financial theoretical system, which classifies three theoretical pillars (the Nonlinear Financial theory, the Finance System Dynamics Theory and the Complex Financial Theory) of Systems Science Financial Theory and illustrates the logical relationship among them through comparison. On the application of the above three theoretical research methods and computer simulation technology, the author does research on the combination of qualitative and quantitative of the related financial issues. Systems Science Financial Theory absorbs several interdisciplinary research methodology and is inclusive, pioneering, universal and expansive.

As a try of new financial theory research after the 2008 U. S. financial tsunami, the financial theory of systems science system established by the author undoubtedly has a very positive realistic significance and theoretical value. We believe that the publication of the book will promote the research and innovation of new financial theory, and will also enhance the research and development of the systems science in economics and other social science fields.

Shouyang Wang

Jun. 2013, Beijing

Director of Systems Engineering Society of China

Director of International Society for Knowledge and Systems Science

Academician of the Third World Academy of Sciences

# 前 言

随着金融系统的演化以及相关学科的发展，金融理论的研究范式也在不断革新。金融系统越来越向高度开放、多层次的非线性动力学复杂系统演化，而现代金融理论、行为金融理论均不能有效认知和揭示金融系统的演化、运作规律，更难实现对金融系统的优化、控制，其研究范式出现了危机，经济与金融系统运行中产生的金融、经济危机等重大现实问题，使得金融理论的研究范式必须发生根本性变革。

金融系统及其外部环境的变化与原有金融理论研究范式的缺陷是金融理论发展的内在动力，相关学科的产生与完善为金融理论的演化提供了条件。

建立在有效市场假说、“理性人”基础上的现代金融理论由于其假设和现实状况的背离，难以对金融“异象”做出有效解释。为此，借助心理学、行为科学的研究范式产生了行为金融理论，尽管解释了部分“异象”，但由于运用心理偏差过于随意，增添了现代金融理论所没有的缺陷。

由于系统科学是研究复杂系统的一般属性、系统生成、演化、转化、涌现、协同与控制的一般规律的学科，重要的是系统科学不仅要揭示系统规律认知系统，而且还要在认知系统的基础上控制系统。因此，随着系统科学的相关理论、方法逐渐成熟，系统科学逐步应用于自然界和人类社会等领域研究中，显露出解决非线性、动力学、复杂性等系统性问题的卓越能力。自 20 世纪 80 年代始，相关学者尝试将系统科学的相关理论方法运用到对金融系统的非线性、动力学性、复杂性等问题的研究中，并取得了重要的研究成果。但这些研究存在着相关理论归属不清晰、概念混淆，未能建立一个较为完善、前沿性的、普适性的理论体系等问题。

基于以上背景，笔者认为有必要以系统科学为基础，采用系统科学的方法论和范式，包括非线性科学(耗散结构理论、协同理论、突变理论、分形理论、混沌理论)、系统动力学和复杂性科学(复杂适应性理论、复杂自适应性临界理论、复杂网络理论、综合集成理论)，构建较为完善的系统科学金融理论体系，包括其构成、科学基础、核心思想、内涵、研究方法、适用研究对象、特点等，并对金融系统进行应用研究。

需要进一步明确的是，系统科学金融理论是以系统科学研究范式为指导，以系统科学的原理、理论、方法和技术为手段，并与金融学、经济学等领域的知识融合，运用综合集成、系统建模、计算机仿真技术、系统控制等方法，分析金融系统的非线性、系统动力学、复杂性特性，揭示金融系统的演化、转化、协同与控制的一般规律，从而实现对金融系统的认知、预测、优化和控制的理论体系。

基于对系统科学金融理论的认知，笔者将本书分为四篇，分别从系统科学金融理论



序、非线性金融理论、系统动力学金融理论、复杂性金融理论四个方面, 尝试构建系统科学金融理论的框架和体系。

第一篇为系统科学金融理论序篇, 主要包括第一章的内容。该篇在分析现代金融理论和行为金融理论研究范式存在的不足和危机的基础上, 提出需要建立与金融特性相匹配的、能解决经济金融运行中重大问题的、具有根本性变革的研究范式和理论体系, 并从多个角度论证以系统科学为金融理论研究范式的可行性和必要性, 由此初步构建系统科学金融理论的体系框架, 并将其与现代金融理论和行为金融理论进行比较, 得出系统科学金融理论研究的科学性、普适性、交叉性和前沿性, 从而就本书的创新点进行论述。

第二篇为非线性金融理论篇, 主要包括第二~七章的内容。该篇以非线性理论为基础, 构建非线性金融理论的理论体系, 主要包括其构成(耗散金融理论、协同金融理论、突变金融理论、分形金融理论和混沌金融理论)、内容、内涵、研究对象、研究方法等, 并针对金融系统运行过程中的非线性特性进行应用研究。

第二章主要研究线性金融理论的基础, 对普遍存在的非线性系统进行介绍, 然后引入研究非线性系统的非线性科学, 以非线性科学为基础构建非线性金融理论的框架, 主要包括耗散金融理论、协同金融理论、突变金融理论、分形金融理论和混沌金融理论。

第三章以耗散结构理论为基础, 对金融系统的开放性、非均衡性等特点进行研究, 构建耗散金融理论, 并运用所构建的熵金融理论对银行系统的脆弱性和保险公司的经营业绩进行宏观评价和微观评价, 在此基础上提出具有针对性的政策建议, 进一步证实所构建的耗散金融理论对研究经济金融问题具有较为显著的指导意义。

第四章以协同理论为基础, 对不同开放条件下金融系统的自组织行为、系统宏观状态产生及转化的条件、金融系统内部运作机制和微观机理等问题进行研究, 构建了协同金融理论, 并运用所构建的协同度金融理论和非线性阈值协整的方法对我国金融监管的现状 & 我国经济增长率与失业率的关系进行实证分析。

第五章以突变理论为基础, 对金融系统突变的特征、来源、优化、控制以及金融系统在运行过程中由一种稳定态跃迁到另一种稳定态的突变机理进行研究, 构建突变金融理论, 运用所构建的结构突变金融理论和突变级数金融理论对货币增速剪刀差与股票价格波动联动关系, 以及我国商业银行系统的监管评价进行实证研究。

第六章以分形理论为基础, 对金融系统内部各个组成部分、金融系统整体, 以及金融系统外部发展环境之间的复杂作用关系进行更加系统、全面、真实的探究, 构建分形金融理论, 并结合金融系统的实际运行对金融系统的自相似性、长期记忆性、分形分布特点、多标度特性、可预测性和分形维数等分形特性做详细的介绍和举例分析说明, 借鉴其中的 R/S 分析法提出金融风险频度和累积性的测度方法, 在理论验证的基础上提出风险度向量方法, 将其应用在对金融市场风险测度的实证研究中, 对金融系统风险管理具有一定的理论和现实意义。

第七章以混沌理论为基础, 对金融时间序列的关联维、李雅普诺夫指数、金融系统发展对初始条件的敏感性依赖, 以及金融系统走向复杂性的时间演化的非周期性进行

研究,构建混沌金融理论,并运用该理论对中美证券市场对比、人民币兑美元汇率、证券投资基金系统、上海银行间同业拆借利率与上交所一日国债回购利率的对比进行研究。

第三篇为系统动力学金融理论篇,主要包括第八~十三章的内容,以系统动力学为基础构建系统动力学金融理论的理论体系,主要包括其构成、内容、内涵、研究对象、研究方法等,并针对金融系统的整体性、多重反馈性、层次性、相似性等系统动力学特性进行相关应用研究。

第八章从国内外和时间两个方面分析了系统动力学的产生、发展与展望,对不同阶段国内外在系统动力学方面取得的成就进行总结和对比。

第九章对系统动力学的原理、特点和分析工具进行梳理和提炼,尝试总结、升华出可指导构建系统动力学金融理论的一般原理框架。

第十章从金融工具子系统、金融市场子系统、金融中介子系统、金融管理子系统、金融环境以及其他经济领域六个方面对国内外专家已经形成的研究成果进行分类和总结。

第十一章以系统动力学为基础,构建系统动力学金融理论,对金融系统的结构、功能及因果反馈关系,金融系统内部、金融系统与环境之间的交互反馈关系和金融系统的运行机制进行研究,并构建金融系统的系统动力学仿真模型,对金融系统未来发展状况进行预测研究。

第十二章从金融系统内部、金融系统与经济发展系统、金融系统与社会发展系统,以及金融系统与国际经济系统四个方面展开系统动力学金融理论的应用研究。

第十三章从九个方面举例说明研究过程中应注意的问题,并逐一给出解决办法,从而提高研究效率,保证研究的顺利进行。

第四篇为复杂性金融理论篇,主要包括第十四~二十章的内容,以复杂性科学、复杂系统和复杂系统理论为基础构建复杂性金融理论的理论体系,主要包括其构成(复杂适应性金融理论、复杂自组织临界性金融理论、复杂网络金融理论、综合集成金融理论)、内容、内涵、研究对象、研究方法等,并针对金融系统的复杂性进行相关应用研究。

第十四章从现实背景和文献研究两个角度对复杂性金融理论的产生背景进行论述。

第十五章对复杂性科学、复杂系统和复杂系统理论进行梳理和提炼,总结出可以指导构建复杂性金融理论的一般原理框架。

第十六章对金融系统的复杂性、整体涌现性特征、复杂金融系统的演化内容、演化途径进行研究,在此基础上构建复杂性金融理论体系,包括复杂适应系统金融理论、复杂自组织临界金融理论、复杂网络金融理论及综合集成金融理论四个组成部分。

第十七章以复杂适应理论为基础构建复杂适应系统金融理论,从构建基础、模型分类、构建原则和方法等不同视角对金融系统的回声模型、演化模型、人工生命模型进行深入研究,创造性地提出基于 Agent 的复杂金融系统建模及仿真,使用 Agent 建模的系统仿真技术及建模工具——Swarm 平台对复杂金融系统进行建模与仿真,并将复杂适应系统金融理论运用到保险系统逆向选择模型的动态仿真研究中,运用 Agent 的复

杂系统建模方法和 Swarm 研究平台构建了复杂保险系统和人工股票市场模型，并进行仿真运行。

第十八章以复杂自组织临界性理论为基础构建复杂自组织临界性金融理论，对金融系统临界状态的进化进行研究，并以证券系统和商业银行系统为例对金融系统中的复杂自组织演化行为进行分析，对沙堆试验、沙堆模型进行探讨，并基于沙堆模型对金融资产和股市脆性行为进行实证应用研究。

第十九章以复杂网络理论为基础构建复杂网络金融理论，对金融系统中微观个体之间存在的相互联系和相互作用进行研究，并运用复杂网络金融理论对交叉持股进行实证研究。

第二十章以综合集成研讨厅理论为基础，构建综合集成金融理论，并运用所构建的综合集成金融理论对金融系统中货币政策多目标决策进行实证研究。

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在本书写作过程中笔者跟踪研读了大量文献，参考融合了国内外专家、学者在相关领域的研究成果，并对相关文献在书中标注，但或存在遗漏，在此，对被引用的相关专家、学者深表谢意，对那些可能被遗漏的文献表示歉意，并恳请他们与笔者或出版社联系，以便将来再版时将他们对本书的贡献进行标注。

作为探索构建一个学科的理论框架和体系的尝试，旨在推进系统科学方法论在金融、经济研究中的应用，很多章节几经重写，力求完善。但是笔者也深感水平有限，必然会有许多不足甚至疏漏之处，恳请专家学者批评指正。

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# Introduction

With the revolution of the financial system and the development of the related disciplines, the research paradigm of the financial theory continues innovating. Financial system evolves into a highly-open and multi-level nonlinear dynamics of complex system, but modern financial theory and behavioral financial theory cannot effectively cognize and reveal the evolution and operation laws of the financial system and it is more difficult for them to optimize and control the financial system. Crises occur in their research paradigms. The important practical issues such as financial and economic problems happening in the operation of the economic and financial system make the research paradigm of the financial paradigm change radically.

The change of financial theory, its external environment and the defects of former research paradigm of the financial theory are the internal forces of the financial theory development. The emergence and improvement of related disciplines provides conditions for the evolution of the financial theory.

It is difficult for the modern financial theory constructed on the basis of the efficient market hypothesis and the reasonable person to explain effectively the financial vision due to the deviation of the assumption from the reality. Therefore, with the paradigms of the psychological and behavioral science, behavioral financial theory occurs. Even though it explains some visions, it adds some defects that do not exist in the modern financial theory, due to the fact that the use of the psychological deviation is too random.

The systems science is a discipline which studies the general attributes, system generation, evolution, transformation, emergence, cooperation and control in the complex system. What is important is that the systems science can not only reveal the law of system to cognize system, but also control the system on the basis of cognizing system. Therefore, with the related theories and methods of the systems science maturing gradually, the systems science is gradually applied in the research of the realms such as nature, human society and so on, revealing its excellent ability to solve systematic problems such as nonlinear, dynamics and complexity. Since the 1980s, the related scholars have tried to apply the related theoretical method of the systems science to the research of the issues in the financial system such as nonlinear, dynamics and complexity and so on. They also acquired important research achievements. But some problems such as the fact that the vesting of the related theory is not clear and the conception is confusing,

the failure to establish a perfect, cutting-edge, universal theoretical system exist in these researches.

Based on the above background, the author thinks, based on the systematic science, it is necessary to construct the perfect systems science financial theoretical system which consists of its constitution, scientific basis, core idea, connotation, research methods, research subjects and characteristics and so on by adopting the methodology and paradigm of the systems science including nonlinear science (dissipative structure, collaboration, mutation, fractal and chaos theory), system dynamics and complex science (complex adaptive, complex adaptive critical, complex networks, integrated theory) and apply this theory to the research of financial system.

One thing to be further clarified is that the Financial Theory of Systems Science is a theoretical system that guided by the system scientific research paradigm, uses the principle, theory, method and technology as the means and integrates with the knowledge of the realms such as finance, economics and so on. It uses the methods of comprehensive integration, system modeling, computer simulation technology and system control to analyze the characteristics of the financial system such as nonlinear, system dynamics, complexity and so on and reveals the general laws of the revolution, transformation, coordination, control of the financial system in order to achieve to cognize, forecast, optimize and control the financial system. The Systems scientific financial theory can not only reveal the law of system to cognize system, but also control the system on the basis of cognizing system.

Based on the cognition of the systems science, the author divides this book into four units, trying respectively from the introduction of The Financial Theory of Systems Science, The Nonlinear Financial Theory, The Financial System Dynamics Theory, The Complex Financial Theory to construct the framework and system of The Financial Theory of Systems Science.

**The first unit** is an introduction to **The Financial Theory of Systems Science**, which mainly concludes the contents of the chapter 1. On the basis of analyzing the shortcomings and crisis of modern financial theory and behavioral finance research paradigm, the book needs to establish a revolutionary paradigm and theoretical system, which matches with financial characteristics and solves the major problems in the economic and financial operation. In the book, the author demonstrates the feasibility and necessity of using system science as financial theory research paradigm from multiple angles, build the framework of Systems Science Financial Theory initially, and compare Systems Science Financial Theory with the modern financial theory and behavioral finance theory. Finally the author concludes scientific, universal, cross-cutting and cutting-edge feature of financial theoretical studies of Systems Science, and innovations are discussed in the book.

**The second unit is The Nonlinear Financial Theory**, from chapter 2 to chapter 7. Based on the theoretical system of nonlinear theory, the author conducts The Nonlinear Financial Theory, which includes its composition (the Dissipation Financial Theory, the Synergistic Finance Theory, the Catastrophe Financial Theory, the Fractal Financial Theory and the Chaos Financial Theory), content, connotations, object of study, research methods, and applies this theory to the research on nonlinear characteristics of the financial system.

Chapter 2 mainly studies the basis of the nonlinear financial theory, and introduces the prevalence of nonlinear systems, then utilizes the nonlinear science to establish the framework of the nonlinear financial theory based on the nonlinear science, including the Dissipation Financial Theory, the Synergistic Finance Theory, the Catastrophe Financial Theory, the Fractal Financial Theory and the Chaos Financial Theory.

Chapter 3 applies the Dissipative Structure Theory to the research of the openness and non-equilibrium characteristics of the financial system, and establishes the Dissipation Financial Theory, and utilizes Entropy Financial Theory to make macroscopic and microscopic evaluation on the vulnerability of the banking system and insurance company's operating results. Then a targeted policy and recommendations is put forward. It is further confirmed that the established Dissipation Financial Theory has a big significance in the study of economic and financial issues.

Chapter 4 is based on the synergistic theory, and studies the self-organizing behavior of the financial system, the generation and transformation conditions of the macroscopic state of the system, the inner workings and the microscopic mechanism of the financial system under different open conditions, and builds synergistic financial theory. Then the author uses the synergistic degree of financial theory and nonlinear threshold co-integration to empirical analysis the current situation of China's financial supervision and the relationship between China's economic growth rate and unemployment.

Chapter 5 on the basis of the catastrophe theory, studies the characteristics, sources, optimization, control of the catastrophe phenomenon in the financial system and the mechanisms in which the financial system switches from a stable state to another stable state. This chapter establishes The Catastrophe Financial Theory and carries on the empirical research on interactive relationship between the correlation of scissors gap of money supply growth and the stock price volatility by the Structural Catastrophe Financial Theory and regulation appraisal of Chinese commercial banks system by the Catastrophe Progression Financial Theory.

Chapter 6 based on fractal theory, probes financial system within the various components of a complex relationship between the external environment for the development of the financial system as a whole as well as the financial system more systematic, comprehensive, real inquiry, establish The Fractal Financial Theory. It combines the actual operation of the financial system self-similar, long-term memory, fractal distribution,

multi-scale features, predictability and fractal dimension equal portions shape characteristics made a detailed description and examples analysis. This part learns from the R/S analysis financial risk frequency and cumulative measure, degree of risk on the basis of theoretical verification vector, and applies it in empirical studies measure of financial market risk. This has a certain theoretical and practical significance to risk management of the financial system.

Chapter 7 takes the research of financial time series correlation dimension, Lyapunov exponent, the development of the financial system for the sensitive dependence on initial conditions and financial system to the complexity of the time evolution of the aperiodic and establishes the Chaotic Financial Theory. We apply the Chaotic Financial Theory to the comparative research of the securities market in China and the United States, empirical study of the RMB-US Dollar exchange rate fluctuations, China's securities investment fund system and comparative study of the Shanghai interbank offered rate and the Shanghai Stock Exchange one-day bond repurchase rate.

**The third unit is The Financial System Dynamics Theory**, from Chapter 8 to Chapter 13. In this unit the author builds the financial theory based on system dynamics, mainly including its structure, content, connotation, research objects and research methods, etc. At the same time, the author carries out application study for the integrity of the financial system, the multiple feedback, gradation and similarity system dynamics characteristics.

Chapter 8 analyzes the generating origin of system dynamics, and through its development the author points out its prospects according to the experts of both at home and abroad. The author also summarizes and compares different phases in the system dynamics achievements.

Chapter 9 refines the features and analysis tools on the system dynamics principle, try to summary and sublimation framework which is guidance to the general principles of the financial system dynamics theory.

Chapter 10 classifies and summarizes research results from domestic and foreign experts in financial markets subsystems, financial instruments subsystems, financial intermediaries subsystems, financial management subsystems, financial conditions subsystems, and the other sectors area of the economy.

Chapter 11 builds the Financial system dynamics theory based on system dynamics, discusses the financial system structure, function and the causal feedback relations, internal financial system, financial and the interaction feedback relations between the environment, the financial system running mechanism, and builds the Financial system dynamics simulation model, studies the prediction of the future development of the financial system.

Chapter 12 studies the application of financial theory from four aspects, including internal financial system, financial and economic development system, financial and so-

cial financial system, financial and the international economic system.

Chapter 13 illustrates nine problems which the researchers should pay attention in the process of research, and give the solutions to each of them, which can improve the study efficiency and ensure the smooth progress of research.

**The fourth unit is The Complex Financial Theory**, mainly including the contents from chapter 14 to chapter 20. The system of complex financial theory, based on complexity science, complex system and complex system theory, consists of its composition (the complex adaptive system financial theory, the complex self-organized criticality financial theory, the complex network financial theory and the integrated financial theory), the connotation, the purposes and approach of the research, etc. In addition, for the complexity of the financial system, the author makes use of the complex financial theory to carry out the relevant application research.

Chapter 14 discusses the background of the complex financial theory from the aspect of realistic background and literature research.

Chapter 15 not only refines complexity science, complex system and complex system theory, but also summarizes the general principles of framework, which can creatively propose the guide to construct the complex financial theory.

Chapter 16 studies the complexity and whole emergence of the financial system, content and approach of evolution of complex financial system, constructing the system of Complexity of financial theory, which includes Complex adaptive system of financial theory, Complex self-organized critical financial theory, Complex network financial theory and Integrated financial theory.

Chapter 17 constructs the Complex adaptive system of financial theory basing on the Complex Adaptive System (CAS), and makes a deep research of the Echo model, evolving model, artificial life model of financial system in accordance with constructing basis, model classification, construction principle and methods. It creatively proposes the modeling and simulation of complex financial system which is based on Agent, using the system simulation technology and modeling tool of Agent-Swarm platform to make model and simulation for complex financial system. Meanwhile, it puts the Complex Adaptive System into the Dynamic simulation research of Insurance system adverse selection model. By using the Agent complex system modeling method and Swarm platform, it constructs the model of Complex insurance system and the artificial stock market and proceeds the simulation run.

Chapter 18 constructs the complex self-organizing criticality financial theory based on complex self-organized criticality theory, studies the evolution of the financial system critical state, and in securities system and commercial Banks, for example complicated self-organization evolution behavior of the financial system were analyzed, and the test, the model of sand is discussed in this paper, and based on the model of financial assets



and stocks and brittle behavior empirically applied research.

Chapter 19 builds the theory of complex network financial based on complex network theory, studies the mutual connection of financial system and interaction between individuals, and makes empirical research by using the theory of complex network financial cross-shareholdings.

Chapter 20 builds integrated financial theory bases on the theory of hall integrated discussion, and uses the construction of the integrated financial theory to study the multi-objective decision of monetary policy.

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In writing, the author looked through lots of literature and references to the integration of domestic and foreign experts and scholars in related research fields, and these relevant literatures were marked in the book. And please accept sincere apologies of the author to cited experts for the perhaps omissions. If it exists, please contact the author or publishers to remark their contributions to the book.

As an attempt of establishing a theoretical framework of the discipline system, this book aims at promoting scientific methodology in the financial system and the application of economic research. Many chapters have been rewritten for several times to strive for perfection. Any comments or critics are warmly welcome.

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