

Original Research Article

On Financial Complexity and Market Modeling Method

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Abstract: The financial market is often the core content of the economic environment for a country. Whether it can take appropriate measures to maintain the stability of operation process of financial market and carry out effective risk management has always been one of the key research tasks costing a lot of energy of the central government and its financial departments. Taking China as an example, the financial market itself is characterized by strong complexity, and all factors are closely related. Moreover, as the whole system is too large, it is difficult to sort out the inducement and occurrence of a certain result. While the information means such as big data is gradually entering people's field of vision, national development and social progress are both related to the financial market. Facing financial complexity, China needs to face up to its existence more actively and implement corresponding solutions. In this article, the complexity of financial market will be analyzed systematically, and the common methods of market modeling will be expounded, aiming to provide some theoretical reference for the employees in related industries.

Keywords: Financial Market; Analysis of Complexity; Conception of Modeling Method

There is a remarkable trend of “global economic integration” recently all over the world, and the financial exchanges between various countries have become more frequent that the financial system shows the trend of integration of global economic system and global financial system. Obviously, affected by the chain relationship, it is the pivot of economic work in various countries to maintain the stable operation of the whole financial market, and it is necessary to strengthen the ability of preventing and managing financial risks. However, the complexity of the financial system itself and the speculative characteristics of the financial market make the market environment fluctuate in an unpredictable situation. A large number of financial risks and “financial crisis” since 1990 have proved the necessity to analyze the complexity of financial markets^[1].

1. The basic characteristics of financial complexity

The research works of many experts engaged in economic research and physics research have proved that the financial system itself is generally open and complex, and is a “giant system”, which continuously exchanges materials, information and capital with the outside of the system. Compared with the complexity of the natural system, the financial complexity is more remarkable due to the existence of the cognitive differences of subjective thinking in financial environment, and it is characterized by chaos and nonlinearity, and belongs to a dissipative structure system with certain dynamic equilibrium^[2].

1.1 Nonlinearity

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The financial system covers many different subsystems, including securities, currency, foreign exchange and futures market, and these subsystems also consist of branch subsystems, and need to meet different financial functional requirements. All of these demonstrate that the financial system has characteristics of distinct multi-level and multi-functional structures. In addition, different subsystems and elements in the financial system have a nonlinear relationship with the external environment, which is reflected in the positive feedback and negative feedback of financial activities. The scale of financial system's virtual capital is generally large. As different subsystems interact and influence each other, the overall influence of it is not a linear superposition of different subsystems, but far exceeds it, showing obvious nonlinear expansion^[3].

1.2 Aperiodicity

The "aperiodicity" reflects the irregular evolution and disorderly evolution of the financial system. During the evolution, the system generally does not repeat the previous path and evolution track. The aperiodicity of the financial system is mainly manifested in the shock response to price changes in the financial market. In the broad environment of economic integration and globalization, the financial systems of different countries are closely related to the external environment, and significantly interact with each other. The financial systems exchange materials and information continuously among countries under a strong synergy. Any regional financial turbulence will possibly cause global turbulence.

1.3 Dynamics

The financial system is always in dynamic development and change. The internal system, the system itself and the environment show significant interaction and mutual adjustment. With the help of good self-organization, the system can explore new ways of dissipation, continue to learn, reorganize and effectively improve the hierarchical structure and functional structure, thus making it develop towards a more advanced and orderly environment^[4].

1.4 Sensitive dependence on initial conditions.

The so-called "sensitive dependence on initial conditions" can be understood as "accumulation effect", and is a key feature in complex nonlinear systems. Any slight change in the initial state during the normal operation of the system may accumulate and expand in a short time due to system evolution, and eventually induce qualitative change. The "butterfly effect" of financial market reflects the sensitive dependence on initial conditions. The financial crisis in Southeast Asia is a typical example.

1.5 Self-organization structure.

"Self-organization" refers to the spontaneous and orderly behavior within the system without external oppression. According to the basic theoretical system of dissipative structure, external energy input is often one of the key conditions for the formation of self-organization structure. Relatively speaking, self-organization structure is often the symbol of complex systems. For the financial market, the macro-control and market supervision of a national government are to control parameters, making the financial market exchange energy with commodity market and economic environment. The essence of market reform is to promote the cooperation and competition of different subsystems in the open giant system, which leads to the construction of orderly parameters, so that the financial market can continuously change to a more advanced and orderly state^[5].

2. Analysis of modeling methods in the financial market

The research on the complexity of financial system belongs to the intersection of natural science and social science, requires integration of professional fields such as physical knowledge, mathematical knowledge and information technology. Besides the conventional financial market theory and economics, the knowledge involved also includes some auxiliary professional knowledge such as mathematical statistics theory and computer science. The research on the complexity of the financial system must be based on the model of the research object, and model building is also a

common way to study the risk factors of the financial system. In practice, the modeling methods used by most researchers include physical modeling, mathematical modeling and computer simulation. The modeling level of financial system can be divided into “up—down” modeling, “down—up” modeling and hybrid modeling; from a mathematical point of view, modeling methods can be divided into linear modeling and nonlinear modeling; in terms of research methods, it can be divided into simulation modeling and optimization modeling^[6].

Most of the risk management modeling of the financial system at the early stage is based on the physical structure elaboration and physical quantity optimization from the macroscopic perspective of the system. It emphasizes the exploration of macroscopic laws in the system and the qualitative elaboration of macroscopic characteristics, shields the subject behavior gap and initiative problems from some microscopic perspectives of financial product transactions in the system, and ignores the complexity of market transactions under the spatial background and time conditions. In traditional macro-quantitative research, linear extension of time axis data and statistical form of macro-quantity are mostly applied, while the optimization model of system evolution mechanism and nonlinear trend extrapolation model of marginal effect are scarce, so it is difficult to clearly explain the causes of macro-quantity changes that influence economic data by mutual interaction between external factors and internal subjects. In addition, the traditional equilibrium state economics model is rough in the terms of system structure relationship, and does not pay attention to the differences and subjective learning in participating and composing micro-subjects of system, and limited rational participation characteristics. Obviously, there are some loopholes in understanding the complexity of financial system, and deviations exist in model or calculation while predicting and analyzing the complexity of financial system.

The method of agent-based model (ABM) has been widely recognized in recent years and proved to be a key way to verify complexity problems. Compared with the traditional modeling method, the most obvious difference ABM is the idea of “Agent”, which is the most basic unit of the system, has a relatively perfect self-goal and internal structure, and has both survival motivation and learning initiative, and can better adapt to the external environment combining the behavior rules of self-learning and self-repair^[7].

Generally, ABM is equipped with a multi-agent system in MAS form, which takes agents with communication and related interests as the key preconditions for modeling, and describes various micro-behaviors of agents as the main features for modeling. Modeling methods of complex systems are adopted, combining computer simulation techniques such as discrete event simulation and subject behavior simulation, together with micro-dynamics simulation of subject interaction. The core idea is to calculate the physical quantity flow of the key features of the representation system and macroscopic perspectives, and to explore the positive path from microscopic action mechanism to macroscopic feature representation by simulating the material exchange between behavior agents and the outside world, the material exchange between agents and sub-agents, and the interaction among agents of complex systems,.

3. Conclusion

To sum up, the complexity of financial market exists for a long time and is slowly formed in the development of the whole market. In different stages of market development, financial market is always making self-improvement and self-transcendence, which cannot be reversed and directly determines its own complexity. For China, because of the objective conditions of developing countries, it is necessary to deeply study the evolution law of financial market, master its principle and systematically analyze its complexity in combination with the actual situation. During this period, besides relying on the western financial theory and models, China needs to carry out appropriate development and innovation on this basis, in order to prevent and control the major risks and hidden dangers as much as possible.

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