Evolutionary Game Model of Information Sharing Behavior in Supply Chain Network With Agent-Based Simulation

Jian Tan, Guizhou University of Finance and Economics, Guiyang, China
Guoqiang Jiang, Guizhou University of Finance and Economics, Guiyang, China
Zuogong Wang, Henan University, Kaifeng, China

ABSTRACT

In the supply chain network, information sharing between enterprises can produce synergistic effect and improve the benefits. In this article, evolutionary game theory is used to analyse the evolution process of the information sharing behaviour between supply chain network enterprises with different penalties and information sharing risk costs. Analysis and agent-based simulation results show that when the amount of information between enterprises in supply chain networks is very large, it is difficult to form a sharing of cooperation; increase penalties, control cost sharing risk can increase the probability of supply chain information sharing network and shorten the time for information sharing.

KEYWORDS
Evolutionary Game Theory, Information Sharing, Supply Chain Network

1. INTRODUCTION

In the era of big data, the importance of information in economic activities has received more and more attention. How to effectively collect and analyze information and use the rules extracted from information to guide production practice has become a key factor for enterprises to improve their own competitiveness. Companies with a high degree of information sharing are often able to demonstrate higher levels of innovation and business. Information sharing refers to information exchange and sharing between different information departments, so as to achieve a more reasonable allocation of resources, save social costs, and create more wealth. It is an essential means to improve the utilization rate of information resources and avoid repeated waste in information collection, storage, and management. It is based on standardization and standardization of information and is guaranteed by law or statute. The efficiency of information sharing depends on the development of information system technology and the improvement of transmission technology.

However, with the extension and expansion of the production chain, the problem of Information Island in the supply chain is becoming more severe. Supply chain refers to a functional network structure that around the core enterprise, starts with supporting parts, makes intermediate products and final products, and finally delivers products to consumers through sales network, linking suppliers, manufacturers, distributors and end users into a whole. The management concept of supply chain management is to seek the overall optimization of the supply chain from the perspective of consumers through cooperation among enterprises. Successful supply chain management can coordinate and integrate all activities in the supply chain, and eventually become a seamless integration process.
Supply chain is a system that includes suppliers, manufacturers, transporters, retailers and customers. Supply chain management refers to all kinds of activities and processes of planning, coordinating, operating, controlling and optimizing the whole supply chain system. Its goal is to deliver the right products needed by customers to the right place at the right time, according to the right quantity, quality, and status, so as to minimize the total cost. Obviously, supply chain management is a management mode embodying the idea of integration and coordination. It requires the members of the supply chain system to work together to cope with the complex and changeable situation of the external market. However, facing the complex and changeable market environment in the era of economic globalization, it is not easy to achieve efficient supply chain management. One of the important reasons is that there is not only a lot of information in the market every moment, which contains abundant opportunities but also indicates a lot of risks. However, enterprises in the supply chain often fail to grasp useful information timely and accurately, so they are baffled when making decisions and are difficult to make correct decisions. In other words, all member enterprises should share enough information to eliminate the uncertainty within the supply chain system. The way to solve this problem is to carry out informatization.

Enterprises should choose as many supply chain partners as possible as possible to implement supply chain informatization. This is because the fundamental goal of enterprises is to maximize their own profits, and the realization of this goal is achieved by satisfying the needs of downstream enterprises. In this process, it must also rely on the supply of upstream enterprises. Therefore, supply and demand is the most closely linked relationship. Every enterprise should consider the problem from the perspective of matching supply and demand. For a node enterprise in the supply chain, it is very concerned about the supply information from the upstream and the demand information from the downstream. If the information can be fully understood, it will be able to target production, transportation, and sales arrangements. Supply chain management requires that after the completion of informatization, managers of enterprises can effectively understand this information through the information systems, rather than forming the ability to control local information in their own enterprises just like traditional single enterprise informatization. Under such demand, supply chain information system becomes one of the key management methods to solve the problem of Information Island of enterprise supply chain. Value creation mechanism of supply chain information system network is composed of three aspects: first, the information system of supply chain network can effectively reduce the cooperation between enterprise transaction costs and improve efficiency of production and service of synergy between enterprises; Secondly, the information system network of the supply chain promotes the visualization of information sharing among enterprises, improves the ability of enterprises to find problems, and improves the possibility of enterprises finding profit space. Finally, the supply chain information system network forms network externality and improves the overall market value of all participants in the supply chain information system network.

The supply chain network is a complex network composed of manufacturers, distributors, customers and other entities (Tang, 2016). It integrates capital flow, logistics, and information flow. Information sharing plays a critical role in the supply chain network: enterprise nodes in the supply chain network. There are often complementary information resources, through the sharing of information can produce synergies, promote the common development of both companies, and thus enhance competitiveness. Companies with a high degree of information sharing among members of the supply chain also have higher carbon information disclosure quality. Therefore, it is of great significance to study the cooperative evolution of supply chain network information sharing and establish a sustainable supply chain network information ecosystem for supply chain low carbonization and management decision-making.

At present, many scholars have applied evolutionary game theory to the supply chain in-depth study. The evolutionary game is to define the dynamic process of group evolution and explain why and how the group will achieve this state (Friedman, 1991; Fishman, 2008). Many scholars use the evolutionary game to study the related problems of the supply chain. Han and Xue (2010) studied
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