A New Evolution Mechanism Model for B2B E-Commerce Network

Zhihong Tian, Beijing Jiaotong University, Beijing, China
Zhenji Zhang, Beijing Jiaotong University, Beijing, China
Xiaolan Guan, Beijing Institute of Graphic Communication, Beijing, China

ABSTRACT

To study the structure and evolution mechanism of B2B e-commerce network, the authors propose a network with several layers description of B2B e-commerce market. The empirical analysis from Alibaba.com shows that degree distribution of the network structure follows power-law. Based on modified BA (Barabasi-Albert) model, a new model is proposed, adding layers, fitness parameters, and more reasonable growth mechanism. The model reveals that, the structure of the network is stable, and the average path length and clustering coefficient are small. The authors also find that the impact of parameters is not decisive, and the emergence of scale-free nature depends on the mechanism itself.

Keywords: Barabasi-Albert (BA) Model, E-Commerce, Evolution Model, Network Science, Scale-Free Network

INTRODUCTION

Chinese e-commerce has developed from 1997 to present, and has experienced three waves: in the first wave (1997-2003), e-commerce market experienced learning, growth and bubble phase; in the second wave (2003-2009), e-commerce market experienced restoration, popularization and crisis phase; in the third wave (since 2009 to now), applications of e-commerce have achieved many substantial progresses, and e-commerce has played a very important role in national economy. Today, more and more enterprises interact with each other through transactions on websites which is called B2B e-commerce. These interactions promote the evolution and shape complex networks of e-commerce market. Going deeply insight into research of structure and evolution mechanism of B2B e-commerce market has a profound and lasting significance.

Research on traditional economics transaction from the perspective of complex network is emerging but to date has not received widespread attention, and mainly focuses on the field of supply chain (Liu & Wang, 2007; Hennet &
Arda, 2008) and enterprise clusters (Li & Qian, 2006). Li et al. gain that the enterprise status in industrial networks is different and industrial networks is a complex network with scale free. The demonstration of industrial networks complexity is showed by the application of semiconductor industrial network in China. Garlaschelli et al. (2005) study the existing shareholders’ network in Japan, Italy, and the US and found that this network contained scale-free network structures. Konno (2009) finds that there exists a hierarchical structure and a negative degree correlation in the transaction network of 800,000 Japanese firms. While in traditional economics transaction, costs and geography conspire to segment the markets, so that they cater to a local consumer base. However, the global reach of the Web could lead to different characteristics on the e-commerce network. Early in 2000, a universal power-law which the distribution of visitors per site follows was found (the case is America Online) (Adamic & Huberman, 2000). Such a disproportionate distribution is characteristic of winner-take-all markets, wherein the top few contenders capture a significant part of the market share. Illuminated by the finding of Adamic and Huberman, Maurer, et al. (2003) present a dynamical competition model of web site growth by establishing prey-predator equations. Their research shows that, under general conditions, as the competition between web sites increases, a sudden transition from a regime in which many sites thrive simultaneously to a “winner-take-all market” arises. The prey-predator equations highlight the important effects of competition among web sites, and imply that this transition is the result of a non-linear interaction among sites which effectively reduces the growth rate of a given site due to competitive pressures from the others. However, they are abstract descriptions without practical significance in e-commerce market. Last but not least, the prey-predator equations which are traditional ecological models can not reveal the non-linear interaction among huge amounts of competitors. In other words, the equations reveal how the parameters affect the above transition, but can not explain why the effect acts.

Our motivation originates from the development of network science and the belief that the network view can benefit Economics greatly and solve the above problems. Today, network is common in our daily lives, in which it refers to large-scale, complex-structured, unsteady interactions in many real world systems, ranging from biology to sociology. Cai et al. (2008) develop a social network model for a mobile e-commerce system, which could give ratings between buyers and sellers in terms of their social relationships, actual geographical distances and transaction records. Piao et al. (2010) establish a multi-agent model for e-commerce transaction network, and analyze degree centrality and betweenness centrality. In their models, the positions of buyers, sellers and products in the transaction network can be determined visually. However, the models neither reveal the evolutionary processes nor explain the emergence of the structure of network.

In the complex network theory of network science, it has been discovered that there is a significant relationship between the behavior of agents and their underlying network structures. Some reviews of complex networks are detailed below Dorogovtsev and Mendes (2003), Vega-Redondo (2007), Barabasi and Albert (1999), Newman (2003, 2004), Boccaletti et al. (2006). Such a relationship between the behavior or interaction of businesses and the structure of B2B e-commerce market is the motivation that stimulate us to study the evolution model for B2B e-commerce market.

The aim of this paper is to study how and why the structure of B2B e-commerce market takes shape. For this purpose, in this paper, we propose a network description of B2B e-commerce, where enterprises are represented as nodes connected by links. Then, we analyze an empirical case from Alibaba.com. Based on the analysis of empirical case and evolution mechanism, we propose a model and simulate it. Our model reveals that, the structure of the network is stable, and the average path length and clustering coefficient are small. We also find that the impact of parameters is not decisive, and the emergence of scale-free nature depends on the mechanism itself.
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