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A Complex Network for Studying the Transmission Mechanisms in Stock Market

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Abstract: This paper introduces a new complex network to describe the volatility transmission mechanisms in stock market. The network can not only endogenize stock market's volatility but also figure out the direction of volatility spillover. In this model, we first use BEKK-GARCH to estimate the volatility spillover effects among Chinese 18 industry sectors. Then, based on the ARCH coefficients and GARCH coefficients, the directional shock networks and variance networks in different stages are constructed separately. We find that the spillover effects and network structures changes in different stages. The results of the topological stability test demonstrate that the connectivity of networks becomes more fragile to selective attacks than stochastic attacks.

Keywords: Complex Network; BEKK; Volatility spillover effects; Endogenous

1. Introduction

More and more scholars have used complex networks to analyze the relationships among financial assets. According to the different definitions of nodes and links, different types of networks can be constructed. Most of them define stocks as nodes [1-10], while there are also scholars define stock indexes as nodes in order to analyze the interaction of the stock markets in different countries [11-13]. And most literatures employed the correlation coefficients to define the links [1-13], others used Granger-Causality effects as links [15]. As for network configurations, minimum spanning tree(MST) is one of the most widely used method. MST uses *N-1* edges to connect *N* nodes to ensure the stability of the whole system [3,4,7,8]. The advantage of MST is that it can greatly simplify the complexity of the networks and facilitate the understanding of topologies. The biggest disadvantage, however, is the huge loss of information. In order to reduce the excessive loss of information, parts of scholars have used the Planar Maximally Filtered Graph(PMFG) to construct the networks [14]. Different with MST, PMFG uses *3N-6* edges to connect *N* nodes. So there may exist circles in the network. But, loss of information is still a problem in PMFG. While, the Winner-takes-all method has solved the issue effectively. In Winner-takes-all, thresholds are set to ensure the strong correlations in the networks [1,2,5,6,9]. And, most scholars use complex networks to study the static problems, which regard a certain

period as an entity [1-6]. While, there are also parts of scholars treat complex networks as a method to describe the changes of problems in different stages, which can consider

the topology features of the networks [7,13]. For example, Sunil Kumar and Nivedita Deo focused on the changes of correlation among developed countries before and after 2008 financial crisis [13]. Further, Liu and Tse used time window to calculate the