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基于复杂网络的金融传染风险模型研究

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To Study the Model of Financial Contagion Risk Base on Complex Networks

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摘要 随着金融创新向更广和更深层面发展,金融体系中的传染风险和系统性风险越来越大,对此类风险进行准确度量是有效宏观审慎管理的重要内容。本文基于复杂网络理论,采用模拟方法对金融传染风险模型进行系统研究。首先,借鉴复杂网络的Watts级联动力学理论,构建了基于随机网络的金融传染模型,其较大的网络连通度水平不仅为传染提供更多的传播渠道,而且抵消了风险共享的能力。其次,引入Gleeson和Cahalane(2007)的分析框架,探讨了计算预期违约银行节点规模的解析模型,并对Watts模型中各种参数对系统风险的影响效应进行测度。最终,形成一个包括网络模拟方法、模型解析结论,以及网络统计分析方法等较全面的计算算法工具集合。

关键词： 传染风险 级联动力学 复杂网络 金融网络 随机图论 连通度

Abstract： The failing bank can lead to the potential collapse of the whole financial system,sophisticated financial instruments based on the assumption of stable equilibria in economic systems was seen as a major cause of the 2008 financial crisis. Contagion risk and the scale of systemic breakdown in the financial system are the key concern for effective macro prudential oversight. Recently these insights from the study of complex networks have been applied to the financial system.
Some simulation-based studies of financial contagion risk on the framework of complex networks models are mainly concerned in this paper. Banks are the nodes, inter-connected if financial flows and exposures exist among them. One of the key problems in this paper is that of understanding the role of the network structure in relation to the contagion effect.
We apply techniques from cascade dynamics on complex networks of Watts, which gives a degree distribution p_k and the average degree of the network$z$.An bank is called vulnerable if their threshold φ is smaller than the inverse of their degree k, i.e.$\varphi \le 1/k$, such that one infected neighbor suffices to attain the threshold. Starting from a small number of failed banks, the aim is to characterize the probability that failures propagate at the systemic level as a function of some relevant parameters, like the connectivity of the network and the net capital of banks. In numerical simulations, it can be found that while greater connectivity helps lower the probability of contagion, it can also increase its spread in the event of problems occurring. Greater connectivity does not only create more channels through which contagion can spread but also improves counteracting risk-sharing benefits.
Most importantly, the proposed methodology can be employed in many segments of the entire financial system, providing a useful tool in the hands of regulatory authorities in assessing more accurate estimates of systemic risk. It is investigated that how several new mathematical modeling approaches represented by the analytical framework of Gleeson may be applied. Overall goal will be to develop a comprehensive toolkit of computational algorithms that will include network simulation methods, analytic results for several models, plus statistical and graphical methods.

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