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Financial Network Stability Under Shocks: Analysis and Reflections

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Abstract:

This study will explore the resilience and stability of financial networks under major shocks, which will be analyzed by reviewing the facts in situations such as the 2008 financial crisis and the research analysis of prominent scholars. One of the main results is that the types of financial networks most susceptible to contagious failures change dramatically as the magnitude or number of negative shocks exceeds a certain threshold. In particular, more financial connectivity is no longer a guarantee of stability. Conversely, interbank liabilities can fuel financial contagion and create a more vulnerable system in the event of a large shock. The results show that in large-scale shocks, "weakly connected" financial networks - for example, those consisting of a pair of connected banks that share a minimal amount of assets and liabilities with the rest of the system - are much more stable than more complete networks. This paper puts forward the consideration of financial network stability, which helps financial networks maintain stability in the face of potential financial shocks to a certain extent.

Keywords: Financial networks; Network stability; Complex networks.

1. Introduction

1.1 Influencing Factors of Financial Network Structure

The „financial network" usually includes various connections and associations within the financial industry or between different industries. This connectivity can include interconnectivity between financial institutions, stock exchange markets, payment systems, fintech companies, and other financial service providers. Financial networks include various relationships between financial institutions, such as capital flows, data transmission, risk communication, and business cooperation. They may also cover the transaction and settlement of financial markets and the issuance and sale of financial products. There are also many factors affecting the stability of the financial network, such as the development of technology and the enactment of relevant laws, which will consolidate the stability of the financial network.

On the other hand, market fluctuations or economic contraction caused by various reasons will challenge the financial network. And because there is often a contagious effect of risk due to the close interconnectedness of financial institutions or markets, it can knock on the entire financial network once a systemically important institution or market fails. The construction and development of financial networks play an important role in the development and innovation of the financial industry. Since financial interconnection among the five sectors of the national economy is a very important mechanism, the flow of funds from deposits, loans, and securities products is transmitted within the financial system. A well-integrated financial system is also important in improving financial efficiency, as it facilitates the sharing of financial risks, access to credit, and reduces costs for residents, businesses, and financial intermediaries [1]. It is, therefore, very important to ensure the stability of the financial network.

1.2 Systemic Risk Systemic

The risk in the financial network is within the entire financial system from the risk of cross correlation and mutual dependence when a certain part of the financial system has suffered losses or collapse, which may lead to the loss of the risk of the entire financial system. Systemic risk usually has the following characteristics: 1) It comes from the entire financial network rather than a single institution or market. 2) It is contagious and can spread rapidly throughout the system. 3) Difficult to eliminate and potentially destructive. Common systemic risk in the financial network has the following several differences reflected: the first is after the financial crisis in the infectious financial network because it is an important financial institution in a credit crisis and other financial institutions credit default so that the risks in the financial network quickly spread and spread to every financial sector. Then, after a shock

to one financial network, it may have a knock-on effect on the operations of other institutions. Finally, as the crisis spreads among institutions, it may lead to a liquidity panic among other institutions, causing liquidity problems throughout the financial network [2]. Have calculated that in the U.S. financial network, tail risks among institutions are highly correlated due to network effects. Therefore, financial regulators and financial institutions need to pay close attention to the impact of the structure of financial networks on the spread of systemic risks and take corresponding risk management and monitoring measures to better resist and reduce the spread of systemic risks.

1.3 Research Purpose and Significance

Financial Networks are not only a playground for the use of basic tools of statistical physics such as ensemble representation and entropy maximization; rather, their particular dynamics and evolution triggered theoretical advancements such as the definition of DebtRank to measure the impact and diffusion of shocks in the whole systems [3]. Although there is a more comprehensive understanding of the financial network than ever, it is still impossible to predict when and why the next major impact on the entire financial network may occur. However, protecting the stability of the financial network is conducive to minimizing the impact on the entire financial network. This article will try to find some lessons for people to avoid future risks based on two specific examples of huge shocks to financial networks.

2. Financial Network and Financial Crisis

2.1 The Importance of Financial Networks

The 2008 financial crisis led to a rethinking of the causes of such massive shocks, and it is widely accepted that the design of financial networks played a crucial role in triggering and influencing the nature of the crisis. The interconnectedness of financial markets is now seen in mainstream research as a key factor in how risk spreads throughout the system, influencing the policy response during the crisis and the regulatory framework developed since then. Unfortunately, however, the specific impact of the structure of financial networks in creating systemic risks and shaping the fragility of the financial system is still not fully understood. This lack of understanding is partly due to a lack of hard empirical evidence on the mechanisms of financial contagion and a lack of a theoretical framework that fully explains the underlying economic dynamics. Nowadays, people have begun to pay attention to the important influence of financial networks in the financial system. As a result, some researchers have begun to explore the influence of financial networks in financial crises and have achieved some results, as can be seen in the work of Professor Acemoglu and others.

2.2 Empirical Analysis

In a study by Prof. Acemoglu et al., the degree of stability in the event of a shock to several different financial networks was explored, with the degree of stability measured by the repayment of interbank loans and the degree of financial contagion [4]. It is concluded that when the size or number of negative shocks exceeds a certain threshold, the types of financial networks most susceptible to infectious failure change dramatically. In particular, more financial interconnection is no longer a guarantee of stability. On the contrary, interbank liabilities can contribute to financial contagion and create a more vulnerable system in the event of a large shock.

2.3 Impact of COVID-19 on Financial Networks Since 2020

Since the 2008 financial crisis, the global economy has recovered to some extent, but in recovery, there has also been a hidden crisis. In a context characterized by strong interconnection between institutions, the need for financial risk protection has never been greater [5]. The literature on systemic risk measures has developed rapidly in recent years [6]. Implementing appropriate regulations [7,8,9] requires that people account for how exposed each institution is to others. However, people‘s research on the stability of financial networks will be tested unexpectedly. At the beginning of 2020, the sudden attack of the new coronavirus epidemic took the world by surprise. It seemed that people‘s normal lives had been suspended for a time. At the same time, the impact of the new coronavirus epidemic on the economy has also been huge, and various countries and regions have more or less regressed their economic output in 2020. Now, four years later, people are also reflecting on the impact of the financial shock caused by the COVID-19 pandemic. What is more important is how this massive shock caused by natural factors has affected the financial network and how people should deal with such shocks.

2.4 Simulation Based on The Impact of COVID-19 on Financial Networks

In his 2023 paper, Zhang Zicong combined the empirical fitness model with the threshold method to construct the bilateral interbank lending network in line with the actual situation and analyzed the topological characteristics of the bank network. Finally, the risk resistance and stability of the banking system are analyzed by simulating the systematic, intentional attacks of major banks. The analysis of bank network topology found that since 2019, the

interbank lending relationship in the interbank lending market has increased, the connection between various banks in the interbank lending network has become closer, and the probability of risk contagion has increased [10]. This means a risk event at the central bank will also cause other banks to suffer. Another paper proposes a new system risk measurement method considering indirect network structures. The spillover effects of deleveraging and price effects in the financial system are captured, and the extent to which losses are magnified in the contagion is calculated. The model was applied to the Chinese banking system, and in small and medium-sized shocks, credit supply is proportional to bank size. However, when the shock is severe, an effective policy is to rescue small and medium-sized banks. In addition, credit supply can affect the network structure; higher credit support will reduce network centrality and thus reduce systemic risk [11].

3. Analysis and Discuss

3.1 Financial Policy and Risk Management

By comparing these papers, it is not difficult to find that stable financial networks when financial shocks do not hit them do not mean they can maintain their stability in the face of large-scale financial shocks. However, when large-scale financial shocks hit them, interconnection among banks will promote financial contagion to a certain extent, which will cause other banks to suffer risk shocks. Ultimately, it affects the entire financial system.

In today's changing financial environment, studying financial network stability can help financial institutions and regulators better understand the interrelationships within the financial system, identify key nodes that can trigger financial contagion, and prevent potential crises in advance. At the same time, an in-depth study of the topology of the financial network, risk transmission mechanism, and market behavior can improve the anti-risk ability of the financial system, reduce the possibility of a financial crisis, and ensure the stability and sustainable development of the financial market. To better understand and manage the complexities and risks of the modern financial system and to contribute to the sound development of the financial system and the stability of the global economy.

3.2 The Ongoing Need to Study the Stability of Financial Networks

Studying financial network stability is essential to adapt to the changing financial environment and challenges. As the global financial system has grown in complexity, financial networks have become more closely connected. Therefore, studying the stability of financial networks helps to identify potential systemic risks, predict the occurrence of financial crises, and formulate effective regulatory policies and risk management measures. The new direction of future research on financial networks may be related to more comprehensive data analysis and modeling by big data and artificial intelligence technologies, which can provide more accurate tools for predicting and managing the stability of financial networks, allowing us to better understand the internal and external shocks and changes to the stability of financial networks. In addition, companies and banks that are part of the financial network need to implement sound business strategies. Enterprises and banks should maintain the degree of mixed business and business complexity at a relatively low level, which is conducive to establishing risk isolation mechanisms to achieve a stable operation and maintain the stable operation of the financial system [10].

4. Conclusion

This paper explores the stability of financial networks in the face of major shocks and the importance of risk management strategies. By analyzing the impact of the 2008 financial crisis and the 2020 COVID-19 pandemic on financial networks, we reveal that financial network stability can be difficult to maintain and that interbank interconnectedness can fuel financial contagion that can spread throughout the financial system. This suggests that while financial networks are stable, their vulnerability to large-scale shocks cannot be ignored. This paper stresses the importance of continuing to study the stability of the financial network and adapting to the changing financial environment and challenges. Future research could explore deeper theoretical discussions and more comprehensive data analysis to deepen understanding of financial network stability and propose more specific risk management strategies. However, this paper lacks real data to support the theory. Therefore, given the shortcomings of this paper, future research needs to combine more field research and case studies to verify the effectiveness of theoretical analysis and provide more powerful support for the actual risk management and decision-making of financial institutions. To sum up, the stability of the financial network is important for the healthy development of the entire financial system. Through continuous and in-depth research and practical exploration, we can better understand and avoid potential major shocks and improve the financial system's resilience. At the same time, combined with field experience and theoretical analysis, a more comprehensive and operational risk management strategy can be developed to ensure the stability and sustainable development of the financial system.

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