Chapter 15
Systemic Risk, Stress Testing, and Financial Contagion: Their Interaction and Measurement

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ABSTRACT
Despite the acknowledgment of the relevance of Systemic Risk, there is a lack of consensus on its definition and, more importantly, on the way it should be measured. Fortunately, there is a growing research agenda and more financial regulators, central bankers, and academics have recently been focusing on this field. In this chapter, the authors obtain a distribution of losses for the banking system as a whole. They are convinced that such distribution of losses is the key element that could be used to develop relevant measures for systemic risk.

Their model contemplates several aspects, which they consider important regarding the concept of systemic risk: an initial macroeconomic shock, which weakens some institutions (some of them to the point of failure), a contagion process by means of the interbank market, and the resulting losses to the financial system as a whole. Finally, once the distribution is estimated, the authors derive standard risk measures for the system as a whole, focusing on the tail of the distribution (where the catastrophic or systemic events are located).

By using the proposed framework, it is also possible to perform stress testing in a coherent way, including second round effects like contagion through the interbank market. Additionally, it is possible to follow the evolution of certain coherent risk measures, like the CVaR, in order to evaluate if the system is becoming more or less risky, in fact, more or less fragile. Additionally, the authors decompose the distribution of losses of the whole banking system into the systemic and the contagion elements and determine if the system is more prone to experience contagious difficulties during a certain period of time.

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1. INTRODUCTION

The importance of systemic risk is hardly disputable. Furthermore, it is at the heart of intense discussions for all regulators and financial authorities. Despite the relevance of systemic risk for the maintenance of financial stability and its recent popularity, it is still work in progress as we lack a universal definition and tools to measure it. However, after the unfortunate recent events, there is a renewed and shared interest by the national and international financial authorities in developing such necessary tools. One of the first challenges to overcome is the confusion on the field created by a few terms recently used, all of them associated with systemic risk: financial contagion, too-interconnected to fail, systemically important institutions, systemic losses, liquidity risk, financial networks, etc. Nevertheless, we argue that what is necessary is a common language to define systemic risk and simple, yet robust, ways of measuring it. We will adopt, for practical reasons the following definition: Systemic risk can be broadly defined as consisting of two components: an initial (macroeconomic) shock and a contagion mechanism. The initial shock weakens one or several financial institutions and then contagion might arise as a result of such shock. Regarding contagion, there can be different channels of transmission. For example, the interbank market, just to mention one of the most widely studied transmission channels in the literature.

Having defined systemic risk, we can now focus on ways to measure it in order to manage it. In most standard risk models, there are risk measures such as expected loss, VaR, CVaR, etc. These risk measures can provide us with an idea of the size of the loss and its likelihood in a systemic crisis. Having said so, in our opinion it is very important to estimate, in the best possible and accurate form, the distribution of losses for the system as a whole, instead of adding up individual risk measures for each bank.

Financial contagion is one of the key elements on the definition of systemic risk; in fact, both terms were used in an interchangeable way in the past. Nowadays, it is clear that it is just one of the components of systemic risk, a very important one though. However, it is not easy to model or quantify financial contagion especially in the presence of indirect contagion or contagion through indirect links.

As in the case of systemic risk, there are many definitions for financial contagion due to the complex way in which financial institutions are related today. Additionally, it is difficult to verify empirically if financial difficulties are transmitted between financial institutions or whether the cause of financial distress is something different, like common exposures. Furthermore, it is necessary to distinguish between two different types of contagion: direct and indirect contagion. While direct financial contagion has been studied widely by several central banks, indirect contagion is in contrast difficult to estimate due to the inherent information problems faced by the financial authorities and researchers.

More recently, there has been a furor to study systemic risk by means of network theory to the point that the term “too interconnected to fail” is widely known by international regulators. Even though, we believe that such approaches (graph theory and network models) are very useful in understanding the relevance of particular institutions due to their connections in the financial system, and to model the transmission of shocks they are not enough to model adequately systemic risk. The studies on payments systems and network theory are the perfect example of a successful application of such approach in the arena of systemic risk but they can only provide a limited view of the problem. The topology of the network of funds flows on the payment systems is very useful to identify some banks, which are relevant players in such a system, banks that can be considered of systemic relevance because of the role they play. Nevertheless, systemic risk is more than payment...