How Resilient is Your Organization?
From Local Failures to Systemic Risk

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Abstract

Empirical evidence of reported losses suggests that insurance firms are interconnected in a nontrivial way. As a result, systemic risk is a real possibility, where the failure of a single firm can have a disproportionate effect on the market by affecting firms connected to it. Systemic risk can be viewed as the result of a cascading process, as it unravels throughout a network structure. In response, this work presents a simple analytical model that can simulate this process. The model is subsequently tested upon an empirical dataset via the means of numerical simulations. Consequently, the systemic role of individual firms, both in terms of triggering a cascade or being affected by one, is established based on two novel indices: the Criticality IDX and the Sensitivity IDX. This article makes three main contributions. First, it provides a novel methodology for quantitatively and objectively assessing the systemic role of individual firms within the insurance domain. Second, it exemplifies the inability of traditional, firm-based information in serving as proxies for mapping these systemic effects. Third, it provides a practical example where network-based information (e.g., Criticality IDX, Sensitivity IDX) can outperform firm-based information (e.g., admissible assets, excess capital) resulting in increased efficiency in the decision-making process. These findings strengthen the need to account for the interconnected nature of the domain while showcasing some of the potential benefits that can be harvested by doing so.

Keywords: systemic risk, cascading process, complex networks, numerical modeling, decision-making

1. Introduction

Systemic risk can be defined as the risk of having interdependent failures, as a result of a *cascading process* (Helbing 2012). Such processes have been identified as the source of failure cascades (also known as chain reactions, avalanches or the domino effect) in a wide variety of fields, ranging from epidemics to social contagion and interbank flows (see Newman 2011; Vespignani 2012; Barrat, Barthelemy, and Vespignani 2008; Vespignani 2009 and references within). In these examples, the failure of a single component (e.g., a social agent, a financial institution, etc.) is capable of inducing a disproportionately large (in fact, theoretically infinite [Helbing 2013]) damage to the overall system. Clearly, these effects are driven by complex, nonlinear relationships between these components, reflecting the intricate structures that underlie these systems. Such structure has been shown to regularly balance between order and chaos (Strogatz 2001). Complex network theory, a descendant of graph theory (Watts 2004), has recently emerged as a unifying approach in exploring the resulting dynamical processes (such as a cascading process) that underlie the behavior of these systems

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