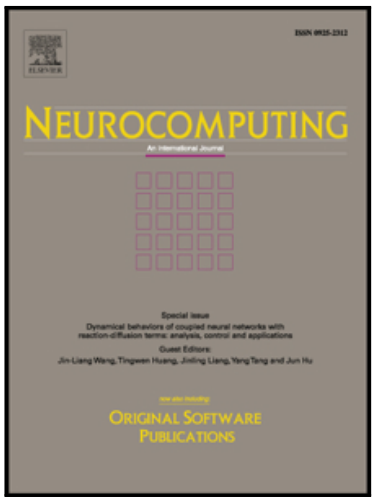

Twitter data models for bank risk contagion

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Abstract

A very important and timely area of research in finance is systemic risk modelling, which concerns the estimation of the relationships between different financial institutions, with the aim of establishing which of them are more contagious/subject to contagion. The aim of this paper is to develop a systemic risk model which, differently from existing ones, employs not only the information contained in financial market prices, but also big data coming from financial tweets. From a methodological viewpoint, we propose a new framework, based on graphical Gaussian models, that can estimate systemic risks with stochastic network models based on two different sources: financial markets and financial tweets, and suggest a way to combine them, using a Bayesian approach. From an applied viewpoint, we present the first systemic risk model based on big data, and show that such a model can help predicting the default probability of a bank, conditionally on the others.

1. Introduction

Systemic risk models address the issue of interdependence between financial institutions and, specifically, measure how bank default risks are transmitted among banks.

The study of bank defaults is important for two reasons. First, an understanding of the factors related to bank failure enables regulatory authorities to supervise banks more efficiently. If supervisors can detect problems early enough, regulatory actions can be taken, to prevent a bank from failing and, therefore, to reduce the costs of its bail-in, faced by shareholders, bondholders and depositors; or those of its bail-out, faced by governments and, ultimately, by the taxpayers. Second, the failure of a bank very likely induces failures of other banks or of parts of the financial system. Understanding the determinants of a single bank failure may thus help to understand the determinants of financial systemic risks, were they due to microeconomic idiosyncratic factors or to macroeconomic imbalances. When problems are detected, their causes can be removed or isolated, to limit "contagion effects".

Most research papers on bank failures are based on financial market models, that originate from the seminal paper of Merton (1974), in which the market value of bank assets is matched against bank liabilities. Due to its practical limitations, Merton's model has been evolved into a reduced form (see e.g. Vasicek, 1984), leading to a widespread diffusion of the resulting approach, and the related implementation in regulatory models.

The last few years have witnessed an increasing research literature on systemic risk, with the aim of identifying the most contagious institutions and their transmission channels. Specific measures of systemic risk have been proposed for the banking sector; in particular, by Acharya et al. (2010), Adrian and Brunnermeier (2011), Brownlees and Engle (2012), Acharya et al. (2012), Dumitrescu and Banulescu (2014) and Hautsch et al. (2015). On the basis of market prices, these authors calculate the quantiles of the estimated loss probability distribution of a bank, conditional on the occurrence of an extreme event in the financial market.

The above approach is useful to establish policy thresholds aimed, in particular, at identifying the most systemic institutions. However, it is a bivariate approach, which allows to calculate the risk of an institution conditional on another (or on a reference market), but it does not address the issue of how risks are transmitted between different institutions in a multivariate framework.

Trying to address the multivariate nature of systemic risk, researchers have proposed a network modelling approach, following the idea in Diamond and Dybvig (1983) and the seminal papers of Sheldon and Maurer (1998), Eisenberg and Noe (2001), Boss et al. (2004), Upper and Worms (2004). In this literature, interconnectedness is related to the detection of the most central players in a network that describes financial flows between agents. While the simplest way of measuring