Systemic risk in banking networks without Monte Carlo simulation

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Abstract

An analytical approach to calculating the expected size of contagion events in models of banking networks is presented. The method is applicable to networks with arbitrary degree distributions, permits cascades to be initiated by the default of one or more banks, and includes liquidity risk effects. Theoretical results are validated by comparison with Monte Carlo simulations, and may be used to assess the stability of a given banking network topology.

1 Introduction

The study of contagion in financial systems is currently very topical. "Contagion" refers to the spread of defaults through a system of financial institutions, with each successive default causing increasing pressure on the remaining components of the system. The term "systemic risk" refers to the contagion-induced threat to the financial system as a whole, due to the default of one (or more) of its component institutions, and it has become a familiar term since the failure of Lehman Brothers and the rescue of AIG in the autumn of 2008.

Interbank (IB) networks constitute financial systems that range in size from dozens to thousands of institutions (Boss *et al.*, 2004; Upper and Worms, 2004; Wells, 2002). An IB network may be modelled as a (directed) graph; the *nodes* or *vertices* of the network are individual banks, while the *links* or *edges* of the network are the loans from one bank to another. Such systems are vulnerable to contagion effects, and the importance of studying these complex networks has been highlighted by Andrew Haldane, Executive director of Financial Stability at the Bank of England in his speech (Haldane, 2009), in which he posed the following challenge: 'Can network