

Systemic risk on the interbank market

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Abstract

We simulate interbank lending. Each bank faces fluctuations in liquid assets and stochastic investment opportunities that mature with delay, creating the risk of liquidity shortages. An interbank market lets participants pool this risk but also creates the potential for one bank's crisis to propagate through the system. We study banking systems with homogeneous banks, as well as systems in which banks are heterogeneous. With homogeneous banks, an interbank market unambiguously stabilizes the system. With heterogeneity, knock-on effects become possible, but the stabilizing role of interbank lending remains so that the interbank market can play an ambiguous role.

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1. Introduction

In banking systems, there is a tendency for crises to spread from institution to institution. This tendency is referred to as 'systemic risk' and, at a large enough scale, leads to 'systemic failure'. Three types of sources for systemic failure have been noted in the literature. First, there can be a 'bank run', a self-fulfilling panic in which depositors and investors attempt to withdraw funds leading to a collapse of the system (see Diamond and Dybvig, 1983; Donaldson, 1992; de Bandt, 1999; Jacklin and Bhattacharya, 1988; Calomiris and Kahn, 1996; Cowen and Kroszner, 1989). Second, given that banks invest in similar types of assets, a large enough failure by one bank can lead to a fall in the price of its assets and affect the solvency of other banks that hold the same

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asset (see, e.g., Radelet and Sachs, 1998, or Edison et al., 2000; Luangaram and Miller, 1998, and Allen and Gale, 2000). The third aspect of systemic risk arises from inter-locking exposures among financial institutions, which form a basis for mutual insurance, on one hand (see Allen and Gale) and on the other, create the potential for one institution's failure to have 'knock on' effects on the financial health of other institutions.

The focus of this paper is on the third source of systemic risk. In particular, we look at a specific form of inter-locking exposure, viz. interbank lending. Such lending is very short term, mainly overnight, and allows banks facing liquidity shortages to cover their obligations and reserve requirements by borrowing from surplus banks. Thus, interbank lending represents one form of safety net for individual banks. At the same time, by creating inter-locking exposure, it has the potential to create knock-on effects from the failure of debtor banks to the balance sheets and reserve holdings of lender banks. Thus, there is a tradeoff between mutual insurance and systemic risk on the overall stability of the system under interbank lending.

The empirical dimensions of knock-on effects have been studied in Humphrey (1986), Angelini et al. (1996), Furfine (2003) and Upper and Worms (2002). The first two papers study knock-on possibilities associated with intra-day netting arrangements between banks, Humphrey for the United States and Angelini et al. for the Italian netting system. Furfine studies the bilateral exchange of interbank credit in the federal funds market of the United States. Upper and Worms analyse the German interbank market. Each of the papers estimates the impact of failure in one bank upon the financial health of the system as a whole. A common theme of their results is that the degree of contagion depends on the size of losses imposed by failing debtor banks on creditor banks in the system, but the empirical focus of these papers is on the size of knock effects to the neglect of the mutual insurance role.

The full tradeoff between individual and system-wide risk is explicitly considered in Allen and Gale and, more recently, Kahn and Santos (2005), although neither paper focuses exclusively on the interbank market. Moreover, these two papers are mainly interested in studying strategic behaviour by banks and the resulting optimality of mutual insurance arrangements between them.

In this paper, by contrast, we are explicitly concerned with the potential for the interbank market to act as a *propagation* mechanism for liquidity crises. Given that such a role is by no means unambiguous, we believe that it is worth studying for its own sake and in abstraction from the reasons for the onset of crises or the microeconomic details of individual behaviour. While these are undeniably important issues, they are not the primary concern of this paper. Rather, the focus is on how the interplay between individual risk characteristics and the interbank market leads to accentuating (or dampening, for that matter) liquidity crises.

In this sense, our focus can be said to be on microstructure rather than on microeconomics. The strategies of the participants are imposed exogenously and the choice between them is not derived from first principles, but given these elements, the impact of different patterns of stochastic properties and bank interdependence is evaluated through numerical simulations. The crises that are generated in our model are not meant to be realistic in their origins, their duration, or their severity; what matters is how these crises vary *relative to each other* under different statistical scenarios. The point of reference for one crisis will be others produced by the same model using different risk characteristics. This approach is related to a small but growing literature that uses techniques from statistical mechanics to study the dynamics of economic and financial systems (see, for example, Bak et al., 1993; Lux and Marchesi, 1999; Iori, 2002; Cont and Bouchaud, 2000).

Our results suggest that interbank lending contributes to a lower incidence of bank failures through the mutual insurance role but, at the same time, does create the tendency for the system

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