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Insolvency and contagion in the Brazilian interbank market

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HIGHLIGHTS

- The contagion chain in the interbank market has a short propagation path.
- Size is not the sole determinant of the amount of contagion losses.
- Only banks originate contagion; most of them are large or medium-sized.
- Most vulnerable financial institutions are not banks.
- We compute a financial system 1-year horizon expected losses lower bound.

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ABSTRACT

This paper proposes a new way to model and analyze contagion in interbank networks. We use a unique dataset from the Brazilian financial system and include all active financial intermediaries. We show that the contagion chain has a short propagation path. We find that first-round contagion is generated only by banks and that medium-sized banks can generate contagion, which implies that size is not the sole determinant of importance within networks. Most vulnerable financial institutions are not banks. Finally, we compute a lower bound for the financial system expected losses in a 1-year horizon. The results contribute to the development of a financial stability-monitoring toolkit.

1. Introduction

This paper presents an analysis of the contagion process in the exposures network of the Brazilian interbank market. The subprime crisis provided evidence that the interbank market is an important source of liquidity. While the freeze on these markets led to liquidity crises and to the insolvency of financial institutions (FIs), it also devastated the confidence of economic agents, feeding back that freeze and amplifying its effects. Interbank markets are a key source of risk, given their speed of contagion. In this paper, we address this issue, performing contagion process analyses for exposures networks built up from FI's exposures. Initially, we employ Eisenberg and Noe's [1] methodology to compute LGDs for single financial institutions. We find that in addition to large FIs, medium- and small-sized FIs can originate contagion and that only banks originate contagion. We also estimate the lowest losses other markets would suffer given idiosyncratic defaults of FIs, finding that the FI size category that potentially inflicts larger losses on other markets is that of large non-banks. This suggests that those FIs use low capital buffers compared to the funds from other markets they invest in the interbank market.

Next, we analyze the critical contagion paths within the exposures network. We perform this analysis on monthly data from July 2011 to June 2012 and find that the critical contagion routes are short, reaching at most three propagation stages.

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Most FIs do not take part in them, as they are not individually vulnerable due to their relatively high capital buffers, which prevent the propagation of contagion processes. The contagion chains start at a bank, usually a large one, and affect a vulnerable FI. Most of the vulnerable FIs are large non-banks. The contagion process most often ends in other markets, the usual source of funds for those vulnerable FIs.

Finally, we compute the expected losses of the financial system. One crucial factor for this computation is to take into account common (macroeconomic) risk factors, which are not captured by the LGDs from idiosyncratic defaults computed for individual FIs. To bring into analysis the effect of common exposures along the financial system, we note that default probabilities can be derived from the macroeconomic risk factors related to balance sheet items or the market prices of the FIs themselves. Along that line, we compute FIs' default probabilities using contingent claim analysis. We compute expected systemic losses on a 1-year horizon, considering initial defaults of a single FI and joint defaults of two and three FIs as well. The computation considers joint defaults as independent events. We also compute a lower bound for these expected systemic losses, finding an average of 0.51% of the total interbank assets.

Our paper is related to the seminal paper by Eisenberg and Noe [1] that presents a clearing algorithm to analyze systemic risk in interbank networks. Using that algorithm, Boss et al. [2] empirically evaluate bank losses in networks related to shocks in market and credit risk factors in the Austrian financial system. Elsinger et al. [3] use standard computation techniques for credit and market risk to estimate the amount that a last resort lender must employ in order to lend to the banking system to avoid contagious defaults. Alessandri et al. [4] present a model for the quantification of systemic risk using banks' balance sheet data and their network interconnections over a 3-year horizon for the English interbank system. Papadimitriou et al. [5], Kuzubaş and Ömercikoğlu [6] analyze systemic risk by investigating how representative topological network measures vary over time. Shin [7] analyzes the relationship between liquidity and risk in a system of FIs' interconnected balance sheets. The liquidity of the financial system as a whole affects the asset prices, which affects the FIs' balance sheets. On the other hand, balance sheets affect assets prices, creating a cycle that can amplify the shocks in the financial system. Our analyses focus mainly on the contagion process, complementing those by Tabak et al. [8], which focuses on the fragility of individual FIs.

Regarding the computation of expected losses, the technique used in this paper is related to the approach used in the seminal paper by Elsinger et al. [9], who consider that FIs' default probabilities, to some extent, can result from common exposures to macroeconomic factors. In economic downturns, default probabilities tend to increase for most FIs regardless of any consideration of default events being correlated. The novelty of our work is that we use the Eisenberg and Noe algorithm and a Contingent Claim analysis (implicit joint default probabilities) to model expected losses on a 1-year horizon from the main components of FIs' balance sheets. Other contributions of this work are as follows. First, our model allows losses originating within the market under analysis to propagate to other markets for which there is no available data, and second, we investigate how the contagion process propagates throughout the network and confirm the presence of short propagation paths in the Brazilian interbank market. In particular, the contagion is preferentially directed outwards the interbank market (other markets) with no contagion losses of systemic proportions.

The remainder of the paper is structured as follows. Section 2 describes the methodology, Section 3 discusses the data, Section 4 analyses the empirical results and Section 5 concludes.

2. Methodology

2.1. Framework

In this paper, besides analyzing the insolvency contagion process through defaults in the interbank market, we compute the expected losses in a 1-year horizon for the entire financial system that result from the default of FIs in the interbank market. We analyze the critical contagion paths that may arise from FIs' defaults to provide information on interbank market organization, emphasizing factors that define the general features of the contagion process. Regarding expected losses, the computation has two stages: in the first, we compute the losses associated with idiosyncratic defaults, and in the second, we associate these losses given defaults to 1-year horizon default probabilities in order to obtain the financial system's expected losses in this horizon.

In the first stage, we compute losses that arise from defaults of individual FIs and from simultaneous defaults of two and three FIs. In this computation, we consider that losses due to a default propagate through the balance sheet: the default of one FI forces its lenders to write off the corresponding assets from their balance sheets, which leads them into distress or default. If they become insolvent, they originate shocks to their lenders. This is the propagation process considered in the methodology of Eisenberg and Noe [1]. We also consider contagions arising from common exposures of FIs to risk factors. We do not, however, consider contagion processes originating through either illiquidity spirals or changes in prices motivated by fire sales of assets. According to Alessandri et al. [4], following Sorge and Virolainen [10], it is possible to link common (macroeconomic) risk factors to default probabilities in two ways: one is to extract risk from balance sheet data, and the second is to extract it from observed asset prices. The first method is pursued in Refs. [9,4]. They divide the banks' balance sheet assets into classes and estimate the performance of each one, summing the profits or losses to the bank's capital. According to Alessandri et al. [4], this method provides a flexible and operational means of capturing a wide range of risks and transmission channels, and also allows more specific analyses of stress tests results. We adopt the second approach,