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Vulnerable banks ☆

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ABSTRACT

We present a model in which fire sales propagate shocks across bank balance sheets. When a bank experiences a negative shock to its equity, a natural way to return to target leverage is to sell assets. If potential buyers are limited, then asset sales depress prices, in which case one bank's sales impact other banks with common exposures. We show how this contagion effect adds up across the banking sector, and how it can be estimated empirically using balance sheet data. We compute bank exposures to system-wide deleveraging, as well as the spillovers induced by individual banks. Applying the model to European banks, we evaluate a variety of interventions to reduce their vulnerability to fire sales during the sovereign debt crisis.

1. Introduction

When a bank experiences financial stress, its troubles could spill over to other banks and threaten to contaminate the broader financial system. This is what regulators refer to when they define and measure systemic risk.

Researchers have emphasized two distinct channels by which financial shocks propagate across institutions. The first channel relies on direct linkages between banks. When two parties write a financial contract such as a swap agreement, a negative shock to one party can transmit to the other as soon as one is unable to honor the contract (e.g., Allen and Babus, 2009; Gorton and Metrick, 2012; Giglio, 2013). Direct linkages of this type can propagate distress, because, once defaulted upon, the creditor bank could lack the funds needed to deliver on its obligations to third parties (Duffie, 2011; Kallestrup, Lando, and Murgoci, 2011; Diebold and Yilmaz, 2011).

A second propagation channel involves fire sales. When a bank sells illiquid assets to reduce its leverage, the sale could depress prices because of a lack of unconstrained buyers, which can trigger financial distress at other banks that hold the same assets. Affected banks could in turn sell other assets

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in an attempt to shore up their balance sheets. Contamination can occur across seemingly unrelated assets and across seemingly unrelated institutions. Liquidation spirals of this sort have been suggested in the extensive theoretical literature on fire sales and are widely believed to be important drivers of systemic risk in modern financial markets.[1]

This paper develops a simple linear model of fire sales spillovers that can be readily estimated using simple data on bank balance sheets. Our model takes as given the asset holdings of each financial institution, a balance sheet adjustment rule applied by institutions when they are hit by adverse shocks, and the liquidity of these assets on the secondary market (i.e., the price impact generated by asset liquidations). Using these assumptions, we can describe the evolution of bank balance sheets following shocks to the value of their assets.

We use the model to develop simple formulas of how fire sale spillovers add up across banks and how susceptible individual banks are to episodes of deleveraging by others. A key output is a measure of a bank's contribution to financial sector fragility, a quantity that we call *systemicness*. Systemicness is proportional to the product of size, leverage, and connectedness. In our model, a bank is connected when it owns large and illiquid asset classes to which other banks also have high exposures. When a highly connected bank sells assets to reduce leverage, its overall impact on other banks is large, because the prices of assets it sells fall and because the assets are held by other banks that then must mark down their balance sheets.

When financial regulators assess the soundness of a bank, they typically measure the vulnerability of the bank to different adverse scenarios. But our model suggests an important distinction between a bank's vulnerability and its systemicness. To see the distinction, consider a small but highly leveraged bank with a portfolio of risky assets. Such a bank could be vulnerable to financial sector deleveraging, in the sense that price impact of fire sales elsewhere in the financial system could significantly impair the bank's balance sheet. But such a bank is unlikely to be systemic, because asset sales triggered by its distress would not trigger much in the way of spillovers.

We develop a number of intuitive results regarding how the distribution of leverage and risk exposures across banks determines systemic risk. For instance, consider a negative return shock experienced by an asset that is held by a set of highly levered banks. This shock has a larger aggregate impact than if the same asset were held by less levered institutions, because the banks that hold the asset have to sell more in a fire sale to maintain their target capital structure. More generally, we show that the banking system is more susceptible to contagion when asset classes that are large in dollar terms are also held by the most levered banks. If the goal is to reduce fire sale spillovers, then assets that are both volatile and illiquid should be dispersed across banks, as the same shocks generate less price impact in a deleveraging cycle. In contrast, if illiquid assets have low price volatility, then it is better to isolate these assets in separate banks, so that they are not contaminated by other assets, which then are subject to larger shocks.

We show how the model can be used to simulate the outcome of various policies to reduce fire sale spillovers in the midst of a crisis. As an example of such policy analysis, consider a forced merger between two vulnerable banks. Sorkin (2009) suggests this was one of the initiatives entertained by the Federal Reserve Bank of New York during the US financial crisis. Such a policy could affect systemic risk because it redistributes existing assets across banks, which can have different exposures to shocks, different sizes, or different leverage ratios. Alternatively, consider the policy question of how to distribute a fixed amount of equity capital from the government across a large set of distressed banks. We find that, from the perspective of systemic risk minimization, stabilization policies that aim to fix vulnerability at individual banks can be inferior to policies that directly target the cross-bank spillovers.

The model is straightforward to estimate using data on bank balance sheets such as that released in stress tests.[2] We apply the model to European banks during the 2010–2011 sovereign debt crisis, and we use their holdings of sovereign bonds to estimate the potential spillovers that would occur in the event that a collection of European sovereigns experienced a significant haircut. Using bank holdings of sovereign bonds as inputs, we find a correlation between our estimates of bank vulnerability and equity drawdowns experienced by European banks in 2010 and 2011. We then use our data to evaluate various policy interventions. We show that forced mergers among the most exposed banks would not have reduced systemic risk very much. However, modest equity injections, if distributed appropriately between the most systemic banks, can cut the vulnerability of the banking sector to deleveraging by more than half.

The remainder of the paper is organized as follows. In Section 2, we develop the model, solve it, and build intuition for financial sector stability under different configurations of leverage and risk exposure across the banks. We defer our discussion of an extensive related literature to Section 3, where we explain how our approach compares with other measures of systemic risk and, especially, to the CoVaR and SRISK systemic risk measures developed by Adrian and Brunnermeier (2010) and Acharya, Pedersen, Philippon, and Richardson (2010). In Section 4, we use commercial bank exposures provided by the July 2011 European Banking Authority (EBA) stress tests to compute the vulnerability of European banks to sovereign defaults. Section 5 explains how the model can be adapted to monitor vulnerability on a more dynamic basis using factor exposures. The final section concludes.

2. A model of bank deleveraging

We start by describing the assumptions. The model combines these assumptions to generate easy-to-implement measures of systemic risk.

[1] See Shleifer and Vishny (1992, 2011), Kiyotaki and Moore (1997), Gromb and Vayanos (2007), Schwarcz (2008), Brunnermeier and Pedersen (2009), and Allen, Babus, and Carletti (2011) for discussion of fire sale-driven amplification.

[2] See Duarte and Eisenbach (2014) for a discussion of how our model can be estimated using data from the call reports of US banks.