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Syndication, interconnectedness, and systemic risk

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ABSTRACT

Syndication increases the overlap of bank loan portfolios and makes them more vulnerable to contagious effects. We develop a novel measure of bank interconnectedness using syndicated corporate loan portfolios, overlap based on industry and region, and different weights such as equal weights, size and relationships. We find that interconnectedness is driven mainly by bank diversification, less by bank size or overall loan market size. Interconnectedness is positively correlated with different bank-level systemic risk measures including SRISK, DIP and CoVaR, and such a positive correlation mainly arises from an elevated effect of interconnectedness on systemic risk during recessions. Overall, our results highlight that institution-level risk reduction through diversification ignores the negative externalities of an interconnected financial system.

1. Introduction

The financial crisis of 2007–2009 demonstrated how large risk spillovers among financial institutions caused a global systemic crisis and worldwide economic downturn. The collapse of the interbank market at the beginning of the crisis suggests that direct linkages between banks are an important channel of contagion across financial institutions (Allen and Gale, 2000; Allen and Babus, 2009; Gorton and Metrick, 2012; Giglio, 2016). A second channel that explains how shocks propagate through financial systems is information contagion (Chen, 1999). A third important channel is commonality of asset holdings. As banks have similar exposure to assets such as syndicated loans, a decline in asset prices can affect the banking system, because of direct exposure of banks to the same assets as well as fire sale externalities (e.g. Shleifer and Vishny, 1992, 2011; Kiyotaki and Moore, 1997). Common exposures of banks are of first order importance as indicated by Federal Reserve Chairman Bernanke in his speech at the Conference on Bank Structure and Competition in May 2010 in Chicago[1]:

> *"We have initiated new efforts to better measure large institutions' counterparty credit risk and interconnectedness, sensitivity to market risk, and funding and liquidity exposures. These efforts will help us focus not only on risks to individual firms, but also on concentrations of risk that may arise through common exposures or sensitivity to common shocks. For example, we are now collecting additional data in a manner that will allow for the more timely and consistent measurement of individual bank and systemic exposures to syndicated corporate loans."*

In this paper, we study interconnectedness in the form of common exposures among financial institutions examining banks' exposure to large syndicated loans. The syndicated loan market

[1] Common exposures have played an important role in various historical crises: The Savings & Loans crisis in the U.S. in the 1980s was caused by maturity mismatch of the asset and liability side of banks' balance sheets and a shock to (i.e., increase of) interest rates (Ho and Saunders, 1981). The Asian financial crisis in the 1990s was associated with exchange rate risks. The recent crises in Ireland and Spain were associated with a decline in real estate prices. The 2007–2009 financial crisis involved a decline in real estate prices as well as various forms of contagion magnifying the extent of the crisis (Hellwig, 1995, 2014).

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provides an ideal laboratory to study interconnectedness of banks. It is the most important funding source for non-financial firms (Sufi, 2007), and banks repeatedly participate in syndicated loans arranged by one another. We know borrower and lender identities and are thus able to track banks' investments in this market to quantify common risk exposures.

To measure commonality in banks' syndicated loan portfolio, we develop a novel measure of interconnectedness for which the key component is the similarity between two banks' syndicated loan portfolios.[2] The similarity is measured as the Euclidean distance between two banks based on their exposures to specific borrower industries or regions in the prior twelve months. We then aggregate the distance of one bank with all other banks in each month and construct our bank-level interconnectedness measure using three different weighting schemes: (1) equal weights for each bank, (2) size weights to account for the fact that larger banks might contribute more to systemic risk, and (3) relationship weights to capture prior contractual relationships between banks. Equal weights are used a benchmark against which we evaluate the effect of size and relationships.

We document a high propensity of bank lenders to concentrate syndicate partners rather than to diversify them, as lead arrangers are more likely to collaborate with banks with similar corporate loan portfolios. We then investigate the determinants of interconnectedness both cross-sectionally and over time. While bank size explains only between 5% and 16% of the variation in interconnectedness in the cross-section in univariate tests (depending on the type of exposure and weighting scheme), we document that diversification explains between 61% and 96% of this variation. Overall, our results suggest that bank size is not a first order determinant of interconnectedness but highlights the importance of banks' diversification motive in understanding interconnectedness in the syndicated loan market.

Recent theoretical work has shown that interconnectedness can increase systemic risk through various forms of financial contagion, because of common exposures in times of crises (Allen et al., 2009; Castiglionesi and Navarro, 2010; Ibragimov et al., 2011; Wagner, 2010).[3]

The first channel relies on direct linkages between banks. Once a bank defaults it can propagate stress to other creditor banks (Allen and Gale, 2000).[4] A second important channel is information contagion (Chen, 1999). If one bank is in distress, investors reassess the risk of other institutions that they believe have similar exposures. Short-term investors may decide not to roll over their investments if solvency risks are high, but engage in precautionary liquidity hoarding (Acharya and Skeie, 2011). A third channel is commonality of asset holdings. Shocks can propagate through fire sales, when banks need to sell assets to reduce their leverage. (Shleifer and Vishny, 1992, 2011).[5]

The time-series evolution of our interconnectedness measure is consistent with interpretation of elevated systemic risk through contagion arising from common exposures. We aggregate the bank-level interconnectedness measure to a market interconnectedness index in each month and document that the benchmark equally-weighted interconnectedness index is persistently lower compared to indexes using the size- and relationship-weighting schemes. This is an important finding. For example, the size-weighted index is larger compared to the equally-weighted one which suggests that banks have greater overlap with larger banks consistent with the literature on bank moral hazard and herding behavior (e.g. Acharya and Yorulmazer, 2008) and banks exploiting government guarantees (e.g. Eisert and Eufinger, 2017).

In the final part of the paper, we relate our interconnectedness indexes to different measures of systemic risk. Similar to approaches used in stress tests that have been conducted in the U.S. and Europe since 2008, the construction of these measures is to estimate losses in a systemic stress scenario and determine a bank's equity shortfall after accounting for these losses. These measures capture asset price as well as funding liquidity risks associated with interconnectedness using market data (Acharya et al., 2014).

We employ three frequently used bank-level systemic risk measures: (1) systemic capital shortfall (SRISK) (Acharya et al., 2017; Brownlees and Engle, 2017), (2) distressed insurance premium (DIP) (Huang et al., 2009), and (3) conditional value-at-risk (CoVaR) (Adrian and Brunnermeier, 2016).[6] All three concepts measure a co-movement of equity or credit default swap (CDS) prices without the notion of causality, i.e. a bank can contribute to systemic risk of the financial system because it initiates a contagious event or because of its exposure to a common factor. Moreover, all measures are constructed to estimate cross-sectional differences in systemic risk at a point in time.

We find a positive and significant correlation between our interconnectedness measure and SRIK, but only during recessions. A one standard deviation increase in interconnectedness increases SRISK by almost one-third relative to the average SRISK. Intuitively, a large shock to the market amplifies the effect of interconnectedness if banks are more vulnerable during recessions. Similarly, we find that interconnectedness increases DIP, but also only during recessions. The economic magnitude is comparable, i.e. a one standard deviation increase in interconnectedness increases DIP by about one-third. Bank size is an important determinant of both SRISK and DIP.

We also find that interconnectedness is positively related to CoVaR during recessions. In contrast to the effect of interconnectedness on SRISK, the effect is somewhat smaller. A possible reason is that CoVaR measures the increase in systemic risk of the market when an individual bank is in distress. During recessions, when the market is already weak, the marginal impact of an increase in bank risk is small.

Overall, our bank level tests suggest a positive and significant correlation between our interconnectedness measure and various systemic risk measures including SRISK, DIP, and CoVaR.[7] Controlling for bank and loan market size as well as various fixed effects we show that, consistent with the theoretical papers cited above, interconnectedness amplifies systemic risk during recessions when asset commonality can cause various forms of contagion such as fire-sales.[8] Another way of interpreting this result is that interconnectedness of banks – that builds up during normal times – is a

[2] For example, Abbassi et al. (2017) apply our distance measure to German banks lending portfolios to explain market-based risk measures.

[3] Wagner (2010) shows that diversification increases systemic risk also in the absence of contagion. While diversification reduces the risk of failure of an individual bank, it also increases the likelihood that they default jointly. Moreover, banks can diversify not only in different industries and regions, but also in different sectors (Acharya et al., 2006) such as sovereign debt or household debt which we cannot do due to data limitations.

[4] Allen and Babus (2009), Diebold and Yilmaz (2014), Gorton and Metrick (2012), Duffie (2013) and Giglio (2013) provide further discussions.

[5] Fire-sale amplifications are also discussed in, for example, Kiyotaki and Moore (1997), Brunnermeier and Pedersen (2009), Allen et al. (2012a) and Greenwood et al. (2015).

[6] Other market-based measures (e.g., based on stock return volatility) are developed in Diebold and Yilmaz (2014, 2015), Billio et al. (2012) and Hautsch et al. (2015).

[7] We also show in an Online Appendix A positive and significant link between our interconnectedness measure and the market based CATFIN measure developed by Allen et al. (2012b).

[8] In contrast, Sedunov (2016) proxies a bank's interconnectedness with aggregate measures of loans and derivative positions to other financial institutions – without distinguishing between recession and expansion periods – and finds no effect of interconnectedness on bank-level systemic risk measures.