Credit Risk and Interdealer Networks*

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Abstract

We study how bank holding companies interact in the corporate bond, syndicated loan, and credit default swap (CDS) markets. These three markets represent different ways to trade credit risk. The corporate bond market allows market participants to trade corporate credit risk directly. Similarly, the syndicated loan market allows direct exposure to corporate credit risk but is limited to only the largest borrowers and has lower secondary market liquidity. Finally, participants in the CDS market take an indirect exposure to the ultimate borrower. CDS markets are the most liquid of the three markets, allowing dealers to more easily assume long and short positions. Moreover, by entering into a CDS contract with another dealer, the firm also exposes itself to counterparty risk. This paper links data from these three different markets to create a more complete picture of how dealers assume and distribute credit risk. We identify key determinants of dealers' net and gross exposures to credit risk. We furthermore map out the interdealer network structures in these markets, allowing us to study how these network structures distribute risk among the dealers and how they shape the total risk borne by the system.

Keywords: Credit Risk, Corporate Bonds, Syndicated Loans, Credit Default Swaps, Interdealer Networks, Systemic Risk.

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1 Introduction

The financial crisis of 2008 and ensuing recession highlighted the importance of bank interconnectness and its implications for systemic risk. In this paper we study the role that interbank networks play in distributing and potentially amplifying or mitigating credit risk throughout the banking system.

Banks may be exposed to credit risk through both fundamental and derivatives positions. While the supply of cash products is determined by the funding needs of the corporate sector, the supply of derivatives depends in large part on the balance sheet capacity of broker-dealers. The demand for derivatives, on the other hand, may be driven by either hedging and/or speculative motives. These inherent differences manifested themselves in disparate outcomes for the cash products and derivatives markets during the financial crisis. Institutions operating in both markets added complexity to the credit risk landscape by creating spillovers from derivatives markets to cash products. These spillovers restricted access to credit for the productive sector of the economy, arguably deepening and prolonging the Great Recession.

In this paper, we study how bank holding companies interact in the corporate bond, syndicated loan, and credit default swap (CDS) markets. These three markets represent different ways to trade credit risk. The corporate bond market allows market participants to trade directly the credit risk of the corporate sector. Similarly, the syndicated loan market allows direct exposure to corporate credit risk but is limited to only the largest borrowers and has lower secondary market liquidity than the corporate bond market. Finally, participants in the CDS market take an indirect exposure to the ultimate borrower. CDS markets are more liquid than either the corporate bond or the syndicated loan market, and allow dealers to more easily assume both long and short positions. By entering into a CDS contract with another dealer, the firm also exposes itself to counterparty risk, thereby increasing its (and the financial system's) gross credit risk exposure. Linking data from these three different markets creates a more complete picture of how dealers assume and distribute credit risk.

Specifically, with this combined data we study the following questions:

1. What determines dealers' net and gross exposures to credit risk?

2. Does the multiplicity of interdealer network structures in these markets matter for the total credit risk borne by the system?

3. If so, do the different network structures amplify or dampen the credit risk coming from the non-financial sector?

4. Finally, do the overlapping network structures create systemic risk in the financial sector?

Data and Methodology. In this study we link three datasets:

- Weekly snapshots of CDS positions (DTCC)
- Syndicated loan originations (Dealscan)
- Corporate bond transactions (TRACE)

To accurately capture the evolution of the networks over time we use transaction level data of corporate bonds, including dealer identities, security CUSIPs, volumes, and prices.

By aggregating the flows in these three markets for each dealer, we study how net and gross exposures are related to dealer characteristics as well as market factors. We use the contract-level data for CDS and syndicated loans to construct the interdealer networks in these markets, and study how these linkages are related to flows in the corporate bond market. In particular, having a network representation for this activity allows us to observe how credit risk flows through the financial system. Understanding the distribution and concentration of credit risk in the network is crucial for evaluating whether interdealer linkages amplify credit risk and create systemic vulnerabilities.

2 Formalizing the Network Structure

We consider a two period model, $t = 0, 1$. Suppose there are n banks, indexed by $i \in \{1, \ldots, n\}$. Let S_b denote the entire set of banks (nodes). These banks lend to corporations.

There are m firms, indexed by $j \in \{1, \ldots, m\}$. Let S_f denote the entire set of firms. A firm j owns assets which will yield some unknown payoff x_j in period 2. Let $\mathbf{x}$ be the vector of payoffs $\mathbf{x} = (x_1, x_2, \ldots, x_m)$ on these firms.

$$\mathbf{x} \sim N(\mu, \Sigma)$$

where Σ is the variance-covariance matrix of the payoffs.

Banks may lend to these corporations via debt contracts. Lending may take two forms: either corporate bonds or syndicated loans.

Corporate Bonds. A bank may buy a corporate bond issed any of these firms. Let y_{ij} be the amount of corporate debt of firm j owned by bank i (the face value of debt). We may

represent these debt holdings in the following $n \times m$ matrix

$$\mathbf{y} = \begin{bmatrix} y_{11} & y_{12} & \cdots & y_{1m} \\ y_{21} & y_{22} & & y_{2m} \\ \vdots & & \ddots & \\ y_{n1} & & & y_{nm} \end{bmatrix}$$

The rows represent the individual banks and the columns represent the different firms they may be invested in through corporate bonds.

Syndicated Loans. In addition to the corporate bond market, banks may also participate in a syndicated loan market. A syndicated loan is a loan made to a corporate entity by a syndicate (group) of banks, with in general one bank being the lead bank. Suppose there are L syndicated loans, indexed by $\ell \in \{1, \ldots, L\}$.

A syndicated loan ℓ will have following attributes:

- the corporation j the loan is made to. Let $j^*(\ell) \in S_f$ denote the corporation j which is given the loan ℓ.

- the face value of the loan which we denote by $z(\ell)$

- the members of the syndicate. Let $S_b(\ell) \subseteq S_b$ denote the set of banks in the syndicate for loan ℓ. For every $i \in S_b(\ell)$, let $\phi(i, \ell)$ denote the proportion of the loan owed to bank i, so that $\sum_{i \in S_b(\ell)} \phi(i, \ell) = 1$.

- the leader bank $i^*(\ell) \in S(\ell)$ of the syndicate.

We can represent the syndicated loans market in a number of ways. First, we can look at the amount owed to bank i by bank j through syndicated loans.

$$z_{ij} = \sum_{\ell | i \in S(\ell), j = j^*(\ell)} \phi(i, \ell) z(\ell)$$

We may again represent these debt holdings in the following $n \times m$ matrix

$$\mathbf{z} = \begin{bmatrix} z_{11} & z_{12} & \cdots & z_{1m} \\ z_{21} & z_{22} & & z_{2m} \\ \vdots & & \ddots & \\ z_{n1} & & & z_{nm} \end{bmatrix}$$

The rows represent the individual banks and the columns represent the different firms they

may have lent to. Thus, the matrix of banks' holdings of firm debt is given by the sum

$$\mathbf{y} + \mathbf{z}$$

Syndicated Loan Network. While the syndicated loans have information about the amount banks lend to firms, it also comprises a network of connections between banks.

One possible way to characterize the network is to simply look at the links of banks participating in syndicated loans to the leaders of these loans. Let η_{ik} denote a connection between bank i and bank k

$$\eta_{ik} = \sum_{\ell | i \in S(\ell) \cap k = i^*(\ell)} \phi(i, \ell) z(\ell)$$

That is, this network shows how much each bank has invested in a loan with each of the leader banks. Kind of like, how much money bank i trusts with a loan lead by bank k. This gives us a syndicate leader network

$$\eta = \begin{bmatrix} \eta_{11} & \eta_{12} & \cdots & \eta_{1n} \\ \eta_{21} & \eta_{22} & & \eta_{2n} \\ \vdots & & \ddots & \\ \eta_{n1} & & & \eta_{nn} \end{bmatrix}$$

where η is an $n \times n$ matrix.

Another way to characterize the network would be to consider all connections to banks in which both are in a common syndicate. For example, let

$$\gamma_{ik} = \sum_{\ell | i,k \in S(\ell)} \phi(i, \ell) z(\ell)$$

denote the amount bank i lends to a firm when bank k is also apart of that syndicated loan. The matrix of γ's would thus give the connections between banks when they are take part of a common syndicated loan.

(Actually we could weight the connections by whether k is a leader or not, and then the network η would be a special case of this weighted network.)

CDS Market. Finally, there is a CDS market. Banks may have bought protection on corporate debt in the form of CDS contracts. Call $S_d \subseteq S_b$ the set of dealer banks who write

(sell) CDS contracts, and let n_d be the number of dealer banks. Let c^i_{jk} denote the obligation to bank i from bank k on the bond of corporation j.

CDS obligations to bank i by other banks are then given by the $m \times n_d$ matrix

$$\mathbf{c}^i = \begin{bmatrix} c^i_{11} & c^i_{12} & & c^i_{1n} \\ c^i_{21} & c^i_{22} & & c^i_{2n} \\ & & \ddots & \\ c^i_{m1} & & & c^i_{mn} \end{bmatrix}$$

There is a $\mathbf{c}^i$ for each bank. Thus, stacking these, we get a three dimensional array $\mathbf{C}$ (size $n \times m \times n_d$) which represents the entire network of CDS contracts.

What is the seniority of these contracts? Are they equal to that of debt contracts? Or more junior?

No counterparty risk. Suppose there is no counterparty risk. That is, in the event of default by a firm on a loan, any CDS written on this loan is honored. Then..

Comments. There are two network structures here: the network characterized by the CDS contracts and the network characterized by the syndicated loan market.