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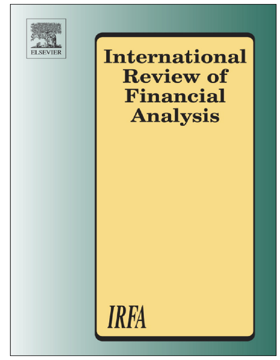

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The Systemic Risk of Leveraged and Covenant-Lite Loan Syndications

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Abstract

By modelling the whole U.S. syndicated loan market as a financial network from 2000to 2022, we find that highly connected institutions hold significant shares of leveraged and covenant-lite loans. Our analysis indicates that the size of leveraged and covenant- lite syndicated loan portfolios increases financial institutions' systemic risk, particularly during recession periods. Although banks commonly sell syndicated loans shortly after origination, our results suggest that they remain vulnerable to pipeline risk. Our study has significant implications for policymakers and regulators, as it can aid in identifying banks exposed to systemic risk associated with leveraged and covenant-lite loans andin ranking systemically important financial institutions accordingly.

JEL classification: G21, C45.

Keywords:
Leveraged loans, covenant-lite loans, loan syndication, systemic risk, financialnetworks.

"Our supervisors are continuing to work … to ensure that banks are properly managing the risks of losses … in the leveraged lending market."

Jerome H. Powell, Federal Reserve chairman

"I am worried about the systemic risks associated with these loans… There has been a huge deterioration in standards; covenants have been loosened in leveraged lending."

Janet Yellen, secretary of the U.S. Treasury

1. Introduction

In this paper, we study the systemic risk posed by leveraged and covenant-lite loans in the US syndicated loan market. Leveraged loans are characterised by a high risk of default,[1] while covenant-lite loans offer lower repayment protection to the lender than normal loans. The syndicated loan market allows lenders to reduce large exposures to single borrowers, thus providing an opportunity for risk diversification. However, as lenders increasingly share exposures to the same pool of borrowers through loan syndications, they become more interconnected and, therefore, may be more prone to systemic risk. In this study, we investigate whether leveraged and covenant-lite loans contribute as a channel of systemic risk in the syndicated loans market. Our focus on leveraged and covenant-lite loans is driven by regulators' concerns that the quality standards of these loans have deteriorated over time.[2]

Dennis and Mullineaux (2000) show that syndicated lending is a "centuries-old process that has shown significant growth in the 1990s". Since it blossomed in the United States in the mid-1980s and with the launch of the Euro in the Euro area in 1999, syndicated lending has become one of the largest debt markets in developed economies.[3] Sufi (2007) notes that about 450 of the largest 500 non-financial firms in Compustat accessed the syndicated loan market between 1994 and 2002. This tendency can be explained partly by an

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[1] Thomson Reuters defines as "leveraged" those loan syndications that satisfy specific criteria, includingan all-in drawn spread of at least 1.75% over LIBOR and a credit rating of BB+/Ba1 or lower (Thomson Reuters, 2018). Details can be found in the Appendix. An all-in drawn spread is defined in DealScan as the "total (fees and interest) annual spread paid over LIBOR for each dollar drawn down from the loan."

[2] Former Federal Reserve Chair, Janet Yellen, expressing concerns about the loosening standards of the $1.3tn market for leveraged loans said "I am worried about the systemic risks associated with these loans. There has been a huge deterioration in standards; covenants have been loosened in leveraged lending." (from The Financial Times article of October 25, 2018 titled "Janet Yellen sounds alarmed over plunging loan standards".)

[3] This market has become so relevant in some regions that a recent study by Acharya et al. (2018) demonstrates how the credit crunch in syndicated lending during the European debt crisis has affected the entire European economy in terms of investment, employment, and firms' sales growth.

increase in supply, as there has been a sharp increase in the number of small- and medium-sized lenders of loan syndications. Syndicated loans are attractive for small- and medium-sized lenders for two main reasons. As explained by Ivashina and Scharfstein (2010), participation in these syndicates allows lenders to share counterparty risk. Additionally, this market allows small-sized financial institutions to lend money to large borrowers who would otherwise be out of reach, by partnering with large financial institutions.

We contribute to the literature in two main ways. Firstly, we investigate the relationship between systemic risk and the exposure of both systemically important and non-systemically important banks to leveraged and covenant-lite syndicated loans. Our study covers the entire U.S. syndicated loans market and encompasses a significant time period from 2000 to 2022, which includes various recessions. By studying the connection between systemic risk and leveraged and covenant-lite lending, researchers and policymakers can identify which institutions are more vulnerable to credit shocks, and how they might transmit or amplify these shocks to other parts of the financial system. This can help design appropriate regulations, supervision, and macroprudential policies to mitigate the potential systemic risk arising from risky lending activities. For example, some possible policy measures could include imposing higher capital requirements, liquidity buffers, or risk retention rules for financial institutions that engage in leveraged lending, or enhancing the disclosure and transparency of the leveraged loan market and its participants.

Loan syndication as a systemic risk factor among syndication lenders may be called into question by the practice of lead arrangers to sell part or all their syndicated loans shortly after origination, as noted in Blickle et al (2020). However, the same authors find that lead arrangers tend to retain riskier loans to prevent reputation risk in case the loans go sour. This suggests that systemic risk may take the form of pipeline risk and be particularly relevant for leveraged loans and covenant-lite loans. The term pipeline risk refers to the potential risks associated with lenders retaining substantial portions of loans considered less desirable or "cold". Bruche et al. (2020) suggest that using an indicator to measure each lender's pipeline risk in connection with its leveraged loan exposure can guide stress tests and help determine appropriate capital charges for bank loans. Indeed, leveraged and covenant-lite loans are more vulnerable to becoming "cold loans" during periods of market stress, as investors may become significantly more risk-averse and less willing to hold such exposures. The inability to readily offload these loans can expose syndicated lenders to heightened credit risk, liquidity risk, and funding challenges. This, in turn, may have destabilizing ripple effects on the stability of the whole financial system.

Our study shows that banks' systemic risk increases during recessions when banks are more exposed to leveraged syndicated loans. We assess this effect by introducing a new indicator, SN_RISK. This is defined as the bank's investment in risky syndicated loans as a proportion of the volume of risky loans in the syndicated loan market. Thus, SN_RISK measures how much market-wide syndication risk is borne by a particular institution at any given time. Our results confirm that SN_RISK helps to explain systemic risk variations across banks, during recession periods and specifically for systemically important institutions. Several papers investigate the syndicated loan market (Dennis and Mullineaux, 2000; Armstrong, 2003; Harjoto et al., 2006; Pascal and Franck, 2007; Ivashina and Scharfstein, 2010; Acharya et al., 2018; Dass et al., 2020). Only recently, however, academic research has started focusing on the systemic risk emerging from leveraged and covenant-lite lending. De Novellis et al.'s (2024) analyse leveraged finance in the banking sector and investigate systemic risk by developing novel indicators that capture credit risk exposure, bank size and interconnectedness. Our research differs from theirs in terms of measures, time frame, and empirical analyses employed. Our results suggest that leveraged and covenant-lite loans are not inherently systemic, but they amplify systemic risk in the event of a crisis. While De Novellis et al. (2024) focus solely on globally systemically important banks (G-SIBs), our analysis encompasses the entire U.S. syndicated loans market. Further, we use a much more comprehensive sample of 33,406 unique syndicated leveraged and cov-lite loans obtained from Dealscan covering an extended period from 2000-2022, which includes the Great Recession. When using network analysis to model the interconnections in the syndicated loan market, our broader perspective reveals that although the number of network connections has decreased over the years, the relationship between the most influential banks in the network has actually intensified. As our findings indicate, this can amplify the spread of contagion effects in the event of a crisis.

Secondly, we contribute to the field of systemic risk analysis by applying an innovative approach developed by Blickle et al. (2020) to estimate lenders' post-origination exposure to syndicated borrowers. Other studies, such as Bruche et al. (2020) and Aramonte et al. (2022), show a notable decline in banks' lending share within the syndicated loan market after loan origination. Blickle et al. (2020)'s methodology allows us to calculate post-origination lending shares using Dealscan data across different types of syndicated loans (e.g. credit lines, term A and B loans) for both lead arrangers and other lenders in the syndicate. Interestingly, despite the introduction of this new methodology, the relative importance of top banks in the loan syndication sector remains largely unaffected. The observed effect primarily involves a redistribution of exposures, resulting in a reallocation of lending shares among lead arrangers and other lenders. However, this new approach enables us to determine holding shares with greater accuracy, thereby providing precise insights into the risk exposure and interdependence of financial intermediaries involved in the syndicated leveraged and covenant-lite lending. Wagner (2010), Raffestin (2014), and Cai et al. (2018) have established a correlation between loan syndications and systemic risk, demonstrating that strong similarities in banks' portfolios increase the likelihood of systemic crises. However, unlike Cai et al. (2018), who only consider lead arrangers and use strong assumptions to gauge their syndicated loan exposures, we consider all lenders in the syndication and estimate their post-origination exposure more accurately with the approach proposed by Blickle et al. (2020).

We employ network analysis to determine the importance, or network "centrality", of financial institutions within the syndicated loan market as a whole, and its leveraged and covenant-lite segments. Previous research has shown that network-based measures of interconnectedness are particularly well-suited to capture complex interactions among financial institutions (Hochberg et al., 2007; Larcker et al., 2013; Houston et al., 2018; Sümer and Özyıldırım, 2019; Bhattacharya et al., 2020; Guo et al., 2021; Asgharian et al., 2022). Our monthly panel regression analysis, tracking 96 global financial institutions from 2000 to 2022, confirms the significance of network centrality as an indicator of systemic risk. The presence of "hubs" or clusters of lenders who are highly interconnected through loan syndications, particularly involving financial institutions that regulators consider systemically important, is evident in our network representations. As a result, our findings could help enhance the methodology currently used by regulators to identify and rank systemically important financial institutions (BCBS, 2018). This focus on network theory is consistent with other studies in the field. Allen and Babus (2009) argue that network theory improves our comprehension of financial systems. Using indirect measures of interconnectedness for a range of financial institutions, Billio et al. (2012) document an increased degree of interrelation in the financial system over time. Interest in financial networks is growing mainly due to their ability to demonstrate how the risk of financial contagion can propagate in the system. As indicated in Acemoglu et al. (2015), a financial system with a higher degree of connectivity is more resilient when faced with small shocks, but a high density of interconnections can facilitate the propagation of larger shocks, creating financial fragility in the system. We contribute to this literature by analysing the topology of the syndicated loans networks over time. Differently from Houston et al. (2018), we do not restrict the analysis to the 300 largest syndicated loan deals in the US market. Instead, we include the entire US syndication sample which enables us to consider also smaller players in the syndicated loan market. Our results show that the increasing presence of more peripheral financial institutions with low centrality decreases the average number of connections over time. However, there is an increasing propensity for more relevant banks in the network to collaborate with each other. This may lead to increased systemic risk stemming from systemically important financial institutions, particularly because of their exposure to leveraged and cov-lite loans, which may cause cascading losses in bad economic times.

We also add to the results of Asgharian et al. (2022) and show that in addition to the network centrality, the lender's exposure to leveraged and covenant-lite loans is a valid measure to assess the systemic importance of banks. Other studies in the literature contribute to a better understanding of the syndicated loan markets. For instance, Godlewski et al. (2012) apply network analysis to the French syndicated loan market, revealing that the structure of the French market allows for an improved flow of information and resources among institutions, which leads to lower loan spreads. Godlewski et al. (2012) results add to previous evidence obtained from network analysis regarding borrowing costs in relation to banks' interconnectedness, which is used as a proxy for banks' experience and reputation (Panyagometh and Roberts, 2010; Ross, 2010). Gao and Jang (2021) examine the structure of the global syndicated market and find that banks that are strictly regulated tend to collaborate with less regulated banks to engage in risky cross-border lending. Alperovych et al. (2022) focus on the leveraged buyout (LBO) segment of the syndicated market and show how the flow of information across the syndication network significantly determines the participation of a bank in the syndication, the amount it contributes to the syndication, and the terms of the loan.

We organise the remainder of the paper as follows. In Section 2, we describe our methodology, and Section 3 presents the data we use in our analysis. In Section 4, we report the main empirical findings and robustness tests, while Section 5 presents the conclusion.

2. Methodology

In this section, we describe the variables of interest and the econometric model used in our analysis. We present firm-level measures of interconnectedness based on network analysis and illustrate alternative definitions of SN_RISK, our measure of syndicated portfolio risk based on leveraged and covenant-lite loans.

Our study employs the methodology proposed by Blickle et al. (2020) to calculate the risk exposure of lenders in the syndicated loan market. Unlike previous literature assuming that lead arrangers hold a 30% exposure to the syndicated loans for at least 12 months (see for example Cai et al., 2018), Blickle and co-authors find that lead arrangers often sell their entire exposure within days of origination, resulting in a significant decrease in their syndicated portfolio. To account for this, we compute the share of syndicated loans held by lead arrangers and other participants immediately after origination using Blickle et al. (2020)'s methodology.

We compare the differences in terms of ranking between lenders' shares calculated based on the methodologies proposed by Cai et al. (2018) and Blickle et al. (2020). These two methodologies are referred to, respectively, as Methodology A and Methodology B in Table 1, which reports the results for the top 10 financial institutions in the whole syndicated loans market (panel A) and its leveraged segment (panel B). Methodology A considers only lead arrangers whereas Methodology B covers all lenders in the syndication market. Although the rankings of the top 10 institutions using the two methodologies are similar, the overall market share of the very top banks falls drastically with Methodology B. For instance, the percentages of shares for the three leading banks, which are JP Morgan, Bank of America, and Citi, fall from 26.7%, 17.2% and 11.1% to 10.0%, 9.2%, and 6.3%, respectively. Interestingly, JP Morgan and Bank of America hold roughly 50% of their syndicated loans not as lead arrangers but as other types of lenders. Despite the differences, both methodologies reveal a significant concentration of exposure to the syndicated leveraged loan market, especially among financially systemically important institutions. Our findings regarding the systemic risk ranking of top banks in the syndicated loan market are consistent with the research conducted by Chu et al. (2019). Their results suggest that banks with a higher total capital ratio tend to have a stronger presence in loan funding compared to other banks participating in the same loan syndication. Notably, this relationship is more pronounced for systemically important banks, which are subject to more rigorous regulations and are mandated to maintain higher capital ratios relative to non-systemically important banks.

2.1. Syndicated loan risk

To investigate the relationship between syndication risk and systemic risk, we introduce a novel measure of syndication risk that captures the importance of leveraged and covenant-lite loans held by a financial institution. Unlike previous studies, which typically assume that lead arrangers hold their share of syndicated loans for 12-months, we assume a one-month holding period based on the observation that lead arrangers in the syndicated loan market often sell off their shares shortly after origination (Blickle et al., 2020).

For each lender i and month t we define the amount of leveraged but not covenant-lite loans issued over a one-month period as $Lev_{i,t}$, the issued amount of covenant-lite but not leveraged loans as $CovLite_{i,t}$, and the amount issued of loans that are simultaneously leveraged and covenant-lite as $Lev\&CovLite_{i,t}$. Then, we propose two main versions of SN_RISK, which serve as our new measures of syndicated portfolio risk. Each version accounts for the riskiness of the syndicated loan portfolio of the lender as well as the lender's market share of the overall syndicated loan market. The first is $SN\_RISK_{i,t}^{Lev}$, which measures the amount of the leveraged loans (which may or may not be covenant-lite) held by lender i divided by the total syndicated leveraged issuance amount in the market.

$$SN\_RISK_{i,t}^{Lev} = \frac{Lev_{i,t} + Lev\&CovLite_{i,t}}{Lev_t + Lev\&CovLite_t} \quad (1)$$

The second, $SN\_RISK_{i,t}^{Lev\&CovLite}$, also considers covenant-lite loans that are not leveraged:

$$SN\_RISK_{i,t}^{Lev\&CovLite} = \frac{Lev_{i,t} + Lev\&CovLite_{i,t} + CovLite_{i,t}}{Lev_t + Lev\&CovLite_t + CovLite_t} \quad (2)$$

Both measures vary between 0 and 1 by construction. We perform various robustness tests by utilizing alternative versions of the two main measures described above. These alternative measures are discussed in detail in Section 4.2.

2.2. Measures of interconnectedness

Given the presence of common loans among banks, the syndicated loan market is well-suited for representation as a network. A network is composed of nodes and edges: the nodes are the lenders participating in loan syndications, while each edge (or linkage) connects two lenders in the same syndicate. We build monthly syndicated loan networks by following the standard framework for undirected networks. Let $N = 1,2,3, \ldots, n$ be the lenders who compose a syndicate. We first build the undirected network G with the set of nodes $V(G) = v_1, v_2, \ldots, v_v$. The v x v adjacency matrix $A(G)$ represents the edges between nodes (i.e. lenders) i and k (where $i \neq k$) in the syndicated loan market. The adjacency matrix is symmetrical, as the connections are between lender i and k or, equivalently, lender k and i. Based on the connection between lenders i and k within 12 months prior to month t, each element of the adjacency matrix is equal to

$$a_{i,k} = \begin{cases} 1, \text{if an edge between lenders i and k exists,} \\ 0, \text{if an edge between lenders i and k does not exists,} \end{cases}$$

From each monthly syndicated network, we compute three measures of centrality, which we employ as proxies for interconnectedness in our regression analysis. The first measure is the degree of (normalised) centrality, which is defined as follows:

$$Degree_{i,t} = \left(\frac{\sum_k a_{i,k,t}}{N-1} \right) * 100, \tag{3}$$

where N is the total number of nodes in the network. Intuitively, the higher the number of connections of a financial institution the higher its degree of centrality.

The second indicator, called closeness centrality, measures the proximity between a node and the others.

$$Closeness_{i,t} = \frac{1}{\sum_k d_{i,k,t}}, \tag{4}$$

where $d_{i,k,t}$ is the distance (length of the shortest path) between node i and node k.

The last measure, called eigenvector centrality, is also a measure of how influential a lender is in the network. However, in eigenvector centrality, linkages are weighted by the importance of the other institutions to which a lender is connected in the network. Intuitively, if two lenders have an equal number of connections, the one connected with more "influential" nodes – i.e., lenders with higher connectivity – will have higher eigenvector centrality. To obtain the eigenvector centrality of institution I, we first identify the largest eigenvalue λ of $A(G)$ and the corresponding eigenvector $x_{i,t}$. Then, we scale the elements of $x_{i,t}$ so that its largest element is 1. The eigenvector centrality of institution i will then be the $i - th$ element of $x_{i,t}$.

2.3. Systemic risk measures

Multiple systemic risk measures are available in the literature (Bisias et al., 2012; Ellis et al., 2021). In this study, we employ the $SRISK$ measure developed by Acharya et al. (2017) and Brownlees and Engle (2017). $SRISK$ depends on the size of a firm, its leverage, and the loss in equity capital the firm is expected to suffer in a systemic crisis, which is characterised by a market drop of more than 40% over six months. $SRISK$ is calculated as follows:

$$SRISK = E(k(D + MV) - MV \mid Crisis)$$
$$= kD - (1 - k)(1 - LRMES)MV$$

where k is the regulatory capital requirement, D is the book value of debt which is calculated as the difference between the book value of assets and the book value of equity and does not change during the crisis period, $LRMES$ (Long-Run Marginal Expected Shortfall) is the expected fractional loss of the firm equity when the market index declines significantly in a six-month period[4]; MV is the current market capitalization of the firm.

2.4.Model

We estimate several models to analyse the relationship between the systemic risk of global financial institutions and the novel measures of network centrality and syndicated leveraged and covenant-lite loan risk. In our main regression analysis, we employ as dependent variable the first difference of $SRISK$ in billions of U.S. dollars (hereafter called $\Delta SRISK$) to address the non-stationarity of $SRISK$, particularly during periods of recession.

The general form of the estimated panel regression is as follows:

$$\begin{aligned}\Delta SRISK_{i,t} = \alpha &+ \beta_1\left(SN\_RISK_{i,t-1} * USRecession_t\right)\\ &+\beta_2\left(SN\_RISK_{i,t-1} * USNon-Recession_t\right)\\ &+\beta_3\left(Interconnectedness_{i,t-1} * USRecession_t\right)\\ &+\beta_4\left(Interconnectedness_{i,t-1} * USNon-Recession_t\right)\\ &+\beta_5 TotalAssets_{i,t-1}\\ &+\beta_6 MarketSize_{i,t-1}\\ &+\beta_7 LaggedSRISK_{i,t-1} + FixedEffects_i + \varepsilon_{i,t}\end{aligned} \quad (7)$$

where, in addition to SN_RISK, we add as controls the one-month lagged lender's size measured as Total Assets in billion dollars ($)[5]; the Market Size of the syndicated loan market in billion dollars; and the one-

[4] It is calculated as $1 - exp(log(1 - d) * beta)$, where d is the six-month crisis threshold for the market index decline and its default value is 40% (the threshold reflects the drop experienced in the financial market during the financial crisis of 2007–2009); and beta is the firm's CAPM beta.

[5] We employ quarterly data whenever available and project them to the following months until the next available data point. In cases where quarterly accounting information is not available, we rely on semi-annual or annual data instead.

period lagged $SRISK$. To investigate whether highly central financial institutions in a syndicated network are more vulnerable to systemic risk during recessions, we use the three measures of centrality obtained from network analysis and presented in Section 2.1. Recession is the National Bureau of Economic Research (NBER)-based U.S. recession dummy. We estimate regressions with bank fixed effects to control for unobserved heterogeneity among lenders in our sample. Standard errors are clustered at the bank level. Although the model's dependent variable is the first difference of $SRISK$, we add $SRISK$ at time t-1 as a control variable to address any persistent effects that may be present in the data. As pointed out in Cai et al. (2018), systemic risk exhibits high persistence over time. This means that certain underlying factors, such as changes in the economic or regulatory environment, could lead to a persistent trend in the data that may not be fully controlled by simply taking the first difference of $SRISK$. By including the lagged value of $SRISK$ as a control variable, we account for these persistent effects.

3. Data

The data used to construct the variables employed in the regression analysis are gathered from various sources. Our main data set consists of daily U.S. syndicated loans obtained from the Thomson Reuters DealScan database. We focus our analysis on the U.S. market for two main reasons. Firstly, the United States alone accounts for nearly half of the outstanding amount of global syndicated loans and has a 72% share of the global leveraged loan amount issued worldwide over the period 2000-2022. Secondly, the framework proposed by Blickle et al. (2020) to estimate each lender's share in the syndication is developed by considering specifically the U.S. market.

The DealScan database provides comprehensive coverage of loans issued to U.S. borrowers by international financial institutions. We extract a large set of variables to develop our main analysis, such as borrowers name, location of headquarter at state level and industry sector, the set of lenders participating in the loan syndication and their holding shares, and several loan details including the market segment to which they belong (i.e. leveraged, highly leveraged, covenant-lite, etc.), the interest charged and the presence of covenants. Appendix A reports the Thomson Reuters description of the criteria used to identify the high-risk loans that are included in the leveraged category. Table A.1 in the Appendix provides a brief description of the key variables in the DealScan database that we employ in this analysis. Table 2 reports descriptive information about the U.S. syndicated loans during 2000–2022, with a breakdown by leveraged, covenant-lite, and both leveraged and covenant-lite loans. When considering the syndicated loans' total issuance amount, we can see that from the year 2003 to the eve of the financial crisis, the market grew significantly. This growth was mainly driven by the booming trend in the U.S. economy, which experienced a long period of economic expansion during these years.

However, the syndicated loan market reversed its trend with the global financial crisis when the issuance amount decreased significantly by about -71%. Over the three-year period from 2007 to 2009 there was also a noticeable decline in the number of unique borrowers (-53%) and unique loans (-55%). As noted by Ivashina and Scharfstein (2010), the fall in the issuance amount was observed across all common types of syndicated loans, including term loans, investment grade, and non-investment grade loans. Additionally, Giannetti and Laeven (2012) found that the collapse in the global syndicated market during this period was characterised by a "flight home effect," where lenders preferred to issue loans to local borrowers instead of funding overseas transactions. However, in the years following the global financial crisis, the market bounced back with syndicated loans reaching a total value of $1.5 trillion issued in 2022. The trend of the syndicated leveraged loan market followed a slightly different pattern, with the issuance amount reaching a peak of almost $1 trillion on the eve of the financial crisis and accounting for almost half of the syndicated loans issued in the U.S. market in 2007. During the global financial crisis, the issuance amount of leveraged loans sharply declined, reaching its lowest point of about $249 billion in 2009. While the market rebounded in the following years, the amount of leveraged loans remained below the level reached in 2007. However, the share of leveraged loans relative to the total market in the post-crisis period often surpassed pre-crisis levels. Figure 1 illustrates these trends. The covenant-lite market also experienced a peak in 2007, with a total amount of $110 billion. However, there is no evidence of any syndicated covenant-lite loans in the DealScan database prior to 2005, and during the global financial crisis, covenant-lite loans nearly disappeared. Since 2011, the covenant-lite market has been on the rise again, increasing from $44 billion to $149 billion in 2022, and accounting for almost 10% of the total syndicated loans market.

Figure 1. This figure represents the size of the U.S. syndicated loans market from 2000 to 2022, with a breakdown for the leveraged loans. The market size is measured by the total newly originated syndicated loan amount during the year in billions of U.S. dollards.

Table 3 presents the distribution of borrowers by industrial sector in the entire syndicated loans market (Panel A) as well as the leveraged (Panel B) and covenant-lite segments (Panel C). The top sectors across the three panels are manufacturing, finance, insurance, real estate, transportation, public utilities, and services. In particular, the services sector is among the most prominent in the leveraged and covenant-lite segments. According to the findings of Blickle et al. (2023), the banks' extensive specialization in particular industries can be attributed to their industry-specific expertise, leading them to prioritize their preferred industry in their lending activities.

Figure 2 represents the geographical distribution of the overall syndicated market (Panel A) and leveraged market (Panel B) across the United States. We can see that Panels A and B are highly similar and indicate that the strongest concentration of the syndication activity is in the states of California, Texas, and New York, with Illinois, Pennsylvania, and Florida following closely behind. Unsurprisingly, these states also correspond to the ones which contribute the most to the aggregate U.S. gross domestic product. While the borrowers in our sample are headquartered in the United States, the lenders are both U.S. and international. We observe a strong presence of large global financial institutions among the top active lenders, many of which are systemically important banks. We adjust for the mergers and acquisitions (M&As) that occurred in the financial sector during the sample period. This adjustment is done to identify lenders at parent company level as reliably as possible. For example, Merrill Lynch was acquired by Bank of America in September 2008. However, in the Thomson DealScan data, the most recent parent, in other words, Bank of America, is retroactively assigned to all Merrill Lynch transactions back to the start of the sample. We correct the data by considering acquired companies as separate entities until their acquisition. To do so, we manually merge the syndicated loans database with the M&A Thomson One database, which includes historical details of M&A activity.

Figure 2. Syndicated loans across the United States

3.1. Syndicated loan networks

Figure 3 provides a graphical representation of the syndicated market using network analysis. Panel A depicts the market in the year 2007, which corresponds to the period of highest syndication activity between 2000 and 2022. Panel B shows the year 2009, which represents the lowest peak of syndicated lending due to the global financial crisis. Additionally, we include the years 2013 and 2021 in the analysis, which are characterised by the second and third highest amounts of leveraged loan issuance, respectively. The analysis includes all banks that are active in the U.S. syndication market during the reference period, including both systemically and non-systemically important institutions.

In each graph, the nodes are red-coloured if a lender is considered globally systemically important, green-coloured if it is domestically systemically important, and blue-coloured if it does not belong to these groups. As described in Section 2.1, there would be an edge between lender i and k when they are both part of the same syndication. However, in Figure 3, we depict two edges per transaction to highlight the systemic importance of the lenders. Specifically, if both lenders are systemically important, both edges are pink-coloured. If one bank is systemically important and the other is not, one edge is pink-coloured and the other is blue-coloured. If both banks are non-systemically important, both edges are blue-coloured. Furthermore, the dimension of the node indicates the lender's share of leveraged and covenant-lite loans within the market.

Figure 3. Syndicated loan networks.

We can see that these networks are characterised by a complex system of relationships. The four years represented reveal the presence of lenders that correspond to the definition of "hubs". These hubs are the most central and active financial institutions that play a crucial role in creating loan relationships in the syndication market. This is particularly evident for banks such as Bank of America, J.P. Morgan, Wells Fargo, and Citi, as well as other systemically important banks. Indeed, their high connectivity is one of the key factors that place them among the globally systemically important banks identified by regulators following the global financial crisis.[6] However, the topological features of the networks also raise concerns about the concept of "too interconnected to fail," which is used to identify super- spreaders in the market (Markose et al., 2012). The high degree of interconnectedness could be a potential source of systemic risk as it may mean that shocks can propagate quickly through the market.

Figure 4 presents the median degree, closeness, and eigenvector centrality trends spanning the years 2000 to 2022 across all lenders in the U.S. syndicated loans market. Panel A shows the median centrality for the entire sample of banks, while Panel B focuses on systemically important financial institutions. The three graphs in Panel A collectively indicate a consistent overarching pattern in the evolving median influence of nodes within the network graph over time. They show an initial gradual decline during the period spanning 2000-2004, followed by a gradual ascent that reaches its peak in 2010 for all three centrality metrics. After this peak, there is a progressive decline occurring from 2011 to 2022 across all three measures, dropping below the levels observed before the financial crisis. This decreasing trend indicates reduced interconnectedness during this period compared to the pre-financial crisis era, influenced by the heightened presence of numerous peripheral financial institutions that, on average, have lower levels of connectivity with other entities in the market. However, the trend of the median eigenvector centrality of systemically important financial institutions, represented in Panel B3, shows an overall increase over the sample period of +24.9%. Eigenvector centrality considers both the number of connections a node has and the importance of the nodes to which it is connected. Despite the growing participation of smaller lenders with low centrality in the syndication market, this result suggests that systemically important institutions tend to collaborate more with other institutions in the network.

Figure 4. Median degree, closeness and eigenvector centrality.

3.2. Other data

To develop our main analysis, we gather additional data from external sources and merge them into our data set. In order to account for the potential impact of regulatory metrics on systemic risk, we obtain Risk Adjusted Capital TIER1, Risk Adjusted Capital TIER2, and loan loss provision data from the Orbis database. To determine whether our main results are robust to alternative definitions of recession periods, we consider

[6] For example, see the 2019 list of globally systemically important banks (G-SIBs) published by the Financial Stability Board on https://www.fsb.org/2022/11/2022-list-of-global-systemically-important-banks-g-sibs/

two recession dummies based on the U.S. business cycle expansions and contractions data provided by the NBER. In particular, in our main regression, we employ the USRECD variable computed with the "peak method", which identifies as recessions the periods from April 2001 to November 2001, from January 2008 to June 2009, and from March to April 2020. In the robustness tests, we use the USRECDM dummy, which is based on the "trough method", in which recessions are dated from March 2001 to October 2001, and December 2007 to May 2009, and February to March 2020. To further investigate the role played by systemically important financial institutions (SIFIs) in our sample, we control for their effect with a dummy variable that takes a value of 1 if the financial institution is classified by the regulators as a globally systemically important bank or domestically systemically important bank. We gather the full set of systemically important institutions from different sources.[7] This analysis is subject to the limitation that the regulatory list of systemically important institutions became available only after the global financial crisis. To overcome this limitation, we assume that each institution identified as systemically important after the financial crisis is also systemically important before the crisis. We have also labelled as systemically important Lehman Brothers and Bear Stearns, which collapsed during the global financial crisis.

4. Results

In our main regressions, we investigate the role of syndication risk and network centrality in explaining changes in an institution's systemic risk. While network centrality measures offer valuable insights into the structure and influence of the syndicated market, our novel measure of syndication risk assesses the degree of risk-taking of a lender in the leveraged and covenant-lite market. The main variables of interest are interacted with a recession dummy and a non-recession dummy to control for business cycle effects.

As shown in Table 4, the coefficients of $SN\_RISK_{i,t-1}^{Lev}$ and $SN\_RISK_{i,t-1}^{Lev\&CovLite}$ interacted with the recession dummy are positive and statistically significant across all specifications. These results suggest a greater impact of syndication risk on systemic risk during periods of economic recession compared to non-recession periods. The economic impact is also significant. Specifically, when SN_RISK increases by one standard deviation during recessions, the estimated increase in the mean $SRISK$ variation is around 25% to 31%, considering at least the previous six months of the US economy being characterised by a recession. This finding indicates that in the event of a future financial crisis, losses in the leveraged and covenant-lite markets could worsen the severity of the crisis. Additionally, higher interconnectedness, as captured by degree, closeness and eigenvector centrality, is associated with higher systemic risk. However, these relationships

[7] The main list is gathered from the database published by the Bank for International Settlement on https://www.bis.org/bcbs/gsib/gsib_assessment_samples.htm. We integrate the list with the information found in country-based official sources: https://www.mas.gov.sg/news/media-releases/2015/mas-publishes-framework-for-domestic-systemically-important-banks-in-singapore; Australian Prudential Regulation Authority, 2013; Basel Committee on Banking Supervision, 2016; Financial Stability Board, 2013; Financial Stability Board, 2016; Reserve Bank of India, 2019.

reveal consistently strong statistical significance only during periods of recession. The results for the three centrality measures are robust when we introduce the measures of SN_RISK, in addition to the centrality measures – Models [4] and [5] for degree centrality, models [7] and [8] for closeness centrality, and [10] and [11] for eigenvector centrality. The results for the network-based centrality measures are consistent with previous studies investigating the relationship between interconnectedness and systemic risk (Cai et al., 2018; Houston et al., 2018).

The recession dummy does not appear as a stand-alone variable in specifications when the interacted terms are employed due multicollinearity concerns. Specifically, as shown in Table 5, the correlation levels between the interacted centrality measures and the recession dummy are 79.6% for degree centrality, 98.6% for closeness centrality, and 83.2% for eigenvector centrality. Furthermore, $closeness\ centrality\ x\ US\ Non-Recession$ has a correlation of -86.8% with the U.S. Recession dummy. Indeed, the VIF values of the interacted closeness centrality are well above 10 (Table A.2). We address these concerns by replacing $Centrality\ x\ U.S. Recession$ and $Centrality\ x\ U.S. Non-Recession$ with the residuals of their orthogonalization with the recession dummy. Results are reported in Table A.3 and our main findings are confirmed.[8]

Our results align with the literature for the coefficients associated with the bank's total assets, which are positive and statistically significant, indicating that larger banks are more sensitive to systemic risk (Cai et al., 2018; Laeven et al., 2016; Sedunov, 2016). The coefficient on market size is positive and significant.

4.1. Systemically important financial institutions

In this section, we study the extent to which our novel measures of syndicated loan risk are useful determinants of changes in the systemic risk variation when SIFIs are considered separately from other financial institutions. This is motivated by the fact that, as indicated by our network analysis and SN_RISK statistics, the actions and risk-taking of SIFIs can have a greater impact on the overall financial system compared to non-systemically relevant institutions. For this purpose, we first re-run the main regressions segmented according to the systemic importance of the lender. Our findings are reported in Table 6. Panel A indicates that, for SIFIs, both the coefficients $SN\_RISK_{i,t-1}^{Lev}$ and $SN\_RISK_{i,t-1}^{Lev\&CovLite}$, when interacted with the recession dummy, are positive and statistically significant across all the model specifications, as in the main regressions. An increase of one standard deviation in a systemically important bank's market share of

[8] We also checked the VIF values of the baseline regression with the orthogonalized variables and none suggests multicollinearity issues. Specifically, the VIF values of the interacted orthogonalized closeness centrality are always below 4 across all model specifications.

highly risky loans during a period of recession is both statistically and economically significant. The estimated increase in the mean $SRISK$ variation is around 28% to 35% when the US economy has been in a recession for at least six months. Similarly, the results for centrality confirm the positive relationship between systemic risk and network centrality during periods of recession. The result is economically significant, as an increase of one standard deviation in centrality during a recession lasting at least six months results in a 16% to 27% rise of systemic risk.

By contrast, Panel B indicates that for non-systemically important institutions, the statistical significance of $SN\_RISK_{i,t-1}^{Lev}$ and $SN\_RISK_{i,t-1}^{Lev\&CovLite}$ is not robust across different specifications. In particular, statistical significance disappears when degree and eigenvector centrality are used. This is probably due to the facts that systemic risk is low for this subset of financial institutions and that their presence in the market of leveraged and covenant-lite loans is small. Nevertheless, centrality interacted with recession is still statistically significant, which suggests that network interconnectedness remains an important determinant of the systemic risk variations for less systemic lenders. Our findings support the relevance of interconnectedness as a potential source of systemic risk across the entire syndicated loan market.

4.2.Robustness

To complement the main analysis, we perform the following robustness tests. Given that larger banks tend to have higher systemic risk (Cai et al., 2018; Laeven et al., 2016; Sedunov, 2016), a possible concern might be that the relationship between the syndication risk measures and systemic risk is driven by bank size. As can be seen in Table 5, this concern might arise because the SN_RISK variable interacted with the non-recession dummy shows a correlation greater than 70% with total assets. To address this potential issue, we orthogonalize the SN_RISK measures with respect to total assets. We report the results in Table A.4. The sign and significance of SN_RISK x $U.S. Recession$ are in line with previous findings, even though significance is weaker (now at the 5% or 10% level). Furthermore, SN_RISK interacted with $U.S. Non-Recession$ is now also positive and significant but not consistently so across all specifications. This suggests that exposure to leveraged and covenant lite loan syndication might increase systemic risk also in normal economic conditions.

To ensure the observed effects stem from the core explanatory variables rather than other time-dependent factors, we control for time fixed effects and utilize time-level clustered robust standard errors. The results are reported in Table A.5 in the Appendix, and they confirm that the previous findings are robust and not driven by other time-dependent factors.

The centrality measures employed in our main analysis are obtained from network- based connections among lenders in the syndicated loans market. However, Cai et al. (2018) propose an alternative method, which looks at the Euclidean distance among lenders' portfolios.[9] We conduct a robustness test by replacing

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[9] Cai et al. (2018) define the monthly Euclidean portfolio distance between two lenders i and k as follows:

$$Distance_{i,k,t} = \frac{1}{\sqrt{2}} * \sqrt{\sum_{j=1}^{J} \left(w_{i,j,t} - w_{k,j,t}\right)^2}, \qquad (8)$$

where $w_{i,j,t}$ is a weight that captures the amount invested by lender i in "specialisation" j in month t. As a robustness test we consider the specialisation by industry of amount allocation. Specifically, we consider the industrial sector to which the borrower belongs (i.e., manufacturing, oil and gas, etc.). Intuitively, a distance equal to 0 between lenders i and k indicates that their loan portfolios are identical. This occurs when lender i lends to borrowers in the same industrial sector or location as those receiving loans from lender k. On the other hand, a distance of 1 signifies a complete difference between the two portfolios, meaning that lenders i and k issue loans to borrowers in different industrial sectors or locations. Second, we use the measure of portfolios distance to compute the interconnectedness of lender i in month t, which is defined as the network-based centrality measures with the interconnectedness based on the Euclidean portfolio distance. However, while the latter considers the similarity or dissimilarity between two lenders' portfolios based on the industries (or U.S. states) in which they have invested, the network analysis provides insights into the relationships between lenders and allow us to identify which lenders are more influential in the syndicated network, and hence more likely to contribute to systemic risk. Differently from Cai et al. (2018), we incorporate the decline in the share detected in the syndicated market after origination by employing a 1-month horizon (Blickle et al., 2020), instead of a 12-month rolling sum, to calculate interconnectedness based on the Euclidean distance. The results are reported in Table A.6.[10] Again, SN_RISK interacted with the recession dummy is positive and statistically significant across all model specifications. The significance of interconnectedness interacted with recession is also robust across the weighting schemes applied to derive the interconnectedness measures.

In the main analysis, the centrality measures are calculated based on the entire syndicated loan market, rather than just the leveraged and covenant-lite market segment. However, we also conducted additional tests by limiting the network analysis to the leveraged and covenant-lite market segment. The results of these tests are presented in Table A.7 and show that our findings remain robust also when focusing solely on the leveraged and covenant-lite segments of the syndicated market.

To account for the potential impact of regulatory metrics on systemic risk, we include Risk Adjusted Capital TIER1, Risk Adjusted Capital TIER2, and loan loss provisions as control variables in some of our models. However, due to their limited availability across the banks in our sample, we did not include these metrics in every model. The results, reported in Table A.8, shows that our main findings remain robust. The coefficient of loan loss provisions is positive and statistically significant, indicating that an increase in provisions is associated with an increase in systemic risk. This may be due to higher levels of loan defaults and credit losses, which can increase the likelihood of distress among lenders and contagion across the financial system.

In light of Berlin et al.'s (2020) finding that lenders maintain control rights by specifying covenants on the revolvers within a loan package for risky borrowers, we refine the definition of covenant-lite loans to exclude those that contain any covenants across all facilities in a package. The results are reported in Table A.9 and demonstrate that our previous findings remain unchanged. One potential issue with our analysis is the assumption that all loans are equally risky. To address this concern, we enhanced our main measure of

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$$Interconnectedness_{i,t} = (1 - \sum_{k \neq 1} x_{i,k,t} * Distance_{i,k,t}) * 100 \qquad (9)$$

As in Cai et al. (2018) we apply the three alternative weighting schemes $x_{i,k,t}$ in which each financial institution in the sample is equally weighted, (2) institutions are size-weighted, or (3) weights reflect the number of lending relationships an institution has in the market.

[10] Results based on regional aggregation are available upon request.

syndication risk in two ways. Firstly, we refine the definition of leveraged loans to include only those that are highly leveraged, and then consider only the leveraged loans that are not highly leveraged. This allows us to examine whether the lender's market share in one of these two specific segments explains systemic risk variations. However, our results reported in Table A.10 indicate that regardless of whether the leveraged loans are highly leveraged or not, the lender's market share in this segment remains a significant explanatory variable for systemic risk variations.

Secondly, we include information on loan spreads as a continuous metric to reflect the risk level of borrowers. To redefine our measure of syndication risk, we weigh each tranche amount by its corresponding Libor spread. This measure can be interpreted such that a higher value indicates a larger share of high-spread loans held by a lender in the market. Therefore, a higher value of $SN\_RISK^{SpreadWeight}$, implies a greater contribution of that lender to lending high-spread loans. Table A.11 reports the results, which are in line with our main conclusions.

To ensure the robustness of our results, we conduct two additional (unreported) tests. Firstly, we replace the recession dummy variable in Table 4 with an alternative one based on a different recession period. Secondly, we replace our main variables of syndication risk with two alternative measures of syndication risk, which weight the lender's exposure to leveraged and covenant-lite loans with respect to the entire syndicated loan market, rather than simply the leveraged and covenant-lite part of it. Also in this case, the results remain qualitatively unchanged.[11]

To employ an alternative measure of systemic risk, we replace our main dependent variable with $\Delta LRMES$ (Brownlees and Engle, 2017). Table A.12 indicates that the main conclusions about SN_RISK, when interacted with the recession dummy, remain robust across all model specifications.

We also test an alternative regression model with only one dummy business cycle dummy, U.S. Recession, and the variables of interest as stand-alone as well as interacted with "U.S. Recession". The results shown in Table A.13 mirror our previous conclusions in that it is only during periods of recession that we consistently detect a positive and significant impact of SN_RISK and centrality measures on systemic risk.

The main analysis in this study uses a dummy variable to identify three separate recession periods. The longest of these corresponds to the Great Financial Crisis. One may question whether our core results are driven solely by such crisis. To address this, we break down the recession periods into three distinct dummy variables: "Recession period 1", which spans from April to November 2001; "Recession period 2", which spans from January 2008 to June 2009; and "Recession period 3", which spans from March to April 2020. The results of this alternative regression analysis are reported in Table A.14 and show that the core findings are confirmed for the Great Financial Crisis and the COVID recession. By contrast, Recession period 1 is not significant. The size of the coefficients and significance of the recession dummies, both when stand alone and

[11] These results are available upon request.

interacted, suggest that it is the severity of the recession that determines the importance of its impact on systemic risk, as one may expect. Indeed, the COVID recession has the largest coefficients as it was associated with the biggest contraction in real GDP (-19.2%), followed by the Great Financial Crisis (-5.1%) and the early 2000s recession (-0.3%).[12]

5. Conclusions

In this paper, we study the U.S. syndicated loans market and, specifically, its leveraged and covenant-lite segments. Since the Great Recession, the proportion of leveraged loans has remained high, at around 40% of the overall market. We investigate the network topology of the market, and its historical evolution indicates a leading role of systemically important financial institutions, which are the key sources of interconnectedness in loan syndications. We calculate measures of network centrality, which we use as proxies of interconnectedness, to explain systemic risk variations at the level of individual lenders. Our empirical analysis reveals that these measures explain systemic risk variations, especially during periods of recession.

To determine whether there is any relationship between loan syndication and systemic risk, we develop SN_RISK, a measure of risk for syndicated loan portfolios. SN_RISK reflects the proportion of leveraged and covenant-lite loans held by a financial institution relative to the syndication market. We focus on these specific market segments of leveraged loans and covenant-lite loans as these types of loans they could embed lead to pipeline risk. This means that these loans could become less marketable during periods of recession and impair the ability of the owner to offload them to other investors. We find that SN_RISK can help explain the systemic risk of lenders over different model specifications and a battery of robustness tests.

Our findings lead us to conclude that banks with a higher market share of risky loans are more vulnerable to losses during a crisis, which could lead to contagion effects and amplify systemic risk. This new measure would be a valuable addition to the toolkit used by regulators and policymakers to assess and rank systemically important institutions both domestically and globally.

[12] See, for reference, https://www.nber.org/research/business-cycle-dating

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author used ChatGPT in order to improve the grammar and flow of the text. After using this tool, the authors reviewed and edited the text as needed and take full responsibility for the content of this work.

Appendix

Thomson Reuters criteria to identify leveraged loans.

Here, we provide the leveraged loan definition reported in Global Syndicated Loans League Table Criteria (2018) by Thomson Reuters. "Deals will be identified as leveraged and included in leveraged loan league tables based on a combination of the following criteria:

- Margins: Transactions with a drawn spread of at least LIBOR+175 bps (basis points) for US. syndications.
- Ratings: Transactions for issuers with senior debt ratings of BB+/Ba1 or lower. In the event of a split rating, the higher rating will apply.
- Private equity sponsor-backed financings: Transactions whereby a private equity sponsor maintains an ownership position allowing them to influence the management of the company via buyouts or leveraging of issuer.
- Loans to unrated companies will be included in the leveraged loan league tables on a case-by-case basis as long as the spread is greater than or equal to the applicable LIBOR margin thresholds. In case the pricing does not represent market characteristics, debt-to-EBITDA levels may be considered on a case-by-case basis for unrated issuers.
- For U.S. leveraged deals structured with an asset-based component with spreads less than the applicable LIBOR margin thresholds, the entire deal would continue to receive leveraged league table credit.
- The following types of loans are excluded from the leveraged league table regardless of pricing and borrower rating: traditional project finance, real estate, and securitization projects.

Thomson Reuters will take a holistic view to determine whether a deal should be tracked in the investment grade, leveraged, or highly leveraged league tables and will look at a series of variables including ratings, pricing, debt ratios, and sponsor involvement to accurately determine appropriate accreditation."

Table A.1. DealScan syndicated loans database: variables selection

This table describes the main variables extracted from the DealScan syndicated loans database and employed in the analysis.

Group	#	Variables

Borrowers details	V1	Borrower name and unique identifier
	V2	State where the borrower is headquartered
	V3	Country and region of headquarter
	V4	Primary Standard Industrial Classification Code to which the borrower belongs
Loans details	V5	Deal and tranche unique identifier
	V6	Tranche origination or amended
	V7	Tranche active date
	V8	Tranche market segment (Investment grade, leveraged, covenant-lite, etc.)
	V9	Tranche covenants
	V10	Tranche market of syndication
	V11	Distribution method (restricted to syndication)
	V12	Tranche type (i.e. term loan A, term loan B, other loan, etc.)
	V13	Tranche currency
	V14	Tranche amount converted in millions of USD
	V15	Tranche base rate & margin (bps)
Lenders details	V16	Lender parent name and unique identifier
	V17	Lender name and unique identifier
	V18	Primary Role (i.e. syndication agent, admin agent, participant, etc.)
	V19	Lender Share (%)

Table A.2. VIF values of regression model presented in table 4 (Syndication risk and network centrality as determinants of systemic risk)

This table reports the VIF (Variance Inflation Factor) values of the main regression model presented in Table 4. The dependent variable is ΔSRISK, the monthly change in SRISK, which is the systemic risk indicator proposed by Acharya et al (2017). The explanatory variables are lagged by one-month. They are: the syndication risk measures SN_RISK and SN_RISK which are defined in Equations (1) and (2); three proxies for network centrality, that is, degree, closeness and eigenvector centrality; the U.S. Recession dummy, based on the USRECD NBER indicator, which is equal to 1 for each month labelled as a recession by the USRECD NBER indicator and zero otherwise. The U.S. non-recession indicator is the complement of the recession dummy. Other control variables included are the lender's total assets (B$), the size of the syndicated loan market (B$), and the one-month lagged SRISK. All regressions include financial institution fixed effects. The sample period includes monthly observations from 2000 to 2022. The bottom of the table reports the number of observations, fixed effects, number of clusters (i.e., financial institutions).

				Degree centrality			Closeness centrality			Eigenvector centrality	
Dependent variable: ΔSRISK	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
SN_RISK × U.S. Recession	1.68			2.33			1.83			2.18	
SN_RISK × U.S. Non-Recession	3.88			4.21			4.08			4.09	
SN_RISK × U.S. Recession		1.68			2.34			1.83			2.19
SN_RISK × U.S. Non-Recession		3.89			4.22			4.08			4.10
Centrality × U.S. Recession			2.24	3.21	3.21	13.86	14.82	14.82	2.39	3.23	3.24

Centrality × U.S. Non-recession			4.98	5.37	5.36	15.63	16.39	16.39	5.29	5.54	5.54
U.S. Recession	1.36	1.36									
Total Assets (B$)	6.31	6.31	6.24	6.43	6.43	6.27	6.54	6.53	6.46	6.56	6.56
Market Size (B$)	1.05	1.05	1.06	1.06	1.06	1.07	1.08	1.08	1.05	1.05	1.05
Lagged SRISK	2.40	2.40	2.34	2.40	2.40	2.32	2.40	2.40	2.35	2.41	2.41
Observations	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154
Financial Institution FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	96	96	96	96	96	96	96	96	96	96	96

Table A.3. Orthogonalisation of centrality

This Table reports estimation results for the panel regression in Equation (7). The dependent variable is ΔSRISK, the monthly change in SRISK, which is the systemic risk indicator proposed by Acharya et al (2017). The explanatory variables are lagged by one-month. They are: the syndication risk measures SN_RISK and SN_RISK which are defined in Equations (1) and (2); three proxies for network centrality, that is, degree, closeness and eigenvector centrality; the U.S. Recession dummy, based on the USRECD NBER indicator, which is equal to 1 for each month labelled as a recession by the USRECD NBER indicator and zero otherwise. The U.S. non-recession indicator is the complement of the recession dummy. Differently from the main analysis, we replace the Centrality×U.S. Recession and Centrality×U.S. Non-Recession with the residuals of their orthogonalisation with the recession dummy. Other control variables included are the lender's total assets (B$), the size of the syndicated loan market (B$), and the one-month lagged SRISK. All regressions include financial institution fixed effects. The sample period includes monthly observations from 2000 to 2022. The bottom of the table reports the number of observations, fixed effects, number of clusters (i.e., financial institutions), and adjusted R-squared values. Robust standard errors are clustered at the lender level (in parentheses).

	Degree centrality			Closeness centrality			Eigenvector centrality		
Dependent variable: ΔSRISK	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SN_RISK × U.S. Recession		0.704***			0.711***			0.678***	
		(0.105)			(0.097)			(0.110)	
SN_RISK × U.S. Non-Recession		0.006			0.005			0.030	
		(0.053)			(0.052)			(0.053)	
SN_RISK × U.S. Recession			0.696***			0.703***			0.670***
			(0.101)			(0.093)			(0.105)
SN_RISK × U.S.			-0.011			-0.012			0.012

Non-Recession									
			(0.054)			(0.052)			(0.052)
Centrality × U.S. Recession (Orth.)	0.051***	0.025**	0.025**	0.048***	0.041***	0.042***	0.234***	0.155***	0.156***
	(0.010)	(0.011)	(0.010)	(0.013)	(0.013)	(0.013)	(0.053)	(0.052)	(0.052)
Centrality × U.S. Non-Recession (Orth.)	0.009	0.009	0.009	0.023**	0.021*	0.022*	-0.009	-0.019**	-0.018**
	(0.006)	(0.007)	(0.007)	(0.011)	(0.013)	(0.013)	(0.006)	(0.009)	(0.008)
U.S. Recession	1.304***	0.428***	0.417***	1.237***	0.270***	0.258***	1.075***	0.261***	0.249***
	(0.372)	(0.109)	(0.107)	(0.370)	(0.092)	(0.091)	(0.300)	(0.080)	(0.079)
Total Assets (B$)	0.002***	0.003***	0.003***	0.003***	0.003***	0.003***	0.002***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-1.129***	-1.227***	-1.207***	-1.117***	-1.204***	-1.185***	-1.118***	-1.244***	-1.225***
	(0.221)	(0.228)	(0.223)	(0.218)	(0.223)	(0.218)	(0.215)	(0.223)	(0.218)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,212	10,212	10,212	10,212	10,212	10,212	10,212	10,212	10,212
Financial Institution FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	93	93	93	93	93	93	93	93	93
Adj.	0.050	0.065	0.065	0.049	0.066	0.066	0.054	0.068	0.068

Table A.4. Orthogonalisation of SN-RISK and SN_RISK

This Table reports estimation results for the panel regression in Equation (7). The dependent variable is ΔSRISK, the monthly change in SRISK, which is the systemic risk indicator proposed by Acharya et al (2017). The explanatory variables are lagged by one-month. Differently from the main analysis, we replace the SN_RISK and SN_RISK variables with the residuals of their orthogonalisation with the total assets variable, interacted by the US Recession and US Non-Recession dummies. We also include three proxies for network centrality, that is, degree, closeness and eigenvector centrality. The U.S. Recession dummy is based on the USRECD NBER indicator, which is equal to 1 for each month labelled as a recession by the USRECD NBER indicator and zero otherwise. The U.S. non-recession indicator is the complement of the recession dummy. Other control variables included are the lender's total assets (B$), the size of the syndicated loan market (B$), and the one-month lagged SRISK. All regressions include financial institution fixed effects. The sample period includes monthly observations from 2000 to 2022. The bottom of the table reports the number of observations, fixed effects, number of clusters (i.e., financial institutions), and adjusted R-squared values. Robust standard errors are clustered at the lender level (in parentheses).

			Degree centrality		Closeness centrality		Eigenvector centrality	
Dependent variable: ΔSRISK	(1)	(2)	(3)	(4)	(6)	(7)	(7)	(8)
SN_RISK × U.S. Recession (Orth.)	0.549**		0.401*		0.503**		0.410*	
	(0.243)		(0.213)		(0.230)		(0.215)	
SN_RISK × U.S. Non-Recession (Orth.)	0.095**		0.077*		0.075*		0.100**	
	(0.042)		(0.042)		(0.041)		(0.045)	
SN_RISK × U.S. Recession (Orth.)		0.546**		0.395*		0.499**		0.405*
		(0.238)		(0.207)		(0.225)		(0.210)

SN_RISK × U.S. Non-Recession (Orth.)		0.074*		0.055		0.053		0.078*
		(0.040)		(0.041)		(0.040)		(0.042)
Centrality × U.S. Recession			0.067***	0.067***	0.052***	0.053***	0.180***	0.181***
			(0.017)	(0.017)	(0.019)	(0.020)	(0.042)	(0.043)
Centrality × U.S. Non-Recession			0.007	0.008	0.023*	0.023*	-0.013	-0.012
			(0.006)	(0.007)	(0.013)	(0.014)	(0.009)	(0.009)
U.S. Recession	1.506***	1.507***						
	(0.362)	(0.362)						
Total Assets (B$)	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-1.054***	-1.059***	-1.274***	-1.292***	-2.325***	-2.377***	-1.054***	-1.069***
	(0.211)	(0.212)	(0.295)	(0.303)	(0.822)	(0.848)	(0.253)	(0.256)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154
Financial Institution FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	96	96	96	96	96	96	96	96
Adj.	0.042	0.042	0.047	0.047	0.044	0.044	0.050	0.050

Table A.5. Syndication risk and network centrality as determinants of systemic risk - year fixed effects

This Table reports estimation results for the panel regression in Equation (7). The dependent variable is ΔSRISK, the monthly change in SRISK, which is the systemic risk indicator proposed by Acharya et al (2017). The explanatory variables are lagged by one-month. They are: the syndication risk measures SN_RISK and SN_RISK which are defined in Equations (1) and (2); three proxies for network centrality, that is, degree, closeness and eigenvector centrality; the U.S. Recession dummy, based on the USRECD NBER indicator, which is equal to 1 for each month labelled as a recession by the USRECD NBER indicator and zero otherwise. The U.S. non-recession indicator is the complement of the recession dummy. Other control variables included are the lender's total assets (B$), the size of the syndicated loan market (B$), and the one-month lagged SRISK. Differently from the main analysis, all regressions include both year and financial institution fixed effects. Also, robust standard errors are clustered at the year and lender level (in parentheses). The sample period includes monthly observations from 2000 to 2022. The bottom of the table reports the number of observations, fixed effects, number of clusters (i.e., financial institutions), and adjusted R-squared values. * indicates that the estimated coefficient is significantly different from 0 at the 10% level, ** at the 5% level, and *** at the 1% level.

			Degree centrality			Closeness centrality			Eigenvector centrality		
Dependent variable: ΔSRISK	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
SN_RISK × U.S. Recession	0.708***			0.650***			0.671***			0.573***	
	(0.143)			(0.165)			(0.147)			(0.151)	
SN_RISK × U.S. Non-Recession	0.019			0.012			0.010			0.040	

	(0.074)			(0.078)			(0.076)			(0.076)	
SN_RISK × U.S. Recession		0.701***			0.645***			0.664***			0.566***
		(0.143)			(0.165)			(0.146)			(0.151)
SN_RISK × U.S. Non-Recession		0.002			-0.006			-0.007			0.023
		(0.076)			(0.080)			(0.078)			(0.078)
U.S. Recession	0.832***	0.822***									
	(0.302)	(0.300)									
Centrality × U.S. Recession			0.076***	0.024**	0.023**	0.063***	0.028***	0.029***	0.233***	0.108***	0.108***
			(0.013)	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)	(0.045)	(0.033)	(0.033)
Centrality × U.S. Non-recession			0.004	0.005	0.005	0.019**	0.013	0.014	-0.017*	-0.018	-0.017
			(0.005)	(0.005)	(0.005)	(0.008)	(0.008)	(0.009)	(0.010)	(0.012)	(0.012)
Total Assets (B$)	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Constant	-2.884***	-2.884***	-2.740***	-2.937***	-2.942***	-3.534***	-3.472***	-3.520***	-2.701***	-2.844***	-2.848***
	(0.821)	(0.821)	(0.814)	(0.816)	(0.816)	(0.895)	(0.891)	(0.896)	(0.815)	(0.821)	(0.821)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154
Financial Institution FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	118	118	118	118	118	118	118	118	118	118	118
Adj.	0.064	0.064	0.056	0.064	0.064	0.052	0.064	0.064	0.059	0.066	0.066

Table A.6. Syndication risk and interconnectedness as determinants of systemic risk

This Table reports estimation results for the panel regression in Equation (7). The dependent variable is ΔSRISK, the monthly change in SRISK, which is the systemic risk indicator proposed by Acharya et al (2017). The explanatory variables are lagged by one-month. They are: the syndication risk measures SN_RISK and SN_RISK which are defined in Equations (1) and (2); the equally-weighted, size-weighted, and relationship-weighted interconnectedness, which are based on Cai et al. (2018) methodology; the U.S. Recession dummy, based on the USRECD NBER indicator, which is equal to 1 for each month labelled as a recession by the USRECD NBER indicator and zero otherwise. The U.S. non-recession indicator is the complement of the recession dummy. Other control variables included are the lender's total assets (B$), the size of the syndicated loan market (B$), and the one-month lagged SRISK. All regressions include financial institution fixed effects. The sample period includes monthly observations from 2000 to 2022. The bottom of the table reports the number of observations, fixed effects, number of clusters (i.e., financial institutions), and adjusted R-squared values. Robust standard errors are clustered at the lender level (in parentheses).

	Equally-weighted (E-W) interconnectedness			Size-weighted (S-W) interconnectedness			Relationship-weighted (REL-W) interconnectedness		
Dependent variable: ΔSRISK	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SN_RISK × U.S. Recession		0.708***			0.700***			0.695***	
		(0.098)			(0.098)			(0.098)	
SN_RISK × U.S. Non-Recession		0.022			0.020			0.020	
		(0.047)			(0.047)			(0.047)	
SN_RISK × U.S. Recession			0.701***			0.693***			0.687***
			(0.094)			(0.094)			(0.094)
SN_RISK × U.S. Non-Recession			0.006			0.004			0.004
			(0.044)			(0.044)			(0.044)

Interconnectedness × U.S. Recession	0.025***	0.013***	0.012***	0.032***	0.023***	0.023***	0.025***	0.010***	0.010***
	(0.007)	(0.005)	(0.005)	(0.009)	(0.007)	(0.007)	(0.006)	(0.003)	(0.003)
Interconnectedness × U.S. Non-recession	0.002	0.005	0.005	0.012**	0.016***	0.016***	0.002	0.003	0.003
	(0.003)	(0.004)	(0.004)	(0.005)	(0.006)	(0.006)	(0.002)	(0.002)	(0.002)
Total Assets (B$)	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-1.174***	-1.491***	-1.458***	-2.009***	-2.386***	-2.373***	-1.221***	-1.356***	-1.345***
	(0.287)	(0.365)	(0.353)	(0.519)	(0.600)	(0.596)	(0.237)	(0.256)	(0.253)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154
Financial Institution FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	96	96	96	96	96	96	96	96	96
Adj.	0.038	0.054	0.054	0.039	0.054	0.054	0.039	0.054	0.054

Table A.7. Leveraged and covenant-lite loan networks

This Table reports estimation results for the panel regression in Equation (7). The dependent variable is ΔSRISK, the monthly change in SRISK, which is the systemic risk indicator proposed by Acharya et al (2017). The explanatory variables are lagged by one-month. They are: the syndication risk measures SN_RISK and SN_RISK which are defined in Equations (1) and (2); three proxies for network centrality, that is, degree, closeness and eigenvector centrality, which, differently from the main model are estimated on the syndicated loan networks of the leveraged and covenant-lite segments, instead of the entire syndicated loans market; the U.S. Recession dummy, based on the USRECD NBER indicator, which is equal to 1 for each month labelled as a recession by the USRECD NBER indicator and zero otherwise. The U.S. non-recession indicator is the complement of the recession dummy. Other control variables included are the lender's total assets (B$), the size of the syndicated loan market (B$), and the one-month lagged SRISK. All regressions include financial institution fixed effects. The sample period includes monthly observations from 2000 to 2022. The bottom of the table reports the number of observations, fixed effects, number of clusters (i.e., financial institutions), and adjusted R-squared values. Robust standard errors are clustered at the lender level (in parentheses).

	Degree centrality			Closeness centrality			Eigenvector centrality		
Dependent variable: ΔSRISK	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SN_RISK × U.S. Recession		0.588***			0.659***			0.592***	
		(0.106)			(0.093)			(0.113)	
SN_RISK × U.S. Non-Recession		-0.015			0.006			0.038	
		(0.045)			(0.045)			(0.047)	
SN_RISK × U.S. Recession			0.581***			0.651***			0.585***
			(0.102)			(0.089)			(0.108)
SN_RISK × U.S.			-0.034			-0.013			0.019

Non-Recession									
			(0.043)			(0.043)			(0.042)
Centrality × U.S. Recession	0.089***	0.040***	0.040***	0.060***	0.031**	0.032**	0.188***	0.078***	0.078***
	(0.020)	(0.013)	(0.013)	(0.020)	(0.012)	(0.012)	(0.041)	(0.029)	(0.029)
Centrality × U.S. Non-Recession	0.014**	0.016**	0.017**	0.025**	0.020*	0.021**	0.000	0.000	0.002
	(0.007)	(0.006)	(0.007)	(0.013)	(0.010)	(0.011)	(0.009)	(0.008)	(0.008)
Total Assets (B$)	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-1.631***	-1.633***	-1.623***	-2.648***	-2.396***	-2.430***	-1.354***	-1.397***	-1.389***
	(0.352)	(0.338)	(0.336)	(0.821)	(0.686)	(0.702)	(0.280)	(0.276)	(0.276)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,102	9,102	9,102	9,102	9,102	9,102	9,102	9,102	9,102
Financial Institution FE	95	95	95	95	95	95	95	95	95
Adj.	0.049	0.056	0.056	0.043	0.055	0.055	0.048	0.055	0.055

Table A.8. Additional regulatory metrics as control variables

This Table reports estimation results for the panel regression in Equation (7). The dependent variable is ΔSRISK, the monthly change in SRISK, which is the systemic risk indicator proposed by Acharya et al (2017). The explanatory variables are lagged by one-month. They are: the syndication risk measures SN_RISK and SN_RISK which are defined in Equations (1) and (2); three proxies for network centrality, that is, degree, closeness and eigenvector centrality; the U.S. Recession dummy, based on the USRECD NBER indicator, which is equal to 1 for each month labelled as a recession by the USRECD NBER indicator and zero otherwise. The U.S. non-recession indicator is the complement of the recession dummy. In addition to the mainregression model, we add as control variables the following regulatory metrics: risk adjusted capital TIER1, risk adjusted capital TIER2, and the provisions for loan asset losses. Other control variables included are the lender's total assets (B$), the size of the syndicated loan market (B$), and the one-month lagged SRISK. All regressions include financial institution fixed effects. The sample period includes monthly observations from 2000 to 2022. The bottom of the table reports the number of observations, fixed effects, number of clusters (i.e., financial institutions), and adjusted R-squared values. Robust standard errors are clustered at the lender level (in parentheses).

			Degree centrality			Closeness centrality			Eigenvector centrality		
Dependent variable: ΔSRISK	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
SN_RISK × U.S. Recession	0.610***			0.576***			0.584***			0.526***	
	(0.081)			(0.098)			(0.086)			(0.089)	
SN_RISK × U.S. Non-Recession	-0.035			-0.063			-0.058			-0.016	

	(0.068)			(0.069)			(0.070)			(0.068)	
SN_RISK × U.S. Recession		0.590***			0.558***			0.564***			0.506***
		(0.080)			(0.095)			(0.084)			(0.086)
SN_RISK × U.S. Non-Recession		-0.061			-0.092			-0.087			-0.044
		(0.061)			(0.062)			(0.063)			(0.061)
Centrality × U.S. Recession			0.058***	0.021**	0.021**	0.047***	0.031**	0.032**	0.149***	0.054***	0.054***
			(0.015)	(0.009)	(0.009)	(0.017)	(0.014)	(0.014)	(0.036)	(0.020)	(0.020)
Centrality × U.S. Non-recession			0.009	0.012*	0.013*	0.023**	0.025**	0.026**	-0.013	-0.014	-0.011
			(0.006)	(0.007)	(0.007)	(0.011)	(0.012)	(0.013)	(0.009)	(0.010)	(0.010)
U.S. Recession	0.352***	0.340***									
	(0.117)	(0.117)									
Total Assets (B$)	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)

Risk Adjusted Capital TIER1	-0.026	-0.026	-0.017	-0.030	-0.030	-0.018	-0.025	-0.026	-0.012	-0.020	-0.020
	(0.019)	(0.019)	(0.020)	(0.021)	(0.021)	(0.019)	(0.020)	(0.020)	(0.019)	(0.018)	(0.019)
Risk Adjusted Capital TIER2	0.030	0.031	0.011	0.023	0.023	-0.011	0.010	0.010	0.013	0.027	0.028
	(0.057)	(0.058)	(0.053)	(0.055)	(0.056)	(0.049)	(0.053)	(0.053)	(0.056)	(0.056)	(0.057)
Provisions for loan asset losses	0.691***	0.696***	0.844***	0.685***	0.690***	0.895***	0.684***	0.688***	0.835***	0.688***	0.693***
	(0.120)	(0.117)	(0.108)	(0.124)	(0.121)	(0.102)	(0.123)	(0.120)	(0.099)	(0.119)	(0.115)
Constant	-1.063***	-1.031***	-1.414***	-1.240***	-1.223***	-2.353***	-2.334***	-2.370***	-1.194***	-1.068***	-1.049***
	(0.259)	(0.253)	(0.403)	(0.342)	(0.341)	(0.845)	(0.820)	(0.836)	(0.323)	(0.278)	(0.276)
Observations	9,049	9,049	9,049	9,049	9,049	9,049	9,049	9,049	9,049	9,049	9,049
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Financial Institution FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	83	83	83	83	83	83	83	83	83	83	83
Adj.	0.078	0.078	0.071	0.078	0.078	0.068	0.079	0.079	0.073	0.079	0.079

Table A.9. Alternative SN-RISK measure based on no covenants

This Table reports estimation results for the panel regression in Equation (7). The dependent variable is ΔSRISK, the monthly change in SRISK, which is the systemic risk indicator proposed by Acharya et al (2017). The explanatory variables are lagged by one-month. Differently from the main results, we include an alternative measure of syndication risk called SN_RISK . This measure is calculated as the ratio of the lenders' leveraged loans and cov-lite loans with no covenants, relative to the total market amount of leveraged loans and cov-lite loans with no covenants. Further, we include the following variables: three proxies for network centrality, that is, degree, closeness and eigenvector centrality; the U.S. Recession dummy, based on the USRECD NBER indicator, which is equal to 1 for each month labelled as a recession by the USRECD NBER indicator and zero otherwise. The U.S. non-recession indicator is the complement of the recession dummy. Other control variables included are the lender's total assets (B$), the size of the syndicated loan market (B$), and the one-month lagged SRISK. All regressions include financial institution fixed effects. The sample period includes monthly observations from 2000 to 2022. The bottom of the table reports the number of observations, fixed effects, number of clusters (i.e., financial institutions), and adjusted R-squared values. Robust standard errors are clustered at the lender level (in parentheses). * indicates that the estimated coefficient is significantly different from 0 at the 10% level, ** at the 5% level, and *** at the 1% level.

		Degree centrality	Closeness centrality	Eigenvector centrality
Dependent variable: ΔSRISK	(1)	(2)	(3)	(4)
SN_RISK × U.S. Recession	0.691***	0.640***	0.659***	0.574***
	(0.093)	(0.102)	(0.089)	(0.105)
SN_RISK × U.S. Non-recession	0.004	-0.020	-0.017	0.019
	(0.044)	(0.043)	(0.043)	(0.044)
Centrality × U.S. Recession		0.027***	0.035**	0.084***
		(0.008)	(0.014)	(0.029)
Centrality × U.S. Non-recession		0.012*	0.026*	-0.005
		(0.007)	(0.014)	(0.009)
U.S. Recession	0.486***			
	(0.130)			
Total Assets (B$)	0.002***	0.003***	0.003***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)

Constant	-1.141***	-1.373***	-2.511***	-1.160***
	(0.211)	(0.288)	(0.817)	(0.242)
Control variables	Yes	Yes	Yes	Yes
Observations	11,154	11,154	11,154	11,154
Financial Institution FE	Yes	Yes	Yes	Yes
Clusters	96	96	96	96
Adj.	0.054	0.054	0.054	0.055

Table A.10. Highly leveraged vs non-highly leveraged loans

This Table reports estimation results for the panel regression in Equation (7). The dependent variable is ΔSRISK, the monthly change in SRISK, which is the systemic risk indicator proposed by Acharya et al (2017). The explanatory variables are lagged by one-month. Differently from the main results, we propose two alternative syndication risk measures. Panel A includes SN_RISK , which considers only highly-leveraged loans, while panel B reports SN_RISK , which includes leverage loans which are not higly leverage. Further, we include the following variables: the three proxies for network centrality, that is, degree, closeness and eigenvector centrality; the U.S. Recession dummy, based on the USRECD NBER indicator, which is equal to 1 for each month labelled as a recession by the USRECD NBER indicator and zero otherwise. The U.S. non-recession indicator is the complement of the recession dummy. Other control variables included are the lender's total assets (B$), the size of the syndicated loan market (B$), and the one-month lagged SRISK. All regressions include financial institution fixed effects. The sample period includes monthly observations from 2000 to 2022. The bottom of the table reports the number of observations, fixed effects, number of clusters (i.e., financial institutions), and adjusted R-squared values. Robust standard errors are clustered at the lender level (in parentheses).

Panel A. Only highly leverage loans

		Degree centrality	Closeness centrality	Eigenvector centrality
Dependent variable: ΔSRISK	(1)	(2)	(3)	(4)
SN_RISK × U.S. Recession	0.519***	0.423***	0.489***	0.382***
	(0.099)	(0.100)	(0.097)	(0.102)
SN_RISK × U.S. Non-Recession	0.015	0.017	0.010	0.032
	(0.043)	(0.042)	(0.043)	(0.041)
Centrality × U.S. Recession		0.036***	0.031**	0.122***
		(0.010)	(0.014)	(0.034)
Centrality × U.S. Non-recession		0.005	0.017	-0.003
		(0.006)	(0.012)	(0.009)
U.S. Recession	0.710***			
	(0.181)			
Total Assets (B$)	0.003***	0.003***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-1.105***	-1.230***	-2.019***	-1.168***

	(0.216)	(0.262)	(0.728)	(0.254)
Control variables	Yes	Yes	Yes	Yes
Observations	11,154	11,154	11,154	11,154
Financial Institution FE	Yes	Yes	Yes	Yes
Clusters	94	94	94	94
Adj.	0.050	0.051	0.051	0.053

Panel B. Leveraged loans which are not highly leverage

Dependent variable: ΔSRISK	(1)	Degree centrality (2)	Closeness centrality (3)	Eigenvector centrality (4)
SN_RISK × U.S. Recession	0.648***	0.599***	0.623***	0.547***
	(0.107)	(0.110)	(0.106)	(0.105)
SN_RISK × U.S. Non-Recession	0.038	0.028	0.027	0.055
	(0.034)	(0.036)	(0.034)	(0.037)
Centrality × U.S. Recession		0.029***	0.034**	0.085***
		(0.009)	(0.014)	(0.030)
Centrality × U.S. Non-recession		0.010	0.023*	-0.011
		(0.007)	(0.013)	(0.010)
U.S. Recession	0.574***			
	(0.159)			
Total Assets (B$)	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-1.177***	-1.374***	-2.404***	-1.148***
	(0.202)	(0.289)	(0.793)	(0.241)
Control variables	Yes	Yes	Yes	Yes
Observations	11,154	11,154	11,154	11,154
Financial Institution FE	Yes	Yes	Yes	Yes
Clusters	94	94	94	94
Adj.	0.055	0.055	0.056	0.056

Table A.11. Price weighted SN-RISK measure

This Table reports estimation results for the panel regression in Equation (7). The dependent variable is ΔSRISK, the monthly change in SRISK, which is the systemic risk indicator proposed by Acharya et al (2017). The explanatory variables are lagged by one-month. Differently from the main results, we propose an alternative syndication risk measures, SN_RISK , which is computed by weighting each tranche amount by its corresponding Libor spread. Further, we include the following variables: the three proxies for network centrality, that is, degree, closeness and eigenvector centrality; the U.S. Recession dummy, based on the USRECD NBER indicator, which is equal to 1 for each month labelled as a recession by the USRECD NBER indicator and zero otherwise. The U.S. non-recession indicator is the complement of the recession dummy. Other control variables included are the lender's total assets (B$), the size of the syndicated loan market (B$), and the one-month lagged SRISK. All regressions include financial institution fixed effects. The sample period includes monthly observations from 2000 to 2022. The bottom of the table reports the number of observations, fixed effects, number of clusters (i.e., financial institutions), and adjusted R-squared values. Robust standard errors are clustered at the lender level (in parentheses).

		Degree centrality	Closeness centrality	Eigenvector centrality
Dependent variable: ΔSRISK	(1)	(2)	(3)	(4)
SN_RISK × U.S. Recession	0.749***	0.720***	0.726***	0.629***
	(0.113)	(0.133)	(0.114)	(0.125)
SN_RISK × U.S. Non-Recession	0.024	0.013	0.013	0.030
	(0.038)	(0.038)	(0.038)	(0.039)
Centrality × U.S. Recession		0.023**	0.034**	0.078**
		(0.011)	(0.017)	(0.031)
Centrality × U.S. Non-recession		0.010	0.026*	-0.004
		(0.007)	(0.016)	(0.010)
U.S. Recession	0.457***			
	(0.156)			
Total Assets (B$)	0.002***	0.002***	0.003***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-1.176***	-1.395***	-2.600***	-1.189***
	(0.217)	(0.303)	(0.932)	(0.264)
Observations	10,104	10,104	10,104	10,104

Control variables	Yes	Yes	Yes	Yes
Financial Institution FE	Yes	Yes	Yes	Yes
Clusters	95	95	95	95
Adj.	0.055	0.055	0.056	0.056

Table A.12. Alternative systemic risk measure: ΔLRMES

This Table reports estimation results for the panel regression in Equation (7). The dependent variable is ΔLRMES, the monthly change in LRMES, which is the systemic risk indicator proposed by Brownlees and Engle (2017). The explanatory variables are lagged by one-month. They are: the syndication risk measures SN_RISK and SN_RISK which are defined in Equations (1) and (2); three proxies for network centrality, that is, degree, closeness and eigenvector centrality; the U.S. Recession dummy, based on the USRECD NBER indicator, which is equal to 1 for each month labelled as a recession by the USRECD NBER indicator and zero otherwise. The U.S. non-recession indicator is the complement of the recession dummy. Other control variables included are the lender's total assets (B$), the size of the syndicated loan market (B$), and the one-month lagged SRISK. All regressions include financial institution fixed effects. The sample period includes monthly observations from 2000 to 2022. The bottom of the table reports the number of observations, fixed effects, number of clusters (i.e., financial institutions), and adjusted R-squared values. Robust standard errors are clustered at the lender level (in parentheses).

			Degree centrality			Closeness centrality			Eigenvector centrality		
Dependent variable: ΔLRMES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
SN_RISK × U.S. Recession	0.330***			0.232***			0.290***			0.218***	
	(0.071)			(0.076)			(0.069)			(0.072)	
SN_RISK × U.S. Non-Recession	0.052			0.047			0.064			0.052	

	(0.049)			(0.046)			(0.047)			(0.047)	
SN_RISK × U.S. Recession		0.327***			0.229***			0.287***			0.215***
		(0.072)			(0.077)			(0.070)			(0.073)
SN_RISK × U.S. Non-Recession		0.047			0.041			0.058			0.046
		(0.049)			(0.045)			(0.047)			(0.047)
Centrality × U.S. Recession			0.062***	0.047***	0.047***	0.033*	0.020	0.020	0.189***	0.150***	0.150***
			(0.013)	(0.014)	(0.014)	(0.018)	(0.017)	(0.017)	(0.040)	(0.043)	(0.043)
Centrality × U.S. Non-recession			0.003	0.001	0.001	-0.003	-0.009	-0.009	0.009	0.004	0.004
			(0.010)	(0.009)	(0.009)	(0.016)	(0.016)	(0.016)	(0.032)	(0.031)	(0.031)
U.S. Recession	1.545***	1.541***									
	(0.230)	(0.230)									
Total Assets (B$)	0.002**	0.002**	0.002**	0.002**	0.002**	0.002**	0.001**	0.001**	0.002**	0.001**	0.001**

	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	12.418***	12.423***	12.418***	12.470***	12.470***	12.566***	12.901***	12.887***	12.453***	12.487***	12.488***
	(0.546)	(0.546)	(0.613)	(0.609)	(0.609)	(1.074)	(1.030)	(1.031)	(0.594)	(0.593)	(0.593)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154
Financial Institution FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	96	96	96	96	96	96	96	96	96	96	96
Adj.	0.178	0.178	0.175	0.176	0.176	0.176	0.178	0.178	0.176	0.177	0.177

Table A.13. Syndication risk and network centrality as determinants of systemic risk - alternative model specification

This Table reports estimation results for the following panel regression. The dependent variable is ΔSRISK, the monthly change in SRISK, which is the systemic risk indicator proposed by Acharya et al (2017). The explanatory variables are lagged by one-month. Differently from the main analysis, we introduce as standalone terms and interacted with the U.S. Recession variable the syndication risk measures SN_RISK and SN_RISK which are defined in Equations (1) and (2). We also include three proxies for network centrality, that is, degree, closeness and eigenvector centrality; and the U.S. Recession dummy, based on the USRECD NBER indicator, which is equal to 1 for each month labelled as a recession by the USRECD NBER indicator and zero otherwise. The U.S. non-recession indicator is the complement of the recession dummy. Other control variables included are the lender's total assets (B$), the size of the syndicated loan market (B$), and the one-month lagged SRISK. All regressions include financial institution fixed effects. The sample period includes monthly observations from 2000 to 2022. The bottom of the table reports the number of observations, fixed effects, number of clusters (i.e., financial institutions), and adjusted R-squared values. Robust standard errors are clustered at the lender level (in parentheses). * indicates that the estimated coefficient is significantly different from 0 at the 10% level, ** at the 5% level, and *** at the 1% level.

			Degree centrality			Closeness centrality			Eigenvector centrality		
Dependent variable: ΔSRISK	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
SN_RISK	2.086			-0.089			0.113			3.784	
	(4.704)			(4.511)			(4.528)			(4.783)	
SN_RISK × U.S. Recession	0.678***			0.647***			0.667***			0.544***	
	(0.075)			(0.092)			(0.078)			(0.086)	
SN_RISK		0.453			-1.874			-1.599			2.043

		(4.384)			(4.373)			(4.338)			(4.449)
SN_RISK × U.S. Recession		0.687***			0.659***			0.676***			0.554***
		(0.075)			(0.093)			(0.078)			(0.086)
Centrality			0.011	0.011	0.012*	0.029*	0.025*	0.026*	-0.001	-0.007	-0.005
			(0.007)	(0.007)	(0.007)	(0.015)	(0.013)	(0.014)	(0.008)	(0.009)	(0.009)
Centrality × U.S. Recession			0.061***	0.016**	0.015**	0.030***	0.009***	0.009***	0.197***	0.091***	0.089***
			(0.013)	(0.006)	(0.007)	(0.007)	(0.003)	(0.003)	(0.044)	(0.026)	(0.026)
U.S. Recession	0.498***	0.486***									
	(0.131)	(0.130)									
Total Assets (B$)	0.002***	0.002***	0.002***	0.003***	0.003***	0.002***	0.003***	0.003***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-1.160***	-1.142***	-1.391***	-1.379***	-1.374***	-2.693***	-2.481***	-2.509***	-1.182***	-1.167***	-1.160***
	(0.216)	(0.211)	(0.315)	(0.289)	(0.288)	(0.905)	(0.800)	(0.816)	(0.262)	(0.243)	(0.242)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154
Financial	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Institution FE											
Clusters	96	96	96	96	96	96	96	96	96	96	96
Adj.	0.054	0.054	0.045	0.054	0.054	0.042	0.054	0.054	0.048	0.055	0.055

Table A.14. Analysis of different periods of recession
This Table reports estimation results for the following panel regression. The dependent variable is ΔSRISK, the monthly change in SRISK, which is the systemic risk indicator proposed by Acharya et al (2017). The explanatory variables are lagged by one-month. Differently from the main analysis, we distinguish three different periods of recession in this specification. Recession period 1 spans from April 2001 to November 2001, Recession period 2 spans from January 2008 to June 2009, and Recession period 3 includes March and April 2020. We introduce as stand-alone terms and interacted with the three U.S. Recessions variables separatly the syndication risk measures SN_RISK and SN_RISK which are defined in Equations (1) and (2), and the three proxies for network centrality, that is, degree, closeness and eigenvector centrality. The U.S. non-recession indicator is the complement of the recession dummy. Other control variables included are the lender's total assets (B$), the size of the syndicated loan market (B$), and the one-month lagged SRISK. All regressions include financial institution fixed effects. The sample period includes monthly observations from 2000 to 2022. The bottom of the table reports the number of observations, fixed effects, number of clusters (i.e., financial institutions), and adjusted R-squared values. Robust standard errors are clustered at the lender level (in parentheses). * indicates that the estimated coefficient is significantly different from 0 at the 10% level, ** at the 5% level, and *** at the 1% level.

			Degree centrality			Closeness centrality			Eigenvector centrality		
Dependent variable: ΔSRISK	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
SN_RISK	0.025			0.012			0.004			0.042	
	(0.042)			(0.042)			(0.040)			(0.044)	
SN_RISK × Recession period 1	0.100			0.093			0.095			0.048	
	(0.102)			(0.148)			(0.115)			(0.135)	
SN_RISK × Recessio	0.612***			0.527***			0.591***			0.516***	

n period 2											
	(0.127)			(0.161)			(0.133)			(0.156)	
SN_RISK × Recession period 3	2.507***			1.825**			2.388***			1.949**	
	(0.773)			(0.829)			(0.783)			(0.832)	
SN_RISK		0.012			-0.004			-0.010			0.027
		(0.040)			(0.041)			(0.039)			(0.042)
SN_RISK × Recession period 1		0.105			0.102			0.100			0.055
		(0.101)			(0.147)			(0.114)			(0.134)
SN_RISK × Recession period 2		0.617***			0.535***			0.597***			0.524***
		(0.128)			(0.164)			(0.135)			(0.157)
SN_RISK × Recession period 3		2.710***			2.064**			2.598***			2.196***
		(0.731)			(0.815)			(0.745)			(0.811)
Centrality			0.014*	0.013*	0.014*	0.033**	0.030**	0.030**	-0.004	-0.009	-0.008

			(0.007)	(0.007)	(0.008)	(0.015)	(0.014)	(0.015)	(0.007)	(0.008)	(0.008)
Centrality × Recession period 1			0.009***	0.003	0.002	0.005***	0.002	0.002	0.041***	0.029	0.028
			(0.003)	(0.008)	(0.008)	(0.002)	(0.004)	(0.004)	(0.011)	(0.027)	(0.027)
Centrality × Recession period 2			0.065***	0.025**	0.024**	0.030***	0.011***	0.011***	0.176***	0.074**	0.073**
			(0.014)	(0.011)	(0.011)	(0.008)	(0.004)	(0.004)	(0.041)	(0.029)	(0.029)
Centrality × Recession period 3			0.328***	0.167***	0.149***	0.118***	0.043***	0.038***	0.717***	0.330***	0.287***
			(0.078)	(0.053)	(0.050)	(0.032)	(0.016)	(0.014)	(0.174)	(0.114)	(0.104)
Recession period 1	0.125	0.115									
	(0.182)	(0.181)									
Recession period 2	0.509***	0.500***									
	(0.179)	(0.180)									
Recession period 3	1.648**	1.446**									
	(0.637)	(0.560)									
Total Assets (B$)	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***

	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.949***	-0.930***	-1.272***	-1.244***	-1.237***	-2.784***	-2.539***	-2.550***	-0.939***	-0.905***	-0.897***
	(0.198)	(0.194)	(0.309)	(0.287)	(0.286)	(0.932)	(0.842)	(0.853)	(0.231)	(0.218)	(0.216)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154
Financial Institution FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	96	96	96	96	96	96	96	96	96	96	96
Adj.	0.073	0.074	0.066	0.076	0.077	0.052	0.074	0.076	0.063	0.075	0.076

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Table 1. Comparison of the top 10 financial institutions' ranking based on different methodologies

This table presents a comparison of the top 10 financial institutions based on their rankings in terms of syndicated loans (panel A) and syndicated leveraged loans amount (panel B). The comparison uses two methodologies: the commonly adopted approach before the introduction of the methodology by Blickle et al. (2020), and the methodology suggested by Blickle et al. (2020). The one called in the table Methodology A considers only lead arrangers and assumes they hold a 30% share of the total syndicated amount for a 12-month period. On the other hand, the one called Methodology B considers every lender in the syndicated market and allows for the estimation of a post-origination share by implementing the results derived from the regression analysis presented in the Blickle et al. (2020) paper, which is applicable to Dealscan data. In the latter case, the amount is held in the portfolio for 1 month. The period of analysis spans from 2000 to 2022.

	Panel A. Syndicated loans market				**Panel B. Syndicated leveraged loans market**			
Rank	Methodology A	Methodology A market share	Methodology B	Methodology B market share	Methodology A	Methodology A market share	Methodology B	Methodology B market share
1	JP Morgan	26.7%	JP Morgan	10.0%	JP Morgan	19.8%	Bank of America	9.0%
2	Bank of America	17.2%	Bank of America	9.2%	Bank of America	17.0%	JP Morgan	8.7%
3	Citi	11.1%	Citi	6.3%	Credit Suisse	8.0%	Credit Suisse	5.4%
4	Wells Fargo	4.9%	Wells Fargo	4.5%	Citi	7.4%	Citi	5.0%
5	Credit Suisse	3.9%	Deutsche Bank	3.2%	Deutsche Bank	5.8%	Wells Fargo	4.8%
6	Deutsche Bank	3.0%	Credit Suisse	3.2%	Wells Fargo	5.1%	Deutsche Bank	4.3%
7	Barclays	2.4%	Barclays	3.1%	Goldman Sachs	3.7%	Goldman Sachs	3.9%

8	Goldman Sachs	2.3%	Goldman Sachs	3.0%	Barclays	3.6%	Barclays	3.3%
9	Morgan Stanley	2.2%	Mitsubishi UFJ Financial Group	2.6%	Morgan Stanley	2.9%	Morgan Stanley	2.6%
10	Wachovia	1.6%	Morgan Stanley	2.2%	General Electric Capital	1.7%	Royal Bank of Canada	2.2%

Table 2. U.S. syndicated loan market: historical trends

This table presents historical trends for the U.S. syndicated loan market and its leveraged and covenant-lite segments. All figures are computed yearly. The issuance amount represents the sum of the principal loan amounts issued during each year. The shares of leveraged, covenant-lite, and simultaneously leveraged and covenant-lite loans are expressed as percentages of the total syndicated loan issuance amount.

	All syndicated loans			***Of which:***											
				Leveraged loans				**Cov-lite loans**				*Simultaneously* **leveraged & cov-lite loans**			
Year	TOT SN issuance amount (B$)	N. unique borrowers	N. loans	Share (as % of TOT SN issuance amount)	Issuance amount (B$)	N. unique borrowers	N. loans	Share (as % of TOT SN issuance amount)	Issuance amount (B$)	N. borrowers	N. loans	Share (as % of TOT SN issuance amount)	Issuance amount (B$)	N. unique borrowers	N. loans
2000	1,236	3,322	#####	25.5%	315	1,673	#####					25.5%	315	1,673	1,846
2001	1,198	3,014	#####	20.3%	243	1,424	#####					20.3%	243	1,424	1,529
2002	1,041	2,991	#####	25.3%	264	1,482	#####					25.3%	264	1,482	1,618
2003	965	3,191	#####	33.7%	325	1,621	#####					33.7%	325	1,621	1,818
2004	1,395	3,765	#####	35.3%	493	2,005	#####					35.3%	493	2,005	2,278
2005	1,711	3,923	#####	35.5%	608	1,882	#####	0.1%	2	4	5	35.5%	608	1,882	2,105

2006	1,880	4,003	#####	36.9%	694	1,950	#####	1.1%	21	45	45	36.9%	694	1,950	2,169
2007	2,100	3,703	#####	45.5%	957	1,854	#####	5.2%	110	129	133	46.0%	967	1,858	2,055
2008	927	2,420	#####	41.7%	386	1,233	#####	0.4%	4	1	1	41.7%	386	1,233	1,325
2009	604	1,743	#####	41.3%	249	965	#####	0.1%	1	1	1	41.3%	249	965	1,030
2010	1,041	2,402	#####	36.5%	380	1,183	#####	0.5%	5	6	6	36.5%	380	1,183	1,266
2011	1,181	2,394	#####	33.3%	393	1,191	#####	3.8%	44	49	50	33.4%	395	1,191	1,242
2012	1,071	2,540	#####	46.4%	497	1,384	#####	5.7%	61	92	93	46.4%	497	1,385	1,478
2013	1,276	2,490	#####	56.5%	721	1,539	#####	21.4%	273	237	250	57.7%	737	1,543	1,642
2014	1,318	2,529	#####	46.2%	609	1,436	#####	17.9%	236	270	272	46.9%	618	1,441	1,508
2015	1,300	2,316	#####	42.1%	548	1,177	#####	12.8%	166	173	179	42.2%	549	1,179	1,231
2016	1,178	2,124	#####	42.0%	495	1,045	#####	15.2%	179	157	162	42.2%	497	1,046	1,082
2017	1,192	2,161	#####	49.5%	590	1,161	#####	23.4%	279	287	296	50.1%	598	1,166	1,228
2018	1,522	2,234	#####	41.6%	633	1,115	#####	17.9%	273	302	304	41.9%	638	1,118	1,158

2019	1,135	2,121	#####	40.0%	454	971	#####	16.2%	184	186	192	41.3%	468	984	1,025
2020	1,079	1,905	#####	40.8%	440	810	850	15.3%	165	142	145	42.6%	460	819	861
2021	1,679	2,513	#####	46.0%	772	1,155	#####	16.7%	280	286	285	46.4%	780	1,165	1,199
2022	1,514	2,150	#####	31.5%	477	687	713	9.8%	149	110	113	31.6%	479	689	713

Table 3. Description of the U.S. syndicated loan market by industry and loan type

This table presents the share of the syndicated loan market represented by each industrial sector, computed as the ratio between the issuance amount to borrowers belonging to that sector and the total issuance amount. Shares are computed over time for the following year groups: 2000–2004, 2005–2007, 2008–2010, 2011–2013, 2014–2016, 2017–2019, and 2020–2022. Panels A, B, and C refer to the entire syndicated loan market, the leveraged segment, and the covenant-lite segment, respectively.

Panel A. Syndicated loans

SIC code and descprition		2000-2004	2005-2007	2008-2010	2011-2013	2014-2016	2017-2019	2020-2022
(20–39)	Manufacturing	28%	27%	30%	29%	30%	32%	29%
(60–67)	Finance, Insurance, Real Estate	24%	20%	19%	18%	18%	18%	19%
(40–49)	Transportation & Public Utilities	22%	19%	17%	17%	16%	13%	13%
(10–14)	Mining	4%	7%	8%	7%	4%	5%	3%
(70–89)	Services	11%	15%	13%	18%	19%	22%	24%
(52–59)	Retail Trade	5%	6%	6%	5%	7%	5%	5%
(50–51)	Wholesale Trade	3%	3%	4%	4%	4%	3%	4%
(91–97)	Public Administration	0%	0%	0%	0%	0%	0%	0%
(15–17)	Construction	2%	2%	1%	1%	1%	1%	2%
(01-09)	Agriculture, Forestry, Fishing	1%	1%	1%	1%	1%	1%	1%
Total syndicated loans issuance amount ($B)		5,750	5,608	2,546	3,462	3,769	3,845	4,194

Panel B. Syndicated leveraged loans

SIC Code and Descprition		2000-2004	2005-2007	2008-2010	2011-2013	2014-2016	2017-2019	2020-2022
(20–39)	Manufacturing	35%	31%	31%	27%	28%	25%	24%
(60–67)	Finance, Insurance, Real Estate	9%	7%	8%	10%	9%	11%	12%

(40–49)	Transportation & Public Utilities	21%	21%	16%	15%	12%	13%	10%
(10–14)	Mining	4%	5%	9%	7%	5%	6%	4%
(70–89)	Services	16%	22%	21%	26%	28%	30%	36%
(52–59)	Retail Trade	8%	7%	8%	7%	10%	7%	6%
(50–51)	Wholesale Trade	5%	5%	6%	6%	6%	6%	6%
(91–97)	Public Administration	0%	0%	0%	0%	0%	0%	0%
(15–17)	Construction	1%	1%	0%	0%	0%	1%	1%
(01-09)	Agriculture, Forestry, Fishing	1%	1%	1%	1%	1%	1%	2%
Total syndicated leveraged loans issuance amount ($B)		1,613	2,222	1,004	1,578	1,642	1,675	1,645
		1,613	2,222	1,004	1,578	1,642	1,675	1,645

Panel C. Syndicated covenant-lite loans

SIC Code and Descprition		2005-2007	2008-2010	2011-2013	2014-2016	2017-2019	2020-2022
(20–39)	Manufacturing	31%	67%	28%	28%	25%	22%
(60–67)	Finance, Insurance, Real Estate	5%		6%	7%	8%	10%
(40–49)	Transportation & Public Utilities	21%		12%	9%	13%	10%
(10–14)	Mining	7%		5%	3%	2%	1%
(70–89)	Services	18%	7%	29%	32%	39%	43%
(52–59)	Retail Trade	11%	20%	11%	13%	6%	6%
(50–51)	Wholesale Trade	4%		7%	7%	4%	5%
(91–97)	Public Administration			0%			0%
(15–17)	Construction	1%		1%	0%	2%	1%
(01-09)	Agriculture, Forestry, Fishing	1%	6%	2%	1%	1%	2%

Total syndicated covenant-lite loans issuance amount ($B)	133	10	375	581	735	584
	133	10	375	581	735	584

Table 4. Syndication risk and network centrality as determinants of systemic risk

This Table reports estimation results for the panel regression in Equation (7). The dependent variable is ΔSRISK, the monthly change in SRISK, which is the systemic risk indicator proposed by Acharya et al (2017). The explanatory variables are lagged by one-month. They are: the syndication risk measures SN_RISK and SN_RISK which are defined in Equations (1) and (2); three proxies for network centrality, that is, degree, closeness and eigenvector centrality; the U.S. Recession dummy, based on the USRECD NBER indicator, which is equal to 1 for each month labelled as a recession by the USRECD NBER indicator and zero otherwise. The U.S. non-recession indicator is the complement of the recession dummy. Other control variables included are the lender's total assets (B$), the size of the syndicated loan market (B$), and the one-month lagged SRISK. All regressions include financial institution fixed effects. The sample period includes monthly observations from 2000 to 2022. The bottom of the table reports the number of observations, fixed effects, number of clusters (i.e., financial institutions), and adjusted R-squared values. Lastly, the table reports a number of hypothesis tests and the hypothesis test's p-value. Robust standard errors are clustered at the lender level (in parentheses). * indicates that the estimated coefficient is significantly different from 0 at the 10% level, ** at the 5% level, and *** at the 1% level.

			Degree centrality			Closeness centrality			Eigenvector centrality		
Dependent variable: ΔSRISK	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
SN_RISK × U.S. Recession	0.699***			0.646***			0.668***			0.582***	
	(0.097)			(0.106)			(0.093)			(0.109)	
SN_RISK × U.S. Non-Recession	0.021			-0.001			0.001			0.038	

	(0.047)			(0.045)			(0.045)			(0.048)	
SN_RISK × U.S. Recession		0.691***			0.640***			0.660***			0.575***
		(0.093)			(0.102)			(0.090)			(0.105)
SN_RISK × U.S. Non-Recession		0.005			-0.019			-0.016			0.020
		(0.044)			(0.044)			(0.043)			(0.044)
Centrality × U.S. Recession			0.072***	0.027***	0.027***	0.059***	0.034**	0.035**	0.196***	0.084***	0.084***
			(0.018)	(0.008)	(0.008)	(0.021)	(0.014)	(0.014)	(0.046)	(0.029)	(0.029)
Centrality × U.S. Non-recession			0.011	0.011	0.012*	0.029*	0.025*	0.026*	-0.001	-0.007	-0.005
			(0.007)	(0.007)	(0.007)	(0.015)	(0.013)	(0.014)	(0.008)	(0.009)	(0.009)
U.S. Recession	0.498***	0.486***									
	(0.131)	(0.130)									
Total Assets (B$)	0.002***	0.002***	0.002***	0.003***	0.003***	0.002***	0.003***	0.003***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Market Size (B$)	0.050***	0.050***	0.047***	0.044**	0.044**	0.047**	0.045**	0.045**	0.055***	0.052***	0.052***
	(0.018)	(0.018)	(0.018)	(0.017)	(0.017)	(0.018)	(0.017)	(0.017)	(0.019)	(0.018)	(0.018)
Lagged SRISK	-0.068***	-0.068***	-0.063***	-0.068***	-0.068***	-0.061***	-0.068***	-0.068***	-0.064***	-0.069***	-0.069***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Constant	-1.160***	-1.142***	-1.391***	-1.379***	-1.374***	-2.693***	-2.481***	-2.509***	-1.182***	-1.167***	-1.160***
	(0.216)	(0.211)	(0.315)	(0.289)	(0.288)	(0.905)	(0.800)	(0.816)	(0.262)	(0.243)	(0.242)
Observations	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154	11,154
Financial Institution FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	96	96	96	96	96	96	96	96	96	96	96
Adj.	0.054	0.054	0.045	0.054	0.054	0.042	0.054	0.054	0.048	0.055	0.055
(SN_RISK × Recession - SN_RISK × Non-Recession) = 0	0.678***			0.647***			0.667***			0.544***	
(SN_RISK × Recession - SN_RISK × Non-Recession) = 0		0.686***			0.659***			0.676***			0.555***
(Centrality *Rec.			0.061***	0.016**	0.015**	0.030***	0.009***	0.009***	0.197***	0.091***	0.089***

- Centrality *Non-Rec.) = 0

Table 5. Correlation matrix

This table reports the correlation matrix of the main variables of interest employed in the empirical analysis, which are respectively: the ΔSRISK; the U.S. Recession indicator (USRECD) based on the NBER definition; the lender's total assets (B$); the size of the syndicated loan market (B$); the network-based proxies of interconnectedness, which are the Degree, Closeness and Eigenvector centrality measures; and the two measures of syndication risk, SN_RISK and SN_RISK

	ΔSRISK	U.S. Recession	Total Assets (B$)	Market Size (B$)	Degree Centrality	Degree Centrality × U.S. Recession	Degree Centrality × U.S. Non-Recession	Closeness Centrality	Closeness Centrality × U.S. Recession	Closeness Centrality × U.S. Non-Recession	Eigen Centrality	Eigen Centrality × U.S. Recession	Eigen Centrality × U.S. Non-Recession	SN_RISK	SN_RISK × U.S. Recession	SN_RISK × U.S. Non-Recession	SN_RISK	SN_RISK × U.S. Recession	SN_RISK × U.S. Non-Recession
ΔSRISK	1																		
U.S. Recession	0.058	1																	
Total Assets (B$)	0.026	-0.008	1																
Market Size (B$)	0.050	-0.171	-0.014	1															
Degree Centrality	0.022	0.004	0.558	0.026	1														
Degree Cent	0.081	0.796	0.076	-0.	0.186	1													

rality × U.S. Recession				134						
Degree Centrality × U.S. Non-Recession	-0.018	-0.380	0.504	0.090	0.880	-0.303	1			
Closeness Centrality	0.023	0.026	0.509	0.043	0.967	0.192	0.845	1		
Closeness Centrality × U.S. Recession	0.066	0.986	0.014	-0.168	0.054	0.884	-0.375	0.075	1	
Closeness Centrality × U.S. Non	-0.047	-0.868	0.252	0.173	0.455	-0.691	0.775	0.453	-0.855	1

-Recession															
Eigen Centrality	0.018	0.023	0.607	-0.033	0.924	0.190	0.805	0.893	0.070	0.402	1				
Eigen Centrality × U.S. Recession	0.089	0.832	0.078	-0.156	0.158	0.973	-0.317	0.168	0.905	-0.722	0.190	1			
Eigen Centrality × U.S. Non-Recession	-0.030	-0.418	0.538	0.051	0.799	-0.333	0.936	0.764	-0.412	0.765	0.855	-0.348	1		
SN_RISK	0.022	0.021	0.735	-0.026	0.639	0.153	0.547	0.598	0.057	0.260	0.593	0.134	0.496	1	
SN_RISK × U.S. Recession	0.102	0.457	0.171	-0.092	0.171	0.703	-0.174	0.168	0.541	-0.396	0.172	0.671	-0.191	0.326	1

SN_RISK × U.S. Non-Recession	-0.020	-0.171	0.704	0.011	0.602	-0.136	0.650	0.560	-0.168	0.441	0.553	-0.142	0.603	0.917	-0.078	1			
SN_RISK	0.020	0.021	0.736	-0.026	0.639	0.152	0.546	0.598	0.057	0.260	0.593	0.134	0.496	0.999	0.325	0.917	1		
SN_RISK × U.S. Recession	0.102	0.457	0.171	-0.092	0.171	0.704	-0.174	0.168	0.541	-0.397	0.172	0.672	-0.191	0.326	1.000	-0.078	0.325	1	
SN_RISK × U.S. Non-Recession	-0.022	-0.170	0.704	0.011	0.602	-0.136	0.649	0.560	-0.168	0.441	0.553	-0.142	0.603	0.916	-0.078	0.999	0.918	-0.078	1

Table 6. SIFIs and non SIFIs

This Table reports estimation results for the panel regression in Equation (7) for systemically important financial institutions (Panel A) and other financial institutions (Panel B). The dependent variable is ΔSRISK, the monthly change in SRISK, which is the systemic risk indicator proposed by Acharya et al (2017). The explanatory variables are lagged by one-month. They are: the syndication risk measures SN_RISK and SN_RISK which are defined in Equations (1) and (2); three proxies for network centrality, that is, degree, closeness and eigenvector centrality; the U.S.

Recession dummy, based on the USRECD NBER indicator, which is equal to 1 for each month labelled as a recession by the USRECD NBER indicator and zero otherwise. The U.S. non-recession indicator is the complement of the recession dummy. Other control variables included are the lender's total assets (B$), the size of the syndicated loan market (B$), and the one-month lagged SRISK. All regressions include financial institution fixed effects. The bottom of the table reports the number of observations, fixed effects, number of clusters (i.e., financial institutions), and adjusted R-squared. Lastly, the table reports a number of hypothesis tests and the hypothesis test's p-value. Robust standard errors are clustered at the lender level (in parentheses). * indicates that the estimated coefficient is significantly different from 0 at the 10% level, ** at the 5% level, and *** at the 1% level.

Panel A. Systemically important financial institutions (SIFIs)

			Degree centrality			Closeness centrality				Eigenvector centrality	
Dependent variable: ΔSRISK	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
SN_RISK × U.S. Recession	0.708***			0.660***			0.670***			0.566***	
	(0.110)			(0.125)			(0.105)			(0.135)	
SN_RISK × U.S. Non-Recession	0.034			0.003			0.001			0.049	
	(0.054)			(0.050)			(0.050)			(0.056)	
SN_RISK × U.S. Recession		0.700***			0.654***			0.661***			0.558***

		(0.106)			(0.121)			(0.101)			(0.131)
SN_RISK × U.S. Non-Recession		0.015			-0.017			-0.019			0.029
		(0.050)			(0.049)			(0.049)			(0.052)
Centrality × U.S. Recession			0.089***	0.035**	0.035**	0.092***	0.057*	0.058*	0.252***	0.119**	0.120**
			(0.024)	(0.013)	(0.013)	(0.037)	(0.028)	(0.028)	(0.061)	(0.051)	(0.051)
Centrality × U.S. Non-recession			0.015	0.016	0.017	0.050*	0.044	0.046	0.009	0.001	0.003
			(0.011)	(0.011)	(0.012)	(0.028)	(0.027)	(0.027)	(0.016)	(0.018)	(0.018)
U.S. Recession	0.744**	0.721**									
	(0.274)	(0.272)									
Total Assets (B$)	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.002***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market Size (B$)	0.087**	0.087**	0.082**	0.078**	0.078**	0.081**	0.078**	0.077**	0.097**	0.091**	0.091**
	(0.035)	(0.035)	(0.034)	(0.033)	(0.033)	(0.034)	(0.034)	(0.034)	(0.037)	(0.036)	(0.036)
Lagged SRISK	-0.068***	-0.068***	-0.062***	-0.067***	-0.067***	-0.061***	-0.068***	-0.068***	-0.064***	-0.068***	-0.068***

	(0.013)	(0.013)	(0.013)	(0.014)	(0.014)	(0.013)	(0.014)	(0.014)	(0.013)	(0.014)	(0.014)
Constant	-2.032***	-1.999***	-2.484***	-2.500***	-2.493***	-4.892**	-4.612**	-4.666**	-2.158***	-2.143***	-2.136***
	(0.390)	(0.380)	(0.618)	(0.573)	(0.572)	(1.844)	(1.692)	(1.723)	(0.544)	(0.512)	(0.511)
Observations	5,279	5,279	5,279	5,279	5,279	5,279	5,279	5,279	5,279	5,279	5,279
Financial Institution FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	26	26	26	26	26	26	26	26	26	26	26
Adj.	0.056	0.056	0.048	0.056	0.056	0.045	0.057	0.057	0.051	0.058	0.057
(SN_RISK × Recession - SN_RISK × Non-Recession) = 0	0.674***			0.657***			0.669***			0.517***	
(SN_RISK × Recession - SN_RISK × Non-Recession) = 0		0.685***			0.671***			0.680***			0.529***
(Centrality *Rec. - Centrality *Non-Rec.) = 0			0.074***	0.019*	0.018*	0.042***	0.013**	0.012**	0.243***	0.118**	0.117**

Panel B. Non systemically important financial institutions (non SIFIs)

			Degree			Closeness			Eigenvector centrality		

			centrality			centrality					
Dependent variable: ΔSRISK	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
SN_RISK × U.S. Recession	0.282***			0.123			0.231**			0.083	
	(0.078)			(0.118)			(0.090)			(0.124)	
SN_RISK × U.S. Non-Recession	-0.021			-0.026			-0.026			-0.000	
	(0.039)			(0.035)			(0.039)			(0.028)	
SN_RISK × U.S. Recession		0.284***			0.127			0.233**			0.088
		(0.077)			(0.116)			(0.088)			(0.122)
SN_RISK × U.S. Non-Recession		-0.026			-0.031			-0.032			-0.006
		(0.041)			(0.038)			(0.041)			(0.031)
Centrality × U.S. Recession			0.031***	0.027***	0.027***	0.018***	0.016***	0.016***	0.082***	0.075***	0.075***

			(0.005)	(0.007)	(0.007)	(0.005)	(0.005)	(0.005)	(0.012)	(0.016)	(0.016)
Centrality × U.S. Non-recession			0.003	0.004	0.004	0.006	0.007*	0.007*	-0.004	-0.004	-0.004
			(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.010)	(0.009)	(0.009)
U.S. Recession	0.444***	0.441***									
	(0.119)	(0.118)									
Total Assets (B$)	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Market Size (B$)	0.008	0.008	0.005	0.005	0.005	0.007	0.007	0.007	0.007	0.007	0.007
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Lagged SRISK	-0.095***	-0.095***	-0.097***	-0.096***	-0.096***	-0.095***	-0.096***	-0.096***	-0.098***	-0.098***	-0.098***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.021)	(0.021)	(0.021)
Constant	-0.383***	-0.381***	-0.415***	-0.413***	-0.412***	-0.700***	-0.706***	-0.710***	-0.370***	-0.371***	-0.370***
	(0.077)	(0.077)	(0.104)	(0.100)	(0.100)	(0.245)	(0.244)	(0.244)	(0.088)	(0.086)	(0.086)
Observations	5,875	5,875	5,875	5,875	5,875	5,875	5,875	5,875	5,875	5,875	5,875
Financial Institution FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	72	72	72	72	72	72	72	72	72	72	72

Adj.	0.055	0.055	0.055	0.055	0.055	0.054	0.055	0.055	0.057	0.057	0.057
(SN_RISK × Recession - SN_RISK × Non-Recession) = 0	0.303**			0.149			0.257**			0.083	
(SN_RISK × Recession - SN_RISK × Non-Recession) = 0		0.310**			0.158			0.265**			0.094
(Centrality *Rec. - Centrality *Non-Rec.) = 0			0.028***	0.023***	0.023***	0.012***	0.009***	0.009***	0.086***	0.079***	0.079***

Highlights

- Leveraged and covenant-lite loans pose systemic risk in US banks.
- We develop a new measure of syndication risk, SN_RISK.
- Network analysis reveals risk concentration in highly connected institutions.
- Findings have important implications for policymakers and regulators.