Title: Credit concentration limit and bank's risk-sharing: Evidence from Syndicated Loans.

Bolortuya Enkhtaivan[1]
bolortuya.enkhtaivan@wmich.edu
Department of Finance and Commercial Law
Western Michigan University
Kalamazoo, Michigan, USA

Zagdbazar Davaadorj
zagdbazar.davaadorj@wmich.edu
Department of Finance and Commercial Law
Western Michigan University
Kalamazoo, Michigan, USA

Devrim Yaman
devrim.yaman@wmich.edu
Department of Finance and Commercial Law
Western Michigan University
Kalamazoo, Michigan, USA

Abstract

Credit concentration is a critical regulatory limit for banks, essential for managing risk when issuing loans. We investigate the impact of the loan concentration level on risk-sharing behavior in syndicated loans. Our findings indicate that a higher loan concentration is negatively associated with a bank's contribution to syndicated loans but positively related to the number of participating banks. These effects are moderated by the levels of borrower, industry, and regional concentration. Additionally, banks under the TARP injection period further reduce their loan contributions. Our results are robust, addressing endogeneity concerns and utilizing alternative measurement approaches. This research provides new evidence on the crucial role of credit limits in influencing banks' risk-sharing behavior.

Keywords: credit concentration limit; syndicated loan

[1]Corresponding author

I. Introduction

In banking, managing exposure to large borrowers is essential for maintaining financial stability. The Government Accountability Office's 2013 report, "Causes and Consequences of Recent Bank Failures," identified high concentrations of commercial real estate loans as a major factor in the collapse of small and medium-sized banks from 2008 to 2011. This highlights a critical issue: while loans are a significant revenue source for banks, they also carry substantial risk. Consequently, when banks evaluate large loan requests, they must carefully assess their credit exposure limits to mitigate potential risks and must incorporate these considerations into their risk-sharing strategies. In this study, we examine how the credit concentration level affects banks' contributions to syndicated loans and the number of banks involved in these loan facilities.

We leverage syndicated loan data at the facility level, which provides a unique setting to examine banks risk sharing behavior in the context of credit concentration. Syndicated loans, where multiple banks participate in extending credit to a single borrower, allows us to capture different levels of risk-sharing behaviors. By controlling for both demand-side factors (borrower characteristics) and supply-side factors (lender characteristics), we can isolate the impact of credit concentration on individual bank's risk-sharing strategy. Additionally, the fixed number of lenders in each facility allows us to assess risk-sharing behaviors at aggregate contractual level.

Deposit insurance programs provided by the FDIC, designed to protect deposit holders, can inadvertently exacerbate issues of moral hazard (Diamond, 1991) and adverse selection (Thakor, 1996) in commercial banks. These inefficient pricings of deposit insurance lead banks to pursue higher-risk portfolios (Kim and Santomero, 1988). Moral hazard arises when banks engage in riskier activities, knowing that depositors are protected and therefore less likely to withdraw their funds. Adverse selection occurs when riskier banks attract more deposits due to the perceived safety net of insurance. To mitigate these risks and discourage moral hazard, regulators have introduced various limits and prudential requirements. One such regulation is the 'Credit Concentration Limit,' which mandates that banks limit their

exposure to a single loan and maintain a diversified loan portfolio. Under current banking supervision regulations, a bank may not issue more than 25 percent of its capital structure (Tier 1 capital plus the allowance for loan and lease losses) in direct and indirect credit and contingent obligations to a single loan thereby encouraging loan diversification.

Under the assumption of regulatory intervention via various limit rules, banks choose to maintain relationships with borrowers, reduce risks, and increase loan diversification by partnering with other banks to form loan syndicates. This strategy enables banks to share the risks associated with large loans while complying with regulatory limits on credit concentration. By collaborating in syndicates, banks can diversify their loan portfolios, mitigate the risks of exposure to single borrowers, and benefit from collective due diligence and credit assessment. Consequently, we expect a negative correlation between a bank's contribution to a syndicated loan and its credit concentration ratio, as taking on additional loans requires a more cautious and diversified lending approach.

We find that a higher loan concentration rate is significantly associated with a lower bank share in the loan facility. This suggests that as banks take on larger loans relative to their overall loan portfolio, they tend to reduce their individual share in syndicated loans to mitigate risk. However, the number of lenders in a facility increases with higher loan concentration rates, as shown by the positive and highly significant. This implies that higher loan concentration prompts banks to collaborate with more lenders, dispersing risk across a larger group. These findings underscore the critical role of credit concentration limits in shaping banks' risk-sharing strategies and promoting loan diversification within syndicated lending.

The effect of loan diversification has been a central debate among researchers, with no clear consensus. Proponents of loan diversification emphasize its benefits for risk management and regulatory compliance. In contrast, advocates of loan concentration argue that specialization can reduce costs and enhance efficiency. By focusing on specific sectors or types of loans, banks can develop deep expertise, streamline processes, and lower transaction costs, leading to greater operational efficiency. Additionally, relationship banking is a key advantage of concentration. Banks that concentrate their lending can build

stronger, more personalized relationships with borrowers, resulting in better credit terms, increased customer loyalty, and more effective monitoring of borrower behavior.

Our additional analyses reveal that lenders' expertise and relationships, measured by borrower concentration, industry concentration, and regional concentration, provide an opposite effect to the loan-to-capital-base ratio on the bank share. This indicates that banks with substantial exposures in these areas are less deterred by higher loan-to-capital ratios and are more willing to retain larger portions of syndicated loans when a new loan falls within one of these concentrations. Furthermore, our analysis of regulatory compliance and monitoring, measured by the Troubled Asset Relief Program (TARP) dummy during the injection period to capture the Difference-In-Difference (DID) effect, shows that banks with TARP further reduce their loan shares. This suggests that regulatory interventions like TARP have a pronounced effect on banks' risk-sharing behavior, encouraging more conservative lending practices.

Our paper contributes to the literature in several significant ways. First, we provide empirical evidence on how credit concentration ratios influence banks' risk-sharing behaviors in syndicated loans. Second, we highlight the moderating effects of borrower, industry, and regional concentrations. This angle contributes to the ongoing debate between the benefits of loan concentration versus diversification, providing evidence that specialization within certain contexts can be advantageous. Third, we examine the moderating role of regulatory interventions, specifically the TARP, in shaping relationship between banks' risk-sharing strategies and loan concentration ratio. This aspect of our study contributes to the understanding of how regulatory policies impact bank behavior, especially in times of financial distress.

The rest of the paper is organized as follows: Section II discusses the related literature and hypothesis development. Section III presents the data and model. Section IV provides our main results. Section V and VII reports additional analyses for moderating effects. Section VIII discusses robustness checks. Finally, Section VIV concludes the paper.

II. Related Literature and hypothesis Development

The relationship between credit concentration and bank risk has been extensively studied, with research highlighting both the benefits and risks associated with loan portfolio strategies. The theoretical framework of Diamond (1984) emphasizes the role of diversification in reducing monitoring costs and resolving incentive problems, highlighting the importance of diversified debt contracts for financial stability. Recently, Shim (2019) argued that loan diversification positively impacts bank stability, particularly in highly concentrated markets, supporting the view that spreading risk across various sectors can enhance financial resilience. On the other hand, Berger et al. (2010) show the loan diversification is related with reduced profit and higher cost in Chinese banks. Similarly Tabak et al. (2011) found that loan portfolio concentration can lead to higher returns and lower default risks, suggesting that banks can leverage their expertise in specific sectors to enhance performance.

While the benefits of loan concentration are recognized, when concentration exceeds a bank's limits or capacities, it becomes imperative for banks to mitigate the associated risks and to comply with regulation requirements. One effective way to reduce this concentration is by sharing the risk with other banks and financial institutions through the formation of syndicated loans. Simons (1993) shows that banks primarily opt for syndicated loans due to capital regulatory requirements and the incentives for sharing risk. In addition to this, several other motivations have been explored, including borrower information transparency, the lead bank's reputation, and longer loan maturities ((Dennis and Mullineaux, 2000), as well as bank capital level (Chu et al., 2019; Jones et al., 2005) and past alliance relationship (Champagne and Kryzanowski, 2007).

The primary goal of financial institution regulations is to mitigate risk-taking incentives and protect depositors (Kim and Santomero, 1988). Barth et al. (2013) demonstrate that stringent capital regulation and robust supervisory systems positively influence bank efficiency. Similarly, Chortareas et al. (2012) find that these effects are evident in European Union banks, particularly in countries with higher-quality institutions. More recently, Hirtle et al. (2020) show that banks receiving greater supervisory attention tend

to hold less risky loan portfolios, exhibit lower volatility, and are less sensitive to industry downturns, without compromising growth or profitability. However, it is important to note that some empirical results suggest that regulations and supervision can have negative effects. Lifted regulation restriction is associated positively with bank performance, particularly lower loan loss Jayaratne and Strahan (1998) find that lifting regulatory restrictions is positively associated with improved bank performance, particularly through lower loan losses. Beck et al. (2006) indicate that overly restrictive regulations can increase the likelihood of banking instability. Additionally, Lambert (2019) highlights that regulatory capture and industry lobbying play a role in impeding the effectiveness of bank regulations, further complicating the relationship between regulatory landscape and bank performance.

Building on the established regulatory frameworks, Morris (2001) highlights that the Basel Committee on Bank Supervision and the World Bank recommended a 25% credit concentration limit, which many countries have adopted with variations around this threshold. This regulatory guideline underscores the importance of managing credit concentration to mitigate risks. Acharya et al (2006) examine the impact of risk concentration at the industry and sector levels, demonstrating that excessive concentration in specific areas can amplify risk exposure. Furthermore, Rao et al (2015) show that borrower concentration is positively related to non-performing loans and negatively related to financial performance, indicating that high concentrations can deteriorate a bank's financial health in China. Consequently, when banks receive a large loan request, they should first assess their credit exposure at the loan level, such as the ratio of the requested loan to their existing loan amounts. If the concentration exposure risk is high, banks can form a syndicate to share the risk and comply with regulatory limits. Therefore, we hypothesize:

H1: Higher loan credit concentration ratios will be associated with a lower share of individual banks and a higher number of participants in syndicated loans.

III. Data and empirical model

For our analyses, we utilize data from three different sources. Loan information is obtained from Thomson Reuter's Dealscan database, bank information is sourced from the Bank Regulatory Call Reports available through Wharton WRDS, and borrower information is drawn from Compustat. The process begins with manually merging the Dealscan and Call Reports datasets based on bank names and locations. Subsequently, we integrate this combined data with borrower information using the Dealscan-Compustat link established by Chava and Roberts (2008), extending this link up to the year 2015 using borrowers' name. Final sample is from 2000 to 2015.

[Table 1 comes here]

Summary statistics for the syndicate loan structure, bank's credit concentration risk measures, and the bank, borrower, and loan control variables are reported in Table 1. On average, a bank contributes approximately 38.39% to the syndicate loan facility. Typically, an average loan involves about 9 lenders, with approximately 6 of them being U.S. lenders and about 5 being banking institutions. On average, there are about 1 to 2 lead banks arranging the deal. Regarding credit concentration risk, each loan amount constitutes about 5% of the lender's total loan portfolio, increasing to 22% for each borrowing firm, as a firm might take multiple loans from the same lender and remain active in a given quarter of the year. On average, lending banks allocate about 36% of their total loan portfolio to a single industry and about 35% to the same county.

Lending banks conform to the regulatory norm of a capital adequacy rate with a mean of 10.4% and accumulate about 1.92% of their total loan portfolio for the allowance for loan and lease loss (ALLL). While the average bank holds about 6.95% of its total assets in liquid form, they spend about 0.89% of their total assets on salaries and benefits. The average loan is issued

for about 4 years, with an interest spread of 177 basis points over the relevant market rate, and an average amount of approximately USD 380 million.

We conduct a multiple regression analysis to measure the effect of loan concentration on a bank's consecutive credit risk-sharing decision at the syndicated loan level. The model is defined as follows:

$$\begin{aligned} Syndicated\ loan\ risk\ share_{\ i,j,t} = \beta_0 + \beta_1 Loan\ concentration\ risk_{i,j,t} \\ +\delta * Loan\ controls_{i,t} \\ +\theta * Borrower\ controls_{i,t} \\ +\gamma * Bank\ controls_{j,t} \\ +\varphi * dQuarter_t \\ +\vartheta * dBorrower\ industry_i \\ +\omega * dDeal\ purpose + \varepsilon_{i,j,t} \qquad (1) \end{aligned}$$

where i identifies a loan, j identifies a lending bank, and t is a time subscript. The dependent variable is the syndicated loan's risk share measured by loan share of a bank *j* for an *i* loan issued at time *t* and number of lenders in the loan facility. The key independent variable is loan concentration risk, measured by the loan amount over the lending bank's total loan portfolio at the year-quarter when the loan is issued. We control for the characteristics of the bank, loan, and borrower.

IV. Main results

We present the analysis of the impact of individual bank's credit concentration risk on its participation in syndicated loans in table 2. Our results indicate that a higher loan concentration rate is significantly associated with a lower bank share in the syndicated loan facility, suggesting that banks with higher concentration risks reduce their individual loan shares to mitigate risk. The

coefficient of the Loan Concentration Rate indicates that a 1% increase in a bank's loan concentration ratio results in a decrease of its share in the loan facility by about 4.78% from the mean. Given the average bank share in the facility is 38.39%, this translates to a reduction of approximately 1.83 percentage points. In monetary terms, if the average loan amount is $380 million, the bank's contribution would decrease by around $6.95 million. On the contrary, the number of lenders in a facility increases with higher loan concentration rates, shown by a positive and significant, implying that as concentration risk rises, banks prefer to spread the risk by involving more lenders. The coefficient of the Loan Concentration Rate in column 3 suggests that a 1% increase in the loan concentration ratio increases the number of lenders by about 4.05% from the mean. This indicates that as concentration risk increases, banks tend to distribute the risk by bringing more lenders into the syndicate. These results underscore the importance of credit concentration limits in shaping banks' risk-sharing strategies and promoting loan diversification within syndicated lending.

[Table 2 comes here]

V. The Moderating effect of various concentration areas.

The Basel Committee on Banking Supervision (BCBS) framework recommends that banks extend their evaluation beyond individual loan credit exposure when examining large loan applications that could potentially breach credit limits at various levels. Initially, banks should assess the exposure level against their current loan portfolio. They should then consider whether the borrower has outstanding loans with the bank to increase the credit exposure. Furthermore, banks should evaluate whether the new loan increases industry-level credit exposure or if its location adds to regional credit exposure within the bank's existing portfolio. If banks follow a specialization and cost minimization approach, they are likely to take a larger share of a syndicated loan when the loan originates from an existing borrower, a familiar industry, or a known regional area. Specialization allows banks to leverage their expertise, reduce monitoring costs, and

manage risks more effectively. Familiarity with the borrower or sector leads to efficient loan processing and potentially higher returns. On the other hand, banks might opt for diversification and take a smaller share to spread risk across various borrowers, industries, and regions. Diversification mitigates the impact of adverse developments in any single sector or area, enhancing the stability and resilience of the bank's portfolio. It reduces concentration risk, protecting banks from sector-specific downturns or regional economic declines. Additionally, diversification aligns with regulatory requirements, promoting financial stability and preventing excessive exposure to particular risks.

Our results in Table 3 show that loan concentration inversely affects a bank's share in syndicated loans, aligning with regulatory expectations. However, this effect is mitigated when banks are specialized in specific borrowers, industries, and regions. The positive interaction coefficient indicates that for banks with high industry concentration, the negative impact of the loan-to-capital-base ratio on bank share is significantly reduced. This implies that banks with substantial industry-specific exposure are less deterred by higher loan-to-capital ratios and are more willing to retain larger portions of syndicated loans within those areas. Furthermore, the number of lenders in a facility increases with higher loan concentration rates, but this effect is moderated by borrower, industry, and regional concentrations. For instance, the interaction term for borrower concentration significantly reduces the number of additional lenders needed, suggesting that banks with specialized knowledge in certain areas can manage higher concentration risks more effectively. This nuanced understanding highlights the importance of both diversification and specialization in managing syndicated loan portfolios.

V.I. The Moderating effect of TARP injections.

Government capital injections, such as those provided through the Troubled Asset Relief Program (TARP), can significantly influence the relationship between loan concentration and a bank's share in syndicated loans. TARP funds are intended to stabilize banks by enhancing their capital base, which can affect their risk-taking behavior. Banks receiving TARP funds may feel more secure in their capital position and therefore might be more willing to maintain or even increase their share in syndicated loans, despite higher

loan concentration risks. On the other hand, the oversight and conditions attached to TARP funds might lead banks to adopt more conservative lending practices, reducing their share in high-concentration loans to mitigate potential risks and comply with regulatory expectations.

To capture the difference-in-difference effect between risk-sharing behavior and concentration exposure, we introduced a TARP dummy variable. This variable equals 1 for the period between the TARP receipt date and the TARP payoff date for each bank, with before and after periods varying depending on each bank's injection timeline. Not all banks received TARP funds, allowing us to compare the behavior of TARP-receiving banks with those that did not receive such funds. By using this approach, we avoid the complication of creating additional interaction terms, while still capturing the moderating effect in the difference-in-difference framework for banks.

Table 4 shows that the bank share in the loan facility show that higher loan concentration rates significantly reduce the bank's share. Although receiving TARP funds does not have a significant direct impact on the bank's share, the interaction between loan concentration and TARP receipt is significant. This indicates that the negative impact of loan concentration on the bank's share is exacerbated for banks receiving TARP funds. TARP-receiving banks further reduce their share in high-concentration loans, likely due to heightened scrutiny and conservative practices imposed by the program

For the number of lenders in the facility, higher loan concentration rates lead to a significant increase in the number of lenders involved. The effect of receiving TARP funds is marginally significant, suggesting that TARP-receiving banks tend to involve more lenders in the syndicated loan facility. However, the interaction between loan concentration and TARP receipt is not significant, indicating that TARP does not significantly alter the relationship between loan concentration and the number of lenders. This suggests that while TARP influences the banks' decisions regarding their share in the loan facility, it does not significantly change the overall syndication strategy in terms of the number of participating lenders.

V.II. Sensitivity analysis.

The effect of loan concentration might vary across different bank risk tolerance samples due to the varying risk management strategies and financial structures employed by banks with different levels of risk tolerance. Thus, the tier 1 capital levels, cash liquidity, and total assets play a role in how banks manage and respond to loan concentration, affecting their overall stability and risk exposure. Banks with higher risk tolerance often engage in more aggressive lending practices, diversifying their portfolios less and concentrating loans in specific sectors or types of borrowers. This concentration can lead to higher potential returns but also increases exposure to sector-specific risks. On the other hand, banks with lower risk tolerance tend to have more conservative lending practices, spreading their risk across a broader range of borrowers and sectors, which can mitigate the impact of any single default or sector downturn.

Table 5 reveal that the impact of loan concentration on bank share and the number of lenders differs significantly based on the bank's risk tolerance and financial characteristics. In Panel 1, we observe that loan concentration negatively affects bank share more in banks with high tier 1 capital and low total assets, indicating these banks may be more sensitive to loan concentration risks. For example, banks in Group 3 (with total assets below $3 billion) show a significant negative relationship (-19.48) with loan concentration, suggesting they are more vulnerable to risks associated with concentrated lending. On the contrary, in Panel 2, the number of lenders increases with higher loan concentration, particularly in banks with high capital and low total assets, indicating that these banks might attract more co-lenders to share the risk. This suggests an interesting interplay between loan concentration, bank risk management practices, and the financial stability of banks, highlighting the importance of tailored risk management strategies for different types of banks.

Furthermore, the effect of loan concentration might vary across different borrower samples due to the varying creditworthiness and financial stability of borrowers. Borrowers with higher credit ratings typically have stronger financial health, better repayment capacity, and more stable cash flows, which reduces the risk for lenders even when loans are concentrated. On the other hand, borrowers with lower

credit ratings or those in financial distress may pose higher risks to lenders, as their likelihood of default is greater. The Altman Z-score categorization (distress, grey, and safe zones) further distinguishes borrowers based on their financial stability, with distressed borrowers being at a higher risk of default. Consequently, the impact of loan concentration on such borrowers is more pronounced, as lenders may be more cautious and require higher risk premiums or additional guarantees.

Table 6 shows significant variations in the impact of loan concentration on bank share and the number of lenders across different borrower samples. In Panel 1, the results indicate that loan concentration has a positive effect on bank share for high-rated borrowers but a negative effect for low-rated borrowers and distressed borrowers. This suggests that banks are more willing to increase their share in loans to high-rated borrowers, perceiving them as lower risk, while they are more cautious with lower-rated and distressed borrowers due to higher perceived risks. In Panel 2, the number of lenders increases with higher loan concentration for all borrower categories, but the effect is more pronounced for distressed borrowers, indicating that more lenders are involved to spread the risk. This highlights the different risk management approaches banks take depending on the borrower's financial stability and creditworthiness, emphasizing the need for diversified lending strategies tailored to the specific risk profiles of borrowers.

The effect of loan concentration might differ across various loan samples due to the distinct risk characteristics and purposes associated with different types of loans. Revolver loans, which provide borrowers with a flexible credit line, may exhibit different risk dynamics compared to term loans, which have a fixed repayment schedule. Secured loans, backed by collateral, inherently carry less risk for lenders than unsecured loans, which lack collateral and thus depend solely on the borrower's creditworthiness. Additionally, refinancing loans, often used to replace existing debt with new terms, can reflect different risk levels compared to non-refinancing loans, which might be used for new investments or operational purposes. These variations in loan types can influence how loan concentration impacts lender behavior and the perceived risk of the lending portfolio.

Table 7 shows notable differences in the impact of loan concentration on bank share and the number of lenders across different loan types. In Panel 1, loan concentration negatively affects bank share for term loans and secured loans, suggesting that banks might be more cautious about concentrating their portfolios in these loan types due to the associated risks. Interestingly, unsecured loans show a positive, though not significant, impact on bank share, indicating that banks might be more willing to concentrate in unsecured loans under certain conditions. For refinancing loans, loan concentration has a significant negative effect, reflecting the higher risk associated with these loans. In Panel 2, the number of lenders increases significantly with loan concentration across all loan types, particularly for term loans, secured loans, and refinancing loans. This suggests that higher loan concentration in these loan types attracts more lenders, likely as a risk-sharing strategy to mitigate the potential adverse effects of loan defaults. These results underscore the importance of considering loan types when assessing the impact of loan concentration on lending behavior and risk management.

V.III. Endogeneity and robustness check.

We further perform analyses using alternative measures of the dependent variable to confirm the robustness of our baseline results. The dependent variables include the Herfindahl-Hirschman Index (HHI), the number of lead banks, the number of U.S. lenders, the number of foreign lenders, the number of banks, and the number of non-banks. Table 8 shows that our results are consistent with our baseline findings. The analyses reveal that loan concentration risk has a significant impact across these various measures. Specifically, loan concentration is associated with changes in market concentration, as well as the composition and number of lenders involved in the loans. These results confirm that our initial observations about the effects of loan concentration hold true, even when using different measures of the dependent variable. The robustness of these findings underscores the reliability of our conclusions regarding the relationship between loan concentration and lender behavior.

Endogeneity issues may arise in our analysis due to the potential reverse relationship between loan concentration and the dependent variables. For instance, a bank's decision to concentrate its loans could be

influenced by unobserved factors that simultaneously affect its share of the market or the number of lenders participating in the loan. These unobserved factors, such as management quality, risk appetite, or market conditions, could lead to biased and inconsistent estimates if not properly accounted for. To address this endogeneity, we use peer concentration level as an instrumental variable, which serves as an exogenous predictor of loan concentration. This approach helps isolate the causal effect of loan concentration on our dependent variables, providing more reliable estimates.

Our findings from the two-stage least squares analysis in table 9 reveal stronger and significant relationships between loan concentration and the dependent variables compared with our baseline results. In the first stage, we observe a strong positive association between peer concentration level and loan concentration, validating our instrument. In the second stage, the results indicate that a higher loan concentration rate significantly decreases bank share, suggesting that concentrating loans can reduce a bank's market share, possibly due to increased perceived risk or reduced diversification. On the other hand, loan concentration has a significant positive effect on the number of lenders, implying that as loans become more concentrated, more lenders are willing to participate, likely as a risk-sharing mechanism. These findings are consistent with our baseline results.

V.IV. Conclusion

Our study provides compelling evidence on the impact of credit concentration limits on banks' risk-sharing behavior in syndicated loans. Findings indicate that higher loan concentration ratios are associated with a significant reduction in a bank's share in syndicated loans. This supports the regulatory expectation that banks mitigate risk by reducing their exposure to any single borrower as their concentration levels increase. Interestingly, this behavior is moderated when banks have higher levels of specialization in borrower, industry, and regional concentrations. Banks with significant exposure in these areas are less deterred by higher loan-to-capital ratios and tend to retain larger portions of syndicated loans within these familiar contexts. Furthermore, our analysis of the Troubled Asset Relief Program (TARP) shows that banks receiving TARP funds further reduce their loan shares in high-concentration loans, likely due to the additional scrutiny and conservative practices mandated by the program. This highlights the significant role of regulatory interventions in shaping bank behavior, particularly during periods of financial distress.

Our research contributes to the ongoing debate on the benefits and drawbacks of loan concentration versus diversification. By providing empirical evidence on the moderating effects of borrower, industry, and regional concentrations, as well as the impact of regulatory interventions like TARP, we offer a nuanced understanding of how banks navigate risk-sharing in syndicated loans. Our findings have important implications for policymakers and financial institutions aiming to balance risk and return in their lending practices, ensuring financial stability and resilience in the banking sector.

References

Acharya, V. V., Hasan, I., and Saunders, A. (2006). Should banks be diversified? Evidence from individual bank loan portfolios. *The Journal of Business*, *79*(3), 1355–1412.

Barth, J. R., Lin, C., Ma, Y., Seade, J., and Song, F. M. (2013). Do bank regulation, supervision and monitoring enhance or impede bank efficiency? *Journal of Banking & Finance*, *37*(8), 2879–2892.

Beck, T., Demirgüç-Kunt, A., and Levine, R. (2006). Bank concentration, competition, and crises: First results. *Journal of Banking & Finance*, *30*(5), 1581–1603.

Berger, A. N., Hasan, I., and Zhou, M. (2010). The effects of focus versus diversification on bank performance: Evidence from Chinese banks. *Journal of Banking & Finance*, *34*(7), 1417–1435. https://doi.org/10.1016/j.jbankfin.2010.01.010

Champagne, C., and Kryzanowski, L. (2007). Are current syndicated loan alliances related to past alliances? *Journal of Banking & Finance*, *31*(10), 3145–3161. https://doi.org/10.1016/j.jbankfin.2006.11.018

Chava, S., and Roberts, M. R. (2008). How does financing impact investment? The role of debt covenants. *The Journal of Finance*, *63*(5), 2085–2121.

Chortareas, G. E., Girardone, C., and Ventouri, A. (2012). Bank supervision, regulation, and efficiency: Evidence from the European Union. *Journal of Financial Stability*, *8*(4), 292–302.

Chu, Y., Zhang, D., and Zhao, Y. E. (2019). Bank capital and lending: Evidence from syndicated loans. *Journal of Financial and Quantitative Analysis*, *54*(2), 667–694.

Dennis, S. A., and Mullineaux, D. J. (2000). Syndicated Loans. *Journal of Financial Intermediation*, *9*(4), 404–426. https://doi.org/10.1006/jfin.2000.0298

Diamond, D. W. (1984). Financial Intermediation and Delegated Monitoring. *The Review of Economic Studies*, *51*(3), 393–414. https://doi.org/10.2307/2297430

Diamond, D. W. (1991). Monitoring and reputation: The choice between bank loans and directly placed debt. *Journal of Political Economy*, *99*(4), 689–721.

Hirtle, B., Kovner, A., and Plosser, M. (2020). The impact of supervision on bank performance. *The Journal of Finance*, *75*(5), 2765–2808.

Jayaratne, J., and Strahan, P. E. (1998). Entry restrictions, industry evolution, and dynamic efficiency: Evidence from commercial banking. *The Journal of Law and Economics*, *41*(1), 239–274.

Jones, J. D., Lang, W. W., and Nigro, P. J. (2005). Agent Bank Behavior in Bank Loan Syndications. *Journal of Financial Research*, *28*(3), 385–402. https://doi.org/10.1111/j.1475-6803.2005.00130.x

Kim, D., and Santomero, A. M. (1988). Risk in banking and capital regulation. *The Journal of Finance*, *43*(5), 1219–1233.

Lambert, T. (2019). Lobbying on regulatory enforcement actions: Evidence from US commercial and savings banks. *Management Science*, *65*(6), 2545–2572.

Morris, J. A. (2001). Risk diversification in the credit portfolio: An overview of country practices. *IMF Working Paper*, *200*(1), 1–51.

Rao, P., Yue, H., and Zhu, J. (2015). An investigation of credit borrower concentration. *Journal of Banking & Finance*, *54*, 208–221.

Shim, J. (2019). Loan portfolio diversification, market structure and bank stability. *Journal of Banking & Finance*, *104*, 103–115. https://doi.org/10.1016/j.jbankfin.2019.04.006

Simons, K. (1993). Why do banks syndicate loans? *New England Economic Review*, *Jan*, 45–52.

Tabak, B. M., Fazio, D. M., and Cajueiro, D. O. (2011). The effects of loan portfolio concentration on Brazilian banks' return and risk. *Journal of Banking & Finance*, *35*(11), 3065–3076. https://doi.org/10.1016/j.jbankfin.2011.04.006

Thakor, A. V. (1996). Capital requirements, monetary policy, and aggregate bank lending: Theory and empirical evidence. *The Journal of Finance*, *51*(1), 279–324.

TABLE 1. Summary statistics

Table 1 presents summary statistics for various syndicate loan structure measures, bank's credit concentration risk measures, and the lender, loan and borrower control variables. All variables are unique at their own levels.

	N	Mean	Sd	median	p25	p75
Syndicate structure = 9,474 unique facilities						
Bank share	9,474	38.39	39.96	16	6.67	100
Number of lenders	9,474	9.06	9.25	6	1	14
Herfindahl index	9,474	3384.52	4216.57	756.25	217.86	10000
Number of leads	9,474	1.41	0.95	1	1	2
Number of US lenders	9,474	5.93	5.29	5	1	9
Number of F lenders	9,474	3.13	5.27	1	0	4
Number of banks	9,474	4.69	3.9	4	1	7
Number of non-banks	9,474	4.37	6.5	2	0	6
Credit Concentration = 32,825 facility-bank obs						
Per loan concentration	32,825	0.05	0.2	0.01	0	0.02
Borrower concentration	32,825	0.03	0.01	0.01	0	0.04
Industry concentration	32,825	0.01	0.03	0.03	0.01	0.13
County concentration	29,170	0.01	0.03	0.04	0.01	0.13
Lender Controls = 4,268 bank-year obs, for unique 406 banks						
Size	4,268	16.81	1.86	16.89	15.69	18
Lender Tier 1 Ratio	4,268	10.42	3.17	9.64	8.25	11.63
Lender Loan Allowance Rate	4,268	1.92	1.44	1.54	1.23	2.15
Lender Management Salary	4,268	0.89	0.52	0.81	0.46	1.24
Lender ROA	4,268	0.67	0.5	0.61	0.32	0.98
Lender Cash	4,268	6.95	7.24	4.7	2.98	7.72
Lender Market Risk	4,268	0.01	0.09	0	0	0
Loan controls= 9,474 unique facilities						
Facility Maturity	9,474	42.42	23.1	38.33	23.33	60.87
Facility Interest rate	9,474	177.45	120.03	155.25	75	250
Facility Amount	9,474	0.38	1.09	0.13	0.03	0.35
Borrower controls= 7,262 borrower-year obs, for unique 3,462 firms						
Borrower Leverage	7,262	0.29	0.18	0.28	0.15	0.4
Borrower Interest Coverage	7,262	12.73	33.46	4.2	1.51	10.33
Borrower Current Ratio	7,262	1.96	1.31	1.63	1.11	2.38
Borrower Tangibility	7,262	0.33	0.26	0.25	0.12	0.52
Borrower Profitability	7,262	0.31	3.62	0.96	0	1.93
Borrower TobinQ	7,262	1.72	0.92	1.42	1.11	1.99
Borrower Size	7,262	5.85	24.3	0.76	0.18	3.34

Table 2: Loan Concentration and Risk Sharing

This table reports analyses of the impact of individual bank's credit concentration risk on its participating syndicate loan structure. The dependent variables are bank's share in the loan facility and number of lenders in that facility. Key independent variable is individual loan concentration risk measured by loan amount over bank's gross loan amount. Control variables include loan, lender and borrower level characteristics. All model specifications include loan purpose dummies as well as time and borrower industry fixed effects. The coefficient estimates that are based on the robust standard errors and clustered at the lender level. The ***, **, and * represent significance at the 1 percent, 5 percent, and 10 percent levels respectively.

VARIABLES	(1) Bank Share	(3) Number of lenders
Loan Concentration Rate	**-4.777***	**4.046*** **
Loan Characteristics		
Facility Maturity	-0.007***	0.002***
Facility Interest rate	0.106***	-0.023***
Facility Amount	-1.269***	2.225***
Borrower Characteristics		
Borrower Leverage	-28.927***	8.734***
Borrower Interest Coverage	0.009	-0.013***
Borrower Current Ratio	2.008***	-0.979***
Borrower Tangibility	8.000***	-5.185***
Borrower Profitability	-0.566***	0.065***
Borrower Tobin Q	0.984*	-0.131
Borrower Size	-0.008	0.028***
Lender Characteristics		
Lender Size	0.546	0.025
Lender Tier 1 Ratio	0.398*	-0.059
Lender Loan Allowance Rate	-0.202	0.069
Lender Management Salary	0.333	0.220
Lender ROA	-0.577	-0.136
Lender Cash	-0.118**	0.000
Lender Market Risk	-1.792	0.100
Constant	13.820	11.779***
Observations	32,825	32,825
R-squared	0.372	0.495
Time FE	YES	YES
Industry FE	YES	YES
Deal purpose dummies	YES	YES

Table 3: Interaction between Loan concentration rate and other concentration limits.
This table reports analyses of the interplay between bank's credit concentration risk and other concentration limits. The dependent variables are bank's share in the loan facility and number of lenders in that facility. Key independent variable is individual loan concentration risk measured by loan amount over bank's gross loan amount. Other concentration limits include borrower, industry, and County level concertation if they become top 75th percentile. Control variables include loan, lender and borrower level characteristics. All model specifications include loan purpose dummies as well as time and borrower industry fixed effects. The coefficient estimates that are based on the robust standard errors and clustered at the lender level. The ***, **, and * represent significance at the 1 percent, 5 percent, and 10 percent levels respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Bank Share	Bank share	Bank share	Number of lenders	Number of lenders	Number of lenders
Loan Concentration Rate	-62.751***	-29.464***	-22.066***	65.280***	26.230***	22.601***
Borrower Concentration Rate	3.137***			1.682***		
Interaction term	56.680***			-60.450***		
Industry Concentration Rate		2.022*			0.902***	
Interaction Term		24.244***			-22.519***	
Region Concentration Rate			2.102**			0.637*
Interaction Term			16.990***			-19.145***
Loan Characteristics	YES	YES	YES	YES	YES	YES
Lender Characteristics	YES	YES	YES	YES	YES	YES
Borrower Characteristics	YES	YES	YES	YES	YES	YES
Observations	32,825	32,825	29,170	32,825	32,825	29,170
R-squared	0.378	0.375	0.384	0.512	0.503	0.522
Time FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Deal purpose dummies	YES	YES	YES	YES	YES	YES

Table 4: Loan concentration rate and TARP.
This table reports analyses of the interplay between bank's credit concentration risk and TARP receipt. The dependent variables are bank's share in the loan facility and number of lenders in that facility. Key independent variable is individual loan concentration risk measured by loan amount over bank's gross loan amount. To capture Difference-in-Difference effect, TARP dummy equals to 1 between TARP receipt date and TARP payoff date for each bank. Control variables include loan, lender and borrower level characteristics. All model specifications include loan purpose dummies as well as time and borrower industry fixed effects. The coefficient estimates that are based on the robust standard errors and clustered at the lender level. The ***, **, and * represent significance at the 1 percent, 5 percent, and 10 percent levels respectively.

VARIABLES	(1) Bank Share	(2) Number of Lenders
Loan Concentration Rate	-4.809*	4.099***
TARP Dummy	-1.323	0.805*
interaction Term	-7.938*	-3.132
Loan Characteristics		
Facility Maturity	-0.007***	0.002***
Facility Interest rate	0.106***	-0.023***
Facility Amount	-1.249***	2.229***
Borrower Characteristics		
Borrower Leverage	-28.916***	8.727***
Borrower Interest Coverage	0.009	-0.013***
Borrower Current Ratio	2.009***	-0.979***
Borrower Tangibility	8.010***	-5.190***
Borrower Profitability	-0.566***	0.065***
Borrower Tobin Q	0.982*	-0.131
Borrower Size	-0.008	0.028***
Lender Characteristics		
Lender Size	0.538	0.024
Lender Tier 1 Ratio	0.401*	-0.062
Lender Loan Allowance Rate	-0.197	0.066
Lender Management Salary	0.371	0.191
Lender ROA	-0.592	-0.128
Lender Cash	-0.120**	0.002
Lender Market Risk	-1.737	0.097
Constant	13.904	11.822***
Observations	32,825	32,825
R-squared	0.372	0.495
Time FE	YES	YES
Industry FE	YES	YES
Deal purpose dummies	YES	YES

Table 5: Subsample analyses by Banks's risk tolerance

This table reports various subsample analyses at lender level. The dependent variable is Bank Share in Panel 1 and Number of Lenders in Panel 2. The first two columns are divided by banks' above and below median loan allowance. The next two columns are by tier 1 capitals. The following two are based on lenders' cash. The last three are based on banks' total assets, where Group 1 includes banks with total assets above $10 billion, Group 2 includes banks with total assets between $3 billion and $10 billion, and Group 3 includes banks with total assets below $3 billion.

Panel 1: Bank Share VARIABLES	Low Tolerance	High Tolerance	High Capital	Low Capital	High Liquid	Low Liquid	Group1	Group2	Group3
Loan Concentration Rate	**-6.31***	**-4.12***	**-6.50****	**-3.18**	**-3.87**	**-6.61*****	**1.12**	**-13.13*****	**-19.48*****
Loan Characteristics	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lender Characteristics	YES	YES	YES	YES	YES	YES	YES	YES	YES
Borrower Characteristics	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	16,410	16,410	16,407	16,410	16,410	16,412	29,151	2,535	1,139
R-squared	0.40	0.37	0.44	0.35	0.42	0.35	0.32	0.70	0.75
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Deal purpose dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES

Panel 2: Lenders VARIABLES	Low Tolerance	High Tolerance	High Capital	Low Capital	High Liquid	Low Liquid	Group1	Group2	Group3
Loan Concentration Rate	**5.99*****	**3.36*****	**4.23*****	**8.57***	**3.10****	**5.85*****	**9.23****	**12.31*****	**8.01*****
Loan Characteristics	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lender Characteristics	YES	YES	YES	YES	YES	YES	YES	YES	YES
Borrower Characteristics	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	16,410	16,410	16,407	16,410	16,410	16,412	29,151	2,535	1,139
R-squared	0.51	0.50	0.53	0.51	0.50	0.51	0.48	0.71	0.81
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Deal purpose dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table 6: Subsample analyses by borrowers' risk tolerance.

This table reports various subsample analyses at borrower level. The dependent variable is Bank Share in Panel 1 and Number of Lenders in Panel 2. The first two columns are divided by borrowers' credit ratings. The next three columns are by Altman Z score, with the distress sample being below 1.81, the safe zone being above 3, and the grey zone being between these two.

Panel 1: Bank Share VARIABLES	High Rated	Low Rated	Distress	Safe	Grey
Loan Concentration Rate	**3.03*** **	**-4.91**	**-5.80***	**-1.12**	**-0.11**
Loan Characteristics	YES	YES	YES	YES	YES
Lender Characteristics	YES	YES	YES	YES	YES
Borrower Characteristics	YES	YES	YES	YES	YES
Observations	13,491	19,334	17,703	7,325	7,797
R-squared	0.22	0.39	0.40	0.53	0.45
Time FE	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES
Deal purpose dummies	YES	YES	YES	YES	YES

Panel 2: Number of Lenders VARIABLES	High Rated	Low Rated	Distress	Safe	Grey
Loan Concentration Rate	**2.19** **	**1.66** **	**4.91*** **	**1.33**	**1.38**
Loan Characteristics	YES	YES	YES	YES	YES
Lender Characteristics	YES	YES	YES	YES	YES
Borrower Characteristics	YES	YES	YES	YES	YES
Observations	13,491	19,334	17,703	7,325	7,797
R-squared	0.50	0.60	0.51	0.64	0.67
Time FE	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES
Deal purpose dummies	YES	YES	YES	YES	YES

Table7: Subsample analyses by loan types.
This table reports various subsample analyses based on different loan types. The dependent variable is Bank Share in Panel 1 and Number of Lenders in Panel 2. The loan types analyzed include Revolver, Term, Secured, Unsecured, Refinancing, and Non-Refinancing loans.

Panel 1: Bank Share VARIABLES	Revolver	Term	Secured	Unsecured	Refinancing	non-Refinancing
Loan Concentration Rate	**-2.85**	**-5.42***	**-7.59***	**1.35**	**-1.49**	**-8.67****
Loan Characteristics	YES	YES	YES	YES	YES	YES
Lender Characteristics	YES	YES	YES	YES	YES	YES
Borrower Characteristics	YES	YES	YES	YES	YES	YES
Observations	21,947	10,878	13,631	13,980	26,019	2,529
R-squared	0.43	0.40	0.43	0.27	0.33	0.60
Time FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Deal purpose dummies	YES	YES	YES	YES	YES	YES

Panel 2: Number of Lenders VARIABLES	Revolver	Term	Secured	Unsecured	Refinancing	non-Refinancing
Loan Concentration Rate	**2.11****	**5.73*****	**2.74*****	**2.37****	**2.68*****	**3.14****
Loan Characteristics	YES	YES	YES	YES	YES	YES
Lender Characteristics	YES	YES	YES	YES	YES	YES
Borrower Characteristics	YES	YES	YES	YES	YES	YES
Observations	21,947	10,878	13,631	13,980	26,019	2,529
R-squared	0.57	0.50	0.60	0.55	0.51	0.74
Time FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Deal purpose dummies	YES	YES	YES	YES	YES	YES

Table 8: Alternative Measure of dependent variable

The dependent variables are measured by HHI, number of lead banks, Number of US lender, Number of Foreign Lenders, Number of banks, and Number of non-banks. Key independent variable is individual loan concentration risk measured by loan amount over bank's gross loan amount. Control variables include loan, lender and borrower level characteristics. All model specifications include loan purpose dummies as well as time and borrower industry fixed effects. The coefficient estimates that are based on the robust standard errors and clustered at the lender level. The ***, **, and * represent significance at the 1 percent, 5 percent, and 10 percent levels respectively.

VARIABLES	(1) HHI	(2) # Lead banks	(3) #US lenders	(4) #Foriegn lenders	(5) # Bank lenders	(6) #Non-banks
Loan Concentration	**-643.82****	**0.177**	**1.484*****	**2.562*****	**1.022*****	**3.025*****
Loan Characteristics						
Facility Maturity	-0.663***	0.000***	0.001***	0.001***	0.001***	0.001***
Facility Interest rate	10.615***	-0.004***	-0.012***	-0.012***	-0.011***	-0.012***
Facility Amount	-88.299***	0.229***	0.677***	1.548***	0.438***	1.787***
Borrower Characteristics						
Borrower Leverage	-2,803***	0.940***	4.380***	4.355***	2.649***	6.086***
Interest Coverage	0.737	-0.003***	-0.007***	-0.006***	-0.006***	-0.007***
Borrower Current Ratio	185.29***	-0.123***	-0.372***	-0.607***	-0.267***	-0.712***
Borrower Tangibility	698.03***	-1.010***	-2.329***	-2.856***	-1.464***	-3.721***
Borrower Profitability	-61.28***	-0.006	0.082***	-0.018	0.068***	-0.003
Borrower Tobin Q	96.431*	0.049***	-0.123*	-0.008	-0.112**	-0.019
Borrower Size	-0.961	0.000	0.006***	0.022***	0.004***	0.024***
Lender Characteristics						
Lender Size	-40.936	0.007	-0.114*	0.139**	-0.112**	0.137*
Lender Tier 1 Ratio	35.804	0.003	-0.014	-0.045	-0.006	-0.053
Lender Loan Allowance	-22.1	0.01	-0.004	0.073*	-0.015	0.084
Management Salary	75.432	0.047	0.143	0.077	0.085	0.134
Lender ROA	4.927	-0.032	-0.15	0.013	-0.042	-0.094
Lender Cash	-9.193***	0.002	-0.006	0.006	-0.009	0.009
Lender Market Risk	-182.349	0.361***	0.152	-0.052	0.284	-0.184
Constant	2,542**	1.708***	6.474***	5.305***	5.879***	5.900***
Observations	32,825	32,825	32,825	32,825	32,825	32,825
R-squared	0.342	0.543	0.448	0.472	0.466	0.466
Time FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Deal purpose dummies	YES	YES	YES	YES	YES	YES

Table 9: Two Stage Least Square Analysis

This table reports the results of a two-stage least squares (2SLS) regression analysis. In the first stage, the instrument variable used is peer concentration level, calculated as the average concentration level of banks of similar size, divided into four groups based on asset size, within the same state, measured quarterly. In the second stage, we conduct our two main baseline analyses to examine the effects on Bank Share and the Number of Lenders.

VARIABLES	(1) 1st stage	(2) Bank Share 2nd Stage	(2) Lenders 2nd Stage
Peer Concentration level	**0.73*** **		
Loan Concentration Rate		**-9.17***	**4.70*** **
Loan Characteristics			
Facility Maturity	0.00***	-0.01***	0.00***
Facility Interest rate	-0.00***	0.11***	-0.02***
Facility Amount	0.04***	-1.25***	2.78***
Borrower Characteristics			
Borrower Leverage	0.04***	-30.22***	9.32***
Interest Coverage	0.00	0.01	-0.01***
Borrower Current Ratio	-0.00	1.84***	-0.94***
Borrower Tangibility	-0.00	7.33***	-4.71***
Borrower Profitability	0.00	-0.55***	0.07***
Borrower Tobin Q	-0.00	1.11*	-0.03
Borrower Size	0.00	-0.01	0.03***
Lender Characteristics			
Lender Size	-0.02***	-0.20	0.12
Lender Tier 1 Ratio	0.00	0.40	-0.07
Lender Loan Allowance	0.01**	-0.16	0.11*
Management Salary	0.02	-0.45	0.69**
Lender ROA	-0.00	-1.39	-0.10
Lender Cash	0.00**	-0.10	-0.00
Lender Market Risk	0.19***	-13.23***	3.45***
Constant	0.37***	25.74*	9.83***
Observations	25,982	25,982	25,982
R-squared	0.51	0.40	0.52
Time FE	YES	YES	YES
Industry FE	YES	YES	YES
Deal purpose dummies	YES	YES	YES