Loan Syndication Structures and Price Collusion*

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Abstract

How does the organizational form of loan syndicates evolve and what are the effects on price collusion? We develop a novel measure of distance in lending expertise among syndicate lenders, and relate this novel measure to the organizational form of loan syndicates and loan pricing. Studying the U.S. syndicated loan market from 1989 to 2017, we find that the organizational form of loan syndicates significantly varies across our lender measure based on similar specializations in lending which we call syndicated distance. Large lead arrangers prefer to form close and concentrated syndicates by letting lenders with similar lending expertise into their syndicates and allocating those lenders higher loan shares. Analyzing loan pricing, we find that concentrated syndicates possess improved screening abilities, but collude on loan pricing. Consistent with Hatfield et al. (2017), we find however that price collusion of concentrated syndicates only occurs during periods of low market concentration. Our findings imply that both the organizational form of loan syndicates and the level of market concentration affect price collusion.

Keywords: Syndicated loans, Loan syndication structure, Loan pricing, Price collusion

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1 Introduction

Over the last two decades, banks have become increasingly interconnected partly because of corporations' growing funding needs, both in size and complexity. The banking industry, however, is competitive by nature. As a result, banks face a fundamental question: Whom should they collaborate with while competing with the rest? If banks differentiate competitors by how similar they are in terms of lending expertise, i.e. our distance measure, the question translates into the following: Should banks collaborate with close or distant competitors? Our paper seeks to investigate this question by relating banks' lending expertise to the organizational form of loan syndicates and analyzes the implications for price collusion. More precisely, we study how banks form loan syndicates and analyze their implications on price collusion by addressing the following questions:[1] How do banks structure loan syndicates?[2] Whom do they choose as syndicate partners, and how are loan shares allocated? How does the organizational form of loan syndicates affect loan pricing, in particular price collusion? And, how does market concentration affect price collusion?

We focus on the effects of similarity in *lending expertise* among banks on syndicate formation, and loan pricing. Cai et al. (2018) provide a comprehensive look at the similarity of two banks' loan portfolios by their *distance* measure between two banks. We extend their distance measure to the syndicated loan level (our novel lender distance measure) to capture the similarity in lending expertise of all lenders within a syndicate. We refer to syndicates with high similarity in lending expertise among lenders as "close" syndicates, and call syndicates "distant", if syndicate lenders' similarity in their lending expertise is low. Our lender distance measure therefore properly assesses the similarity, or closeness in lending expertise of lenders within a syndicated loan.

We hypothesize that lenders with higher similarity in lending expertise have lower production costs to produce borrower-specific information (Boot (2000)). Borrowers might benefit from improved screening and monitoring abilities of closer syndicates, if lead arrangers pass on some of these savings to the borrower. These cost savings might be particularly pronounced for loans with higher information asymmetries between the borrower and the lenders. We conjecture, that closer syndicates might reduce loan pricing for borrowers.

An alternative hypothesis is that improved information gathering by syndicates with higher similarity in lending expertise might enable lenders to "hold-up" borrowers due to higher information asymmetries between the borrower and outside lenders (Sharpe (1990),

[1] Loan syndicates are ideal for the purpose of our paper. A syndicate consists of: (i) one or multiple lead arrangers that are delegated to screen/monitor the borrower and administer the loan/syndicate, and (ii) participant lenders whose main role is often just funding part of the loan. Lead arrangers choose whom to invite to join the syndicated loan and may delegate certain tasks to the senior members of the syndicate, e.g., co-leads, and co-agents. Thus, loan syndicates provide rich content about the interrelationships among lenders.

[2] We use "banks" to broadly refer to all types of financial institutions that are involved in the syndicated loan market, including commercial banks, investment banks, institutional investors, etc.

Rajan (1992)). Besides lower production costs resulting from higher similarity in their lending expertise, lenders often already possess borrower-specific and reusable information (Chan et al. (1986)). Also, these lenders with similar lending expertise might include alternative lead arrangers from the perspective of the borrower, potentially strengthening the "lock-in" effect. Consequently, we hypothesize that closer syndicates might collude on loan pricing to extract rents from the borrower.

We further hypothesize, that price collusion might be more pronounced during periods of low market concentration. As theoretically shown by Hatfield et al. (2017), in markets with syndication there exists a certain level of market concentration below which the scope for price collusion *increases* with reductions in market concentration. This mechanism results from an in-period punishment of lead arrangers, in that "price collusion can be sustained by a strategy in which firms [lead arrangers] refuse to join the syndicate of any firm [lender] that deviates from the collusive price." In the syndicated loan market, lead arrangers use confidential blacklists to exclude certain banks from syndicates.[3] We first investigate this hypothesis on a stand alone basis. Then, based on our "hold-up" hypothesis of close syndicates, we conjecture that price collusion during low market concentration might be particularly pronounced for close syndicates.

To investigate how lender distance affects the organizational form of loan syndicates and loan pricing, we empirically analyze the U.S. syndicated loan market, using Thomson Reuters LPC DealScan's loan origination data. We utilize a distance measure between pairs of banks to compute our distance measure on the similarity in lending expertise of lenders within a syndicated loan. We then compute measures of syndicate formation and market concentration in the U.S. syndicated loan market.

First, we examine how lead banks structure syndicates. If lead arrangers structure a syndicate based on how similar lenders' lending expertise in the syndicate should be, the question translates into how lender distance affects the syndicate structure. We find that close syndicates are associated with smaller and more concentrated syndicates. That is, close syndicates consist of fewer lead arrangers, co-agents, and participants and have higher syndicate concentration (as measured by the Herfindahl index) compared to syndicates with higher lender distance. As discussed above, these closer syndicates might reinforce lenders ability for both improved screening and price collusion.

Second, we analyze how lead arrangers distribute the loan among syndicate lenders. That is, whom lead arrangers choose as members of the syndicate, and how lead arrangers allocate loan shares among the members. While choosing lenders with higher similarity in lending expertise into the syndicate might result in benefits from improved screening or price collusion, it might also increase competition for future syndicated loans from the borrower. Consistent with these trade-offs, we find that lead arrangers are more likely to choose either very close or very distant lenders for more senior roles (co-leads, co-

[3] According to anecdotal evidence, these blacklists are wide-spread in the U.S. syndicated loan market and regularly used by lead arrangers to punish lenders.

agents) of the syndicate. In contrast, lead arrangers choice of participants becomes more likely with closer distance in lender expertise. Also, except for very distant syndicates, lead arrangers allocate higher loan shares to syndicate members across all loan roles once distance in lender expertise reduces. Consistent with lead arrangers reduced need to signal credit quality, or mitigate moral hazard, we find that lead arrangers do not retain higher loan shares in syndicates with high information asymmetries of the borrower once the syndicate distance is close. Consequently, similarity in lending expertise is an important factor determining the formation of loan syndication structures.

Third, we investigate how lenders similarity in lending expertise affects loan pricing. As discussed above, there exist potentially two opposing effects on loan pricing from syndicates with higher similarity in lenders' lending expertise. On the one hand, borrowers might benefit from lenders' improved screening and monitoring, as lead arrangers can pass on some of the cost savings to borrowers. On the other hand, hold-up of the borrower might lead to collusive loan pricing. Analyzing the *net* effect of these two opposing forces, we find that closer lender distance resulted in cheaper loan pricing until 2009 (consistent with improved screening), and more expensive loan pricing since 2010 (consistent with price collusion). Disentangling those opposite effects, we find strong evidence consistent with improved screening in close syndicates over the entire sample period, while price collusion only occurred since 2010.

Fourth and finally, we investigate the effect of market concentration on loan pricing. As discussed above, lower market concentration might enable lenders to collude on loan pricing. We first test the stand-alone effect of market concentration on loan pricing, and then interact our lender distance measure with different levels of market concentration to investigate their joint effect. We find that a reduction of market concentration below a certain level results in higher loan pricing. Further, when interacting market concentration with lender distance, we find that during periods of low market concentration price collusion only occurs for close syndicates.

The paper proceeds as follows. Section 1.1 provides a brief literature review and summarizes the contribution of our paper. In Section 2, we describe the institutional setup, and theoretical framework. In addition, we develop our syndicated loan distance measure. Data are described in Section 3 with summary statistics for our sample of syndicated loan facilities and the syndicated loan distance measure. Section 4 shows the empirical results of tests on our hypotheses on both of syndicate formation and loan pricing. Section 5 is conclusion.

1.1 Related Literature

We make several contributions to the existing literature. First, our paper is related to the growing literature on loan syndication. Among others, Chowdhry and Nanda (1996), Pichler and Wilhelm (2001), and Tykvova (2007) theoretically analyze the rationale for

syndication and find that syndicates are formed for reasons such as risk sharing, knowledge transfer, and circumventing regulation. Empirical papers on syndicated loans have examined syndicate structure from the perspectives of information asymmetries (e.g., Lee and Mullineaux (2004), Jones et al. (2005), and Sufi (2007)), lenders' reputation (e.g., Dennis and Mullineaux (2000) and Gopalan et al. (2011)), corporate governance (e.g., Ferreira and Matos (2012)), and liquidity management (e.g., Gatev and Strahan (2009)). While this line of research has usually taken the organizational form of syndicates as given, recently member choice in loan syndicates has been studied (e.g. Sufi (2007), Cai (2010), Altunbas and Kara (2011)). This paper, to the best of our knowledge, is the first to examine syndicate structures from the perspective of the similarity in lending expertise among syndicate lenders and to study syndicate formation more broadly (beyond syndicate member choice).

Our paper is also related to the literature on syndicated loan pricing. Empirical papers have examined syndicated loan pricing from the perspectives of information asymmetry (e.g., Ivashina (2009), Cai (2010), Bharath et al. (2009)), liquidity (e.g., Gupta et al. (2008)), syndicated loan composition (e.g., Lim et al. (2014)), business cycle (e.g. Santos and Winton (2008), Santos (2010)), corporate governance (e.g., Ferreira and Matos (2012)), and pipeline risk (Bruche et al. (2017)). Our paper contributes to this literature by analyzing the effects of similarity in lending expertise among syndicate lenders and market concentration on loan pricing.

Finally, this paper is also related to studies in the industrial organization literature examining collusion. Among others, Nocke and White (2007) and Hatfield et al. (2017) theoretically analyze collusion in repeated extensive form games and show that under certain circumstances collusion can exist. For example, Hatfield et al. (2017) develop a model of syndicated markets with repeated interaction of lenders, in which low market concentration facilitates collusion. This resembles our result that price collusion of close syndicates occurs only during periods of low market concentration.

Also, collusion in syndicates has been widely discussed in the IPO market (e.g., Chen and Ritter (2000), Hansen (2001), and Abrahamson et al. (2011)). Our work provides empirical evidence of collusion in the syndicated loan market.

2 Setting, Theoretical Framework and Distance Measure

In this section, we first describe the institutional setup of syndicated bank lending. Then, we discuss the theoretical framework. Finally, we develop our new syndicated loan lender distance measure.

2.1 Institutional Setup

In this sub-section, we first provide a brief overview of the syndicated loan market. Then, we describe the syndication process. Finally, we highlight the key dimensions in which lead arrangers can affect the syndicate structure and the loan distribution to other banks.[4]

Syndicated Loan Market In a syndication two or more banks provide a loan to a borrower. Compared to bilateral loans, syndicated loans are usually more efficient to administer and cheaper. Consequently, annual total issuance volume in the U.S. market increased from $177bn in 1990 to $2,017bn in 2007, and quickly recovered from a drop during the Global financial crisis to $2,121bn in 2016. Also, almost all publicly listed firms in the U.S. use syndicated loans to borrow (e.g. Sufi (2007)), and with a median loan amount of $116mn individual syndicated loans are also large. Borrowing volumes from syndicated loans are larger than from public debt and equity issuance combined (Drucker and Puri (2007)). For banks, loan syndication is sizable too, with annual originated syndicated loan volume being 9.6% of total assets (Cai et al. (2018)).

While institutional investors engage in syndicated loans primarily based on risk-return considerations, banks consider the overall profitability of the borrower-creditor relationship. Moreover, lead arrangers also focus on the profitability of their creditor-creditor relationships. Specifically, in the syndication process lead arrangers possess a high leeway in structuring the syndicate and distributing the loan to other lenders, which might beneficially serve their own relationship to these creditors.

Syndication Process The syndication process follows two main stages. In the first stage, the issuer awards the mandate for the syndicated loan to a lead arranger. Mostly, borrowers invite their relationship banks and other banks to bid on the syndicate by outlining their pricing and syndication strategy. To determine loan pricing, each lead arranger performs an independent credit analysis of the borrower and creditors make bids. The issuer chooses the lead by awarding the mandate.

In the second stage, the lead arranger prepares an "information memorandum" describing the issuer and terms of the transaction for marketing the loan to other lenders. The document also contains information on compensation for lenders at different tiers (see below on details on different tiers), which come in the form of a spread over a base rate (e.g. LIBOR), and usually different kinds of fees (e.g. commitment fee, upfront fee). Using the "information memorandum", the lead arranger starts "book running" by contacting other banks and asking them for commitments to join the syndicate (see below on a discussion on the involved trade-offs). If total demand, in form of commitments, equals the target issue amount, the deal is "fully subscribed" and can be closed. If the total

[4]The following discussion of syndicate formation maily follows Esty (2001) and Standard & Poor's *A Syndicated Loan Primer* (April 2016).

commitments are higher or lower than the target amount, the deal is "oversubscribed" or "undersubscribed", with syndicated loans being predominantly "oversubscribed". The lead arranger possesses different options to proceed, such as scaling back commitments, re-initiating to ask for commitments, scaling back the loan amount, and retaining a larger share itself in the loan. Once the lead arranger decides on the allocation of commitments, the syndication closes, lenders sign the final loan document, and funds are transferred to the borrower.

Consequently, lead arrangers possess significantly leeway during the syndication process to affect both the syndicate structure as well as loan shares to other syndicate lenders.

Syndicate Structure With respect to syndicate structure, lead arrangers can decide whether to allocate monitoring and administrative tasks to other banks, or to structure, administer, and distribute the loan itself. For example, an 'administrative agent' monitors the loan and handles interest and principal payments, or a 'documentation agent' chooses a law firm and handles documentation. These "joint mandates" usually also increase the chance of a successful syndication, as lenders in more senior roles often commit to larger loan shares and might support loan distribution. Successful syndication might consequently also be a motive by the borrower to request "joint syndication" himself.

In addition, lead arrangers face an important trade-off when deciding on the size of the syndicate. On the one hand, smaller syndicates provide benefits to the borrower in the form of greater confidentiality, concentrated voting control, and administrative convenience. For lenders, smaller syndicates result in greater revenues, and increased influence to modify loan terms over the life of the loan. On the other hand, larger syndicates provide benefits to the borrower as competition usually increases among bidding lenders, which can reduce loan pricing and increase the chance of successful syndication. The lead arranger might benefit due to higher underwriting fees from other lenders to compensate his increased syndication efforts, and from not having to disappoint otherwise excluded bidding lenders. Participating lenders might benefit in meeting their diversification objective and by receiving easier approval in the lender's internal credit application process.

Loan Distribution With respect to loan distribution, lead arrangers also possess high leeway to decide, which banks join the syndicate and at which tiers. Lead arrangers usually allocate more senior roles in the syndicate to its own relationship banks to strengthen their relationship by rewarding them with higher fee compensation. Also, lenders in more senior roles are selected based on lenders experience in lending to specific industries or regions. Finally, lead arrangers might follow borrowers request to reward other of the borrower's relationship banks to more senior roles. Otherwise, lenders obtain the status of participant lenders, whose main role is often just funding part of the loan.

Finally, lead arrangers also possess leeway in the allocation of loan shares. Allocating higher loan shares to lenders in more senior roles can also reward lead arrangers relation-

ship banks by increasing their revenues from interest payments and fees. Also, borrowers might also ask the lead arranger to invite other borrower relationship banks into the syndicate. Lead arrangers might want to reduce their loan shares for more risky loans, which might however conflict with agency considerations. Specifically, lead arrangers can mitigate adverse selection by holding a larger loan share to credibly signal the loan quality. In addition, a larger loan share also incentivizes lead arrangers ex-post monitoring of the loan, which can mitigate the impact of moral hazard. Allocating a higher loan share to lenders in more senior roles in the syndicate can similarly mitigate agency considerations, and increase incentives to pool borrower screening and monitoring expertise of more senior lenders.

2.2 Theoretical Framework

In this sub-section, we outline the theoretical framework for analyzing the role of syndicated loan lender distance and market concentration on loan pricing. First, we describe the economic mechanisms underlying loan pricing. Second, analyzing this framework we provide a number of testable hypotheses.

Effects of Close Syndicates: Improved Borrower Screening and Monitoring

The theoretical literature on banking relationships views borrower-lender relationships as a mechanism, in which lenders produce borrower-specific information that is durable and reusable over time (Boot (2000)). Close syndicates consist of lenders with higher similarity in their lending expertise (compared to lenders in more distant syndicates). Collectively, lenders in close syndicates might thus more effectively produce borrower-specific information, both during the due diligence and monitoring phases of evaluating a borrower. Also, lenders often syndicated loans to the same borrower, so that lenders already possess borrower-specific and reusable information (Chan et al. (1986)). Close syndicates are also more likely to pool information. Further, lead arrangers might pass on some of the benefits from improved screening and monitoring to the borrower, thereby lowering loan pricing. This leads to the following hypothesis on the effect of lender distance on loan pricing:

Hypothesis 1: *Lenders are more likely to reduce loan pricing if syndicates become closer.*

Effects of Close Syndicates: Price Collusion

An alternative hypothesis is that improved information gathering by close syndicates, borrowers might be more inclined to be "locked-in" into such syndicates (see Sharpe (1990), and Rajan (1992)). If borrowers are locked-in, lenders will be more likely to extract rents. This leads to the following hypothesis:

HYPOTHESIS 2: *Lenders are more likely to increase loan pricing if syndicates become closer.*

Importantly, hypotheses 1 and 2 are not mutually exclusive. Close syndicates might be able to have lower production costs for borrower screening and monitoring, but at the same time also increase loan pricing due to hold-up of the borrower. In our empirical analysis, we first test the *net* effect of hypotheses 1 and 2, and then try to separate these two opposing effects.

Low Market Concentration: Higher Scope for Price Collusion

The theoretical literature on loan pricing in syndicates shows that lower market concentration fosters price collusion (Hatfield et al. (2017)).[5] Specifically, in markets with syndication there exists a certain level of market concentration below which the scope for price collusion *increases* with reductions in market concentration. This mechanism results from an in-period punishment of lead arrangers, in that "price collusion can be sustained by a strategy in which firms [lead arrangers] refuse to join the syndicate of any firm [lender] that deviates from the collusive price." The authors show that this punishment strategy becomes more forceful in markets with lower market concentration.[6] This leads to the following hypothesis:

HYPOTHESIS 3: *Below a certain level of market concentration, price collusion increases with reductions in market concentration.*

Taken together, our two hypotheses 2 and 3 predict that price collusion should be most pronounced during periods of low market concentration for loans originated by closer syndicates. In our empirical analysis, we first test hypothesis 3 on a stand alone basis, and then test for the joint effect of hypotheses 2 and 3.

2.3 Lender Distance Measure

In this sub-section, we develop our key explanatory variable to measure the similarity, or closeness in lending expertise of lenders within a syndicated loan, namely our lender distance measure.

2.3.1 Distance between two lenders

The key intermediate measure to compute our lender distance measure, is the distance between two lenders measure developed in Cai et al. (2018). This measure captures the

[5] Hatfield et al. (2017) motivate their theory by observations of investment banking fees for initial public offerings (IPOs), which are also syndicated.

[6] According to anecdotal evidence, lead arrangers in the syndicated loan market regularly punish banks by adding them to confidential blacklists that exclude them from syndicates.

similarity in the syndicated loan portfolios of two lenders, which we use as a measure for the similarity in lending expertise between these two lenders.

To compute the syndicated loan portfolio of an individual lender in a given month, we compute each lead arranger's total originated loan facility amount during the prior 12 months.[7] Next, we compute each lead arranger's portfolio weights in lending specialization related to borrower industry, using the 2-digit borrower SIC-industry.[8] Let $w_{s,j,t}$ be the weight (share) that lead arranger s invests in industry j during the 12 months prior to month t.[9]

Using these lending specializations, the distance between two lenders is computed as the Euclidean distance between those two lenders in the J-dimensional space as

$$distance_{s,k,t} = \frac{1}{\sqrt{2}} \sqrt{\sum_{j=1}^{J} (w_{s,j,t} - w_{k,j,t})^2} \tag{1}$$

where $\text{distance}_{s,k,t}$ is the distance in lending specialization between lender s and lender k in month t, with $s \neq k$. The distance measure ranges between zero and unity, with a smaller distance indicating a higher similarity in the two lenders' lending expertise.

2.3.2 Syndicated loan lender distance

Next, we compute our syndicated loan lender distance measure. Suppose in syndicate i are N_i pairs of lead arranger(s) and other syndicate members. The syndicated loan lender distance is the average distance of these N_i pairs of lead arranger-lender in the 12 months prior to the loan origination month t. Let $Distance_{i,t}$ denote the lender distance in syndicate i that is arranged in month t. Then

$$Distance_{i,t} = \frac{1}{N_i} \cdot \sum_{n=1}^{N_i} distance_{s^n,k^n,t} \tag{2}$$

where $distance_{s^n,k^n,t}$ denotes the distance between the n^{th} pair of lead arranger s^n and syndicate member k^n in month t, where $s^n \neq k^n$.

Note that the lender distance measure centers on the similarity in lending expertise from the viewpoint of the lead arranger(s), and thus excludes distance pairs among non-lead syndicate members. Thus, for syndicates with more than two lenders, lender distance can differ even within the same set of lenders in the same originating month. Also, note that the lender distance measure captures the similarity in lending expertise during the prior 12 months to the loan origination month t. Consequently, the same syndicate structure can exhibit varying distances over time, depending on the evolution of the similarity in lending expertise of the lenders in the syndicate.

[7] Loan amounts are split equally across all lead arrangers in the loan, if a loan has multiple leads.

[8] Also, we examine lending specialization related to borrower region (using 3-digit borrower zip code), and obtain very similar results.

[9] Industry weights across J industries for each lead arranger i sum up to unity ($\sum_{j=1}^{J} w_{s,j,t} = 1 \ \forall t$).

In Appendix Table A.2, we show a computational example of the syndicated loan lender distance.

3 Data and Summary Statistics

In this section, we first briefly describe our data. Then, we describe the classification of lender roles and provide summary statistics regarding lenders, borrowers, and syndicated loan facilities. Finally, we discuss our new loan lender distance measure.

3.1 Data

Our primary data source is a sample of syndicated loans from Thomson Reuters LPC Dealscan, which contains information on loan contract terms, borrower characteristics, lender roles, syndicate structure, and loan distribution. Dealscan contains a fairly complete coverage of syndicated loans, especially for the U.S. market. Our original data set contains 127,040 syndicated loans to 31,927 firms originated from a total of 1,299 lead arrangers during January 1988 to March 2017. To focus our analysis and make the computation of our loan lender distance measure manageable, we follow the literature and restrict our sample to larger lead arrangers so that on average lead arrangers in our sample annually originate one percent of syndicated loans in the market.[10] Our final sample contains 123,752 syndicated loans to 30,722 U.S. firms from January 1988 to March 2017 that were originated by 223 lead arrangers.

Importantly, these 223 lead arrangers also frequently obtain less senior roles in the syndicate so that 95.2% of the syndicate's co-agents and 77.2% of the syndicate's participants are covered in the sample.[11] These high coverages are consistent with lead arrangers in the syndicated loan market regularly engaging in reciprocal lending arrangements as documented by Cai (2010). That is, lead arrangers also regularly serve in less senior roles in syndicates, where their participant lenders led the syndicate. The non-covered participants in our sample are mostly foreign banks, or smaller domestic financial institutions that do not (or at most sporadically) originate syndicated loans in the U.S. market. Consequently, our sample contains a fairly high coverage of lenders across different lender roles to investigate syndicate formation.

We show in this paper that the average lender distance in a syndicated loan is much smaller than the average lender distance between two randomly selected lenders. In other words, lead arrangers actively choose lenders that have similar lending expertise as themselves. Thus, participants covered in our sample represent those that are also more likely to be selected into syndicates.

To obtain richer financial information on individual borrowing firms, we link our syndicated loan data to Compustat using matchings from Chava and Roberts (2008), Schwert

[10] For consistency of the distance measure, the selection of lead arrangers follows Cai et al. (2018).
[11] In Appendix A.3 we provide details on the classification of lender roles.

(2017), and Cai et al. (2018). Through this matching, we retrieve borrower financial data for up to 48,317 syndicated loans (39% of the sample).

3.2 Summary Statistics

Table 1 shows summary statistics. Panel A of Table 1 presents lead arranger characteristics. The sample contains 33,861 unique lead arranger-months. On average, a lead arranger has a market share of 1% during the prior 12 months, in which 65 syndicated loans with a total volume of $11.3 billion were arranged. Four out of five lead arrangers (82%) are banks (as opposed to finance companies, institutional investors, etc.) and hence are considered having expertise in screening, monitoring, and relationship lending. Consequently, most lenders in the syndicated loan market constitute competitors for a lead arranger, when deciding on syndicate formation.

Panel B of Table 1 presents borrower characteristics, which are reported based on the time of loan origination. An average borrowing firm in our sample has sales of $3.54 billion at loan closing. 38% of loans are first syndicated loans of the borrower in the syndicated loan market in our sample period, while the average number of previous syndicated loans is 4.1. Among borrowers whose firm type is known, 64% are identified as private firms, and 36% as public firms. Among the borrowers with Compustat data, the average book value of total assets is $12.3 billion, the average book leverage ratio is 37%, the average earnings to asset ratio is 6%, 56% have an S&P debt rating, and 29% have an S&P investment-grade debt rating.

Panel C of Table 1 reports loan characteristics. The average syndicated loan facility is $271 million, with a loan maturity of 50 months. About one-third (34%) of loans are classified as term loans. The average interest rate spread on drawn funds is 252 basis points over LIBOR. The most common loan purpose is working capital and corporate purposes (72%), followed by acquisitions (22%), refinancing (18%), and backup lines (5%), where a loan facility can have multiple loan purposes.

Importantly for our analysis, DealScan provides rich information on the syndicate structure and loan distribution. On average, a syndicated loan has 6.0 lenders, splitting into 1.6 lead arrangers, 1.3 co-agents, and 3.2 participants. To measure the concentration of a syndicate, we compute the Herfindahl index as the sum of squared individual loan shares of syndicate lenders.[12] We also report summary statistics of loan shares, which are computed as the average among the lender group if there is more than one in the syndicate. On average, lead arranger(s) retain 31.4% of the loan, 14.7% are held by co-agents, and 14.7% are also held by participants. Importantly for our analysis on syndicate formation, these variables on syndicate structure and loan distribution show a high degree of variation. Compared to the summary statistics on syndicate structure reported by Sufi

[12]The Herfindahl index ranges between zero and one, where one being most concentrated (a single lender holding 100% of the syndicated loan).

(2007) for the period from 1992 to 2003, on average, the total number of lenders in the syndicate has shrunk, loan shares of lead arrangers increased, and consequently syndicate concentration also increased.

Finally, Panel D of Table 1 reports summary statistics of the market concentration of the syndicated loan market. On average, the Herfindahl index of market concentration is 0.11, which indicates an "unconcentrated market" based on the definition of the U.S. Department of Justice.[13] As shown in Figure 2, the market concentration varied over time, with about a tenth of months constituting a "moderately concentrated" market (greater or equal than 0.15) and also a moderate degree of variation in the "unconcentrated market" range.

In Appendix Table A.1, we list the variable definitions.

3.3 Lender Distance Measure

For the sub-sample where we are able to compute lender distant pairs, we construct our new syndicated loan lender distance measure. As discussed above, this measure captures the similarity in lending expertise of the lead with the lenders in the syndicate, and ranges between zero and one. Figure 1 shows that lender distance declined over time, indicating that the similarity in lending expertise of lenders within a syndicate increased over time. In other words, on average lenders in syndicates became closer competitors to the lead arranger over time. To ensure that this time-trend does not affect our results, we carefully control for year fixed effects in our regressions.[14] As shown in Panel C of Table 1, on average, the lender distance of a syndicated loan is 0.29, which is less than half of any randomly selected lender pair of 0.61 (see Panel A of Table 1).[15] This finding provides indicative evidence that similarity in lending expertise might be an important factor in syndicate formation. Finally, the lender distance measure has a standard deviation of 0.14, implying that there is sufficient variation in the data for the empirical analyses.

Table 2 lists the top three lead arrangers for close, mid, and distant syndicates from 2014 to 2016 by classifying lender distance into the lowest, middle, and highest one-third of the originating month of the syndicate. The top three lead arrangers (Bank of America, JPMorgan Chase, and Wells Fargo) are identical across close, mid, and distant syndicates, even in their ranking. This provides evidence that a lead arranger regularly forms syndicates with different lender distances, indicating that lead arrangers can actively decide on the similarity in lending expertise of the lenders it chooses to include in a syndicate. Also, concentration of lead arrangers is most pronounced for close syndicates, with the top three lead arranger arranging 43% of close syndicates (compared to 32% for

[13] See https://www.justice.gov/atr/horizontal-merger-guidelines-08192010

[14] In our analysis on 'loan pricing and market concentration' (Table 9), we include three-year fixed effects as otherwise most of the variation in the market concentration measure would be absorbed by year fixed effects.

[15] Note that the computation of the distance between two lenders measure is completely identical as in Cai et al. (2018). Consequently, also summary statistics in our longer sample period are very similar.

distant syndicates, and 17% for mid syndicates).

4 Empirical Analysis

In this section, we first analyze how distance among lender pairs and syndicated loan lender distance affects syndicate formation. Next, we show how borrower and loan characteristics differ across different degrees of syndicated loan lender distance and show their syndicate formation characteristics. Finally, we test our hypotheses by investigating how syndicated loan lender distance and market concentration affects loan pricing.

4.1 Distance and Syndicate Formation

In this sub-section, we examine how lead banks structure syndicates. If lead arrangers structure a syndicate based on how close or distant competitors are who it wants to join the syndicate, the question translates into the following: How does lender distance affect the syndicate structure? As outlined in the introduction and the institutional setting, choosing close competitors can have both positive effects (e.g., improved screening) and negative effects (e.g., price collusion among lenders) to the borrower. Syndicate structure might influence the magnitude of these effects. Smaller and more concentrated syndicates increase lenders stake in the loan, which should reduces moral hazard and align incentives among lenders for better screening and monitoring. However, smaller and more concentrated syndicates might also reduce price competition among lenders, and foster price collusion. In addition, assigning lenders into more senior syndicate roles might also reinforce these effects, as it mitigates lenders moral hazard and gives lenders a larger share in the proceeds from the syndicate.

We seek to find supporting evidence consistent either with hypothesis 1 or 2. The general regression specification we test is

$$Synd_{i,t} = \alpha + \beta_1 \cdot Distance_{i,t} + \beta_2 \cdot Distance_{i,t}^2 + \gamma \cdot X_{i,t} + \varepsilon_{i,t} \tag{3}$$

where the dependent variable $Synd_{i,t}$ are different measures of syndicate structure, such as the number of lenders, the number of lead arrangers, the number of co-agents, the number of participants, and the concentration of the syndicate (Herfindahl). The key right-hand-side variables $Distance_{i,t}$ and $Distance_{i,t}^2$ measure the (squared) syndicated loan lender distance of syndicate i originated in month t. We allow ex-ante for a non-linear relationship of $Distance_{i,t}$ to capture the possibly non-linear net effect from the following two opposing forces. On the one hand, choosing lenders with higher similarity, or closeness in lending expertise into the syndicate might reduce production costs due to improved screening, or increase revenues from price collusion. On the other hand, choosing closer competitors into the syndicate might increase competition for future syndicated loans from the borrower. Either of these two forces might dominate the net effect at different levels of lender distance.

The control variables ($X_{i,t}$) are consistent to the ones used in the literature (such as in Sufi (2007)), and include various borrower characteristics, loan characteristics as well as year, industry, state, loan purpose, and interest type fixed effects. Standard errors are heteroscedasticity robust and clustered by borrower 2-digit SIC industry.

Table 3 reports the results. While we think of lead arrangers having an intention to form closer or more distant syndicates, we only observe the ex-post realized distance in loan syndicates. Consequently, our results on syndicate formation display correlations between our lender distance measure and the syndicate structure. In all regressions on the number of lenders, leads, co-agents, and participants, the estimated coefficients reveal a concave relationship of our distance measure that is significant at the 1% level. Consistent with our conjecture of the above discussed opposing forces, we find that the number of syndicate lenders (and the number of lenders across all roles) slightly reduces for very distant syndicates and strongly reduces for mid and close syndicates (see Figure 3 (a)).[16] These effects are also economically significant. For example, as reported in column (1), a syndicate with a loan lender distance being one standard deviation lower than the median is associated with on average 5 fewer lenders in the syndicate (or -83% at a mean of 6.04 lenders). Consistent with the importance of more senior roles for improved screening and price collusion, the economically strongest difference in the number of syndicate members results from fewer participants.

Analyzing the effect of lender distance on syndicate concentration (Herfindahl) shows similar results (column (5)), with lender distance having a convex effect on syndicate concentration (see Figure 3 (b)). That is, while syndicate concentration reduces for closer lender distance in very distant syndicates, syndicate concentration increases for closer lender distance in mid and close syndicates. In terms of magnitude, a syndicate with a one standard deviation lower lender distance than the median syndicate is associated with a higher concentration of the syndicate by 0.05 (or 20% at a mean Herfindahl of 0.27).

4.2 Distance and Loan Distribution

Next, we analyze how lead arrangers distribute loans to other syndicate lenders. As discussed in the institutional setting above, loan distribution consists of choosing syndicate members and allocating loan shares. That is, we address the questions of whom lead arrangers choose to let into the syndicate? And, among those chosen syndicate members, how do lead arrangers allocate loan shares?

4.2.1 Syndicate Member Choice

First, we examine lead arrangers choice of syndicate members. We seek to find supporting evidence consistent with hypotheses 1 or 2, in that lead arrangers might choose lenders

[16] Note, median (mean) lender distance is 0.26 (0.29), and the centered 80% interval ranges from 0.15 to 0.47. One standard deviation of lender distance is 0.14.

with similar lending expertise to either delegate screening and monitoring responsibilities within the syndicate, or collude on loan pricing. Utilizing the distance measure between two banks, we measure the degree of similarity in lending expertise between the lead arranger and potential syndicate members. We separately investigate lead arrangers choice of co-lead arrangers, co-agents, and participants. The general regression specification we test is

$$\begin{aligned} Member_{s,k,i,t} = \alpha_i + \beta_1 \cdot distance_{s,k,t} + \beta_2 \cdot distance^2_{s,k,t} \\ + \gamma_1 \cdot RELL_{s,k,t} + \gamma_2 \cdot RELB_{k,i} + \gamma_3 \cdot MS_{k,t} + \varepsilon_{s,k,i,t} \end{aligned} \tag{4}$$

where the dependent variable $Member_{s,k,i,t}$ are different indicator variables that equal one if lead arranger s chooses lender k in a specific role in loan syndicate i that is originated in month t. Lender roles are co-lead arranger, co-agent, and participant. Linking this analysis to our previous investigation on syndicate structure above, we exclude syndicates in which lead arrangers decided not to assign lenders into these roles.[17] Also, as lead arrangers usually start by assigning lenders to more senior roles, we exclude lenders that are chosen in more senior roles from the choice set of loan membership for less senior roles such as participants.[18]

The key independent variable is $distance_{s,k,t}$ (and $distance^2_{s,k,t}$), measuring the (squared) distance between lead arranger s and lender k in the 12 months prior to month t. Thus, $distance_{s,k,t}$ measures whether lead arrangers choose lenders with close or distant similarity in lending expertise into the syndicate. Consistent with the discussions above, we also allow for a non-linear relationship of $distance_{s,k,t}$ on syndicate member choice. We control for loan facility fixed effects, to rule out any facility-specific effects, such as borrower characteristics, lead arranger characteristics, time-specific effects, and loan characteristics. In addition, we also control for the effects of prior relationships between the lead arranger and lender as well as prior relationships between the potential syndicate member and the borrower. Specifically, $RELL_{s,k,t}$ is an indicator variable for whether lead arranger s syndicated a loan with lender k prior to month t (no matter what roles the two lenders took). $RELB_{k,i}$ is an indicator variable for whether lender k syndicated a loan to the syndicate's borrower prior the originating month of syndicate i (no matter what role it took). In addition, we include the market share of lender k in the 12 months prior to month t ($MS_{k,t}$) to proxy for lender k's reputation, market size, lending capacity, or power in the syndicated loan market. Standard errors are heteroscedasticity robust and clustered by lead arranger.

Table 4 reports the results. In all regressions, the estimated coefficients on the distance measure show a convex relationship that is significant at the 1%-level. Consistent with our hypotheses on improved screening and price collusion of close syndicates, the propensity

[17] E.g., syndicates without a co-lead arranger are excluded in the regression for co-lead arranger choice

[18] Our results are very similar without restricted choice sets.

to be chosen as syndicate member increases for closer (compared to mid) syndication. At the same time, the likelihood of being selected as syndicate member increases for distant (compared to mid) syndicates, consistent to our conjecture of lead arrangers avoiding future competition for the same borrower. However, there is an important difference between these convex relationships across different lender roles. For the selection of co-leads (column (1)), lead arrangers are much more likely to choose more distant (compared to mid) competitors, and to some degree also very close competitors (see Figure 4 (a)).[19] Lenders with a one standard deviation higher distance between the lead arranger and the lender compared to the median are associated with a higher likelihood of being chosen as co-lead by 3.0%-points. In comparison, lenders at the 25th-percentile (compared to the 10th-percentile) of distance between the lead arranger and the lender have a higher likelihood of being chosen by 1.0%-point. The results on the selection of co-agents are very similar (column (2)). These findings on the selection of co-leads and co-agents are consistent with the trade-off between the benefits of lower production costs and price collusion of selecting close lenders, and the benefit of reduced future competition when selecting distant lenders.

In contrast to the results for co-leads and co-agents, lead arrangers predominantly prefer to choose participant lenders with more similar lending expertise (see column (3) and Figure 4 (b)). Consequently, lead arrangers select participant lenders that reinforce improved screening and price collusion. The estimated control variables provide consistent results.

4.2.2 Allocation of Loan Shares

Next, we investigate how the lead arranger allocates loan shares among the lenders in the syndicate. Again, we aim to investigate whether lead arrangers allocate higher loan shares to closer syndicates to align incentives for improved screening or price collusion (hypothesis 1 or 2), or allocate higher loan shares in more distant syndicates to reduce future competition. Specifically, we analyze how the allocation of loan shares to lenders with different roles (lead, co-agent, and participant) varies across syndicates. As multiple lenders with the same role in a syndicate cannot be considered as independent observations, we compute the average loan share for each role across possibly multiple lenders of that role to avoid understating standard errors.[20] To investigate the allocation of loan shares across syndicates, we estimate regression specification (3) as discussed above, except for using loan share as dependent variable.

Table 5 reports the regression results. In all regressions, the estimated coefficients reveal a convex relationship of our lender distance measure and all coefficient estimates

[19] Note, median (mean) distance between two lenders is 0.63 (0.61), and the centered 80% interval ranges from 0.29 to 0.88. One standard deviation of distance between two lenders is 0.23.

[20] All results continue to hold once we take each individual lenders' loan share as observations for the regressions.

are significant at the 1%-level. Consistent to our findings from syndicate member choice, we find that lead arrangers prefer to allocate higher loan shares in both close syndicates and distant syndicates (compared to mid syndicates). For close and mid syndicates, for example, a smaller lender distance is associated with higher loan shares across all loan roles (see Figure 5). This effect is most pronounced for lead arrangers (and co-agents) compared to participants. For example, on average the loan share for lead arrangers of syndicates with a lender distance being one standard deviation smaller than the median syndicate lender distance have a 5.4%-points (or 17% at a mean of 31.4%-points) higher loan share. In contrast, the lower sensitivity of the loan share of participants to variations in syndicate lender distance is consistent to a higher average number of participants in loan syndicates. Overall, these findings are consistent to our results on syndicate structure from Table 3 above and show that lead arrangers form more concentrated syndicates by allocating higher loan shares for both close and distant (compared to mid) syndicates.

Analyzing the allocation of loan shares among lenders of the same role within the syndicate also provides consistent results. As shown in Appendix Table A.4, lead arrangers allocate higher loan shares to lenders across all loan roles once the distance between the lead arranger and the lender reduces. These effects are all statistically significant, and the economic magnitude is most pronounced for participant lenders. Consequently, lead arrangers also discriminate in the allocation of loans shares among lenders within a syndicate.

When investigating the retained loan share by lead arrangers across loans with different degrees of information asymmetries, we find additional evidence consistent with improved screening and monitoring abilities of close syndicates (hypothesis 1). The literature on information asymmetries in syndicated loans has shown that if informational asymmetries are severe, lead arrangers retain a higher loan shares (e.g., Sufi (2007)). However, if screening and monitoring expertise is indeed higher in close syndicates, lead arrangers might not have to signal credit quality, or mitigate moral hazard by retaining larger loan shares for those loans with higher informational asymmetries. Consistent with this conjecture, we show that lead arrangers do not retain higher loan shares in syndicates with high information asymmetries of borrowers once the syndicate distance is close (see Appendix Table A.5). In comparison, for syndicates with mid and distant lender distance, lead arrangers retain higher loan shares. Also, analyses for the concentration of syndicates (Herfindahl) show consistent results.

4.3 Close versus Mid versus Distant Syndicates

The above tests provide important insights into how lead arrangers structure loan syndicates, choose syndicate partners, and allocate loan shares. The question of who benefits from these different types of syndicate formation remains to be answered. To address this question, and summarize our results on how syndicate formation differs across syndicated

loan lender distance, we analyze how syndicates differ across lender distance.

We use the syndicated loan lender distance (as defined in equation (2)) to group our sample of syndicated loans into terciles, i.e. close, mid, and distant syndicates.[21] The sub-sample of close syndicates consist of syndicates, in which lender distance is below the lowest one-third lender distance in the originating month. The sub-sample of mid syndicates are syndicates with lender distance above the lowest one-third and below the lower two-thirds of lender distance in the originating month, whereas distant syndicates consist of the reaming syndicates, i.e. those with lender distance above the lowest two-thirds in the originating month. We then look into differences in borrower characteristics, loan characteristics, syndicate structure, and loan distribution across close, mid, and distant syndicates.

Table 6 reports the mean values for these three sub-samples (columns (1) to (3)). Also, in columns (4) to (5) the table reports the mean differences between close and mid syndicates (μ_{Close} - μ_{Mid}), as well as distant and mid syndicates ($\mu_{Distant}$ – μ_{Mid}), which are all statistically significant. We find that on average borrowers in mid syndicates are most likely to be public firms, more likely to be rated (and more likely to be investment-grade rated), have borrowed previously most often from the syndicated loan market (and are least likely to be first time borrowers in the syndicated loan market), and show higher sales at closing. In addition, mid syndicates have on average larger loan sizes, tend to have longer maturities, have fewer term loans, and lower interest spreads on drawn funds over LIBOR. In terms of syndicate formation, mid syndicates have on average the largest number of lenders (also, across all lender roles), lenders hold smaller loan shares (also across all lender roles), and syndicates are consequently least concentrated. In other words, mid syndicates seem to have safer borrowers and safer loans, which is reflected in less concentrated syndicates (compared to close, and distant syndicates). These results are consistent to previous findings that loans with intermediate lender distance form larger and less concentrated syndicates, also because of lower information asymmetries. In contrast, distant syndicates lend on average to riskier borrowers, lend smaller loan amounts, and charge higher interest spreads on drawn funds over LIBOR. Syndicates consist on average of fewer lenders, lenders retain higher loan shares, and loans are more concentrated.

Close syndicates lend on average to somewhat riskier borrowers than mid syndicates (but much safer than distant syndicates), and lend smaller loan amounts with somewhat shorter maturities. Consistent with slightly riskier borrowers, but safer loans than mid syndicates, interest spreads on drawn funds over LIBOR are a bit higher than for mid syndicates. However, syndicate formation differs considerably. Close syndicates consist of on average only five lenders (compared to 9 lenders for mid syndicates), with fewer lenders across all lender roles (leads, co-agents, and participants). Consequently, loan shares are higher across all lender roles, with a lead arranger retaining on average about one-third

[21] We choose three groups to reflect the non-linearity of our results above.

of the loan (compared to about one-fifth for mid syndicates). Correspondingly, syndicate concentration is highest.

These findings resemble our previous results that lead arrangers form small and concentrated syndicates consisting of lenders with higher similarity in their lending expertise that might enable those lenders to perform improved screening and monitoring (Hypothesis 1), and/or collude on loan pricing (Hypothesis 2). At this stage, it remains unclear who benefits from these close syndicates.

In the following sub-sections, we address this question and investigate the effects of syndicated loan lender distance and market concentration on loan pricing.

4.4 Distance and Loan Pricing

As discussed in the theoretical framework, there are potentially two opposing effects on loan pricing from close syndicates with high similarity in lenders lending expertise. On the one hand, borrowers might benefit from improved screening and monitoring, because lead arrangers can pass on some of these savings to borrowers (Hypothesis 1). On the other hand, borrowers might be "locked-in" into close syndicates so that lenders would be more likely to extract rents (Hypothesis 2). We first examine the *net* effect of these two opposing forces by estimating the following regression model

$$Spread_{i,t} = \alpha + \beta_1 \cdot Distance_{i,t} + \beta_2 \cdot Distance_{i,t}^2 + \gamma \cdot X_{i,t} + \varepsilon_{i,t} \tag{5}$$

where the dependent variable $Spread_{i,t}$ is the interest spread over LIBOR on drawn funds of syndicate i originated in month t. The key right-hand-side variables $Distance_{i,t}$ (and $Distance_{i,t}^2$) measure the (squared) syndicated loan lender distance of lenders in syndicate i in the 12 months prior to month t. We allow ex-ante for a non-linear relationship of $Distance_{i,t}$ on loan pricing, because (i) the stand alone effects of closer lender distance might neither linearly reduce loan pricing due to lower production costs of borrower-specific information, nor linearly increase loan pricing due to borrower "hold-up"; and (ii) the net effect might be dominated by either of the two opposing effects across different levels of lender distance. We separately test for whether the *net* effect of lender distance on loan pricing is linearly, or non-linearly. If lender distance reduces loan pricing for closer syndicates, the improved screening and monitoring effect dominates (Hypothesis 1). If lender distance increases loan pricing for closer syndicates, the price collusion effect dominates (Hypothesis 2). In addition, besides analyzing the effect of lender distance on loan pricing across the entire sample period, we also investigate the time-variation of this effect. Specifically, we test whether the effect of lender distance on loan pricing changed after the Global financial crisis (since 2010). The control variables, fixed effects, and standard errors specification is identical to Table 3.

Table 7 reports the regression results. Columns (1) and (2) report results for the entire sample period, and show that a reduction in lender distance monotonically reduces loan

pricing (see Figure 6 (a)). In the linear specification, loan lender distance is statistically significant at the 1%-level, while at the non-linear specification only the squared lender distance is statistically significant. In terms of magnitude, a reduction of lender distance by one standard deviation from the median reduces loan pricing by 5bps (or 2.0% at a mean of 252bps) in the linear specification and by 1.5bps (or 0.6%) in the non-linear specification. Consequently, these results provide mixed evidence on the *net* effect of close syndicates on loan pricing. While significant economic reductions in the linear specification is consistent with improved screening and monitoring (Hypothesis 1), the marginal economic effect in the non-linear specification might indicate collusive loan pricing (Hypothesis 2).

The results on the time-variation of lender distance on loan pricing are reported in columns (3) to (6). Lender distance has a positive and linear effect on loan pricing from 1989 to 2009, while the effect is convex from 2010 to 2017 (see Figure 6 (b)). These coefficient estimates are all statistically significant at the 1%-level. In terms of magnitude, a reduction of lender distance by one standard deviation from the median reduces loan pricing by 5bps (or 2.0% at a mean of 252bps) until 2009, while *increases* loan pricing by 10bps (or 4%) since 2010. This implies that the effect of close syndicates on loan pricing significantly changed after the Global financial crisis. Consequently, in close syndicates the *net* effect of lender distance on loan pricing is dominated by improved screening and monitoring (Hypothesis 1) until 2009, while it is dominated by collusive pricing (Hypothesis 2) since 2010. At this stage it remains unclear, why loan pricing increased for close syndicates since 2010. To answer this question, we next disentangle the two opposing effects of improved screening/monitoring and price collusion.

4.5 Improved Screening versus Price Collusion

To disentangle the opposing effects of improved screening/monitoring and price collusion, we utilize the cross-sectional variation in the degree of informational asymmetries of the borrower. That is, we split borrowers into "opaque" and "non-opaque" firms, with loans to opaque borrowers having a higher degree of information asymmetry. If price collusion is identical across opaque and non-opaque borrowers, the difference between loan pricing for opaque and non-opaque borrowers quantifies a lower bound for the stand alone effect of improved screening/monitoring.[22] Consequently, the stand alone effect of price collusion is bounded above by the overall *net* pricing effect minus the upper bound of the improved screening/monitoring effect. Also, the stand alone effect of price collusion is bounded below by zero.

We disentangle the stand alone effects of improved screening/monitoring and price collusion separately for each of the two sub-periods discussed above. This approach also

[22]The difference captures a lower bound, as lenders in closer syndicates might also mitigate some degree of information asymmetry in loans to non-opaque borrowers. Also, if lenders collude more in loan pricing to opaque borrowers than to non-opaque borrowers (e.g., because the hold-up problem of non-opaque borrowers is more severe), our findings would continue to represent a lower bound.

allows us to investigate the change magnitude of the stand alone effects over time, thus providing insights why loan pricing increased for close syndicates since 2010. We estimate the following regression model

$$\begin{aligned} Spread_{i,t} = \alpha &+ \beta_1 \cdot Distance_{i,t} + \beta_2 \cdot Distance_{i,t}^2 \\ &+ \beta_3 \cdot Distance_{i,t} \cdot Opaque_i + \beta_4 \cdot Distance_{i,t}^2 \cdot Opaque_i \\ &+ \gamma \cdot X_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{6}$$

where the variables $Spread_{i,t}$ and (squared) $Distance_{i,t}$ are defined as in the regression model (5). For the same reasons as discussed above, we again allow ex-ante for a possible non-linear relationship of $Distance_{i,t}$ on loan pricing. $Opaque_i$ is an indicator variable for whether syndicated loan i is taken by an opaque borrower, with "opaque" borrowers being defined as unrated firms, or small firms.[23] The key right-hand-side variables are the interaction terms of $Distance_{i,t}$ (and $Distance_{i,t}^2$) with $Opaque_i$. That is, whether the effect of lender distance on loan pricing differs for opaque (compared to non-opaque) borrowers. The control variables, fixed effects, and standard error specifications are identical to regression model (5) above, besides that we include a base line effect for opaque borrower (instead of unrated borrower).

Table 8 presents the estimates. Consistent with Table 7, the coefficient estimates reveal a linear relationship between lender distance and loan pricing until 2009 (see columns (1) and (2) and Figure 7 (a)). However, the effect is only statistically significant for loans with high informational asymmetries. In terms of magnitude, a reduction of lender distance by one standard deviation reduces loan pricing for opaque borrowers (compared to non-opaque borrowers) by 5bps (or 2% at a mean of 252bps). This is our estimated effect for the lower bound of the improved screening and monitoring effect of close syndicates until 2009. Given our estimates of the *net* effect of close syndicates of 5bps from Table 7, our estimate for the price collusion effect until 2009 is zero. In sum, we find evidence consistent with improved screening and monitoring of close syndicates until 2009 (Hypothesis 1), but no evidence on price collusion (Hypothesis 2).

Columns (3) and (4) report the estimates for the sub-period from 2010 to 2017. Consistent with Table 7, the coefficient estimates reveal a non-linear relationship between lender distance and loan pricing since 2010. In terms of statistical significance, the stand-alone effect of (squared) lender distance and the interaction terms of (squared) lender distance with opaque borrowers are all statistically significant at least at the 5%-level. Despite statistical significance, loan pricing remains unchanged for close syndicates once lender distance reduces (see Figure 7 (b)). However, for non-opaque borrowers smaller lender distance *increases* loan pricing for close syndicates (see Figure 7 (b)). In terms of mag-

[23] Small firms are defined as the smallest one-third of borrowing firms in the sample by sales at closing at the time of loan origination. Our results continue to hold if we define "opaque" borrowers solely by unrated borrowers.

nitude, in loans to non-opaque borrowers a reduction in lender distance by one standard deviation from the median increases loan pricing by 18bps (or7% at a mean of 252bps). This negative *net* effect of loan pricing for loans to non-opaque borrowers is consistent with price collusion in close syndicates (Hypothesis 2). We thus quantify the lower bound for the improved screening and monitoring effect of close syndicates since 2010 as 18bps. Consequently, we find evidence for both improved screening and monitoring (Hypothesis 1) as well as price collusion (Hypothesis 2) in close syndicates since 2010. While the magnitude of the improved screening and monitoring effect increased over time, the opposing price collusion effect increased in higher magnitude dominating the *net* effect of loan pricing since 2010. The question of why lenders in syndicates started to collude on loan pricing remains to be answered.

4.6 Market Concentration and Loan Pricing

A possible explanation for the occurrence of price collusion since 2010 as show above might be low market concentration. As stated in hypothesis 3, below a certain level of market concentration, price collusion might increase with further reductions in market concentration. While market concentration declined since the early 2000s, only since 2010 did the syndicated loan market reach low levels of market concentration (see Figure 2). Next, we first test hypothesis 3 on a stand alone basis, and then test for the joint effect of hypothesis 2 (price collusion in close syndicates) and 3.

To investigate the effect of market concentration on loan pricing, we add a linear and squared term of market concentration as additional explanatory variables to our regression model (5) above. Consistent with our theoretical hypothesis 3, we also allow for a non-linear relationship of market concentration on loan pricing to be able to capture increases in loan pricing for reductions of market concentration below a certain level. We measure market concentration in the syndicated loan market by the Herfindahl index in the 12 months prior to the syndicate origination month. The remaining control variables, fixed effects, and standard error specifications remain identical to regression model (5) above, besides that we replace year fixed effects by three-year fixed effects to allow for an identification of the market concentration effect.

To investigate the joint effect of close lender distance and market concentration on loan pricing, we interact our (squared) lender distance measure with indicator variables

for different levels of market concentration. We estimate the following regression model

$$\begin{aligned} Spread_{i,t} = \alpha &+ \beta_1 \cdot Distance_{i,t} + \beta_2 \cdot Distance_{i,t}^2 \\ &+ \beta_3 \cdot Distance_{i,t} \cdot MarketConcLow \\ &+ \beta_4 \cdot Distance_{i,t}^2 \cdot MarketConcLow \\ &+ \beta_5 \cdot Distance_{i,t} \cdot MarketConcHigh \\ &+ \beta_6 \cdot Distance_{i,t}^2 \cdot MarketConcHigh \\ &+ \gamma \cdot X_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{7}$$

where the variables $Spread_{i,t}$ and (squared) $Distance_{i,t}$ are defined as above. $MarketConcLow_t$ and $MarketConcHigh_t$ are indicator variables for whether the market concentration in the 12 months prior to month t is low, or high, respectively (with intermediate market concentration is the omitted group). Specifically, we split market concentration into terciles, with low market concentration being the lowest one-third of observations in our sample period and high market concentration as the highest one-third (and intermediate market concentration the remaining one-third). Splitting market concentration across terciles again might allow us to capture a non-monotonic effect of market concentration on loan pricing as predicted in hypothesis 3. The key independent variables are the interaction terms of $Distance_{i,t}$ (and $Distance_{i,t}^2$) with $MarketConcLow_t$ and $MarketConcHigh_t$. The remaining control variables, fixed effects, and standard error specifications are identical to the specification for the stand alone effect of market concentration, besides that we additionally include indicator variables for low and high market concentration.

Column (2) in Table 9 reports the regression results for the stand alone effect of market concentration. We find a statistically significant and convex relationship of market concentration on loan pricing. Consistent with hypothesis 3, reductions in market concentration first reduce loan pricing, but below a certain level loan pricing increases with further reductions in market concentration (see Figure 8 (a)). In terms of magnitude, a reduction of lender distance by one standard deviation from the median *increases* loan pricing by 2bps (or 1% at a mean of 252bps). While small in economic magnitude, this effect might be more pronounced for close syndicates.

Column (3) reports coefficient estimates for the joint test of hypothesis 2 and 3. We find that the interaction terms of (squared) lender distance with low and high market concentration are statistically significant at least at the 5%-level (with intermediate market concentration being the omitted group). Consistent with standard industrial organization intuition that lower market concentration increases competition, a reduction in market concentration from high to intermediate levels reduces loan pricing across all levels of lender distance (see Figure 8 (b)). Consistent with collusive pricing in markets with syndication during periods of low market concentration (hypothesis 3), however, once market concentration declines from intermediate to low levels, loan pricing does not continue to

reduce across all levels of lender distance. Specifically, while loan pricing further reduces (or remains unchanged) for mid and distant syndicates, consistent with our hypothesis on price collusion in closer syndicates (hypothesis 2) loan pricing *increases* for close syndicates (see Figure 8 (c)). In terms of magnitude, a reduction of market concentration from intermediate to low *increases* loan pricing for close syndicates by 8bps (or 3% at a mean of 252bps) at the 25th-percentile of lender distance, and 13bps (or 5%) at the 10th-percentile, respectively. This finding is consistent with the joint effect of hypothesis 2 and 3, namely that during periods of low market concentration only close syndicates engage in collusive loan pricing. This result implies that the *net* pricing effect of close syndicates is dominated by improved screening and monitoring during periods of high and intermediate market concentration, while it is dominated by price collusion during periods of low market concentration.

4.7 Robustness

One concern might be that our results on the time-variation of loan pricing are affected by low levels of market concentration since 2010. To rule out this concern, we re-estimate our results on the time-variation of loan pricing restricting the first sub-period to an (equivalently long) period of low market concentration, namely 1989-1996:q1. As reported in Appendix Table A.6, this robustness check confirms our previous results. That is, consistent to hypothesis 1, closer lender distance linearly reduces loan pricing prior to 2010. Our findings thus indicate that despite low levels of market concentration, lenders in close syndicates did not collude on loan pricing prior to 2010. Consequently, these findings also imply that price collusion in the syndicate loan market since 2010 might be an active choice of lenders.

5 Conclusion

In this paper, we investigate the formation of loan syndicates and their effects on loan pricing. Consistent with our hypotheses of smaller and more concentrated syndicates magnifying close syndicates' improved screening/monitoring and price collusion abilities, we find that lead arrangers form close and concentrated syndicates by choosing lenders with similar lending expertise and allocating these lenders higher loan shares. Analyzing the effects of close syndicates on loan pricing, we find evidence of both improved screening/monitoring abilities and price collusion. However, while close syndicates resulted in improved screening/monitoring throughout the entire sample period, close syndicates only engaged in price collusion since 2010. Analyzing the effects of market concentration on loan pricing shows that below a certain level of market concentration, price collusion increases with reductions in market concentration. Investigating the joint effect of close syndicated and market concentration shows that close syndicates engage in price collusion

only during periods of low market concentration. Overall, our findings imply that both the organizational form of loan syndicates and the level of market concentration affects price collusion.

Our empirical findings have two important implications. First, to our knowledge we are the first to provide evidence of price collusion in markets with syndication beyond the well-documented price collusion in IPO markets. We are also the first to show that both the organizational form of loan syndicates and the level of market concentration affects price collusion. Thereby, we provide empirical evidence consistent with the theory of price collusion in syndicate markets from Hatfield et al. (2017), which contradicts standard industrial organization intuitions.

Second, our work also highlights an important channel of how banks become interconnected in the financial system. As discussed above, borrowing volumes from syndicated loans are larger than from public debt and equity issuance combined, so that banks interconnectedness through syndicated loans is relevant. Banks increase their portfolio overlap with close competitors by forming close and concentrated loan syndicates. As shown in Cai et al. (2018), higher interconnectedness of banks through similarity in their syndicated lending elevates systemic risk during recession periods. We document a new channel of how banks become interconnected, namely through the formation of close and concentrated loan syndicates.

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Figure 1: Mean Syndicated Loan Lender Distance Across Time

This figure shows the annual mean lender distance of syndicated loans from 1989 to 2016. Lender distance of the syndicated loan is the average distance between the lead arranger(s) and all the other syndicate members in the previous 12 months based on lender specialization by borrower 2-digit SIC industry.

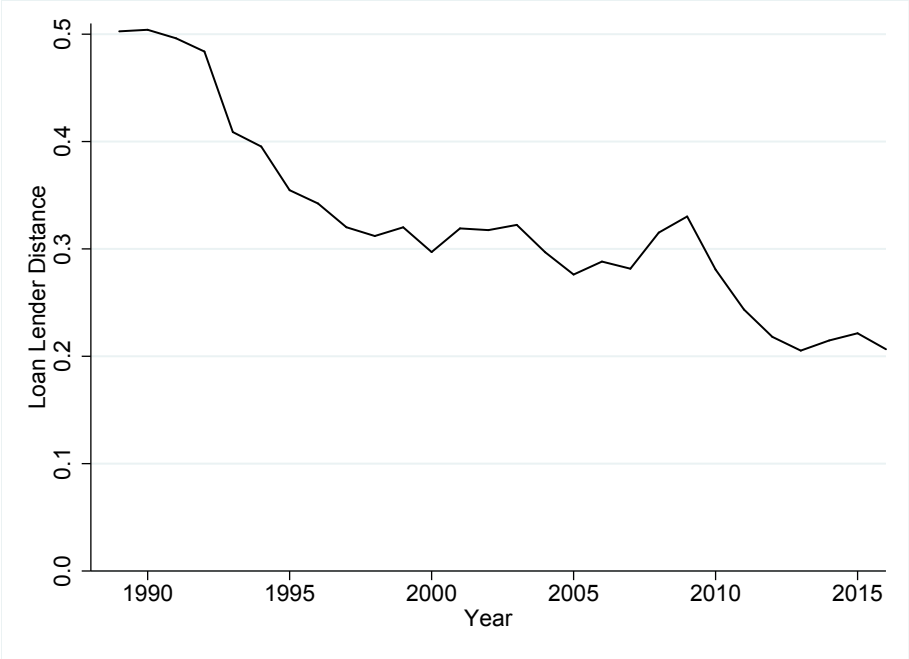


Figure 2: Market Concentration of the U.S. Syndicated Loan Market Across Time

This figure shows the market concentration of the U.S. syndicated loan market from 1989 to 2016. Market concentration is the Herfindahl index based on the market share of each bank based on the originated loan amount as lead arranger during the year.

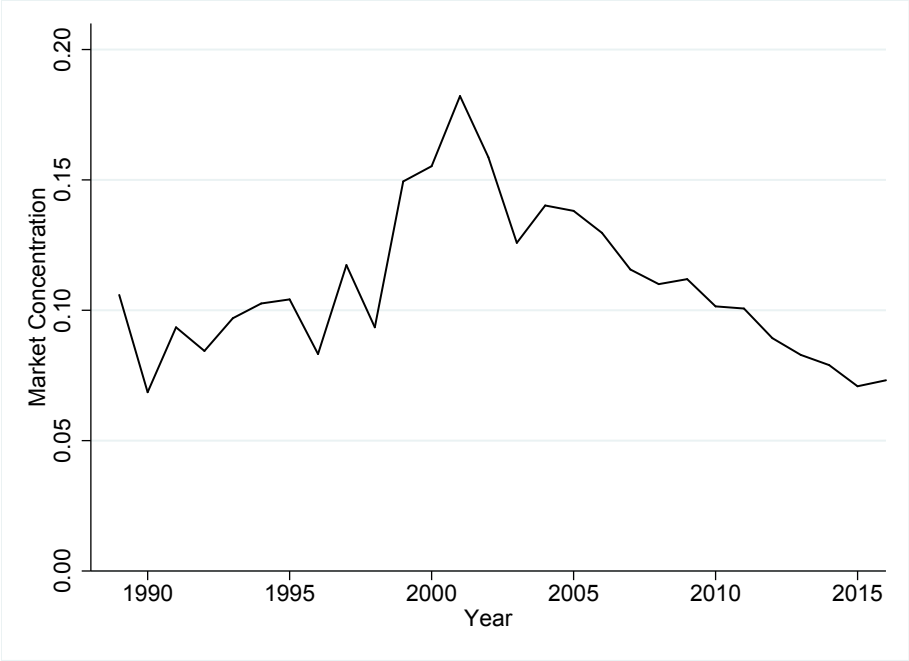


Table 1: Summary Statistics for Syndicated Loan Facilities

This table presents summary statistics for the sample of syndicated loan facilities made to U.S. firms between January 1989 and March 2017. Panel A reports lead arranger characteristics based on 33,861 unique lead arranger-months. Panels B and C report borrower and loan characteristics, respectively, based on 123,752 loan facilities. Panel D reports market characteristics based on 339 months.

(a) Lead Arranger Characteristics
(Based on 33,861 lead arranger-months, and 3,346,592 lender pair-months)

	N	Mean	SD	10th	50th	90th
Market share (%), previous 12 months	33,861	1.00	3.14	0.00	0.08	1.97
# of loans as lead arranger	33,861	65.05	174.91	1	10	155
$ of loans as lead arranger ($mm)	33,861	11,288	40,244	43	703	21,792
Bank indicator	33,861	0.82	0.39	0	1	1
All lender pairs:						
Distance between two lenders	3,346,592	0.61	0.23	0.29	0.63	0.88

(b) Borrower Characteristics
(Based on 123,752 loan facilities)

	N	Mean	SD	10th	50th	90th
All borrowers:						
Sales at closing ($mm)	69,357	3,541	18,683	59	500	6,881
# of previous syndicated loans	123,752	4.13	6.35	0	2	12
First borrower loan indicator	123,752	0.38	0.49	0	0	1
Private borrower indicator	106,976	0.64	0.48	0	1	1
Public borrower indicator	106,976	0.36	0.48	0	0	1
Borrowers with *Compustat* data:						
Total book assets ($mm)	46,533	12,317	71,769	107	1,158	17,643
Book leverage ratio	46,297	0.37	0.27	0.05	0.34	0.68
Earnings to asset ratio	44,022	0.06	0.24	-0.01	0.07	0.16
Debt rating indicator	48,317	0.56	0.50	0	1	1
Investment-grade rating ind.	48,317	0.29	0.45	0	0	1

Summary Statistics for Syndicated Loan Facilities
(continued)

(c) Loan Characteristics
(Based on 123,752 loan facilities)

	N	Mean	SD	10th	50th	90th
Syndicated loan characteristics:						
Facility amount ($mm)	123,752	271	683	14	95	600
Maturity (months)	112,647	50	25	12	60	80
Spread on drawn funds (bps)	104,950	252	164	63	225	450
Term loan indicator	123,752	0.34	0.47	0	0	1
Purpose of loan indicators:						
Working capital/corporate	123,752	0.72	0.45	0	1	1
Refinancing	123,752	0.18	0.38	0	0	1
Acquisitions	123,752	0.22	0.42	0	0	1
Backup lines	123,752	0.05	0.22	0	0	0
Syndicate structure:						
Total number of lenders	123,752	6.04	6.83	1	4	13
Total number of lead arrangers	123,752	1.55	1.24	1	1	3
Total number of co-agents	123,752	1.30	2.56	0	0	4
Total number of participants	123,752	3.16	5.42	0	1	8
Concentration of syndicate (Herfindahl)	23,194	0.27	0.24	0.06	0.19	0.55
Loan distribution:						
% kept by lead arranger	23,633	31.37	23.94	8.10	24.00	64.00
% held by co-agents	11,679	14.68	10.77	5.18	11.55	28.45
% held by participants	20,847	14.70	13.39	3.23	10.00	33.33
Syndicated loan lender distance:						
Lender distance	100,015	0.29	0.14	0.15	0.26	0.47

(d) Market Characteristics
(Based on 339 months)

	N	Mean	SD	10th	50th	90th
Market concentration	339	0.11	0.03	0.08	0.10	0.15

Table 2: Top Lead Arrangers, by Loan Lender Distance

This table shows the top five lead arranger (by number of arranged loans) for close, mid, and distant syndicates in the sample from 2014 to 2016. The sub-sample of close, mid, and distant syndicates consist of syndicates, in which the lender distance is in the lowest, middle, and highest one-third of the originating month, respectively. Lender distance at the syndicated loan facility level is defined as the average distance between the lead arranger(s) and all other syndicate members in the previous 12 months based on lender specialization in borrower 2-digit SIC industry.

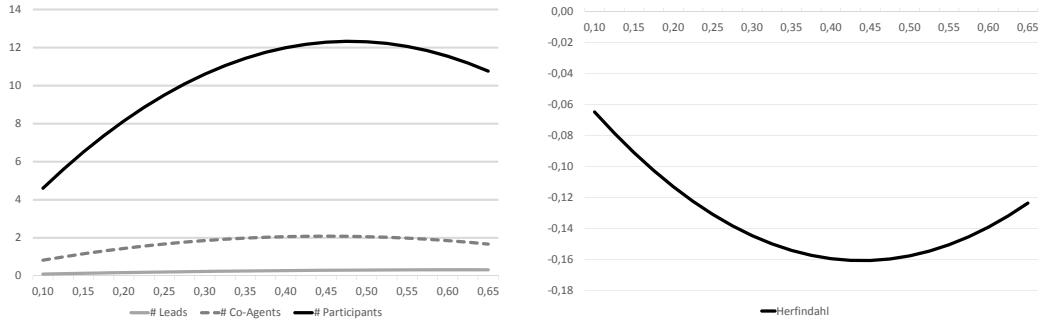
(1) Close Syndicates		(2) Mid Syndicates		(3) Distant Syndicates	
Lead arrangers					
	# loans		# loans		# loans
Bank of America	2,054	Bank of America	827	Bank of America	1,912
JPMorgan Chase	1,794	JPMorgan Chase	667	JPMorgan Chase	1,682
Wells Fargo	1,544	Wells Fargo	490	Wells Fargo	1,327
Citigroup	823	KeyCorporation	476	Citigroup	835
Deutsche Bank	659	Bank of Montreal	389	Barclays	620
Total number of lead arrangers	12,583	Total number of lead arrangers	11,720	Total number of lead arrangers	15,563

Table 3: Syndicate Structure

This table reports coefficient estimates from regressions relating syndicate structure to lender distance of the syndicated loan. The dependent variables are the number of lenders, leads, co-agents, and participants in a syndicated loan, and the concentration of the loan syndicate (Herfindahl). Concentration of the loan syndicate is computed as the sum of the squared loan share of each individual syndicate member, and can range between zero and one, with larger values indicating a higher concentration. Lender distance of the syndicated loan is the average distance between the lead arranger(s) and all the other syndicate members in the previous 12 months based on lender specialization by borrower 2-digit SIC industry. All regressions include year, loan purpose, interest rate type, borrower 2-digit SIC industry, and borrower state fixed effects. Robust standard errors allowing for clustering by borrower 2-digit SIC industry are in parentheses. * indicates that the estimated coefficient is significantly different from zero at the 10% level, ** at the 5% level, and *** at the 1% level.

	(1) # Lenders	(2) # Leads	(3) # Co-Agents	(4) # Participants	(5) Herfindahl
Lender distance	61.902***	1.024**	9.288***	51.455***	-0.732***
	(3.932)	(0.406)	(0.967)	(3.073)	(0.065)
Lender distance^2	-64.948***	-0.813**	-10.330***	-53.687***	0.834***
	(4.404)	(0.405)	(1.052)	(3.418)	(0.075)
Private borrower indicator	0.020	0.069***	-0.163***	0.115	-0.006
	(0.128)	(0.022)	(0.051)	(0.118)	(0.004)
Unrated borrower indicator	-0.324*	-0.123***	0.043	-0.248	0.020***
	(0.189)	(0.025)	(0.065)	(0.162)	(0.005)
Investment-grade borrower ind.	0.567*	-0.093**	0.239**	0.423*	-0.002
	(0.301)	(0.046)	(0.118)	(0.215)	(0.005)
First borrower loan indicator	-0.653***	0.088***	-0.040	-0.703***	0.024***
	(0.133)	(0.011)	(0.043)	(0.139)	(0.005)
Ln[borrower's sales at closing]	1.011***	0.111***	0.246***	0.649***	-0.011***
	(0.083)	(0.016)	(0.037)	(0.065)	(0.002)
Ln[loan facility amount]	2.387***	0.094***	0.831***	1.460***	-0.056***
	(0.113)	(0.014)	(0.042)	(0.080)	(0.003)
Ln[loan maturity in days]	1.019***	0.078***	0.286***	0.655***	-0.028***
	(0.114)	(0.024)	(0.045)	(0.097)	(0.003)
Term loan indicator	0.906***	0.101***	-0.041	0.839***	0.016***
	(0.172)	(0.025)	(0.061)	(0.124)	(0.006)
N =	33,709	33,709	33,709	33,709	12,113
Adjusted R^2	0.3555	0.4352	0.2429	0.2438	0.4151

Figure 3: Visualization of Coefficient Estimates from Table 3



(a) Lender distance and # Leads, Co-Agents and Participants

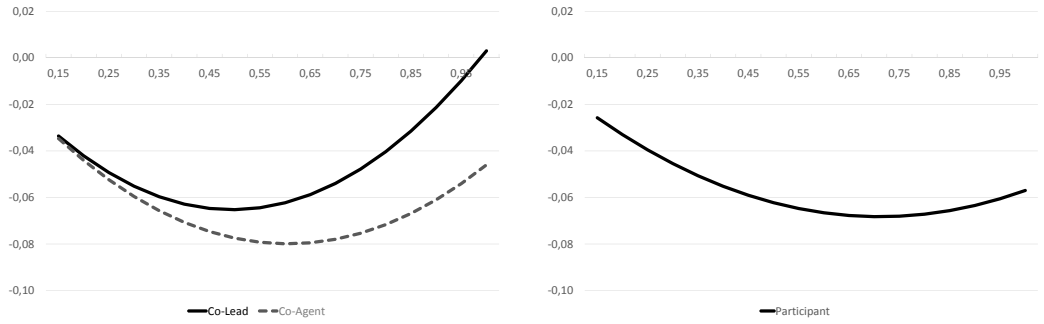
(b) Lender distance and Herfindahl

Table 4: Loan Distribution: Choice of Syndicate Members

This table reports coefficient estimates from regressions relating the likelihood of a potential lender being chosen as a syndicate member by the lead arranger to the distance between the potential lender and the lead arranger. Lenders can be chosen into different loan roles, namely co-leads, co-agents, or participants. The dependent variable is an indicator variable for whether the potential lender is chosen as a member into these syndicate roles (0 if no and 1 if yes). Chosen co-leads (and co-agents) are excluded from the choice set in subsequent regressions for less senior syndicate membership roles. The independent variable of interest is the distance between the syndicates lead arranger(s) and the potential lender in the previous 12 months based on lender specializations in borrower 2-digit SIC industry. All regressions include loan facility fixed effects. Robust standard errors allowing for clustering by lead arranger are in parentheses. * indicates that the estimated coefficient is significantly different from zero at the 10% level, ** at the 5% level, and *** at the 1% level.

	(1) Syndicate Co-Lead Indicator	(2) Syndicate Co-Agent Indicator	(3) Syndicate Participant Indicator
Distance from lead arranger	-0.264***	-0.264***	-0.192***
	(0.025)	(0.018)	(0.012)
Distance from lead arranger^2	0.267***	0.218***	0.135***
	(0.022)	(0.020)	(0.012)
Previous relationships with lead	-0.001	0.004***	0.014***
	(0.001)	(0.000)	(0.001)
Previous relationships with borrower	0.125***	0.169***	0.246***
	(0.010)	(0.004)	(0.007)
Market share (%), previous 12 months	0.014***	0.005***	0.001***
	(0.001)	(0.001)	(0.000)
Loan facility fixed effects	Yes	Yes	Yes
N =	9,838,197	8,168,392	12,388,715
Adjusted R^2	0.1882	0.1328	0.1612

Figure 4: Visualization of Coefficient Estimates from Table 4



(a) Distance from Lead Arranger and Syndicate Membership: Co-Lead and Co-Agents

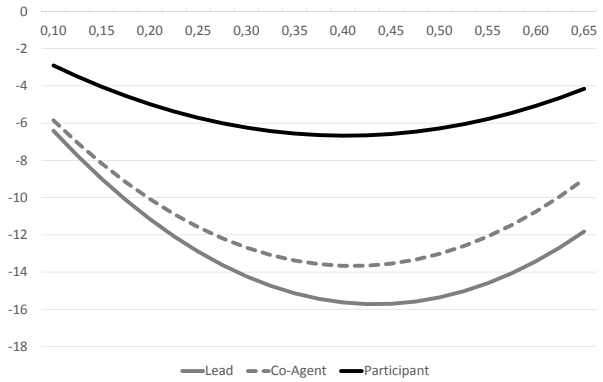
(b) Distance from Lead Arranger and Syndicate Membership: Participants

Table 5: Loan Distribution: Allocation of Loan Shares

This table reports coefficient estimates from regressions relating loan distribution to lender distance of the syndicated loan. The dependent variables are the share of the loan in percentage taken by lead arrangers, co-agents, and participants, respectively. Lender distance of the syndicated loan is the average distance between the lead arranger(s) and all the other syndicate members in the previous 12 months based on lender specialization by borrower 2-digit SIC industry. Loan shares are computed as the average loan share of lenders with the same loan role within the syndicate. All regressions include control variables as in Table 3 as well as year, loan purpose, interest rate type, borrower 2-digit SIC industry, and borrower state fixed effects. Robust standard errors allowing for clustering by borrower 2-digit SIC industry are in parentheses. * indicates that the estimated coefficient is significantly different from zero at the 10% level, ** at the 5% level, and *** at the 1% level.

	(1) % Held by Lead	(2) % Held by Co-Agent	(3) % Held by Participant
Lender distance	-72.503***	-66.652***	-33.152***
	(6.922)	(8.090)	(4.725)
Lender distance^2	83.559***	81.215***	41.165***
	(8.371)	(9.163)	(5.423)
Control variables	Yes	Yes	Yes
N =	12,272	7,463	11,474
Adjusted R^2	0.4160	0.4205	0.4886

Figure 5: Visualization of Coefficient Estimates from Table 5



Lender distance and % held
by Lead, Co-Agent and Participant

Table 6: Close vs. Mid vs. Distant Syndicates

This table reports the means of close, mid, and distant syndicates on various borrower, loan characteristics, syndicate structure, and loan distribution, and the mean differences between close and mid as well as distant and mid syndicates. That is, the mean of close syndicates, minus the mean of mid syndicates ($\mu_{Close} - \mu_{Mid}$), and the mean of close syndicates, minus the mean of mid syndicates ($\mu_{Distant} - \mu_{Mid}$), respectively. The sample of 123,752 syndicated loan facilities is split into three sub-samples based on the monthly one-third, and two-thirds of the lender distance of the syndicated loan. The sub-sample of close syndicates consists of syndicates in which lender distance is up to the one-third of the originating month, the sub-sample of mid syndicates consist of syndicates in which lender distance is above the one-third and up to the two-third of the originating month, whereas the sub-sample of distant syndicates consists of the remaining syndicates. Lender distance at the syndicated loan facility level is defined as the average distance between the lead arranger(s) and all the other syndicate members in the previous 12 months based on lender specialization in borrower 2-digit SIC industry. * indicates that the mean difference is significantly different from zero at the 10% level, ** at the 5% level, and *** at the 1% level.

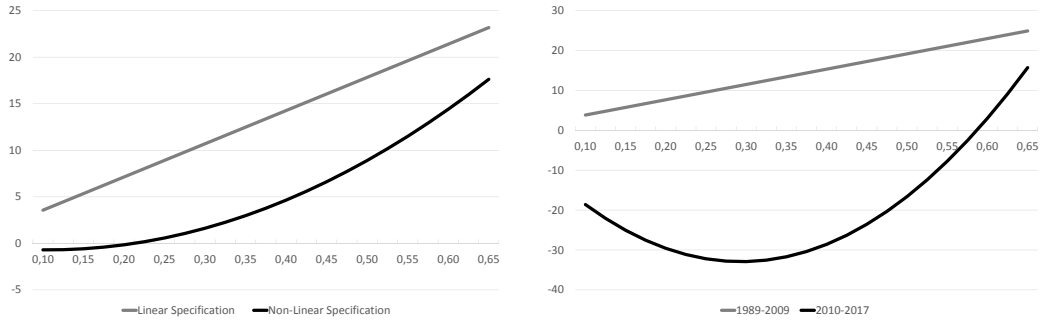
	Syndicate Distance			Differences	
	Close	Mid	Distant	Close-Mid	Distant-Mid
	(1)	(2)	(3)	(4)	(5)
Borrower characteristics:					
Public borrower indicator	0.359	0.406	0.306	-0.047***	-0.100***
Debt rating indicator	0.627	0.667	0.521	-0.041***	-0.146***
Investment-grade rating indicator	0.325	0.373	0.252	-0.048***	-0.121***
# of previous syndicated loans	4.907	5.383	3.502	-0.477***	-1.881***
First borrower loan indicator	0.299	0.281	0.418	0.018***	0.137***
Sales at closing ($mm)	3,893	4,921	3,025	-1,028***	-1,895***
Syndicated loan characteristics:					
Facility amount ($mm)	312	399	221	-87***	-178***
Maturity (months)	48.627	50.940	51.294	-2.314***	0.354*
Term loan indicator	0.322	0.314	0.364	0.008**	0.051***
Spread on drawn funds (bps)	236	231	266	5***	35***
Syndicate structure:					
Total number of lenders	5.202	9.130	6.781	-3.928***	-2.349***
Total number of lead arrangers	1.659	1.821	1.556	-0.162***	-0.264***
Total number of co-agents	1.256	2.149	1.363	-0.892***	-0.786***
Total number of participant lenders	2.273	5.138	3.810	-2.865***	-1.328***
Concentration of syndicate (HHI)	0.270	0.171	0.250	0.098***	0.079***
Loan distribution:					
% kept by lead arranger	31.437	21.316	29.776	10.121***	8.460***
% held by co-agent lender	17.661	12.124	15.531	5.537***	3.407***
% held by participant lender	16.479	10.200	15.578	6.279***	5.378***

Table 7: Loan Pricing and Time-Variation in Loan Pricing

This table reports coefficient estimates from regressions relating loan pricing to the lender distance at the syndicated loan facility level, over the entire sample period and a split of the sample period. The sample period is split into a first sub-period from 1989 to 1996:q1, and a second sub-period from 2010 to 2017:q1. The dependent variable is the interest spread over LIBOR on drawn funds measured in basis points. The independent variables of interest is the (squared) lender distance of the syndicated loan, which is the average distance between the lead arranger(s) and all the other syndicate members in the previous 12 months based on borrower 2-digit SIC industry. All regressions include control variables as in Table 3 as well as year, loan purpose, interest rate type, borrower 2-digit SIC industry, and borrower state fixed effects. Robust standard errors allowing for clustering by borrower 2-digit SIC industry are in parentheses. * indicates that the estimated coefficient is significantly different from zero at the 10% level, ** at the 5% level, and *** at the 1% level.

	Spread on Drawn Funds (bps)					
	Full Sample		1989-2009		2010-2017	
	(1)	(2)	(3)	(4)	(5)	(6)
Lender distance	35.66***	-13.19	38.33***	32.31	-17.94	-224.44***
	(8.56)	(22.75)	(8.82)	(27.93)	(23.32)	(53.04)
Lender distance^2		62.00**		7.44		382.46***
		(29.38)		(34.13)		(82.51)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
N =	31,024	31,024	25,774	25,774	5,250	5,250
Adjusted R^2	0.4544	0.4545	0.4578	0.4578	0.4492	0.4509

Figure 6: Visualization of Coefficient Estimates from Table 7



(a) Lender Distance and Loan Pricing: Full Sample

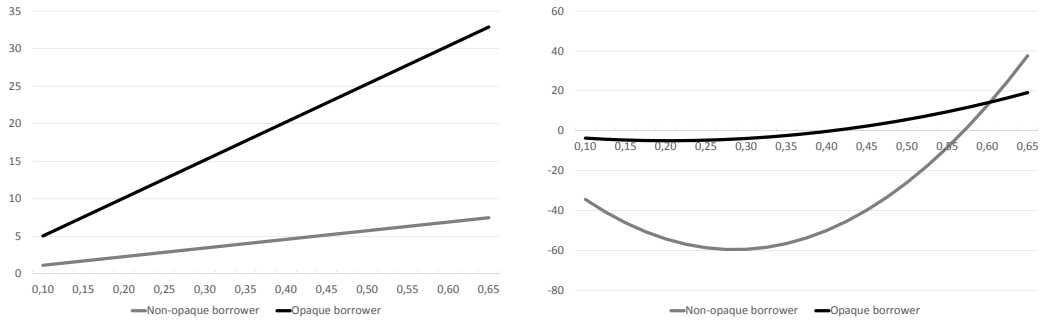
(b) Lender Distance and Loan Pricing: Sub-periods

Table 8: Improved Screening versus Price Collusion

This table reports coefficient estimates from regressions relating loan pricing to the lender distance at the syndicated loan facility level and information asymmetry of the borrower, separate for two sub-periods. An "opaque" borrower is an unrated firm, or a small firm (defined as the smallest one-third of borrowing firms in the sample by sales at closing at the time of loan origination). The first sub-period spans from 1989 to 2009, and the second sub-period from 2010 to 2017. The dependent variable is the interest spread over LIBOR on drawn funds measured in basis points. The independent variables of interest are the (squared) lender distance of the syndicated loan, which is the average distance between the lead arranger(s) and all the other syndicate members in the previous 12 months based on borrower 2-digit SIC industry, and interactions of these variables with "opaque" borrower, respectively. All regressions include control variables as in Table 3 (besides including an opaque borrower indicator instead of unrated borrower) as well as year, loan purpose, interest rate type, borrower 2-digit SIC industry, and borrower state fixed effects. Robust standard errors allowing for clustering by borrower 2-digit SIC industry are in parentheses. * indicates that the estimated coefficient is significantly different from zero at the 10% level, ** at the 5% level, and *** at the 1% level.

	Spread on Drawn Funds (bps)			
	1989-2009		2010-2017	
	(1)	(2)	(3)	(4)
Lender distance	11.51	-5.41	-66.72*	-417.59***
	(12.32)	(38.57)	(39.54)	(124.03)
Lender distance^2		23.47		731.38***
		(47.68)		(216.10)
Lender distance x Opaque	39.07**	100.79*	90.01*	368.37**
	(17.73)	(54.09)	(50.65)	(168.04)
Lender distance^2 x Opaque		-75.94		-610.45**
		(61.26)		(283.09)
Control variables	Yes	Yes	Yes	Yes
N =	25,774	25,774	5,250	5,250
Adjusted R^2	0.4532	0.4532	0.4447	0.4465

Figure 7: Visualization of Coefficient Estimates from Table 8



(a) Lender Distance and Loan Pricing: 1989 - 2009

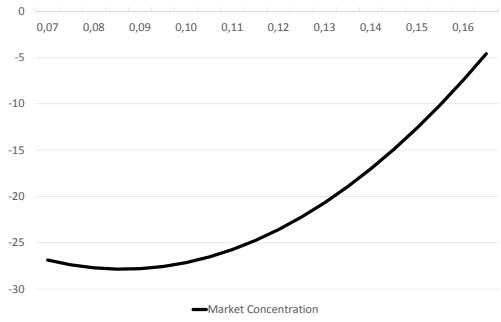
(b) Lender Distance and Loan Pricing: 2010 - 2017

Table 9: Loan Pricing and Market Concentration

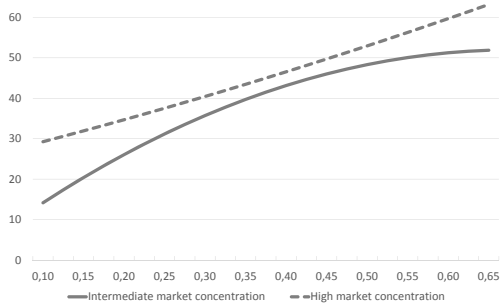
This table reports coefficient estimates from regressions relating loan pricing to the lender distance at the syndicated loan facility level and market concentration. The dependent variable is the interest spread over LIBOR on drawn funds measured in basis points. Market concentration is the Herfindahl index based on the market share of each bank based on the originated loan amount as lead arranger during the previous 12 months. Lender distance of the syndicated loan is the average distance between the lead arranger(s) and all the other syndicate members in the previous 12 months based on lender specialization by borrower 2-digit SIC industry. The independent variables of interest are market concentration (squared) and the interaction of lender distance (squared) with low and high market concentration, whereas low market concentration is an indicator variable for the lowest one-third of market concentration in the sample period, and high market concentration is an indicator variable for the highest one-third of market concentration in the sample period. All regressions include control variables as in Table 3 (and column (3) additionally indicators for low and high market concentration) as well as three-year, loan purpose, interest rate type, borrower 2-digit SIC industry, and borrower state fixed effects. Robust standard errors allowing for clustering by borrower 2-digit SIC industry are in parentheses. * indicates that the estimated coefficient is significantly different from zero at the 10% level, ** at the 5% level, and *** at the 1% level.

	Spread on Drawn Funds (bps)		
	(1)	(2)	(3)
Lender distance	67.66***	66.60***	152.74***
	(22.99)	(22.66)	(37.64)
Lender distance^2	-14.06	-12.70	-112.22**
	(30.36)	(29.89)	(48.19)
Market concentration		-646.04*	
		(364.09)	
Market concentration^2		3746.33**	
		(1565.41)	
Lender distance x Low market concentration			-170.73***
			(56.01)
Lender distance^2 x Low market concentration			183.74***
			(65.69)
Lender distance x High market concentration			-103.31**
			(48.61)
Lender distance^2 x High market concentration			128.58**
			(58.46)
Control variables	Yes	Yes	Yes
N =	31,024	31,024	31,024
Adjusted R^2	0.4343	0.4354	0.4346

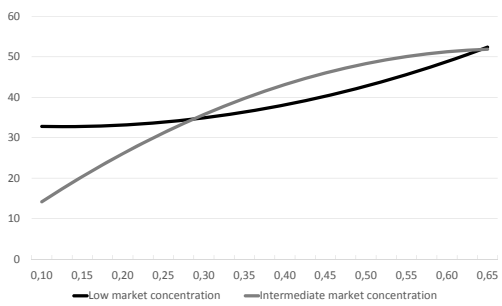
Figure 8: Visualization of Coefficient Estimates from Table 9



(a) Market Concentration



(b) Lender Distance and Market Concentration: Intermediate vs. High



(c) Lender Distance and Market Concentration: Low vs. Intermediate

Table A.1: Variable Definitions

This Appendix lists the variables used in the empirical analysis and their definitions.

Variable	Description
Panel A: Lead Arranger Characteristics	
Market share (%), previous 12 months	Market share of a lender in the U.S. syndicated loan market based on the total loan amount the lender originated during the previous 12 months
# of loans as lead arranger	Number of loans arranged as lead arranger in the U.S. syndicated loan market during the previous 12 months
$ of loans as lead arranger ($mm)	Amount of loans arranged by a lender in the U.S. syndicated loan market in USD million based on the total loan amount the lender originated during the previous 12 months
Bank indicator	An indicator variable for whether the lender is a bank (as opposed to finance companies, institutional investors, etc.)
Lender's previous relationships with lead	An indicator variable for whether a lender previously syndicated a loan with the lead arranger (no matter what roles the two lenders took)
Lender's previous relationships with borrower	An indicator variable for whether a lender previously syndicated a loan to the borrower (no matter what role the lender took)
Distance between two lenders	The distance in lending specializations between two lenders in the U.S. syndicated loan market during the previous 12 months

Variable Definitions (continued)

Panel B: Borrower Characteristics	
All borrowers:	
Sales at closing ($mm)	Borrower's sales at closing in USD million at the time of loan origination
# of previous syndicated loans	The number of syndicated loans that the borrower took prior to the time of loan origination
First borrower loan indicator	An indicator variable for whether the borrower's syndicated loan is the first syndicated loan
Private firm indicator	An indicator variable for whether the borrower is a private firm at the time of loan origination
Public firm indicator	An indicator variable for whether the borrower is a public firm at the time of loan origination
Borrowers with *Compustat* data:	
Total book assets ($mm)	Total assets of a borrower (book value) in USD million at time of loan origination
Book leverage ratio	Book leverage ratio of a borrower at the time of loan origination, computed as $(Longterm\ Debt + Current\ Liabilities)/Total\ Book\ Assets$
Earnings to asset ratio	Earnings to asset ratio of a borrower at the time of loan origination, computed as $(Depreciation + Income\ before\ extraordinary\ items) / Total\ Book\ Assets$
Debt rating indicator	An indicator variable for whether the borrower has a long-term S&P debt rating at the time of loan origination
Investment-grade rating indicator	An indicator variable for whether the borrower has a long-term S&P investment-grade rating at the time of loan origination
Unrated borrower indicator	An indicator variable for whether the borrower is unrated by S&P (no long-term debt rating) at the time of loan origination
Opaque borrower	An indicator variable for whether the borrower is either an unrated firm or a small firm (defined as the smallest one-third of borrowing firms in the sample by sales at closing at the time of loan origination)
Panel C: Loan Characteristics	
Syndicated loan characteristics:	
Facility amount ($mm)	Facility amount of the syndicated loan in USD million
Maturity (months)	Maturity of the syndicated loan in months
Spread on drawn funds (bps)	Loan interest rate spread over LIBOR on drawn funds measured in basis points
Term loan indicator	An indicator variable for whether the syndicated loan is a term loan
Purpose of loan indicators:	
Working capital/corporate	An indicator variable for whether the purpose of the syndicated loan is either working capital, or corporate

Variable Definitions (continued)

Refinancing	An indicator variable for whether the purpose of the syndicated loan is refinancing
Acquisitions	An indicator variable for whether the purpose of the syndicated loan is aquisitions
Backup lines	An indicator variable for whether the purpose of the syndicated loan is backup lines
Syndicate structure:	
Total number of lenders	Total number of lenders in the syndicate
Total number of lead arrangers	Total number of lead arrangers in the syndicate
Total number of co-agents	Total number of co-agents in the syndicate
Total number of participants	Total number of participants in the syndicate
Concentration of syndicate (Herfindahl)	Syndicate concentration as measured by the Herfindahl index (the sum of squared loan share by individual lenders)
Loan distribution:	
% kept by lead arranger*	Loan share retained by lead arranger(s)
% held by co-agent lender*	Loan share held by co-agent(s)
% held by participant lender*	Loan share held by participant(s)
Syndicated loan lender distance:	
Lender distance	The average distance in lending specializations between the lead arranger(s) and other syndicate members of the syndicated loan in the U.S. syndicated loan market during the previous 12 months
Panel D: Market Characteristics	
Market concentration	Market concentration in the U.S. syndicated loan market as measured by the Herfindahl index (sum of the squared lenders market share during the previous 12 months)

* Represents the average loan share of lead arrangers/co-agents/participants if there is more than one lead arranger/co-agent/participant in the syndicate.

Table A.2: Example of Computing the Syndicated Loan Lender Distance

This appendix shows how the syndicated loan lender distance is computed using a real example of a syndicate classified as "close". Specifically, it uses a syndicated loan to Stancorp Financial Group Inc. originated on June 16, 2014 (DealScan facilityid 324171), which displays syndicated loan characteristics similar to the average close syndicate (loan amount: $250 million; loan maturity: 48 months; term loan indicator: zero; spread on drawn funds: 137.5bps). The syndicate also shows a very similar syndicate structure than the average close syndicate in the sample. It consists of five lenders, led by a large lender in the syndicated loan market (Wells Fargo), has two co-agents (JPMorgan Chase, and U.S. Bancorp) and two participants (Barclays, and Goldman Sachs). First, we show the distance between two lenders for each pair of lenders at the loan origination month. Second, we compute the syndicated loan lender distance as the average distance of all pairs of lead arranger-lender at the time of loan origination. Consequently, only the lender distance pairs from Wells Fargo with the other four lenders (JPMorgan Chase, U.S. Bancorp, Barclays, and Goldman Sachs) enter the computation.

Distance between two Lenders

	Wells Fargo (Lead)	JPMorgan Chase (Co-Agent)	U.S. Bancorp (Co-Agent)	Barclays (Participant)	Goldman Sachs (Participant)
Wells Fargo	-				
JPMorgan Chase	**0.097**	-			
U.S. Bancorp	**0.113**	0.103	-		
Barclays	**0.162**	0.104	0.154	-	
Goldman Sachs	**0.151**	0.124	0.132	0.167	-

Computation of Syndicated Loan Lender Distance

$$
\begin{aligned}
Distance_{s,t} &= \frac{1}{N_s}\sum_{n=1}^{N_s} distance_{in,kn,t} \\
&= \frac{1}{4}\left(Distance_{WF,JPMC,t} + Distance_{WF,USB,t} + Distance_{WF,Barc,t} + Distance_{WF,GS,t}\right) \\
&= \frac{1}{4} \times (0.097 + 0.113 + 0.162 + 0.151) = 0.131
\end{aligned}
$$

Appendix A.3: Classification of Lender Roles

We classify lenders into three categories based on the seniority of their role in the syndicate, namely: (i) lead arranger, (ii) co-agent, and (iii) participant lender. Using lender roles from DealScan, we classify a lender as a lead arranger if its "LenderRole" falls into the following: administrative agent, agent, arranger, bookrunner, coordinating arranger, lead arranger, lead bank, lead manager, and mandated arranger. If no lead arranger or multiple lead arrangers are identified, we then cross-check the information with another field named "LeadArrangerCredit". For a lender to be a lead, this field needs to equal "Yes." If two or more lead arrangers are still identified, they are then co-leads.

We identify a lender as a co-agent if it is not in a lead position and its "LenderRole" falls into the following: co-agent, co-arranger, co-lead arranger, co-lead manager, co-lead underwriter, collateral agent, co-manager, co-syndications agent, documentation agent, joint arranger, joint lead manager, managing agent, senior co-arranger, senior co-lead manager, senior co-manager, and syndications agent.

Lenders with neither lead nor co-agent roles are classified as participant lenders.

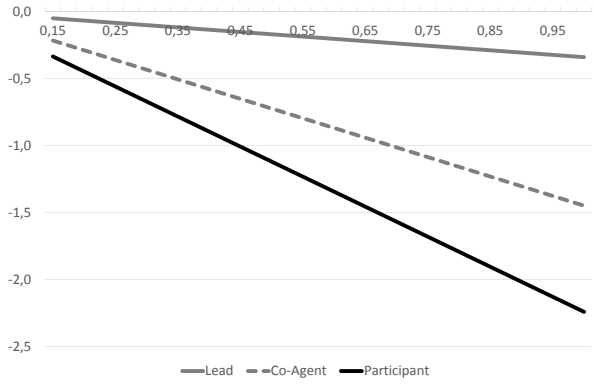
See Standard&Poor's (2016) for descriptions of lender roles.

Table A.4: Loan Distribution: Allocation of Loan Shares within Syndicates

This table reports coefficient estimates from regressions relating loan distribution to lender distance of the syndicated loan. The dependent variables are the share of the loan in percentage taken by lead arrangers, co-agents, and participants, respectively. Lender distance of the syndicated loan is the average distance between the lead arranger(s) and all the other syndicate members in the previous 12 months based on lender specialization by borrower 2-digit SIC industry. Loan shares are identified through within syndicate variation and loan shares are lender-specific. Regressions on the loan share for lead arrangers are restricted to loans with at least three lead arrangers. Regressions on the loan share for co-agents and participants are restricted to syndicates with one lead arranger. All regressions include control variables as in Table 4 as well as loan facility fixed effects. Robust standard errors allowing for clustering by lead arranger are in parentheses. * indicates that the estimated coefficient is significantly different from zero at the 10% level, ** at the 5% level, and *** at the 1% level.

	(1) % Held by Lead	(2) % Held by Co-Agent	(3) % Held by Participant
Distance from lead arranger	-0.341*	-1.449***	-2.241***
	(0.176)	(0.247)	(0.157)
Control variables	Yes	Yes	Yes
Loan facility fixed effects	Yes	Yes	Yes
N =	53,216	25,546	62,918
Adjusted R^2	0.8797	0.9463	0.8963

Figure A.1: Visualization of Coefficient Estimates from Table A.4



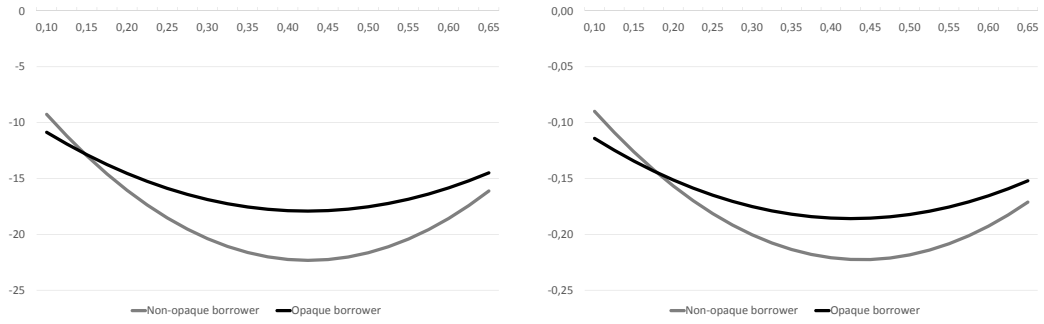
Distance from Lead Arranger and % held by Lead, Co-Agent and Participant

Table A.5: Syndicate Formation and Information Asymmetry

This table reports coefficient estimates from regressions relating syndicate formation to lender distance of the syndicated loan and information asymmetry of the borrower. Lender distance of the syndicated loan is the average distance between the lead arranger(s) and all the other syndicate members in the previous 12 months based on lender specialization by borrower 2-digit SIC industry. An "opaque" borrower is an unrated firm, or a small firm (defined as the smallest one-third of borrowing firms in the sample by sales at closing at the time of loan origination). A "first" loan is the first syndicated loan the borrower has taken in the syndicated loan market in our sample period. All regressions include control variables as in Table 3 (besides including an opaque borrower indicator instead of unrated borrower) as well as year, loan purpose, interest rate type, borrower 2-digit SIC industry, and borrower state fixed effects. Robust standard errors allowing for clustering by borrower 2-digit SIC industry are in parentheses. * indicates that the estimated coefficient is significantly different from zero at the 10% level, ** at the 5% level, and *** at the 1% level.

	% Held by Lead			Herfindahl		
	(1)	(2)	(3)	(4)	(5)	(6)
Lender distance	-72.975***	-104.936***	-82.393***	-0.735***	-1.015***	-0.807***
	(6.978)	(10.963)	(8.005)	(0.066)	(0.104)	(0.071)
Lender distance^2	84.306***	123.289***	95.817***	0.838***	1.156***	0.923***
	(8.428)	(13.852)	(10.269)	(0.076)	(0.134)	(0.087)
Lender distance x Opaque		47.985***			0.440***	
		(14.734)			(0.135)	
Lender distance^2 x Opaque		-56.142***			-0.481***	
		(17.031)			(0.155)	
Lender distance x First loan			35.215***			0.287***
			(11.476)			(0.092)
Lender distance^2 x First loan			-37.967***			-0.299***
			(12.514)			(0.098)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
N =	12,272	12,272	12,272	12,113	12,113	12,113
Adjusted R^2	0.4155	0.4170	0.4161	0.4151	0.4166	0.4155

Figure A.2: Visualization of Coefficient Estimates from Table A.5



(a) Lender Distance and % held by Lead

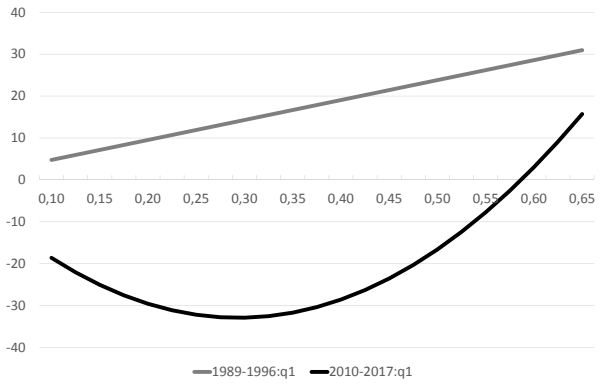
(b) Lender Distance and Herfindahl

Table A.6: Loan Pricing during Periods of Low Market Concentration

This table reports coefficient estimates from regressions relating loan pricing to the lender distance at the syndicated loan facility level, separately across two sub-periods. The sub-period span from 1989 to 1996:q1, and from 2010 to 2017:q1, respectively. The dependent variable is the interest spread over LIBOR on drawn funds measured in basis points. The independent variables of interest is the (squared) lender distance of the syndicated loan, which is the average distance between the lead arranger(s) and all the other syndicate members in the previous 12 months based on borrower 2-digit SIC industry. All regressions include control variables as in Table 3 as well as year, loan purpose, interest rate type, borrower 2-digit SIC industry, and borrower state fixed effects. Robust standard errors allowing for clustering by borrower 2-digit SIC industry are in parentheses. * indicates that the estimated coefficient is significantly different from zero at the 10% level, ** at the 5% level, and *** at the 1% level.

	Spread on Drawn Funds (bps)			
	1989-1996:q1		2010-2017:q1	
	(1)	(2)	(3)	(4)
Lender distance	47.63***	106.15	-17.94	-224.44***
	(16.78)	(66.92)	(23.32)	(53.04)
Lender distance^2		-59.67		382.46***
		(64.56)		(82.51)
Control variables	Yes	Yes	Yes	Yes
N =	4,872	4,872	5,250	5,250
Adjusted R^2	0.4221	0.4222	0.4492	0.4509

Figure A.3: Visualization of Coefficient Estimates from Table A.6



Lender Distance and Loan Pricing:
Low Market Concentration