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Link About It: Information Asymmetry, Knowledge Pooling and Syndication in Project Finance Lending

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Link About It: Information Asymmetry, Knowledge Pooling and Syndication in Project Finance Lending

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Abstract

In a collaborative setting, banks have an additional way to deal with asymmetric information between themselves and their borrowers: by pooling information. We explore the extent to which lead arrangers in the project finance syndicated lending market strategically choose their new partners in order to pool information, thereby lowering the overall degree of asymmetric information between themselves and their borrowers. We find that information pooling explains with whom banks collaborate, why they reach further into their network to find new partners and why they go outside their existing network if the need to pool information is high enough.

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Lending is the business of dealing with asymmetric information, sometimes through contractual arrangements, often through monitoring, but frequently also in other ways that involve pooling information, over time, or from different sources. When little is known about a borrower, lenders may rely on relationship lending. Building a relationship with its borrower can be a powerful way for a financial intermediary to deal with asymmetric information. As a result, an extant body of literature has focused on studying the relationships between lenders and borrowers (e.g. Berlin and Mester, 1998; Bharath et al., 2011; Boot, 2000; Elsas, 2005; Ongena and Smith, 2001; Cantillo and Wright, 2000; Degryse and Ongena, 2005). In order to be able to realize the gains (both for lender and borrower) from relationship lending, the lender has to be able to lock in the borrower, at least to some extent. But what happens when the borrower is a project company, where repeated lending is by no means obvious, lock in is very difficult and where there is no borrowing history, credit ratings or credit register that the lender can use? In that case, the lender is exposed to large information asymmetry (adverse selection) problems. These problems may become even more sever when lending takes place not through one lender, but through a syndicate, since the collaborative intentions of lenders in a syndicate are largely unobservable (Leland and Pyle, 1977; Holmstrom, 1982; Ball, Bushman and Vasvari, 2008; Tykvova, 2007; Sufi, 2007).
We investigate how lenders cope with their need to reduce information asymmetry vis-à-vis their borrower, and their need to reduce moral hazard among syndicate members through the composition of project finance loan syndicates. Information asymmetry in the project finance loan market prevails because loans are extended to project companies established to undertake a single, newly to be established project. As a result, lenders are unable to establish a relationship with the project company beyond the life of the project. However, the syndicate's lead arrangers -informed lenders respons-

ible for screening, monitoring, and setting up the loan terms- build up informational capital by gaining project-specific, tacit information and know-how when arranging projects. Informational capital is important because arranging project finance loans require extensive knowledge (Gatti, 2013). In turn, informational capital can be used when setting up future project finance loans, thereby reducing information asymmetry problems. Ideally, lenders would like to arrange project finance loans with lenders that complement their own informational capital and at the same time carry low moral hazard.

A large body of literature focuses on the moral hazard stemming from status asymmetry between lead arrangers and participant lenders in loan syndicates (e.g. Simons, 1993; Boot, Greenbaum and Thakor, 1993; Dennis and Mullineaux, 2000; Jones, Land and Nigro, 2005; Sufi, 2007; Ball, Bushman and Vasvari, 2008; Ivashina, 2009; Gadanecz, Kara and Molyneux, 2012; Champagne and Kryzanowski, 2007; Dennis and Mullineaux, 2000). What this literature largely fails to address is how lead arrangers form loan syndicates such that the lack of borrower information is mitigated while potential moral hazard problems among lead arrangers are reduced. Song (2004) studies how lead banks form a syndicate with the purpose of increasing their joint informational capital but disregards the moral hazard problems arising among the lead banks in the syndicate. We argue that an important way lead arrangers can mitigate moral hazard problems is by arranging loans with lead arrangers in their stock of lender relationships, i.e. those they know through previous syndicates. However, the extent to which their joint information capital is complementary is expected to be lower than the joint informational capital from lead arrangers that have not arranged loans together in the past. It is the tradeoff between these two considerations that determines how lead arrangers make strategic decisions about syndication.

Studying the lead arranger composition of project finance loan syndicates allows us to delve deeper in a key decision process in financial intermediation, and to contribute to the extant literature on financial intermediation in four different ways. First and foremost, we contribute to the larger literature that investigates the impact of borrower information asymmetries on lending decisions and syndicate structure. Second, we study how lenders build and maintain relationships with each other. While most research in syndicated lending uses the syndicate as its unit of analysis, we follow Champagne and Kryzanowski (2007) and Song (2004) and take a network view to explain the structure of syndicates. Each of us takes a different approach to the network of syndicates. In Champagne and Kryzanowski (2007) lender pairs are the key unit of analysis. Song (2004) instead focuses on the type of bank -commercial or investment- joining the syndicate as a lead arranger. We contend that lenders follow a portfolio perspective to loan syndication and decide whether to form new lender relationships or reinforce existing ones based on the stock of lender relationships they already have. This allows us not only to study lender relationships as a potential source of moral hazard, but it also allows us to understand how lenders manage their relationships. Third, we study the importance of asymmetric information in shaping relationships in a collaborative setting, with varying degrees of asymmetric information. With our network approach to the portfolio of relationships each lender in the syndicated loan market maintains, we can observe two things: which lenders collaborate, and how distant are those who do not collaborate. These two elements are key in studying asymmetric information in a setting where the collaborative intentions of lenders are largely unobservable (Leland and Pyle, 1977; Holmstrom, 1982; Ball, Bushman and Vasvari, 2008). Lenders obtain information directly from other lenders with whom they have previously collaborated. In addition, they can obtain information about other lenders as well through the network they have built so far. As a simple example, consider two lenders that have never cooperated in a syndicate together, but have both cooperated with a third lender. The existence of such a common (past) partner can help mitigate asymmetric information concerns. Fourth, we study project finance loan syndicates, where lenders give out loans that are both sizable and often geared towards rather risky projects (Kleimeier and Megginson, 2000; Esty and Megginson, 2003; Esty, 2004; Gatti, 2013). Banks that engage in project finance through syndicated lending dip their toes into a pool that has expanded considerably both geographically and number wise in the last ten years (Kleimeier and Megginson, 2000; Esty and Megginson, 2003; Esty, 2004; Gatti, 2013). Not surprisingly, they join together in loan syndicates to pool funding and share loan management-related tasks and costs. By pooling resources, financial institutions participating in project finance loan syndicates also pool knowledge, and possibly build relationships with partner institutions, thus exploiting yet another way of overcoming asymmetric information in lending (Champagne and Kryzanowski, 2007; Holmstrom, 1982). Therefore, studying project finance loan syndicates allows us to study the relationships among lenders in a market where information about the borrower is difficult to come across and lender-borrower relationships are difficult -if not impossible- to build. In markets like this, loan syndicates allow lenders to actively collaborate and exchange know-how when lending to borrowers from whom little is known.

We find that that lead arrangers indeed reach out to new partners with whom there are no network connections when lending to firms with -to them- high degrees of asymmetric information. Lending to those firms also means lead arrangers are willing to reach out further into their network to syndicate with new partners. Key to lead arrangers' decision to pool information with new partners is the arrangement of a project finance loan in sectors that are beyond their current area of expertise. Our findings suggests that lead arrangers consider that the potential moral hazard that comes from working with new partners takes a back seat to the benefits they derive from pooling information in this manner. Importantly, our results hold across sample periods and are independent of the degree to which banks are already active as lead arrangers.

The remainder of this paper is organized as follows. In Section 1, we describe important institutional details about syndicated lending and the project finance loan market. Section 2 develops our set of testable hypotheses. The econometric model is presented and discussed in Section 3. Section 4 explains the data, dependent and independent variables used to test our hypotheses, and provides summary statistics. Our analyses and results appear in Section 5, and the robustness tests appear in Section 6. We conclude with a brief discussion of our findings and their implications in Section 7.

1 Background on Project Finance Lending

We investigate syndicate formation in the context of project finance lending. We focus on project finance loans rather than syndicated lending as a whole for several reasons. First, informational capital is particularly important in project finance because of the contractual nature of project finance. Second, because of the transactional nature of project finance lending, banks need to rely on informational capital. Third, moral hazard within syndicates can have severe consequences in project finance because projects are highly levered with non-recourse debt. Before outlining our hypotheses, we need to define project finance in more detail and thereby substantiate our reasons for selecting project finance loan syndicates as the focus of our analysis.

In project finance one or more parent companies, called the sponsors, set up an independent project company in order to realize a new investment in a single-purpose, limited-life capital asset. This project company is both legally and financially independent from the sponsors. As a legally independence entity, the project company is the owner of the asset and is responsible for its realization, financing and operation. The financing of the new investment relies heavily on bank loans with debt-to-capital ratios of 75% for the average project company (Esty, Chavich and Sesia, 2014). Due to the financial independence of the project company, this debt is non-recourse. Banks cannot rely on the sponsors but must look only towards the project's cash flows for repayment.

While the use of project finance can be traced back to the Roman Empire, its first modern uses involved the development of US railroads in the 19th century and the development of oil fields in the US and North Sea in the 1930s and 1970s (Gatti, 2013; Kleimeier and Megginson, 2000). Since then, project finance has spread around the globe and been applied in various industries including the public sector. Private sector sponsors have typically applied project finance for asset-rich investments in the industrial, oil and gas or mining sectors. In the 1990s, the private and public sectors started cooperating to realize infrastructure projects in the transportation, power and telecommunication sectors (Esty, Chavich and Sesia, 2014). During our sample period from 1987 to 2014, project companies raised $2,512 bn in project finance loans worldwide, accounting for 4.21% of the global syndicated loan market. 39.5% of these loans financed infrastructure projects followed by projects in the manufacturing (15.8%) and mining sectors (10.4%) (see Table 1).

In order to finance a new project without established cash flows with a highly levered capital structure that is dominated by non-recourse debt, risk management of the pro-

Table 1: Project finance around the world

Sector	Number of Projects	Total Loan Volume USD Billions	Market Share
Infrastructure	2,125	993.4	39.5%
Manufacturing	802	395.9	15.8%
Mining	493	261.7	10.4%
Agriculture, forestry & fishing	942	256.7	10.2%
Construction	651	248.0	9.9%
Other services	469	130.4	5.2%
Finance, insurance & real estate	428	111.9	4.4%
Public administration	134	89.6	3.6%
Retail trade	53	15.1	0.6%
Wholesale trade	45	10.2	0.4%
Total	6,142	2,512.0	100%

	Min	Mean	Max	St.Dev.
Loan size (USD Millions)	0.04	170.54	72,728.56	0.00
Number of lead arrangers	1.00	2.11	36.00	2.39
Maturity (years)	0.17	7.78	42.72	0.20
Total loans				6,142
Fraction of loans with >1 lead arranger				39.29

Note: The infrastructure sector covers transportation, communications, electric, gas and sanitary services. Sample period: 1987 to 2014. Source: DealScan.

ject is essential. Project finance thus relies on a large set of contractual agreements that involves construction companies, suppliers, customers, and host governments. The aim is to allocate each risk to the party that is best able control and manage it. For example, the construction company is typically offered a fixed-price turnkey contract so that it bears the risk of construction delay and cost overruns. Suppliers and customers enter long-term, fixed-price supply and offtake contracts, respectively. Ideally, these supply and offtake contracts are aligned so that price and volume risk is hedged. The exact nature of these contracts depends on the project's industry. Pipeline projects typically employ throughput agreements that enforce a minimum usage level on the customer while take-or-pay contracts are common in other industries. However, for projects that sell to a large number of customers, for example toll roads, such contracts are infeasible. It is common for a project to rely on more than 40 contracts involving as many as 15 different parties. Large projects can, however, be far more complex as the Baku-Tbilisi-Ceyhan pipeline project, financed in 2002 for $3.6 bn, illustrates. Its contractual structure consisted of 200 documents with 17,000 signatures from 78 parties (Esty, Chavich and Sesia, 2014).

The loan syndicate becomes involved in the project after the sponsors have set up the project company and arranged the contractual structure. The key roles in the syndicate are those of lead arranger and participant. During the initial phase of the financial negotiations, the lead arrangers assess the credit quality of the project including the financial projections and contractual structure and negotiate the loan terms. Next, the arrangers invite other banks to participate in the funding of the loan. After financial closure, the arrangers monitor the project and renegotiate on behalf of the syndicate in case of financial distress (Esty and Megginson, 2003).

Given the high-leverage and non-recourse nature of project finance, the screening and monitoring efforts of the lead arrangers are critical - even more so than in standard syndicated lending. Lead arrangers need to understand the industry specifics of the project in order to properly assess the project's financial projections and contractual structure. In project finance lending, arrangers thus need informational capital that encompasses not only the financial but also the operational aspects of the project.

Project finance loans are extended to project companies established to undertake a single, newly to be established project. Thus, lead arrangers cannot establish a relationship with the project company beyond the life of the project and have to rely on informational capital. Even if lead arrangers have an existing lending relationship with the sponsors of the project company, this is of little use as the project company is both legally and financially independent from the sponsors. Thus, project finance loans are in essence transaction loans in contrast to general syndicated loans that have characteristics from both relationship and transaction loans (Dennis and Mullineaux, 2000). Instead of gaining tacit information and know-how about the borrower through a lending relationship, lead arrangers need to obtain tacit information and know-how about the project-specific transaction.

2 Hypotheses

Do arrangers reinforce their connections with other lead arrangers or create new ones every time they arrange loans? Syndicated lending is typically assumed to be a market of repeated collaborations where past lender collaborations determine their future collaborations when syndicating loans (Sufi, 2007; Champagne and Kryzanowski, 2007; Pichler and Wilhelm, 2001). In this case, we should see repeated collaborations among lead arrangers. Of all lead arranger collaborations formed between 1987 and 2014, 32% include new co-arranger partners. This means lead arrangers do not always rely on their past lending relations to syndicate current or future deals. Why do lead arrangers tend to collaborate with new partners to such a large extent? We answer this question by analyzing the information pooling needs of lead arrangers in a network setting.

2.1 Information Pooling Needs

Lead arrangers build information capital by evaluating projects, setting up the complex series of contractual and financial arrangements project finance loans require, and monitoring the progress of the project (Brealey, Cooper and Habib, 1996; Gatti et al., 2013). In part, this process is straightforward: project finance lending, being a transaction market, allows lead arrangers to specialize and develop competences (Das and Nanda, 1999). These competences are important because project finance loans often require extensive knowledge of the industry the project operates in (Gatti et al., 2013). Hence, it is in the interest of banks to know a sector well and become familiar with the legal, institutional and managerial requirements that projects in certain industries demand. This information and experience can be leveraged when financing similar projects or projects within the same industry.

The inability to leverage existing informational capital when lending to unfamiliar industries prompts lead arrangers to pool information with other lead arrangers. As a result of this information pooling, each lead arranger has a portfolio of lead arranger collaborations. Managing this portfolio is key to the overall success of a bank on the project finance syndicated lending market. The right portfolio of collaborations pools as much information as possible and necessary.

The benefits of information pooling need to be balanced against its costs, arising from moral hazard problems associated with information production (Pichler and Wilhelm, 2001) and costly monitoring (Diamond, 1984). Moral hazard is reduced when lead arrangers work with banks with whom they have previously partnered (Holmstrom, 1982; Tykvova, 2007).Champagne and Kryzanowski (2007), for instance, show that two banks are more likely to join a syndicate in the future when they have already collaborated in the previous five years. However, from an information generation perspective, the marginal information value of prior partners decreases. Gulati (1995) argues that as the number of collaborations between two firms increases, the additional information to be exchanged between them decreases. Therefore when a lead arranger's information pooling needs increase, collaborating with new partners becomes more attractive. This brings us to our first hypothesis:

Hypothesis 1 (Information Pooling Needs). *Banks collaborate with new partner banks when information pooling needs are high.*

2.2 Information Pooling Efforts

From a network perspective, a partner bank can take three distinct shapes. First, it can be a bank that is already part of the bank's portfolio of collaborations. Second, it can be a bank that is a new partner, but connected to the focal bank through the project finance syndication network. Third, it can be a new partner with whom there are no network connections.

Co-arranging with a new partner exposes the lead arranger to higher moral hazard, the more distant the new partner is in the network. Banks can try to lower the risk associated with collaborating with more distant partners by obtaining information about potential new partners from their portfolio of collaborations. Referrals about new partners can travel through the network until they reach the lead arranger through its portfolio of collaborations (Granovetter, 1983; Brass et al., 2004). The quality of the referrals deteriorates as they travel longer distances through the network. In this respect, the quality of the referral mimics the quality of the message in the so-called telephone game.[1]

There is, however, also an upside to connecting to more distant new partners. The more closely connected banks are in the project finance lending network, the more complementary the informational capital is. As a result, reaching out further into the network is expected to yield benefits when banks face high information pooling needs, possibly offsetting the moral hazard concerns. As a result, our second hypothesis is:

Hypothesis 2 (Information Pooling Efforts). *Banks collaborate with more distant new partner banks when information pooling needs are high.*

3 The Econometric Model

Our overall objective is to ascertain what determines a bank's decision to pool information through new syndications. Formally testing our two hypotheses requires the use of two related, but slightly different approaches. The first approach results in Model 1, with which we assess the extent to which banks pool information by collaborating with

[1] In the telephone game, one person whispers a message into the ear of the next person through a line of people until the last player announces the message to the entire group. Although the objective is to pass around the message without it becoming distorted errors typically accumulate in the retellings.

new partner banks. The second approach results in Model 2, with which we assess how far banks are willing to go to find new partner banks in order to pool information.

3.1 Model 1: information pooling needs

Before we find out the lengths (of a network) banks are willing to go to collaborate with new partners in order to pool information, we need to establish whether they use this strategy in the first place. If the channel we are interested in exists, then new partnerships 'arrive' as banks need to pool information. Our main variable of interest is the Number of New Collaborations, which is a count variable. Hence, we use a Poisson regression, and our Model 1 is as follows:

$$\begin{aligned}\text{Number of New Collaborations} = &\alpha + \\ &\beta_1 \text{Information Pooling Needs}_{\text{bank}} + \\ &\beta_2 \text{Information Pooling Needs}_{\text{portfolio}} + \\ &\beta_3 \text{Controls} + \epsilon\end{aligned} \tag{1}$$

The information pooling needs of a bank increase when it starts lending to new industries, reflected in a higher value for Information Pooling Needs$_{\text{bank}}$. However, when the existing portfolio of collaborations of the focal bank already meets that information pooling need, the bank can rely on this complementary expertise and will be prone to collaborate with fewer, new syndicate partners. We measure the difference between this complementary expertise and the bank's own informational capital with Information Pooling Needs$_{\text{portfolio}}$, where a higher value indicates a larger complementarity. As a result, we expect β_1 to be positive and β_2 to be negative. We explain the exact measurement of the two explanatory variables in detail in Section 4.4.1. In addition, we control for the number of project finance loans the bank is responsible for arranging and include bank fixed effects.

3.2 Model 2: information pooling efforts

Model 2 relates the decision of a bank to collaborate with new partners with the extent to which it is willing to search for these new partners. To what lengths (quite literally) is a bank willing to go into the project finance lending network to find new partners? Of course, the true effort is a latent variable. We approximate it using the syndicated lending network features, as before. For this purpose, we measure each bank's New Syndicate Partner Distance. Specifically, we measure the distance as the number of banks the lead arranger has to go through to reach the new partner, scaled by the farthest distance between banks in the network. Hence, the minimum value for this measure is zero, and its maximum is 1, which is also the value it takes if the new partner is not connected in any way to the bank. The result is Model 2, which we can estimate use a Tobit specification:

$$\begin{aligned}\text{New Syndicate Partner Distance} = &\alpha + \\ &\beta_1 \text{Information Pooling Needs}_{\text{bank}} + \\ &\beta_2 \text{Information Pooling Needs}_{\text{portfolio}} + \\ &\beta_3 \text{Controls} + \epsilon\end{aligned} \tag{2}$$

Ceteris paribus, we expect a lead arranger to search more and therefore 'travel' a longer distance when searching for information as its information pooling needs increase. Therefore, the set of independent variables in equation (2) is the same as in equation (1). We expect β_1 to be positive and β_2 to be negative.

4 Data

Our sample of lead arrangers active in project finance lending comes from the Loan Pricing Corporation's DealScan database (henceforth DealScan), the preferred database for studying loan syndications.[2] We use all project finance loans reported in DealScan between 1987 and 2014 to create the syndicate portfolios of lead arrangers active in project finance lending. We exclude all deals that (a) are not syndicated, (b) do not report any lead arrangers, (c) were canceled, (d) are bonds or floating-rate notes. In order to have a comprehensive understanding of new and old lead arrangers partners in the project finance lending market, we include all project finance deals regardless of country of issuance or size. Applying these filters yield 6,142 transactions accounting for 4.2% of all syndicated loans issued between 1987 and 2014.

4.1 The network structure of project finance lending

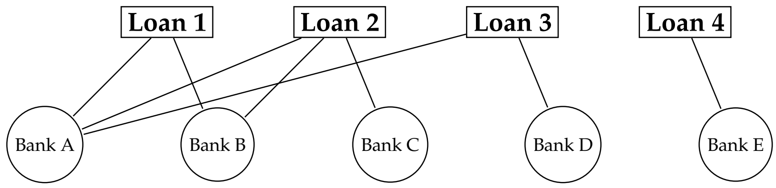
Project finance loans are typically syndicated with not only multiple participants but also multiple lead arrangers. Between 1987 and 2014, 39% of all 6,142 project finance loans were arranged by multiple banks as Table 1 shows. While on average the number of lead arrangers is a moderate 2.11, some projects can have a much more substantial number of lead arrangers. Among the largest projects are the Qatargas II project (Qatar, 2005) with 36 lead arrangers and the Marafiq Independent Water & Power Plant (Saudi Arabia, 2007) with 32 lead arrangers. Over time, as lead arrangers syndicate more and more project finance loans, they work with various co-lead arrangers and thereby build

[2] See for example Dennis and Mullineaux (2000); Esty and Megginson (2003); Champagne and Kryzanowski (2007); Francois and Missonier-Piera (2007); Sufi (2007); Bharath et al. (2011); Cai, Saunders and Steffen (2011); Gopalan, Nanda and Yerramilli (2011); Gadanecz, Kara and Molyneux (2012); Hainz and Kleimeier (2012).

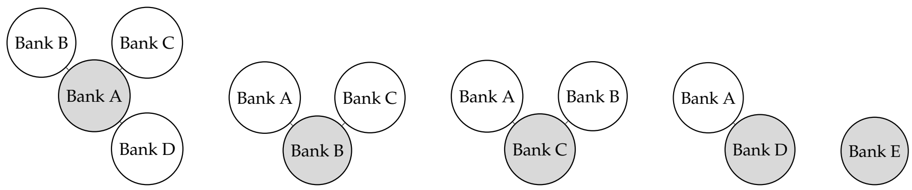
a portfolio of collaborations.

Figure 1 illustrates how banks form their collaborative portfolios over time. Panel (a) provides a simple picture of the project finance loan market in which four loans are syndicated. Banks A to E act as lead arrangers and jointly or individually arrange these project finance loans. For example, banks A and B collaborate to jointly arrange loan 1 while bank E individually arranges loan 4.

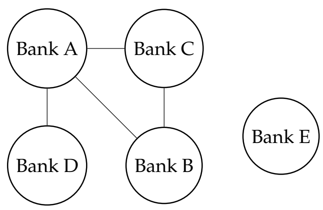
Figure 1: From loans to networks: a visualization of the project finance market



(a) Project finance syndicated loan market



(b) Collaboration portfolios of banks A through E



(c) Project finance syndication network

Panel (b) illustrates the collaborations among banks A to E. Each focal bank has built up its own portfolio of collaborations. For example, focal bank A has the largest collaboration portfolio as it jointly arranges loan 1 with bank B, loan 2 with bank B and C and loan 3 with bank D. In contrast, focal bank D's portfolio of collaborations only consists of bank A with whom it arranges loan 3. Focal bank E has no collaborators as it arranges loan 4 individually.

While Panel (b) shows each bank's collaboration portfolio, Panel (c) models the project finance market as a whole and shows the syndication network that results from each bank's collaborations. Banks A, B, C, and D are linked within the syndication network either directly or indirectly. Bank D is directly linked to bank A due to its collaboration in loan 3. Bank D is also indirectly linked to bank B and C as bank A co-arranges loans 1 and 2 with both of these banks. Thus the distance between bank D and B in the network is 2 as they can reach each other in two steps, e.g. from D to A to B or vice versa. Now consider the distance between banks D and C: the shortest distance between them is 2 as they are connected via A but they are also connected more indirectly via A and C with a distance of 3.

For our later empirical analyses regarding information pooling, we will start by looking at all project finance loans that a given bank arranges as shown in Panel (a) in Figure 1. We classify these projects by their respective industry. This allows us to measure the industry distribution of a bank's project finance loan portfolio and derive an industry specialization measure which serves as a proxy for the informational capital of the focal bank. Due to the extensive contractual structure of project finance, we consider the industry of the project to be the key determinant of the project-specific knowledge that the arranger needs to acquire in order to properly screen and monitor the project.

Next we will contrast the informational capital of the focal bank with that of the banks in its portfolio of collaborations as shown in Panel (b) of Figure 1. We contend that if the informational capital differs substantially between a given bank and its collaboration portfolio, then the bank can extend its informational capital by reaching out to its collaborators without exposing itself to moral hazard.

In contrast, if the informational capital of the focal bank coincides with that of its partners, then the bank can only extend its informational capital by reaching out to distant or even completely new partners, such as bank E in Figure 1. This exposes the bank to moral hazard which we believe to increase with the distance between the focal bank and a new partner in the network (see panel (c) of Figure 1).
Thus, we conduct our analyses bank's collaboration portfolio perspective on the syndication network.

4.2 Sample of lead arranger collaboration portfolios

Our analysis takes place at the portfolio level of each lead arranger. Estimating a lead arranger's determinants for co-arranging project finance loans with new lead arranger partners requires data for each lead arranger and each arranger's set of unique collaborations. To distinguish between new and recurrent collaborations, we follow Baum, Shipilov and Rowley (2003); Baum et al. (2005); Champagne and Kryzanowski (2007), and Godlewski, Sanditov and Burger-Helmchen (2012) and label each collaboration using a five-year history starting in 1992 and ending in 2014. Thus, a lead arranger in 1992 arranging a syndicated project finance loan with another lead arranger it has already worked with in the period between 1987 and 1992 is assumed to not be starting a new network connection in doing so. If the same two lead arrangers have not worked together in that period, or ever before, then it is considered to be a new network connection.
We used a five-year history for two particular reasons. First, syndicate ties through co-arrangement are the strongest during the first years of a project finance loan. The first years of the project are the riskiest demanding more due diligence and monitoring

from the project's lead arrangers (Baum et al., 2005). Second, using a five-year history permit us to gauge more accurately and reliably the strength of the ties among lead arrangers by incorporating information on repeated collaborations over a number of years. We refer to these sets of lead arranger collaborations as lead arranger collaboration portfolios.

In this way, our sample of 1,109 unique lead arrangers in principle could contain a total of 25,507 possible lead arranger portfolios. Granted, not every lead arranger in our sample arranges loans every single year and not every lead arranger collaborates with others. Filtering for active lead arrangers and co-arrangement in two consecutive years leaves us with a total of 1,677 lead arranger collaboration portfolios.

4.3 Dependent Variables

4.3.1 Number of New Collaborations

In order to identify which of the lead arrangers in a portfolio of collaborations are new as opposed to recurrent, we compare how the set of new and recurrent lead arranger partners in the portfolio changes from one year to the next. To illustrate, consider once again the example in Figure 1. Bank A in Figure 1 has a lead arranger portfolio consisting of three different banks, Bank B, Bank C, and Bank D. If in the next time year, Bank A still works (or has worked in the past 5 years) with those banks and starts working with Bank E, the connection to the latter is its only new collaboration.

Table 3 contains an overview of the number of new syndicate partners the banks in our sample of project finance loan syndicates form. In our sample of 1,677 lead arrangers the average lead arrangers seeks out almost eight new lead arranger partners and in some instances, it may collaborate with up to 46 new partners.

4.3.2 New Partner Distance

In order to identify the lengths to which a lead arranger is willing to go to find a new lead arranger partner, we compare the average number of bank relationships (nodes in the network) the new partner is removed from the lead arranger to the maximum distance that same lead arranger can travel to reach the ends of the network. Of course, some banks - such as bank E in Figure 1 - cannot be reached that way. Therefore, we normalize the total travel distance and let it range between close to zero and one, where the value of one corresponds to the distance to a bank like Bank E in Figure 1.
The formula below shows how the variable new partner distance is calculated:

$$\text{New Partner Distance} = \left\{ \sum_{i=1}^{N} \frac{\text{Distance}_i}{\text{Maximum Distance} + 1} \times \mathbb{1} + \text{M} \right\} \times \frac{1}{\text{N+M}} \qquad (3)$$

where Distance_i is the *degrees of separation*[3] between the lead arranger and the new lead arranger partner i in time t-1; Maximum Distance is the maximum degree of separation between the lead arranger and any other bank within the network; $\mathbb{1}$ is an indicator variable equal to one when the lead arranger joins a syndicate with new lead arranger partners within the network and zero otherwise; and M is the count of new lead arranger partners that such as bank E in Figure 1 cannot be reached. Hence, all new partners that are unreachable to the lead arranger are assigned a distance equal to one. And, M is the count of all new partners that can be reached by the lead arranger.
In Table 3, we can see that the average lead arranger in our sample travels relatively large distances when collaborating with new lead arranger partners. On average, new lead arranger partners are at a distance of 0.837 from the lead arranger prior to collaborating, fairly close to the maximum distance of one. Furthermore, with a minimum

[3] See Milgram (1967)

distance equal to 0.453, lead arrangers go at least half-way through their networks to search for new lead arranger partners.

4.4 Independent Variables

4.4.1 Information Pooling Needs

A lead arranger's need for information pooling depends on two things: the information capital it has amassed itself, and the information capital to which it has access through its existing collaboration portfolio.

A lead arranger may need to pool information with a new lead arranger partner when the information capital it has built up through previous loans is not sufficient. An example of such a case is when a lead arranger intends to fund a project in an industry it has no prior experience with. That brings us to our first information pooling need measure:

$$\text{Information pooling needs}_{\text{Lead arranger}} = \sum_j \frac{\left|\text{Number PF Loans}_{\tau,j} - \text{Number PF Loans}_{\tau-1,j}\right|}{\text{Number PF Loans}_{\tau-1 \text{ to } \tau}}, \tag{4}$$

where Number PF Loans is the count of project finance loans arranged by a lead arranger. The subscript j refers to each of the ten different industry classifications a project can be classified into, and τ refers to the five-year history of each lead arranger's lending activity. Hence, equation (4) measures the proportion of loans to new industries a lead arranger has taken on. The lower this measure, the higher the information pooling needs of this lead arranger.

Table 3 shows that the average lead arranger is indeed rather specialized and thereby has relatively high information pooling needs resulting in an average score of 17.2% albeit with maximum values up to by 100%. Figure 2(a) shows the underlying distribution and confirms that most lead arrangers' information pooling needs, based on their own portfolio of syndicated project finance loans, are indeed fairly high.

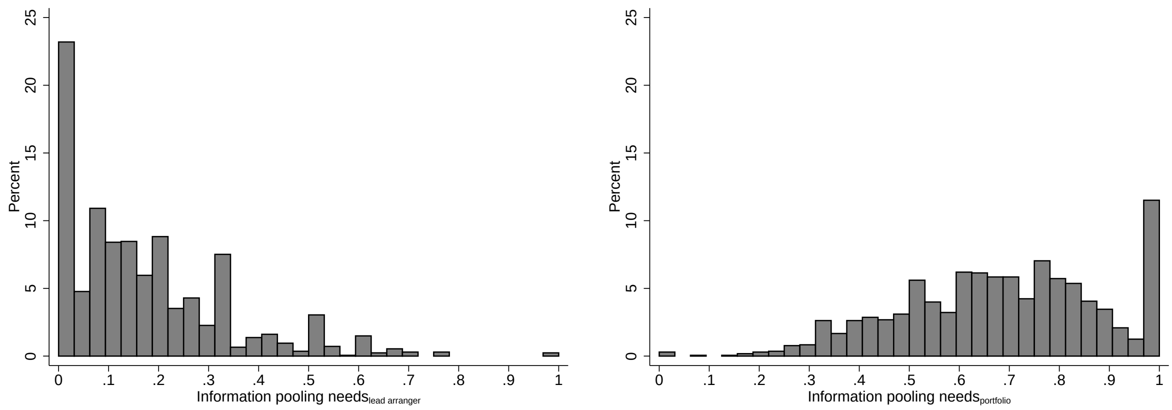
Of course, a lead arranger's information pooling needs also depend on the complementary experience and knowledge with those that are already part of its portfolio of collaborations. In order to measure this complementarity between the lead arranger and its portfolio of collaborations, we measure how different the lead arranger's lending portfolio is with respect to its lead arranger partners. Equation (5) shows how this variable is calculated:

$$\text{Information pooling needs}_{\text{portfolio}} = \sum_j \frac{\left|\text{Number PF Loans}^{\text{Lead arranger}}_{\tau-1,j} - \text{Number PF Loans}^{\text{Portfolio}}_{\tau-1,j}\right|}{\text{Number PF Loans}^{\text{Lead arranger}}_{\tau-1} + \text{Number PF Loans}^{\text{Portfolio}}_{\tau-1}}, \quad (5)$$

where Number PF $\text{Loans}^{\text{Lead arranger}}_{\tau-1,j}$ refers to the number of project finance loans in industry j arranged by the lead arranger in the previous five-year period and Number PF $\text{Loans}^{\text{Bank}}_{\tau-1,j}$ refers to the number of project finance loans in industry j arranged by the lead arranger's portfolio of collaborations over the same time.

Table 3 shows that over the sample period from 1992 and 2014, the average lead arranger has a lending portfolio that is 68.3% complementary to that of its lead arranger collaboration portfolio. Figure 2(b) shows us the underlying distribution and demonstrates that whereas less than 1% of all lead arranger collaboration portfolios is not complementary at all (resulting in a score equal to zero), approximately 12% of all collaboration portfolios is perfectly complementary (resulting in a score equal to one).

Figure 2: Distribution of our two key independent variables: Information pooling $\text{needs}_{\text{lead arranger}}$ and Information pooling $\text{needs}_{\text{portfolio}}$



(a) Information pooling $\text{needs}_{\text{lead arranger}}$ **(b)** Information pooling $\text{needs}_{\text{portfolio}}$

4.5 Controlling for the scale of operations

More active lead arrangers are likely to collaborate with more lead arranger partners, including new partners. Therefore, we account for how active lead arrangers are in a given year, by including as a control the count of project finance loans arranged by a lead arranger.[4] Table 3 shows that the average lead arranger in our sample takes on between one and 68 project finance loans in any given year between 1992 and 2014. But given that project finance loans are capital-intensive and lengthy loans, it is no surprise that the average lead arranger only manages about five new project finance loans each year.

[4] Results remain robust when accounting for the U.S. dollar value of loans arranged instead of the count of project finance loans.

Table 2: Main variable definitions

Information Pooling	
New Lead Arranger Partners	This is the number of syndicate partners in a lead arranger's collaboration portfolio identified as new. Partners are categorized as new when they have not co-arranged any project finance loans with the focal bank in the previous five years.
New Lead Arranger Partner Distance	This is the average distance a bank is willing to search in order to find new partners. It is calculated as follows: $\text{New Lead Arranger Partner Distance} = \left\{ \sum_{i=1}^{N} \frac{\text{Distance}_i}{\text{Maximum Distance} + 1} \times \mathbb{1} + \text{M} \right\} \times \frac{1}{\text{N+M}}$ where Distance_i is the *degrees of separation* between the focal bank and the new partner bank i in time t-1; Maximum Distance is the maximum degree of separation between the focal bank and any other bank within its extended network; $\mathbb{1}$ is an indicator variable equal to one when the focal bank partners with new banks within its extended network and zero otherwise; and M is the count of new partners from other bank clusters beyond the focal bank's extended network.
Proportion of Unreachable New Lead Arranger Partners	This is the ratio of the count of unreachable new syndicate partners to the count of all new syndicate partners. Unreachable new syndicate partners do not have any "common banks" with the focal bank.
Unreachable New Lead Arranger Partners (Dummy)	This is a dummy variable equal to one if lead arrangers collaborate with at least one unreachable new syndicate partners.
Information Pooling Needs	
Information pooling needs$_{\text{lead arranger}}$	This is the change in lending specialization of focal bank between the current five-year moving window (τ) and the previous five-year moving window ($\tau - 1$). It is calculated as the absolute sum of the difference in the number of loans issued per sector between $\tau - 1$ and τ over the sum of all loans issued during both time periods: $\text{Information pooling needs}_{\text{bank}} = \sum_j \frac{\left\| \text{Number PF Loans}_{\tau,j} - \text{Number PF Loans}_{\tau-1,j} \right\|}{\text{Number PF Loans}_{\tau-1 \text{ to } \tau}}$ where Number PF Loans is the count of project finance loans arranged by each bank. The subscript j refers to each of the ten different industry classifications a project can be classified into, and τ refers to the five-year moving window of each bank's lending activity.
Information pooling needs$_{\text{portfolio}}$	Difference in the specialization between the focal bank and its lead arranger collaboration portfolio's lending specialization. It is calculated as the absolute sum of the difference between the number of loans issued by the focal bank in a specific sector and the number of loans issued by its network of collaborations in the same sector divided over the total number of loans issued by them altogether: $\text{Information pooling needs}_{\text{portfolio}} = \sum_j \frac{\left\| \text{Number PF Loans}^{\text{Bank}}_{\tau-1,j} - \text{Number PF Loans}^{\text{portfolio}}_{\tau-1,j} \right\|}{\text{Number PF Loans}^{\text{Bank}}_{\tau-1} + \text{Number PF Loans}^{\text{portfolio}}_{\tau-1}}$ where the $\text{Number PF Loans}^{\text{Bank}}_{\tau-1,j}$ refers to the number of project finance loans in industry j arranged by the focal bank in the previous time period and Number PF $\text{Loans}^{\text{portfolio}}_{\tau-1,j}$ refers to the number of project finance loans in industry j arranged by the focal bank's portfolio of collaborations in the previous time period.
Controls	
Number PF Loans	Number of project finance loans arranged by the focal bank at time t. We use this as a control because the dependent variable is the number of new syndicate partners which increases with the number of loans the focal bank arranges.

Unless otherwise indicated, all variables are measured from t-5 through t-1.

Table 3: Summary statistics

Variable	Mean	Median	Std. Dev.	Min	Max
Information Pooling					
New Lead Arranger Partners	7.762	5.000	7.251	1.000	46.000
New Lead Arranger Partner Distance	0.837	0.833	0.143	0.453	1.000
Proportion of Unreachable New Partners	0.282	0.303	0	1	1677
Unreachable New Partners (Dummy)	0.671	0.47	0	1	1677
Information Pooling Needs					
Information pooling needs$_{\text{lead arranger}}$	0.172	0.136	0.165	0.000	1.000
Information pooling needs$_{\text{portfolio}}$	0.683	0.690	0.200	0.000	1.000
Controls					
Number PF Loans	5.521	3.000	7.069	1.000	68.000

The unit of observation is the lead arranger collaboration portfolio level. The data set consists of 25,207 possible yearly lead arranger collaboration portfolios, for which only 1,677 are active arrangers in at least two consecutive years between 1992 and 2014. Hence the sample contains 1,677 lead arranger collaboration portfolio observations. For each lead arranger collaboration portfolio, we report the main explanatory variables used in the econometric models. See Table 2 for variable definitions.

5 Results

In order to establish the impact of information pooling needs on lead arrangers opting to collaborate with new partner banks, we first test our two hypotheses. Subsequently, we delve into two aspects related to both hypotheses in more detail. First, we explore the most extreme way lead arrangers connect to new partners: by collaborating with a lead arranger with whom there are no network connections. We refer to such lead arranger partners as *unreachable* new partners because they are not in any way linked to the lead arranger. Second, we assess whether there are scale economies in information pooling through new partner collaborations by exploring what determines how many of these unreachable new partners a lead arranger collaborates with when pooling information.

5.1 Model 1: information pooling needs

We start by assessing how lead arrangers' need to pool information when arranging loans for projects in unfamiliar industries drives them to start new lead arranger partnerships. To this purpose, we use a Poisson regression to estimate equation (1) and summarize our findings in Table 4 and Figure 3. We report these results in column (1) of Table 4. In line with our first hypothesis, we find that lead arrangers indeed reach out to new partners when faced with this information pooling need.

We then consider whether a lead arranger with a portfolio of collaborations already complementing its informational capital is less inclined to start new partnerships. We report the corresponding results in column (2) of Table 4. Again in line with our first hypothesis, we find that lead arrangers reach out to fewer new partners when their existing portfolio of collaborations already contains complementary information capital. Finally, we combine both information pooling determinants and report them in column (3) in Table 4.

For the analysis of the *economic* strength of both effects, we focus on the results obtained from estimating the complete model (3), the corresponding incidence rate ratios (4), and the impact of a one standard deviation change in a lead arranger's information pooling needs (5).

To interpret the positive and significant coefficient for Information pooling$_{\text{lead arranger}}$ in column (3), recall that arranging loans in 'new' sectors means lead arrangers are not able to leverage their existing informational capital and thus face a knowledge gap. By pooling information through new partner banks, they may be able to narrow this gap. Indeed, lead arrangers having to arrange project finance loans in different sectors than those in which they have experience collaborate with 48.9% more new partners, as the 1.489 incidence ratio[5] in (4) for Information pooling$_{\text{bank}}$ demonstrates. If we consider that the average lead arranger in our sample works with 7.762 new partners, an increase of 48.9% in new collaborations translates into almost four new partners being added to its portfolio of collaborations. Similarly, when a lead arranger has a loan portfolio that changes by one standard deviation (or by 0.165) -in terms of industry specialization- it will collaborate with an average of 6.8% new partners, holding all other variables constant.

In order to understand how arranging loans in different sectors actually determines the number of new syndicate partners, we refer to Figure 3(a). In this figure, we depict the extent to which a bank arranges loans in unfamiliar sectors (horizontal axis) and the predicted number of new syndicate partners with whom a bank collaborates

[5] Incidence rate ratios are calculated by exponentiating the coefficients in (3) in Table 4, which are reported in log form.

Table 4: Information pooling through new lead arranger partners

	New Lead Arranger Partners Poisson Regression				
	Coefficient estimates			Incidence rate ratio	Incidence rate ratio σ_x
	(1)	(2)	(3)	(4)	(5)
Information pooling needs$_{\text{lead arranger}}$	0.403***		0.398***	1.489	1.068
	[0.061]		[0.061]		
Information pooling needs$_{\text{portfolio}}$		-0.280***	-0.271***	0.763	0.947
		[0.065]	[0.065]		
Number PF Loans	0.039***	0.038***	0.038***	1.034	1.038
	[0.001]	[0.001]	[0.001]		
Constant	1.684***	2.012***	1.935***		
	[0.289]	[0.295]	[0.295]		
Bank fixed effects	Yes	Yes	Yes		
Observations	1677	1677	1677		
Pseudo-R^2	0.273	0.271	0.274		

We estimate the relationship between pooling information needs and new partner collaborations using a Poisson regression. Estimation results in columns (1) through (3) correspond to Poisson regressions, where (1) concerns the effect of a lead arranger's change in lending specialization on its pooling information through new partnerships, (2) concerns the effect of a lead arranger's existing pool of information on it pooling more information through new partnerships, and (3) is the complete model. The results presented in (4) correspond to the exponentiated coefficient obtained from estimating the full model, that is the exponentiated values presented in (3). The results presented in (5) correspond to the exponentiated coefficients from (3) multiplied times the standard deviation of each corresponding independent variable. The dependent variable is the number of New Lead Arranger Partners. Bank fixed effects included in the regressions. Standard errors are shown in brackets. We use *, **, and *** to denote significance at the 1%, 5% and 10% levels respectively.

(vertical axis). In line with the positive and significant estimated coefficient for Information $\text{pooling}_{\text{bank}}$ reported in (3) in Table 4, lead arrangers collaborate with new partners at higher rates when arranging loans in sectors new to them. Thus, enlarging their information pools. While banks arranging loans in the same sectors (Information $\text{pooling}_{\text{bank}}$=0) have an average of 7.24 new partners, new partners increase to almost eight when Information $\text{pooling}_{\text{bank}}$ is equal to 0.20, and to approximately 11 when Information $\text{pooling}_{\text{bank}}$ is equal to the maximum value of one.

A second reason banks may pool information stems from the overlap in information capital between a bank and its portfolio of collaborations. In essence, lead arrangers holding portfolios of collaborations with different information capital have less of a need to pool additional information through new collaborations. This effect is proxied with the variable Information $\text{pooling}_{\text{portfolio}}$. According to the negative coefficients for Information $\text{pooling}_{\text{portfolio}}$ reported in (2) and (3), when a lead arranger has a portfolio of collaborations with a complementary lending experience in terms of industry specialization, the need to pool information decreases. The incidence ratio of 0.763 for Information $\text{pooling}_{\text{portfolio}}$ reported in (4) indicates that when the overlap in information capital between the focal bank and its portfolio of collaborations is at its highest, the focal bank collaborates with 23.7% fewer new partners. For smaller differences, say 10%, lead arrangers connect with 2.7% fewer new partners, *ceteris paribus*.[6] In the same manner, when the overlap in information capital between the focal bank and its portfolio of collaborations changes by one standard deviation (or 20%), lead arrangers choose to collaborate with 5.3% fewer new partners.

To gain a better understanding of how the overlap in information capital between the focal bank and its portfolio of collaborations determines the number of new syndicate

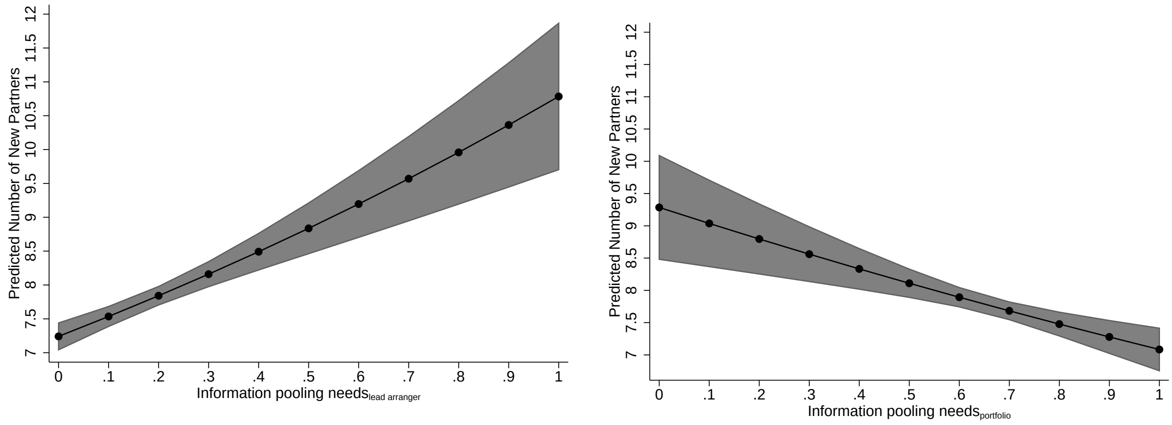
[6] This is calculated as $e^{(\beta_2 \times 0.10)}$.

partners, we turn to Figure 3(a). In this figure, we plot the degree of specialization of a lead arranger with respect to its portfolio of collaborations (on the horizontal axis), and the predicted number of new syndicate partners with whom a bank collaborates (vertical axis). The downward sloping line indicates that as the lending experience of a lead arranger differs more from that of its portfolio of collaborations, the rate at which it will collaborate with new partners decreases. This suggests that the need to pool information through new partner banks decreases when the focal bank's information capital is complemented by that of its portfolio of collaborations. In fact, whereas a lead arranger with a lending specialization most similar to that of its collaborators (Information $\text{pooling}_{\text{portfolio}}$=0) is expected to arrange loans with 9.5 new syndicate partners, a lead arranger with a lending specialization that is the least similar to that of its collaborators (Information $\text{pooling}_{\text{portfolio}}$=1) is expected to arrange loans with about 7.5 new syndicate partners. This difference in the number of new collaborations corresponds to the decrease of 23.7% (incidence rate ratio 0.763) reported in column (4) in Table 4.

Comparing our findings for both Information $\text{pooling}_{\text{bank}}$ and Information $\text{pooling}_{\text{portfolio}}$, we concluded that these results support our first hypothesis. We find that a bank's changing lending specialization appears to be a more important factor determining the number of new bank collaborations. With a 10% change in its lending specialization, the number of new partners changes by 4.89%, whereas a 10% change in the lending of its peers results in a 2.7% change in the number of new partners.

Since the benefits of information pooling need to be balanced against the moral hazard costs lead arrangers are willing to face when pooling information, we proceed by proxying the latter with the distance to new partner banks in order to test our second

Figure 3: Predicted number of new partners.



(a) Predicted number of new partners per changes in Information pooling $\text{needs}_{\text{lead arranger}}$

(b) Predicted number of new partners per changes in Information pooling $\text{needs}_{\text{portfolio}}$

The solid line is the predicted number of new partners the focal bank in our sample has per changes in Information pooling $\text{needs}_{\text{lead arranger}}$ and Information pooling $\text{needs}_{\text{portfolio}}$, ceteris paribus. 95% confidence interval bands in dark gray.

hypothesis.

5.2 Model 2: information pooling efforts

Next, we investigate the lengths at which lead arrangers are willing to go when establishing new partnerships. We estimate equation (2) using a Tobit regression, present the results in Table 5, and illustrate them in Figure 4. The first three columns in Table 5 present the estimated coefficients for the latent new partner distance when accounting for a lead arranger's lending in unfamiliar industries (1), a lead arranger informational capital in comparison to that of its portfolio of collaborations (2), and the complete model (3). Column (4) in Table 5 presents the complete model's marginal effects on the observed new partner distance when all other variables are equal to zero. For inter-

Table 5: Information pooling through distant, new partners

	New Lead Arranger Partner Distance Tobit Regression			
	Latent variable coefficients			Observed variable ME
	(1)	(2)	(3)	(4)
Information pooling needs$_{\text{lead arranger}}$	0.079**		0.080**	0.076**
	[0.033]		[0.033]	[0.032]
Information pooling needs$_{\text{portfolio}}$		0.054	0.056*	0.054*
		[0.034]	[0.034]	[0.032]
Number PF Loans	-0.000	-0.000	-0.000	-0.000
	[0.001]	[0.001]	[0.001]	[0.001]
Constant	0.310**	0.273*	0.258*	0.480***
	[0.136]	[0.140]	[0.140]	[0.005]
Bank fixed effects	Yes	Yes	Yes	
Observations	1677	1677	1677	
LR test: all coefficients = 0 (χ^2)	841.77	838.70	844.52	

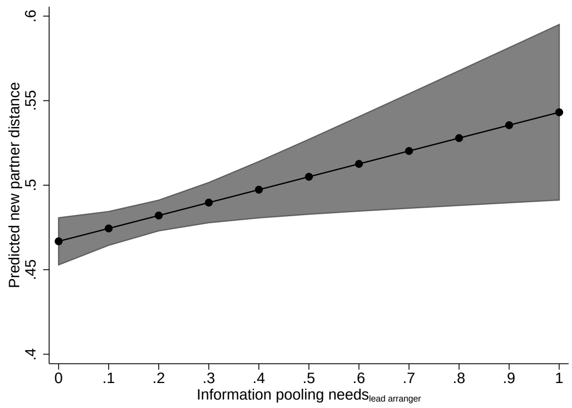
We estimate the determinants of a bank's willingness to reach out to far new partners in order to pool information using Tobit regression maximum likelihood estimates (MLE). Columns (1) through (3) present the estimated coefficients on the latent variable new partner distance for three different estimations. The first and second estimations concern the effect of a bank's search for new partners when its lending specialization changes and when it pools information through its existing collaborations. The complete model is presented in column (3). Column (4) presents the full model's marginal effects on the observed new partner distance when all other variables are equal to zero. The unit of observation is the bank. The dependent variable is the New Partner Distance. Standard errors are shown in brackets. We use *, **, and *** to denote significance at the 1%, 5% and 10% levels respectively. Goodness of fit reported as likelihood ratio chi-squared tests.

pretation purposes, we refer to the estimates reported in column (4).

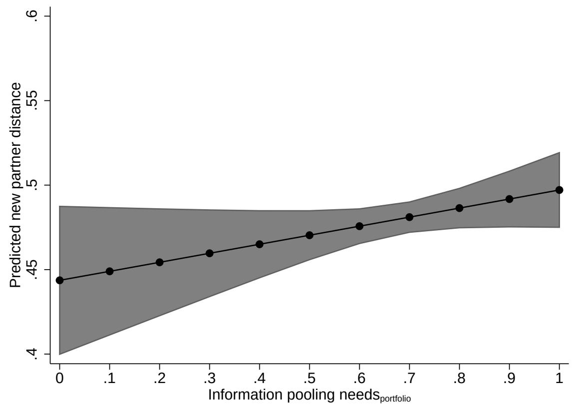
In line with our second hypothesis, we find that banks reach out to more distant new partners when they need to pool information. First, when a bank is unable to leverage its existing information capital because it arranges project finance loans in unfamiliar industries, new partners will join from more distant parts of the project finance syndicated lending network. The positive and significant marginal effect for Information pooling needs$_{\text{lead arranger}}$ in (4) supports this finding. When a bank arranges loans in completely unfamiliar industries -as opposed to arranging loans in only familiar industries- new partner distance changes by 0.076, ceteris paribus. To put that number into perspective, let us switch to Figure 4(a). In this figure, the x-axis shows different values for Information pooling needs$_{\text{lead arranger}}$ and the y-axis shows the predicted new partner distance. A bank not needing to pool information because it only arranges loans in industries in which it has experience (Information pooling needs$_{\text{lead arranger}}$=0) collaborates with new partners who are on average 0.467 further away in the network. This means that such a bank would search almost halfway through the length of the project finance syndication network to search for new partners. However, a bank arranging loans in sectors where its experience is limited to non-existent (Information pooling needs$_{\text{lead arranger}}$=1) collaborates with new partners who are on average 0.543 further away in the network. That is, this bank collaborates with new partners that are more than 16% further away in the network.

A bank may also pool information when the overlap in information capital with its existing portfolio of collaborations is high. The positive and statistically significant coefficient for Information pooling needs$_{\text{portfolio}}$ in column (4) in Table 5 supports this argument. If the information capital of a bank and its existing portfolio of collaborations overlaps, the bank needs to pool information through new partners that are farther away. This distance increases at an average rate of 0.054 as reported in Table 5.

Figure 4: Predicted new partner distance.



(a) Predicted new partner distance per Information pooling needs$_{\text{lead arranger}}$



(b) Predicted new partner distance per Information pooling needs$_{\text{portfolio}}$

This figure charts the predicted distance banks are willing to search when collaborating with new partner banks at different values of information pooling needs, ceteris paribus. The x-axis represents changes in information pooling needs, and the y-axis represents the corresponding predicted distance of new partner banks. 95% confidence interval bands in dark gray.

When the lead arranger has collaborators do not that complement its experience and know-how, the need to pool information should be higher. As a result, it is expected to collaborate with new partners that are further away. Indeed, in Figure 4(a), we observe that lead arrangers having a portfolio of collaborators that specializes in the same sectors form syndicates with new partners that are located further away in its network.[7]

[7] The network distance is 0.44 when Information pooling needs$_{\text{portfolio}}$ = 0 vs. a distance of 0.50 when Information pooling needs$_{\text{portfolio}}$ = 1.

5.3 Why do banks collaborate with new partners outside their existing network?

Some banks within the project finance lending network may not have any network connections, as is the case for banks A and E in Figure 1(c). Indeed, in our sample 28.15% of all possible new partners are out of reach. From a moral hazard perspective, these banks are expected to pose the biggest problem. Nevertheless, banks do connect to these new, formerly 'out of reach' partners. Do lead arrangers accept these potential moral hazard problems because they seek to benefit from lager information pooling opportunities, or simply because the collection of *reachable* banks they can choose from is limited?

We address this question by controlling for the number of potential partners a bank can reach out to. After all, a bank may *have to* search for new partners farther away when its existing pool of partners has been exhausted. We therefore create a variable called % Stock of Collaborations measuring the percentage of banks within reach that are already part of the portfolio of collaborations. When % Stock of Collaborations approaches one, a bank has exhausted the potential partners available within reach and is more likely to reach beyond its network, similar to bank A reaching out to bank E in Figure 1(c). To assess what determines the likelihood that this happens, we create a dichotomous variable equal to one when a lead arranger chooses a new partner that is classified as unreachable and zero otherwise. Table 6 contains our findings when we explain this variable using both the need for pooling information and the % Stock of Collaborations. Columns (1) through (3) present the log odds coefficients from estimating a Logit regression, where (3) presents the results for the full model. Column (4) contains the corresponding odds ratios for the full model in (3). To explain the direction of the effects, we will focus on (3). To explain the economic meaning of the effects, we will focus on (4).

We again find supporting evidence for our information pooling efforts hypothesis. According to the results presented in Table 6, banks are indeed more prone to collaborate with unreachable partners when arranging project finance loans in sectors outside their specialization. Such a need to pool information is reflected in a positive and significant log odds for Information pooling needs$_{\text{lead arranger}}$. The log odds equal to 1.327 in (3) indicate that when a lead arranger's lending specialization changes by one or 100%, the log odds of collaborating with unreachable new partners increase by 1.327 -or the odds increase by 3.769, see (4). However, once we control for a lead arranger's stock of collaborations, the extent to which its portfolio of collaborations offer complementary know-how is no longer a determinant for this form of information pooling.

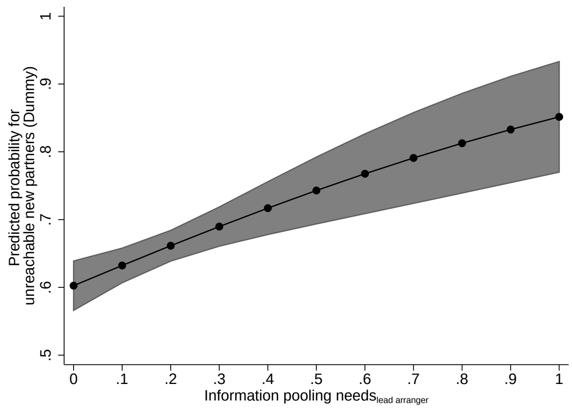
To further investigate how different levels of Information pooling needs$_{\text{lead arranger}}$ affect the probability of a lead arranger collaborating with new partners outside its network, we include Figure 5(a). In the figure, the x-axis represents different levels of Information pooling needs$_{\text{lead arranger}}$ and the y-axis represents the predicted probability of collaborating with new partners outside the network. While the average predicted probability of a lead arranger choosing to collaborate with unreachable new partners is equal to 74%, the likelihood at which new partners outside the network are chosen increases rapidly with a lead arranger's need to pool information due to its own gap in industry-specific know-how. When a lead arranger does not need to pool information because it arranges loans in familiar sectors (Information pooling needs$_{\text{lead arranger}}$ = 0), the probability of picking new partners outside the network is 60%. As information pooling needs increase, this probability increases, reaching 85% when Information

Table 6: Information pooling through new partners previously outside the network

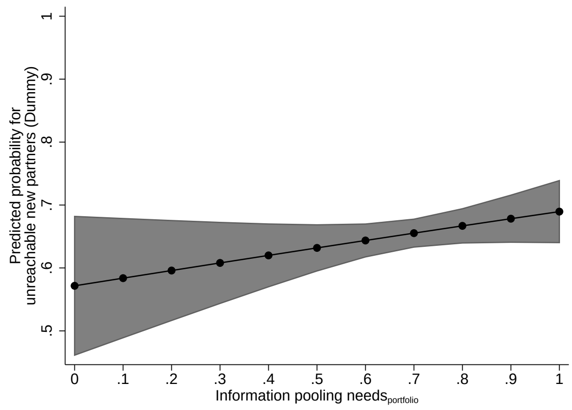
	Unreachable new lead arranger partners (dummy) Logit Regression			
	Log Odds			**Odds Ratio**
	(1)	(2)	(3)	(4)
Information pooling needs$_{\text{lead arranger}}$	1.660***		1.682***	5.375
	[0.468]		[0.470]	[2.527]
Information pooling needs$_{\text{portfolio}}$		0.644	0.684	1.981
		[0.448]	[0.451]	[0.894]
Number PF Loans	0.228***	0.239***	0.234***	1.264
	[0.030]	[0.031]	[0.030]	[0.038]
% Stock of Collaborations	3.533***	3.687***	3.701***	40.486
	[1.188]	[1.206]	[1.204]	[48.739]
Bank fixed effects	Yes	Yes	Yes	
Observations	1330	1330	1330	
Pseudo-R^2	0.213	0.206	0.214	
LR test: all coefficients = 0 (χ^2)	364.76	353.71	367.07	

We estimate the determinants of a bank pooling information by syndicating with new partners previously outside the network using a Logit regression maximum likelihood estimates (MLE). Columns (1) through (3) present the log odds estimates for the effect of a bank's search for new partners previously outside the network when its lending specialization changes (1) and when it pools information through its existing collaborations (2). The complete model is presented in column (3). Column (4) reports the odds ratios corresponding to the log odds coefficients reported in (3). The unit of observation is the bank. The dependent variable is a dichotomous variable equal to one when a bank collaborates with at least one new partner previously outside the network and zero otherwise. Standard errors are shown in brackets. We use *, **, and *** to denote significance at the 1%, 5% and 10% levels respectively.

Figure 5: Predicted probabilities of collaborating with new partner banks outside the existing network.



(a) Predicted probability of collaborating with unreachable new partner banks per Information pooling needs$_{\text{lead arranger}}$



(b) Predicted probability of collaborating with unreachable new partner banks per Information pooling needs$_{\text{portfolio}}$

This figure charts the predicted probabilities of banks collaborating with new partners previously outside the network at different values of information pooling needs, ceteris paribus. The x-axis represents changes in information pooling needs, and the y-axis represents the corresponding predicted probabilities. 95% confidence interval bands in dark gray.

pooling $\text{needs}_{\text{bank}} = 1$.

These results provide further evidence that lead arrangers carefully balance the costs and benefits of collaborating with new partner banks. In this particular case, where new partners may be of particular concern given the expected moral hazard problems, lead arrangers indeed only reach out if the need to pool information from the lead arranger itself.

5.4 If, then how many?

Given that banks are willing to collaborate with new partner banks from whom a referral cannot be obtained, how many of the new collaborators are in fact outside its existing network?

In order to find out what determines the extent to which banks are willing to pursue this strategy, we estimate a series of regressions where the dependent variable is the ratio of the number of new partners outside the network and the total number of new partner banks. We call this variable Proportion of Unreachable New Partners. We include our key independent variables, Information pooling $\text{needs}_{\text{lead arranger}}$ and Information pooling $\text{needs}_{\text{portfolio}}$, two controls, Number of PF Loans and % Stock of Collaborations, as well as bank fixed effects. Because our dependent variable ranges between zero and one, we estimate the effect on Proportion of Unreachable New Partners using both Tobit and GLM regressions. We present our results in Table 7.

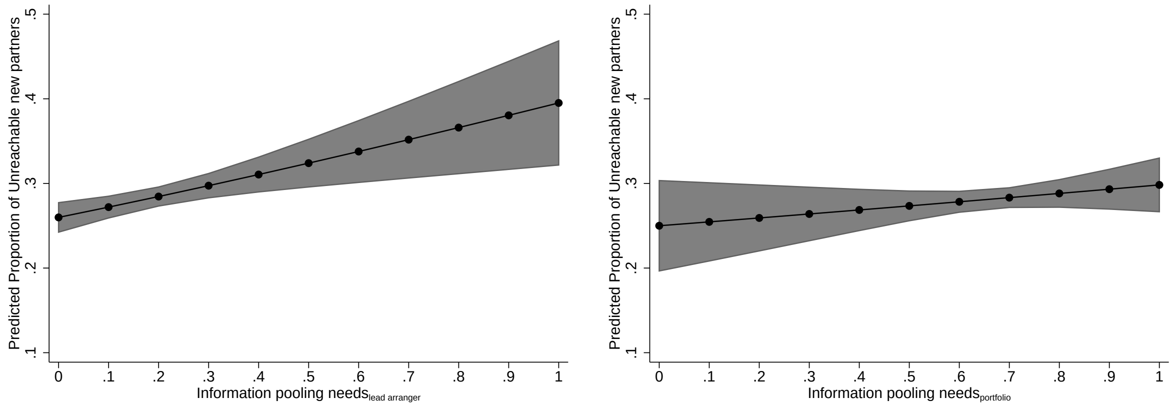
The need to pool information not only pushes lead arrangers to reach further into their network for new partners, but also increases the share of new partners that were previously outside that network, as shown by the positive and significant coefficients for

Table 7: Information Pooling

	Proportion of New Lead Arranger Partners Previously Outside the Network					
	Tobit Regression			**GLM Regression**		
	Latent variable coefficients			**Coefficient estimates**		
	(1)	(2)	(3)	(4)	(5)	(6)
Information pooling needs$_{\text{lead arranger}}$	0.237***		0.239***	0.754***		0.762***
	[0.066]		[0.066]	[0.237]		[0.236]
Information pooling needs$_{\text{portfolio}}$		0.078	0.085		0.273	0.298
		[0.068]	[0.068]		[0.263]	[0.264]
Number PF Loans	-0.002	-0.001	-0.001	-0.016***	-0.015***	-0.015***
	[0.002]	[0.002]	[0.002]	[0.005]	[0.006]	[0.006]
% Stock of Collaborations	1.343***	1.338***	1.354***	5.080***	5.054***	5.123***
	[0.158]	[0.159]	[0.158]	[0.569]	[0.571]	[0.574]
Constant	-0.162	-0.185	-0.241	-2.668***	-2.782***	-2.947***
	[0.284]	[0.288]	[0.291]	[0.651]	[0.774]	[0.693]
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1677	1677	1677	1677	1677	1677
LR test: all coefficients = 0 (χ^2)	919.96	908.43	921.51			
Pseudo-R^2	0.348	0.344	0.349			
AIC				1.186	1.188	1.187
BIC				-9315.769	-9313.004	-9308.827

We estimate the determinants of a bank pooling information by arranging project finance loans with new partners previously outside its network using Tobit and GLM regression maximum likelihood estimates (MLE). We present six different estimations in columns (1) through (6). Columns (1) through (3) correspond to our Tobit regressions and columns (4) through (6) correspond to our GLM regression estimates. The first and second estimations, reported in columns (1), (4), (2) and (5) concern the effect of a bank's change in lending specialization and its pooled information on it pooling more information through collaborations with new partners outside the network, respectively. The results from estimating our complete model are reported in columns (3) and (6). The unit of observation is the bank. The dependent variable is the ratio of the number of new partners outside the network and the total number of new partner banks. Standard errors are shown in brackets. We use *, **, and *** to denote significance at the 1%, 5% and 10% levels respectively.

Figure 6: Predicted proportion of new partners previously outside the network.



(a) Predicted proportion of new partners previously outside the network per Information pooling $\text{needs}_{\text{lead arranger}}$

(b) Predicted proportion of new partners previously outside the network per Information pooling $\text{needs}_{\text{portfolio}}$

This figure charts the predicted proportion of new partners previously outside the network with whom lead arrangers collaborate at different values of information pooling needs, ceteris paribus. The x-axis represents changes in information pooling needs, and the y-axis represents the corresponding predicted probabilities. 95% confidence interval bands in dark gray.

Information pooling needs$_{\text{lead arranger}}$ in columns (1), (3), (4) and (6). Meanwhile, the stock of information already gathered in its network, as proxied by Information pooling needs$_{\text{portfolio}}$ has no significant impact. Instead, lead arrangers' willingness to reach out to new partners outside their network increases with their lending activity (Number PF Loans) and the number of potential partner banks the lead arranger can reach (% Stock of Collaborations). Finally, the positive and significant coefficient for the % Stock of Collaborations confirms that, as expected, banks that already collaborate with more banks within their reach are more likely to subsequently connect outside their existing network.

6 Robustness tests

6.1 Robustness across sample periods

Given that our analyses include observations from a period when DealScan's coverage is limited (Carey and Nini, 2007; Kleimeier and Chaudhry, 2015) as well as the latest financial crisis period, we examine the robustness of our results to the exclusion of these two time intervals. Hence, we re-estimate equations (1) and (2) using two different samples. One sample consists of 1,564 banks arranging project finance loans between 1997 and 2014, thus excluding the first years of ur full sample, when DealScan coverage arguably is less complete. The second sample consists of 916 banks arranging project finance loans between 1992 and 2007, excluding the latest financial crisis. We exclude the latest financial crisis period because uncertainty and risk influence the rate at which banks collaborate with each other (Hale, 2012; Lee and Mullineaux, 2004; Minoiu and Reyes, 2013), and hence may influence our results.

The results are presented in Table 8. Results in (1) and (3) report the Poisson regression estimates for the Number of New Partners in years 1997-2014 and 1992-2007, respectively. Results in (2) and (4) report the Tobit regression estimates for the distance of new partners in years 1997-2014 and 1992-2007, respectively.

The estimated coefficient for Information pooling needs$_{\text{lead arranger}}$ remains robust with a positive and significant value throughout the two chosen sample periods for both estimated regressions. Notwithstanding, Information pooling needs$_{\text{portfolio}}$ remains a robust determinant for information pooling through new syndicate partners only when excluding the first coverage years of DealScan (1). However, it is not an important determinant for information pooling during periods of financial stability (2). During such periods, lead arrangers collaborate with new partners mostly because of their own limited informational capital. Furthermore, during periods of financial stability, lead arrangers are more prone to also collaborate with new partners that are located farther away in the project finance lending network (4) even if their portfolio of collaborations offers complementary know-how. In essence, the potential moral hazard problems that new and distant partners pose is not a problem to lead arrangers having an informationally-complementary portfolio of collaborations during financially stable periods of time.

6.2 Robustness across loan arranging activity

In this second robustness analysis we address an issue that may have confounded our results so far: if arranging more loans simply means having more new lead arrenger partners, then our findings so far may lead us to overestimate the importance of pool-

Table 8: Information Pooling in two sample periods: 1997-2014 and 1992-2007

	New Lead Arranger Partners		**New Lead Arranger Partner Distance**	
	Poisson Regression		**Tobit Regression**	
	Coefficient estimates		**Latent variable coefficients**	
	1997-2014	**1992-2007**	**1997-2014**	**1992-2007**
	(1)	(2)	(3)	(4)
Information pooling needs$_{\text{lead arranger}}$	0.419***	0.251***	0.059*	0.1116***
	[0.066]	[0.082]	[0.034]	[0.045]
Information pooling needs$_{\text{portfolio}}$	-0.351***	-0.025	0.020	0.092**
	[0.073]	[0.087]	[0.036]	[0.043]
Number PF Loans	0.037***	0.069***	0.001	-0.000
	[0.001]	[0.002]	[0.001]	[0.002]
Constant	2.006***	1.703***	0.294**	0.218
	[0.297]	[0.300]	[0.135]	[0.139]
Bank fixed effects	Yes	Yes	Yes	Yes
Observations	1564	916	1564	916
Pseudo-R^2	0.2898	0.3488		
LR test: all coefficients = 0 (χ^2)	4238.50	3200.46	839.01	532.49

We estimate the determinants of a bank pooling information when the bank is either highly active in arranging loans or not using Poisson and Tobit regression estimates. We present four different estimations in columns (1) through (4). Columns (1) and (2) correspond to our Poisson regressions and columns (3) and (4) correspond to our Tobit regression estimates. The first and third estimations, reported in columns (1) and(3) concern the effect of information pooling in later years of our sample, and the second and fourth estimations reported in columns (2) and (4) respectively, concern the effect of information pooling in periods without financial distress. Standard errors are shown in brackets. We use *, **, and *** to denote significance at the 1%, 5% and 10% levels respectively.

Table 9: Information Pooling across two samples of loan arranging activity: higher than 50th percentile (High), and lower than 50th percentile (Low)

	New Syndicate Partners		New Partner Distance	
	Poisson Regression		Tobit Regression	
	Coefficient estimates		Latent variable coefficients	
	High	Low	High	Low
	(1)	(2)	(3)	(4)
Information pooling needs$_{\text{lead arranger}}$	0.269***	0.315***	0.131***	0.063
	[0.089]	[0.105]	[0.046]	[0.049]
Information pooling needs$_{\text{portfolio}}$	-0.367***	-0.079	0.009	0.146***
	[0.093]	[0.114]	[0.046]	[0.050]
Number PF Loans	0.027***	0.229***	0.000	-0.010
	[0.001]	[0.023]	[0.001]	[0.011]
Constant	2.306***	1.582***	0.554***	0.187
	[0.085]	[0.309]	[0.045]	[0.150]
Bank fixed effects	Yes	Yes	Yes	Yes
Observations	726	951	726	951
Pseudo-R^2	0.230	0.267		
LR test: all coefficients = 0 (χ^2)	1633.87	1719.33	378.42	654.52

We estimate the determinants of a bank pooling information when the bank is either highly active in arranging loans or not using Poisson and Tobit regression estimates. We present four different estimations in columns (1) through (4). Columns (1) and (2) correspond to our Poisson regressions and columns (3) and (4) correspond to our Tobit regression estimates. The first and third estimations, reported in columns (1) and(3) concern the effect of high loan arranging activity on information pooling, and the second and fourth estimations reported in columns (2) and (4) respectively, concern the effect low loan arranging activity on information pooling. Standard errors are shown in brackets. We use *, **, and *** to denote significance at the 1%, 5% and 10% levels respectively.

ing information.

We test this alternative explanation by re-estimating equations (1) and (2) using two different samples. The first sample is composed of the 726 banks arranging more than the 50th percentile in the number of project finance loans in our sample and the other sample is composed of banks arranging fewer loans than the 50th percentile.[8] The results from our estimations are reported in Table 9. Results for the first sample are reported in columns (1) and (3) and are labeled *High* and the results for the second sample are reported in columns (2) and (4) and are labeled *Low*.

Hence, do lead arrangers arranging more loans influence the extent to which we observe more new partnerships being formed? The results presented in Table 9 in (1) and (2) show no evidence for this claim. In essence, we find that whether the number of project finance loans they arrange is in the above or below the median, lead arrangers pool information through new syndicate partners when arranging project finance loans in unfamiliar industries. The positive and significant coefficients for Information pooling $\text{needs}_{\text{lead arranger}}$ in (1) and (2), support this finding. When lead arrangers have a collaboration portfolio offering complementary experience and know-how, they have fewer new syndicate partners. However, while the information pooled through a lead arrangers' collaboration portfolio influences its decision to work with new partners, this only matters when the lead arranger is more active in arranging project finance loans (1).

Regarding how much moral hazard lead arrangers are willing to accept by collaborating with distant new partners, we find that our results remain partially robust with the exception of lead arrangers responsible for arranger fewer than the median

[8] The 50th percentile in the number of project finance loans arranged per bank in our sample is equal to three.

number of project finance loans (4). Under this scenario, lead arrangers seem to go to greater lengths when searching for new partners even if their portfolio of collaborations already offers non-overlapping know-how. However, this does not refute the idea that less active lead arrangers pool less information. In fact, they pool information at higher rates.

7 Conclusion

In this paper, we have explored the extent to which banks active as lead arrangers in the project finance syndicated lending market strategically choose their new partners in order to pool information, thereby lowering the overall degree of asymmetric information between themselves and their clients. Partner selection is of particular importance in a market like this with high risks and opaque borrowers, where traditional tools to lower the (impact of) asymmetric information between borrower and leander such as collateral and credit ratings are often of little or no use.

We find that the need to pool information explains why banks choose to collaborate in a loan syndicate with new partners, why they reach further into their network to find these new partners and why they even go outside their existing network if the need to pool information is high enough. Banks active in the project finance syndicated lending market pool information when they finance projects in new sectors and when their existing partners' lending portfolios are concentrated in the same sectors as their own. Consequently, in a syndicated setting, project finance lending appears to be a relationship market with rather complex debt structures, where banks collaborate with the purpose of leveraging each other's know-how when screening and monitoring.

As a result, the findings in this paper, provide an important and thus far largely missing piece of the lending puzzle: in addition to the traditional contract design and monitoring tools of banks, and complementary to relationship lending, strategic alliances in a syndicated setting appear to provide banks with another means of dealing with opaque, risky borrowers.

At the same time, our findings also give rise to new avenues for future research. For example, we can also explore how market information asymmetries affect the length of the new partnerships created in the syndicated lending market. Are banks more inclined to sustain new partnerships for a longer time as a way to strategically mitigate further moral hazard problems? Finally, our data and previous research in loan syndication show the existence of a home bias in lending when market information asymmetries rise (Giannetti and Laeven, 2012; Ivashina and Scharfstein, 2010). Hence, future research should more closely examine home bias reversals through the creation of new syndicate partnerships. Are banks more likely to partner with the more reputable foreign banks because they signal lower moral hazard?

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