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Competition between arm's length and relational lenders: Who wins the contest?☆

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ABSTRACT

Using geo-coded data with the location of bank branches and borrowers, we study the effect of bank competition on lending. The impact of competition depends on the incumbent's and the entrant's lending technologies. The addition of a relational lenders' branch increases the probability of exit of and reduces the size of loans issued by all types of incumbents, while the opening of a branch by an arm's length lender only affects the probability of exit from arm's length incumbents. We believe relational lenders can compete more effectively by extracting and using private information unavailable to arm's length entrants.

1. Introduction

To date, most of the empirical work studying bank competition has assumed that all banks use the same lending technology. Banks are, however, diverse in their approaches. Stein (2002), for example, motivated by the observation that banks tend to cut back on small-business lending after mergers, argues that relationship lending requires decentralized authority and decision-making that are incompatible with large organizations. These types of organizational differences might also affect how banks react to competition. Thus, fully understanding the implications of banking market competition requires asking the question: competition from whom?

In this paper, we show that lending technology has a crucial role in answering this question. In particular, relational lenders compete stronger and are at the same time better equipped to fight back competitors relative to arm's length lenders. Specifically, the opening of a branch with relational lending technology, i.e., one that makes lending decisions based on soft information collected by

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trained loan officers at the business site (Stein 2002), increases the probability of exit and reduces the size of loans issued by both relational lending and arm's length lending incumbents. In contrast, the opening of a branch by an arm's length lender only affects the probability of exit from arm's length incumbents. These results suggest that relational lenders can use their soft information technology to obtain proprietary information about borrowers and can use this information to capture part of the market. Arm's length entrant lenders only rely on publicly available information and, hence, represent less of a threat to existing lenders.

Our results are consistent with the fast proliferation of FinTech in developed countries, where lending relies mostly on credit bureau information available to the incumbent as well as the (arm's length) FinTech entrant. As expected from our results, the proliferation of FinTech[1]has been much slower in developing countries that still rely heavily on relational lenders, which are well equipped to defend themselves from (arm's length) FinTech competition.

Our analysis also allows us to understand whether the entrant initiates additional borrowing or just crowds out borrowing from incumbents ("substitution"). We distinguish these effects by using two measures of distance: the distance between the entrant and existing branches and the distance between the entrant and existing borrowers. Since we expect that additional lending to borrowers located near the entrant branch would be larger, the distance between the entrant and existing borrowers being irrelevant would suggest additional lending is negligible.

Our findings suggest that arm's length entrants neither crowd out existing lending nor initiate additional lending, while relational lending entrants not only crowd out existing lending but also initiate new lending. Specifically, when a new relational lending bank branch opens, both the distance with existing banks and the distance with existing borrowers are relevant for explaining lending by incumbent branches. In contrast, when a new arm's length bank branch opens, these distances are not relevant for explaining lending by incumbent branches.

Consistent with the explanation that it is the ability to obtain soft information that makes a new entrant competitive, we find that the location of a new relational lender strongly affects its ability to compete. Increasing the distance between the entering relational lender and the incumbent bank from zero to one kilometer reduces the effect on the intensive margin of credit from −14.2 to −6.1 percent, and reduces the effect on the extensive margin of credit from −2.3 to −1.0 percent. However, the distance between an arm's length entrant and the incumbent bank is irrelevant. We believe that since arm's length banks rely on public information to make lending decisions, their proximity to the borrower does not improve their ability to compete.[2]

We are the first to explore these challenging questions empirically. Most extant literature relies on competition changes due to regulatory overhauls that affect the entire banking sector and do not take into account the technology of competing banks. We employ a research design that combines local variation in competition by banks with different technologies induced by the opening of new bank branches of existing banks. In our setup, we can use saturated regressions to account for concurrent firm-level shocks. Intuitively, our analysis compares how the same firm's credit from bank A, whose branch is closer to the competing new branch of bank C, changes relative to credit from bank B, whose branch is farther away from the new branch of bank C. The underlying theoretical assumption is that distance matters for competition. The empirical identification assumption is that the exact location of the new branch, (e.g., whether it is close to the branch of bank A or bank B), is uncorrelated with the firm's relative demand for credit from bank A and bank B.

This paper contributes to the expanding literature on the role of distance in banking. Petersen and Rajan (2002) report that the development in information technology increases the distance between banks and borrowers and reduces the role of physical banking. However, Brevoort and Hannan (2006) argue that the increase in firm-to-branch distance is only happening at the high end of the distribution; for small banks and with small businesses, distance still plays an important role in lending. As shown in Degryse and Ongena (2005) and Agarwal and Hauswald (2010), access to bank credit, particularly for small businesses, declines as the distance between the bank and borrower grows. In addition, Herpfer et al. (2021) takes advantage of the construction of new infrastructure and finds that the resulting reduction in distance increases the likelihood of initiating a new borrowing relationship. We complement these papers by introducing the distance between bank branches as an additional variable in this analysis. It turns out that this distance is crucial in explaining lending patterns.

Our paper also relates to a series of[3] papers that study the effect of competition in local credit markets.

For example, it complements the analysis in[4] Guiso et al. (2004) about the effect of bank concentration on financial outcomes by introducing a dynamic component into the analysis. Documenting that the effect of competition strongly depends on the incumbents' and entrants' lending technologies also complements theoretical and empirical work about the link between competition and bank-borrowers' information asymmetry (Petersen & Rajan 1995, Stein 2002, Hauswald & Marquez 2006, Degryse & Ongena 2007, Agarwal & Hauswald 2008, Gropp & Guettler 2018, de Haas et al. 2021). This literature suggests that relational lenders invest more in soft information generation in more competitive banking markets and that more intense local bilateral competition increases credit constraints for small firms. Our paper also contributes to understanding how changes in market structure that might affect banks' size,

[1] See, for example, the vast literature that studies the consequences of the U.S. banking sector deregulation (Jayaratne & Strahan 1996, Black & Strahan 2002, Stiroh & Strahan 2003, Demyanyk et al. 2007, Huang 2008, Kerr & Nanda 2009, Beck et al. 2010, Amore et al. 2013, Chava et al. 2013, Cornaggia et al. 2015, Hombert & Matray 2017).

[2] These results support the findings in Agarwal and Hauswald (2010) which suggest firms with closer competing banks are more likely to switch lenders and later become delinquent. They do not, however, distinguish between the lending technology of the banks.

[3] Moreover, Ergungor (2006) and Gilje et al. (2016) demonstrate that physical bank presence also matters for real estate finance.

[4] Beck et al. (2019) show that the probability for a firm to connect to a bank substantially decreases in distance, but that in the case of an Islamic bank, distance plays a less important role.

corporate structure, or technologies could affect market competition. These changes might come from deregulation (Jayaratne & Strahan 1996, Bertr& et al. 2007, Gropp et al. 2014), mergers (Garmaise & Moskowitz 2006, Liebersohn 2021), or bank closures (Nguyen 2019, Bonfim et al. 2021) among other reasons.

This paper is closely related to two complementary papers that investigate the effect of changes in local bank competition on loan outcomes–(Nguyen 2019, Liebersohn 2021). The former paper studies branch closings in the U.S. and finds that merger-induced branch closings reduce local small business lending. The latter paper investigates divestitures in the U.S. and finds that increased competition drives higher deposit rates and increased mortgage refinancing. These findings imply that while a relationship makes it difficult to find alternative borrowing options, it also protects firms from increased competition. Our paper contributes to these findings by explicitly studying the effect of increased competition due to branch openings on firms[5] borrowing from banks with different lending technologies.

2. Theoretical background

The importance of firm-to-bank distance is driven by two main reasons: borrowers' transportation costs and lenders' expenditures to overcome asymmetric information. Location differentiation models (Salop 1979) imply that borrowers face transportation costs from visiting their bank, which increase by distance–e.g., when a potential borrower visits a branch to apply for a new loan. Note that during our observation period, loan applicants were required to present loan officers with their ID cards in person. Hence, these borrower transportation costs are relevant for both types of lenders. In the case of relational lending, it also becomes more costly to overcome asymmetric information by gathering proprietary soft information (Hauswald & Marquez 2006).

Spatial bank competition thus implies that branches with more nearby competitors face competition more intensively. Fig. 1 illustrates this argument. In period 1, there are two branches of different banks in a homogeneous commercial area. The circles around the branches visualize the decrease in the firm- to-branch tie due to increasing firm-to-branch distance. Thicker lines denote closer ties, while the dashed line indicates the weakest tie. The branches are located 1 km from each other and organized as A-B. In Fig. 1a, a new branch C of a different bank opens 0.5 km from A and B. The shaded areas show firm locations that are closer to the entrant C compared to the incumbents A and B. Over time, the entrant should be able to capture borrowers that are located in the shaded areas because of the discussed distance-related arguments. In Fig. 1b, we illustrate a different scenario in which a new branch C of a different bank opens 0.25 km from A and 0.75 km from B. In this case, the entrant puts more competitive pressure on incumbent A compared to B, which is indicated by the larger shaded area between branches A and C compared to the smaller size of the shaded area between B and C.

Notably, the sketched spatial bank competition should[6] differ with respect to bank lending technology. Petersen and Rajan (1995) argue that increased competition leads to lower loan rates which, in turn, makes banks reluctant to invest in relationship banking. However, Boot and Thakor (2000) show that increased interbank competition affects relationship and arm's length lending asymmetrically, and incumbent banks choose to lend on a relational basis to insulate themselves from pure price competition. Dinc (2000) argues that increased capital market competition (i.e., borrowers' access to the bond market) provides a close substitute for arm's length lending, hence reducing banks' return on arm's length lending accordingly. Therefore, relationship lenders may protect themselves against increased competition coming from arm's length lenders.

As the theoretical evidence with regard to the link between competition and bank orientation appears inconclusive, it is ultimately an empirical question to analyze the effect of competition on different types of bank lending outcomes. Hence, we test the two hypotheses:

1. The firm-to-branch distance affects competition when the bank relies on soft information to make lending decisions.
2. The location of an arm's length lender does not affect competition.

Proving the first hypothesis would support the explanation in Hauswald and Marquez (2006) that soft information extraction makes lending distance-dependent, while proving the second hypothesis would support the idea that borrowers' transportation costs are not crucial for lending decisions.

3. Institutional setting

We study the effect of changes in local bank competition in the Dominican Republic between the years 2008 and 2012. At the beginning of the sample period, there were 13 commercial banks and 14 savings banks active in the Dominican Republic. Two of the[7]

[5] Additionally, Gissler et al. (2020) explore how different types of lending institutions react to an increase in bank concentration and find that conventional banks seek more relational lending, while non-banks tend to increase the extensive margin of credit to- ward riskier borrowers. Nonetheless, in Gissler et al. (2020), data limitations largely limit the extent to which different mechanisms at play can be disentangled.

[6] In addition, banks incur distance-related transportation costs in monitoring outstanding loans (Sussman & Zeira 1995). We assume in this paper that these costs are orthogonal to the type of bank lending technology because all banks have similar access to credit registry information in our setup, which is the ultimate source to detect non-performing borrowers.

[7] Boot and Thakor (2000) reach the opposite conclusion as in their model increased capital market competition deters bank entry to the market lowering the interbank competition.

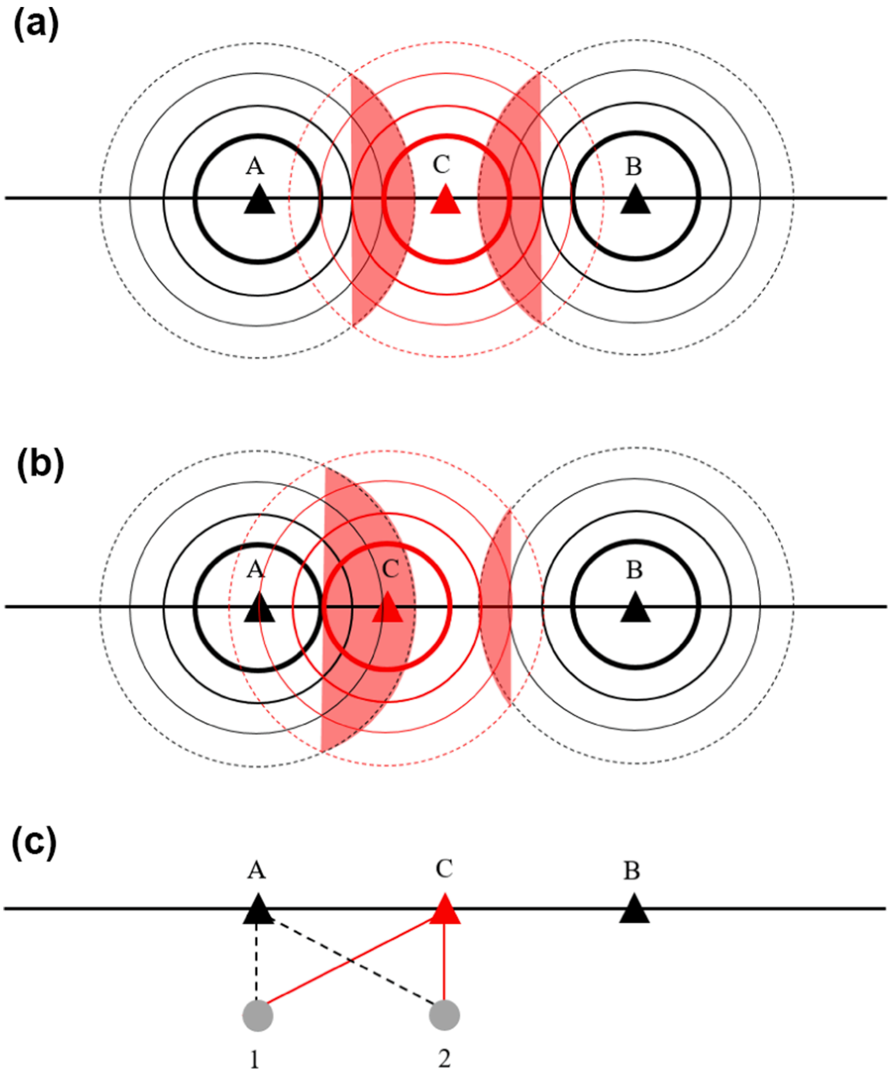

Fig. 1. Illustrative Example. The figure provides an illustrative example. There are two existing branches of different banks in a homogeneous commercial area. The circles around the branches visualize the decrease in firm-to-branch tie due to increasing firm- to-branch distance. Thicker lines denote closer ties while the dashed line indicates the weakest tie. The branches are located in a straight line 1 km from each other and organized as A-B. In Fig. 1a, a new branch C of a different bank opens 0.5 km from A and B. The shaded areas show firm locations that are closer to the entrant C compared to incumbents A and B. In Fig. 1b, a new branch C of a different bank opens 0.25 km from A and 0.75 km from B. In Fig. 1c, we further introduce two firms that are located 0.5 km from A and C, respectively. We omit the circles around the bank branches to concentrate on the firm-to-branch distance aspect.

commercial banks at the time were foreign. One from the U.S. with 1 percent of the outstanding credit issued by banks in the country, and one from Canada with 8 percent of bank credit. All savings banks were local at the time. Besides, the 3 largest commercial banks accounted for 69 percent of bank credit. Our sample bank ADOPEM was the largest lender to small and medium-sized enterprises in the Dominican Republic in terms of the number of borrowers. It specialized in small businesses and had a 7.5 percent market share of the savings bank credit. During the sample period, only one institution with more than 0.1 percent of the market share failed. The first month/year with the available cap ratio is Jan 2012, and the aggregate capitalization ratio (industry asset-weighted average) for that point in time is 14.9 percent. The aggregate ratio for commercial banks is 14.6 and the savings bank aggregate ratio is 19.7 percent. Our sample bank ratio is 20 percent.

The Dominican Republic represents a well-suited natural laboratory for the study of competition given the steady development of its economy and banking system. Between 2006 and 2012 the number of registered bank branches increased from 598 to 816, which constitutes a 36 percent increase. The GDP figure during the same period draws a similar line, which highlights that the growth in the number of bank branches is the natural consequence of steady economic growth.

We compile the openings of new bank branches one year before the estimation time interval, to avoid any sort of simultaneity that could occur with the outcome. We are able to map the geographic location of existing bank branches of all 27 banks that are regulated by the central bank, as well as the geographic location of each new branch opening. There were 192 new branch openings within the period of interest. This information is particularly suitable to investigate spatial[8]competition between banks, as we observe exactly when and where banks decided to expand their operations.[9]Our measure of competition consists of the number of competing bank branches around a given branch *b*. We use a weighting approach, which we explain in more detail in Section 5, to account for the fact that closer branches compete more intensively.

By exploiting unique institutional details of the Dominican Republic's banking system, we are also able to determine whether banks (and their branches) are relational or arm's length lenders. Specifically, there are two types of banks in the country: "Bancos de Ahorro y Crédito" and "Bancos Múltiples". Bancos de Ahorro y Crédito can only accept long-term deposits and therefore cannot issue checking accounts. Historically, this limitation resulted in these banks focusing on the less formal (more opaque) businesses that did not require a checking account to operate. Since information about these borrowers is limited, these banks developed on-site soft information evaluation technologies.

Bancos Múltiples can accept all types of deposits and historically have focused on more formal businesses with credit bureau information. These banks did not develop on-site evaluation technologies until very recently (well past our sample time). We denote Bancos de Ahorro y Crédito as *Relational lenders* throughout the paper. For these lenders, the firm-to-branch distance is crucial since they make lending decisions based on soft information collected by trained loan officers at the business site (Stein 2002). Bancos Múltiples make lending decisions based mostly on hard information obtained from the credit bureau; therefore, we denote this second type of lender as *Arm's length lenders*. Firm-to-branch distance should matter far less for these lenders. Anecdotal information obtained from the central bank and managers of "Bancos de Ahorro y Crédito" and "Bancos Múltiples" confirms the lending technology of these banks was as described at the time.

Smaller, more opaque firms usually start borrowing from relational lenders only, but get access to arm's length lending as they build a credit history. In our empirical analysis, we measure the extent to which the lending technology of the incumbent and the lending technology of the entrant affect bank competition for firms borrowing from both types of lenders. Since distance should matter differently for the two types of lending technologies, we allow for our competition intensity measure to dissipate with distance at[10] a different rate as we describe in more detail in Section 5.

4. Data

The sample covers the period from 2008 to 2012 and consists of all the borrowers of ADOPEM, the largest lender to small and medium-sized enterprises in the Dominican Republic in terms of the number of borrowers. ADOPEM has 300,000 borrowers and US $84 million in total lending in the year 2012. The data comes from ADOPEM's administrative information system, the Dominican Republic's Credit Bureau, and the Dominican Republic Office of Free Access to Public Information. ADOPEM provides comprehensive administrative information for all borrowers, including all loans sanctioned by the bank as well as the repayment performance of overdue borrowers. ADOPEM also provides the exact address information of borrowers. The domestic credit bureau provides detailed information on the financial activities of the borrowers in other financial institutions, including their repayment performance. The Dominican Republic Office of Free Access to Public Information provides detailed information about the geographic location of existing branches, as well as the date and location of new branch openings for all 27 regulated financial institutions operating in the country.

Note that the coverage of borrowers and the sample period were dictated by data availability. One of the authors worked with the partner bank ADOPEM in the Dominican Republic between 2006 and 2007. There are two challenges in merging bank and credit bureau data. First, credit bureau data can only be obtained with the borrowers' consent in the Dominican Republic, so we were constrained to those borrowers who had given such consent to the bank. Second, due to domestic privacy regulations, data with borrowers' identities could not leave the bank premises. Therefore, the identities needed to be removed at the bank premises to use the data for research purposes. For that purpose, the aforementioned co-author was hired as a pro-bono consultant and worked at the bank de-identifying the data.[11]He later joined a regulatory institution in the U.S. and in his position as an economist, he cannot work for a financial institution (even if pro-bono) so no further updates of the data were possible.

4.1. Relationship proxies

This subsection presents summary statistics by lending technology and explores whether these statistics are consistent with the existing literature. We rely on credit bureau data for loans issued between 2008 and 2012. Panel A of Table 1 provides the number of loans per firm during the life of the relationship. The average number of loans per firm-bank pair is 2.00 (1.38) for relational (arm's length) lenders. The difference is around 0.6 loans, which is highly statistically significant. Fig. 2 provides a histogram for the number

[8] ASOCIACIÓ N CENTRAL DE AHORROS Y PRÉ STAMOS was dissolved on Jan 17, 2007; it had 0.4 share market share at the time of dissolution.

[9] Much of the developing world has been experiencing a similar steep increase in branch expansion: the number of bank branches in developing countries rose from 9 per 100,000 population to almost 13 between 2004 and 2015. A recent report by the Federal Deposit and Insurance Corporation documents that although the number of branches in the U.S. started to decline after 2009, the per capita density of banking offices remained high even in rural counties (Breitenstein & McGee (2015)).

[10] In Section 4.1, we provide supporting descriptive statistics for our approach.

[11] Note that BBVA was acquiring ADOPEM after the sample period.

of loans per firm-bank pair by type of lender. While arm's length lenders grant their borrowers repeated loans in only 27 percent of the observations, relational lenders grant repeated loans in more than 40 percent of the cases. Panel A of Table 1 further provides the number of loans for firms that borrow from both bank types and for larger firms (total assets above median) separately. Results are comparable to the unconditional case. Panel B reports the average initial loan maturity per firm-bank relationship (in months). We focus on firms that borrow from both types of banks to make the statistics comparable. For this sample, relational lenders grant loans with longer maturities relative to arm's length banks (16.6 versus 15.6 months).

Panel C shows the relationship length, measured in months, between the approval of the first loan and the full repayment of the last loan (per firm-bank pair). Note that we condition on the loans that have been repaid before the end of the observation period since the length of the relationship is undefined for borrowers still in a relationship. We find a relationship length of 24.87 months for relational and 20.19 months for arm's length lenders (focusing again on firms that borrow from both types of banks). The difference is 4.7 months and it is highly[12] statistically significant. We obtain similar results once we concentrate on larger firms. All in all, our statistics are in line with the existing literature.

4.2. Sampling restrictions

We cover the period from 2008 to 2012 and rely on new loan initiations between a firm and a bank at the yearly level. In order for our estimation procedure to work, we restrict our attention to firms that have a borrowing relationship with a particular bank in at least two consecutive years and that those years also coincide with another borrowing relationship with at least one bank. This is the most important sampling restriction as there are lots of firms with just one bank relationship during this whole time period. We then match this sub-sample with the ADOPEM address files that have unique city and address information for each firm.

The second part of the sampling comes from the firm-to-branch matching. Since our data only identifies firm-bank relationships, we infer the corresponding branch based on proximity. We first identify loan relationships with only one available branch of the corresponding bank for that particular year in branch *b*'s city. We are able to match about 35 percent of the observations this way. For the rest of the firms, we use geocoding algorithms to obtain the exact firm location and choose the closest branch of the corresponding bank based on calculated distances. We drop those firms for which we do not have reliable address information or firms for which we only obtain city-level locations.

In order to get rid of potential outliers with respect to a branch location, we drop isolated bank branches if their distance to the next competitor branch is more than 10 km. We also require for each city that both relational and arm's length lenders have open branches in a firm's city at the beginning of the observation period (see **Table A1** in the appendix). Finally, we drop those banks that have fewer than 1,000 observations over the full sampling period.[13]Because we use an extensive set of fixed effects, this restriction ensures that our identification does not come from a few observations within a subset of infrequent lenders.[14] This leaves us with 5,450 firms borrowing from the 6 biggest banks with 318 branches, adding up to 24,186 observations at the firm-bank-year lev el.

5. Descriptive statistics

Panel A of Table 2 presents the descriptive statistics for the intensive margin analysis, which uses the natural logarithm of the initially granted loan amount of borrower *i* at branch *b* in year *t* in Dominican Pesos. For relational lenders, the average log loan amount is 10.25, which corresponds to 28,148 Dominican Pesos or 817 US-Dollars using the average exchange rate during the observation period. Of the sample, 82.2 percent corresponds to relationship lending because our sample comes from the database of a relational lender (ADOPEM). Since large companies usually borrow only from arm's length lenders, our sample includes mostly small and medium-sized firms. This notion is also evident from the average loan amount granted by arm's length lenders: at an average of 42,650 Dominican Pesos (1,238 US-Dollars), these are substantially larger.

5.1. Identification strategy

The challenge of identifying the impact of local bank competition on credit is that changes in competition are not exogenous. For example, increases in competition due to new branch openings usually happen in areas of high economic or demographic growth.

In this work, we address this challenge by using a measure of competition that relies on the distance between incumbent (existing) and entrant branches. While the location of the entering branch depends mainly on local loan demand, the relative distances among existing branches, which we use to estimate the intensity of competition, is of minor relevance to the changes in economic conditions. The above-mentioned Fig. 1 helps to clarify our identification strategy where, for a given loan demand, closer bank branches[15] compete more intensively with each other because there are more overlapping firms within the close vicinity of these branches.

The following example further illustrates our empirical approach: Firm *f* has two lending relationships with bank A and bank B. We

[12] Repeated loans over time create a possibility for a relational lender to learn about the customer. Arm's length lenders on the other hand mostly rely on hard information, which results in infrequent loan issuance with shorter relationship spans.

[13] We use firm address information as input and obtain geographic coordinates using Here Maps.

[14] This restriction is only for incumbent banks that lend to firms. We use the full set of bank branch openings for the measure of competition. Moreover, we obtain qualitatively similar results if we do not drop these observations from the sample.

[15] Note that we focus on the openings of existing banks.

Table 1
Relationship proxies: Descriptive statistics.

	Type of lender		
	Relational	Arm's length	Difference
Panel A: Number of loans			
All firms	2.00	1.38	0.62***
Borrowing from both bank types	1.99	1.38	0.61***
Large firms	1.98	1.36	0.62***
Panel B: Initial loan maturity (months)			
All firms	12.28	15.61	−3.33***
Borrowing from both bank types	16.60	15.61	0.99***
Large firms	13.75	16.83	−3.08***
Panel C: Relationship length (months)			
All firms	22.62	20.19	2.43***
Borrowing from both bank types	24.87	20.19	4.68***
Large firms	24.73	20.72	4.01***

The table shows the descriptive statistics for several relationship proxies when we split the raw credit bureau data for any loans issued between 2008 and 2012 by the banks' lending technology. *Relational lenders* are those that use soft information to make their lending decisions, while *Arm's length lenders* concentrate on hard and verifiable information. Panel A provides the number of loans per firm during the observation period for terminated firm-bank relationships. Panel B reports the average initial loan maturity per firm-bank relationship (in months). Panel C shows the relationship length (in months) between the approval of the first loan and the full repayment of the last loan (per firm-bank relationship). Note that we condition on loans that have been repaid before the end of the observation period in panels B and C. The third column reports the difference in these relationship proxies between relational and arm's length lenders as well as the significance level using a standard *t*-test. *, **, and *** indicate significance at the 10 %, 5 %, and 1 % level, respectively.

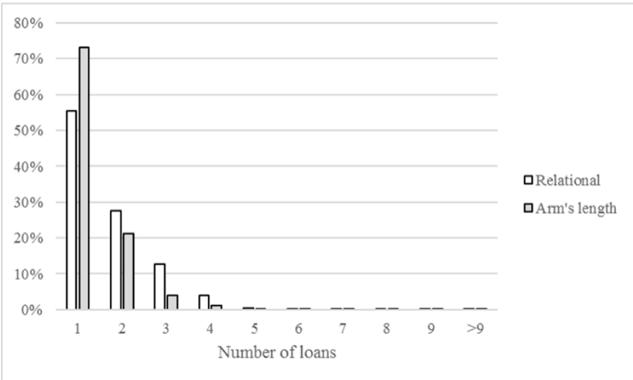

Fig. 2. Number of loans by bank type. The figure provides a histogram of the number of loans per firm when we split the credit bureau raw data for any loans issued between 2008 and 2012 by the banks' lending technology. Note that we only use terminated firm-bank relationships (refer to Panel A of Table 1). *Relational lenders* are those that use soft information to make their lending decisions, while *Arm's length lenders* concentrate on hard and verifiable information.

assume that firm *f* is served by the banks' closest bank branches (denoted *a* and *b*). In the year 2000, the loan amount with bank A was 1,000, while the loan amount with bank B was 1,500. Branch *b* experienced increased competition from a new branch opened by bank C in branch *b*'s close vicinity in the year 2001, while branch a was not affected. In this example, branch *b* was reducing its lending to firm *f* to 1,250.

In our setup, it is not possible to rule out a scenario where an entering bank purposely chooses to locate near the branch of a"weak" bank. In that case, the incumbent branch might lose more to the entering branch simply due to its decline. Branches may also choose to cluster in certain locations due to economies of scale and information sharing as in Qi et al. (2021). However, our identification relies on branch competition variation within a bank over time, which allows us to control for any bank-level strategy.

In addition to using a branch-to-branch competition measure, our baseline specification includes a rich set of fixed effects that control for (i) a firm's aggregate demand for credit in each period, for example, those related to investment opportunities, (ii) supply of credit in each period at the bank level, such as shocks to the balance sheet, and (iii) firm-bank level heterogeneity, such as the duration of the relationship between the firm's management and the bank's loan officer:

$$Y_{ibt} = \alpha_{it} + \alpha_{Bt} + \alpha_{iB} + \beta_1 Comp_{bt-1} + \varepsilon_{ibt} \quad (1)$$

Table 2
Descriptive statistics: Intensive margin sample.

	Mean	N	S.D.	Min.	p10	Median	p90	Max.
Panel A: ln(Initial loan amount)								
Relational lender	10.25	19,885	0.83	7.78	9.21	10.31	11.29	15.9
Arm's length lender	10.66	4301	0.99	6.68	9.55	10.6	11.92	15.37
Panel B: Bank competition measure (Comp)								
Branches by relational lender	0.98	24,186	0.77	0	0.11	0.75	2.1	4.49
Branches by arm's length lender	250.36	24,186	92.53	39.41	124	276.66	350.03	369.85
Panel C: Substitution measure (Subst)								
Branches by relational lender	0.67	20,976	0.77	0	0	0.37	1.81	5.14
Branches by arm's length lender	270.38	20,976	88.5	34.89	136.11	305.9	358.82	379.81

The table shows the descriptive statistics for the intensive margin sample. Panel A provides respective information for the initial loan amount, which serves as the main dependent variable. It is used as the natural logarithm of the initial loan amount of borrower i at branch b in year t in Dominican Pesos. *Relational lenders* are those that use soft information to make their lending decisions, while *Arm's length lenders* concentrate on hard and verifiable information. Panel B shows descriptive statistics for the bank competition measure, *Comp*, which is applying an exponential weight of the distance in kilometers between branch b in year $t-1$ and all competitor branches. In Panel C, we provide descriptive statistics for the firm-to-branch substitution measure, *Subst*, using the distance between the firm and its incumbent branch's competitors based on the same construction principle used for the branch-to-branch competition measure. In Panels B and C, the decay parameter depends on the type of bank: for a relational lender, the parameter is.
−0.84, while for an arm's length lender it is −0.01.

The outcome variables Y_{ibt} are[16] the natural logarithm of the initial loan amount of borrower i at branch b in year t, ln(*Loan volume*) and a dummy, *New loan*, that equals one for a new granted loan by branch b to firm i in year t. For the aggregate analysis in Section 6.5,[17] we also use a default dummy, *Default*, that equals.

one when borrower i that is granted the loan at time t was overdue for more than 90 days on any of its loans at some point in the future.

(α_{it}) are firm-time fixed effects, (α_{Bt}) are bank-time fixed effects, and (α_{iB}) are firm-bank fixed effects, and $Comp_{bt-1}$. Including firm-time fixed effects allows us to estimate the effect of changes in branch- specific bank competition on the loan amount for the *same* firm in the *same* year (Khwaja & Mian 2008). Our main measure of competition, $Comp_{bt-1}$, is at the branch-by-year bt level. We hence decided to cluster on the branch level.

We assume that competition decreases in distance exponentially, which is a common assumption in economics. More specifically, we measure competition between two branches of the incumbent bank b and the competitor bank b_n using the function $\theta * distance_{b,bn}$, where θ is the decay parameter that indicates how quickly the degree of competition increases when the distance between branches decreases. The decay parameter θ has a value of −0.84 for relational and −0.01 for arm's length lenders. The methodology to estimate these values and some intuition on their magnitudes, are presented below.

We compute the total competition for bank branch b with a set of competitors $b_1, b_2, b_3, \ldots, b_N$ as the summation of competition with each branch:

$$Comp_{bt-1} = \sum_{n=1}^{N_{t-1}} \exp^{\theta * distance_{b,bn}} \tag{2}$$

The time-series variation in[18] our measure of competition described in equation (2) is driven by openings of new branches during our observation period. In the regressions, the competition intensity is measured at $t-1$, while the outcome variables are computed at time t respectively, i.e., we capture changes in outcome[19] variables one year after changes in competition.

As demonstrated in Hauswald and Marquez (2006), proximity facilitates soft information generation for relational lenders. Therefore, in our setup, it is important to distinguish the distance to a branch of a relational lender versus a branch of an arm's length lender. For this reason, we assume the decay parameters for both types of lenders to be different.

It is evident from equation (2) that the decay parameter, θ, enters non-linearly into our baseline specification. Consequently, this requires a joint estimation of θ together with the rest of the parameters via non-linear least squares (NLS) using equation (1). Consistent

[16] Firm-bank level heterogeneity also captures any time-invariant differences between branches.
[17] See for instance, empirical evidence in Hertzberg et al. (2010) about loan officer rotation.
[18] Exponential weighting via distance has been extensively used in the literature to address trade costs (Chaney (2014)), innovation spillovers (Figueiredo et al. (2015)), housing externalities (Rossi-Hansberg et al. (2010) and Autor et al. (2014)), and commuting costs (Ahlfeldt et al. (2015)) etc.
[19] This parameter is, for example, small in absolute value (low decay) in models of trade, and large in absolute value (high decay) in models of housing. Rossi-Hansberg et al. (2010) pick a decay parameter of −2.3 when they model the effect of housing price changes in the nearby neighborhood, while Dam and Koetter (2012) use a decay parameter of −0.04 to incorporate spillover effects of German cities.

with our intuition, this estimation produces a much faster decay parameter for relational lenders (−0.84) than for arm's length lenders (−0.01). This means that a distance of one kilometer reduces the intensity of competition for entrants of relational lenders by 56.8 percent, while it reduces the intensity of competition for entrants of arm's length lenders by only 1 percent. The decay parameter, in principle, is different for each regression. For instance, decay parameters may be different depending on the type of incumbent lender. Robustness checks show that our results are unaffected by using a wide range of decay parametrization for the two types of lending technology (see **Table A3** in the appendix). To simplify exposition, we only estimate the decay parameters for the baseline specifications of the intensive margin analysis via NLS for relational and arm's length lenders and keep the parameters constant throughout the paper. Specifically, we plug in the NLS-decay parameter in equation (2) and use the resulting competition measure, $Comp_{bt-1}$, for fixed effects estimations of equation (1).

Panel B of Table 2 provides descriptive statistics for $Comp_{bt-1}$ using a decay parameter −0.84 for relational and −0.01 for arm's length lenders. For the former, the competition measure varies between (close to) zero and 4.49,[20]with an average of 0.98. These low levels reflect the strong decay in the case of relational lenders, for which local soft information generation is paramount. In contrast, competition measures are much higher for arm's length lenders,[21] with an average of 250, which is driven by the very low decay.

These results imply that distance does not matter for this type of bank, which relies on publicly available information and thus does not depend on being close to the borrower.

6. Empirical results

6.1. Intensive margin

We first investigate the effect of competition on incumbent branches with respect to the intensive margin of loan amount changes using equation (1) with data on the firm-bank-year level. The outcome variable, ln(*Loan volume*), is the natural logarithm of firm *i*'s newly granted loan amount at branch *b* in year *t*.

Table 3 provides the results. To interpret the coefficient, we need to take the exponentially weighted distance between the incumbent and entrant into account. Specifically, as described in more detail in Section 5, we measure the competition between two branches of the incumbent bank *b* and the competitor bank b_n using the function $\theta * distance_{b,bn}$, where θ is the decay parameter that indicates how quickly the degree of competition increases when the distance between branches decreases. Evaluated at zero distance, the adjustment factor is 1 and evaluated at an infinite distance, the adjustment factor is 0. In between, we have 0.4317 for a distance of one kilometer ($e^{-0.84*1}$), and 0.0150 for a distance of five kilometers ($e^{-0.84*5}$) for branch openings of a relational lender. The first column estimate equals −0.1424, which is statistically significant at the 1 % level. The point estimate implies a negative impact of branch openings by relational lenders. To interpret the magnitude of the coefficient, we multiply it with the exponentially weighted distance: while an entrant at the exact same location as the incumbent (−0.1424*1) reduces the newly granted loan amount by 14.24 percent on average, the reduction declines to 6.15 percent (−0.1424*0.4317) for a distance of one kilometer or to 0.21 percent (−0.1424*0.0150) for a distance of five kilometers. Hence, we observe a substantial effect for close openings, which quickly dies off once the distance between the entrant and incumbent increases.

In the case of branch openings of arm's length lenders, we find the decay parameter to be exceedingly low: the adjustment factors equal 0.9900 for a distance of one kilometer ($e^{-0.01*1}$), and 0.9512 for a distance of five kilometers ($e^{-0.01*5}$). The respective third column results for the impact of branch openings by arm's length lenders show an insignificant estimate of 0.0162.

Overall, we find a reduction in the newly granted loan amount at the incumbent for close entrants of a relational lender. This result is not surprising given that a firm will shift some of its loan demand from the incumbent to the entrant based on proximity. However, the fact that we have insignificant results for arm's length incumbents needs further clarification. If the competition is coming from an arm's length lender, theory suggests that existing branches would resort to more relational lending due to this threat (Dinc 2000). Therefore, existing branches–especially relational lenders–could protect their customers by further expanding credit. These two opposing dynamics could offset one another.

Furthermore, we investigate whether the effect of competition depends on both the lending technology of the entrant and the lending technology of the incumbent. We interact the competition measures, $Comp_{bt-1}$, with a dummy variable, *Relational lender*, that equals one if the incumbent is a relational lender.

Hence, while the individual coefficient provides the impact of branch openings for borrowers at arm's length incumbents, the interaction shows the differential effect for borrowers at relational incumbents.

The second column shows results for the interaction effect with the incumbent's lending technology for relational openings. We find an interaction term estimate of 0.0542, which is statistically insignificant. However, the sign is reasonable and the magnitude of the coefficient is economically large: while the effect of branch openings of relational lenders decreases the loan size at arm's length incumbents by up to 18.83 percent, this decrease appears to be more moderate (−13.41 percent) at relational incumbents.

The interaction term for branch openings of arm's length bank openings for relational incumbents in column four is 0.0154 and statistically significant at the 5 percent level. Given the small decay of −0.01, this effect remains relatively constant even for larger distances: loan amounts at relational incumbents are 1.52.

(1.46) percent higher compared to arm's length incumbents in the case of entry by an arm's length lender one (five) kilometer(s)

[20] See Davidson and MacKinnon (2004) for details.

[21] See also further discussion in the results section.

Table 3
Intensive margin analysis.

Decay parameter:	−84 %	−84 %	−1 %	−1 %
Comp - Branches by relational lender	−0.1424***	−0.1883**		
	(0.0380)	(0.0822)		
Comp - Branches by relational lender		0.0542		
* Relational lender				
Comp - Branches by arm's length lender		(0.0731)	0.0162	−0.0290
			(0.0186)	(0.0263)
Comp - Branches by arm's length lender				0.0154**
* Relational lender				(0.0070)
Firm-Time FE	Y	Y	Y	Y
Bank-Time FE	Y	Y	Y	Y
Bank-Firm FE	Y	Y	Y	Y
N	24,186	24,186	24,186	24,186

The table shows intensive margin results with interaction effects by the incumbent's lending technology. The outcome variable, ln(*Loan volume*), is the natural logarithm of firm *i*'s newly granted loan amount at branch *b* in year *t*. The bank competition measure, *Comp*, is applying an exponential weight of the distance in kilometers between branch *b* in year $t-1$ and all competitor branches. The decay parameter depends on the lending technology of the entrant: for relational lenders, the parameter is −0.84 while for arm's length lenders it is −0.01. The competition measures are calculated separately for all branches by relational, denoted by *Comp - Branches by relational lenders*, and arm's length lenders, *Comp - Branches by arm's length lenders*. We further interact these competition measures with a dummy variable, *Relational lender*, that equals one if the incumbent is a relational lender. The standard errors in parentheses are clustered at the branch level. *, **, and *** indicate significance at the 10 %, 5 %, and 1 % level, respectively.

apart from the incumbent's branch.

All in all, we find that borrowers at arm's length lenders receive smaller loans than borrowers at relational lenders in case of branch openings by arm's length lenders. In contrast, the entry of a relational lender reduces the loan amount for borrowers at both types of incumbents. These results suggest that relational lenders can use their soft information technology to obtain proprietary information about borrowers, and can use this information to gain market share. Entering arm's length lenders only rely on publicly available information and hence represent less of a threat to existing lenders.

6.2. *Extensive margin*

Our identification strategy in the previous section relies on firms that borrow from multiple banks on more than one occasion. To generalize the effect of competition on loan outcomes of different lending technologies we complement the intensive margin analysis above with a test of the extensive margin of any credit incidence. Here, we relax the sample restrictions to an extent that we include every firm that has loan relationships with at least two banks over the course of the sampling period.[22] We condition that a firm could potentially borrow from a set of banks and match any actual and potential firm-to-branch pairs. For every firm, we initiate the estimation a year before the first borrowing relationship. As in the case of the intensive margin analysis, we use the six major banks as potential lenders and match firm-to-branch pairs based on 2008 branch information. Specifically, we match the closest available branch of each bank to the firm of interest.[23] This way, we are able to assess the effect of local competition on the formation of new loan relationships within the set of potential lenders.

This relaxed sampling restriction allows us to use information from 49,823 firms that obtain 186,568 new loans over the course of five years. We observe 1,165,460 potential and actual lending relationships, while the share of actual loans is 24.8 percent in the case of relational and 7.9 percent in the case of arm's length lenders. Since our main data provider is a relational lender, the majority of the actual lending relationships happens through relational lenders.

Next, we perform the same set of baseline regressions using equation (1) with firm-time, bank-time, and bank-firm fixed effects. As an outcome variable, we use a dummy, *New loan*, that equals one in case of a new loan granted by branch *b* to firm *i* in year *t*. The results shown in Table 4 represent the effect of competition on the likelihood of receiving a new loan.

The results in column one, for the impact of branch openings of relational lenders on new lending, imply a reduction of 2.25 (0.97 %, 0.03 %) percent for zero (one, five) kilometers difference to the incumbent branch. Results in column two suggest that this effect is stronger for borrowers at arm's length incumbents (−2.76 %). Even though the interaction term does not enter significantly (1.2 %), the total effect for borrowers at relational incumbents (−1.56 %, i.e., −2.76 % +1.2 %) becomes statistically insignificant (based on an untabulated Wald test). Hence, we find tentative evidence that openings of relational lenders reduce new lending, while relational incumbents seem to be able to mitigate this threat to some extent.

Columns 3 and 4 show results with respect to the impact of branch openings of arm's length lenders on new lending. Coefficient estimates are mixed, showing no significant effect for both incumbent types (column 3), while there seems to be a reduction once we add the relational incumbent interaction term (column 4). The sign of the interaction term is in line with the intensive margin results in

[22] Results are qualitatively similar if we use a more comprehensive sample of firms with at least one lending relationship.

[23] Otherwise, we follow the data cleaning described in Section 4.2.

Table 3, even though the coefficient is not significant. All in all, we find evidence that openings of arm's length lenders reduce new lending irrespective of incumbent type.[24]

6.3. Substitution analysis

So far, we have relied on a competition measure at the branch level based on the distance-weighted number of competitors to the branch of interest. However, as illustrated in Section 2, the distance between the firm and the entering branch matters because a firm enjoying further options from competing branches could substitute its credit away from the incumbent branch. Agarwal and Hauswald (2010) show that the closer the firm is to a branch of a competitor bank the less likely it is to stay with the incumbent bank. On the other hand, it is also possible that incumbent lenders purposely allocate additional credit to firms in case of increasing competition by, for instance, lowering the interest rate (Degryse & Ongena 2005). We, therefore, propose a measure at the *firm-to-branch* level using a subsample of firms with precise location information. Our empirical setup with *branch-to-branch* competition and *firm-to-branch* substitution measures aims to distinguish the aforementioned effects.

We construct a measure at the firm-to-branch level using distance information between the firm and the competitor branches with respect to the incumbent branch based on the same construction principle used for the branch-to-branch competition measure (see Section 5). Specifically, we compute a substitution measure between firm i and its incumbent branch b's competitors $b_1, b_2, b_3, \ldots, b_N$ as the summation of the weighted distance between firm i with each competitor branch b_n in year $t-1$:

$$Subst_{ibt-1} = \sum_{n=1}^{N_{t-1}} \exp^{\theta * distance_{i,bn}} \tag{3}$$

Note that we have variation in $Subst_{ibt-1}$ at the branch level because the measure depends on the incumbent branch b.[25] This measure allows for the possibility of having two firms with loan relationships with the same incumbent branch that are affected differently based on the locations of the competitor branch and these firms. In Fig. 1c, where a new branch C of a different bank opens 0.5 km from A and B, firm 2 that is located closer to branch C's location, experiences a stronger increase in $Subst_{ibt-1}$ than firm 1 that is further away from branch C.

We construct the substitution measure using the same decay parameters for relational and arm's length branch openings as in the previous subsections to facilitate the comparison and interpretation of results. Table 2 provides summary statistics for our measure, $Subst_{ibt-1}$. Note that the sample size is reduced from 24,186 to 20,976, because for the substitution measure, we need to rely on those firms with precise location information.[26] The substitution measures are on average relatively similar to the competition measures, which is again driven by the difference in decay parameters.

Adding the substitution measure to equation (1) yields:

$$Y_{ibt} = \alpha_{it} + \alpha_{Bt} + \alpha_{iB} + \beta_1 Comp_{bt-1} + \beta_2 Subst_{ibt-1} + \varepsilon_{ibt} \tag{4}$$

Table 5 shows regression results for equation (4). In column 1, we find evidence for substitution from the incumbent to competitors in case of relational branch openings. The coefficient implies that new loan volume decreased by 29.65 (12.8, 0.44) percent for openings that are zero (1, 5) kilometers apart from the firm. This effect seems to be larger than the branch-to-branch competition effect, for which we find a coefficient estimate of 9.24 percent. Unreported Wald tests show, however, that these two coefficients are not significantly different. While our competition measure identifies the average change in loan amount for a branch facing stronger competition, the substitution measure singles out the relative effect for firms that are enjoying further credit options nearby. This means new entrants in the close vicinity of a firm drive part of the borrowing of this firm away from the incumbent branch and towards entrant/competitor branches. This is above and beyond the drop in the loan amount due to the increasing competition that the incumbent branch already faces.

It is often the case that increasing competition for a branch would also yield more nearby options for a firm which makes our two measures highly correlated. To address potential multicollinearity issues between $Comp_{bt-1}$ and $Subst_{ibt-1}$ measures, we drop the branch-to-branch competition measures from the estimation. Our results in the second column show that the substitution effect is larger once we do not control for branch-to-branch competition. In contrast, we do not find any significant substitution effects for openings of arm's length lenders, supporting the previous results on the intensive margin analysis. This finding further strengthens the conclusion that distance does not matter for transactional lenders.

Finally, we complement the results of intensive margin substitution with an analysis at the extensive margin introduced in the previous subsection. It is possible that a new branch close to a firm is more likely to attract the firm than it is for a distant firm. On the other hand, existing branches may respond to this increase in competition by offering new loans to close firms. Our extensive margin setup with actual and potential loan relationships may distinguish these opposing forces. Here we use matched firm-to-branch pairs

[24] Note that the findings in this subsection are only suggestive due to data limitations. Ideally, any analysis at the extensive margin should be done conditional on loan applications (e.g., as in Jimenez et al. (2014)).

[25] We only consider all competitor branches excluding the branches from branch b's bank.

[26] This decrease is driven by our matching approach to include firms in our sample if there is only one branch per bank active in the firm's city even though we are not able to exactly geocode the firm location. See Section 4 for details.

Table 4
Extensive margin analysis.

Decay parameter:	−84 %	−84 %	−1 %	−1 %
Comp - Branches by relational lender	−0.0225**	−0.0276**		
	(0.0094)	(0.0112)		
Comp - Branches by relational lender		0.012		
* Relational lender		(0.0129)		
Comp - Branches by arm's length lender			−0.0035	−0.0080**
			(0.0035)	(0.0040)
Comp - Branches by arm's length lender				0.0014
* Relational lender				(0.0013)
Firm-Time FE	Y	Y	Y	Y
Bank-Time FE	Y	Y	Y	Y
Bank-Firm FE	Y	Y	Y	Y
N	1,165,460	1,165,460	1,165,460	1,165,460

The table shows the results of the extensive margin analysis. The outcome variable is a dummy that equals one if branch *b* granted a new loan to firm *i* in year *t*. The bank competition measure, *Comp - All branches*, is applying an exponential weight of the distance in kilometers between branch *b* in year $t-1$ and all competitor branches. The decay parameter depends on the lending technology of the entrant: for relational lenders, the parameter is −0.84 while for arm's length lenders it is −0.01. The competition measures are calculated separately for all branches by relational, denoted by *Comp - Branches by relational lenders*, and arm's length lenders, *Comp - Branches by arm's length lenders*. We further interact these competition measures with a dummy variable, *Relational lender*, that equals one if the incumbent is a relational lender. The standard errors in parentheses are clustered at the branch level. *, **, and *** indicate significance at the 10 %, 5 %, and 1 % level, respectively.

Table 5
Intensive margin analysis: Substitution.

Decay parameter:	−84 %	−84 %	−1 %	−1 %
Comp - Branches by relational lender	−0.0924**			
	(0.0401)	−0.3972***		
Subst - Branches by relational lender	−0.2965**			
	(0.1211)	(0.1062)		
Comp - Branches by arm's length lender			−0.0149	
			(0.0310)	
Subst - Branches by arm's length lender			0.0264	0.0117
			(0.0363)	(0.0221)
Firm-Time FE	Y	Y	Y	Y
Bank-Time FE	Y	Y	Y	Y
Bank-Firm FE	Y	Y	Y	Y
N	20,976	20,976	20,976	20,976

The table shows substitution results for the intensive margin analysis. The outcome variable, ln(*Loan volume*), is the natural logarithm of firm *i*'s newly granted loan amount at branch *b* in year *t*. The substitution measure, *Subst*, uses the distance between the firm and its incumbent branch's competitors based on the same construction principle used for the branch-to-branch competition measure. The latter is defined as in the previous tables. The decay parameter depends on the lending technology of the entrant: for relational lenders, the parameter is −0.84 while for arm's length lenders it is −0.01. The standard errors in parentheses are clustered at the branch level. *, **, and *** indicate significance at the 10 %, 5 %, and 1 % level, respectively.

introduced in the extensive margin section and compute substitution measures accordingly.[27] We then estimate equation (4) with a dummy outcome variable, which is equal to 1 in case of an actual loan and zero if there is no loan relationship between branch *b* and firm *i* in year *t*.

Table 6 presents the results of the substitution analysis at the extensive margin. As in the case of the intensive margin substitution analysis, we find strong evidence for substitution effects due to branch openings by relational lenders. The likelihood to obtain a new loan decreases by 8.03 (3.47, 0.12) percent for openings zero (1, 5) kilometers apart from the firm. While the branch-to-branch competition measure still has a negative sign, the coefficient does not enter significantly. Results remain qualitatively similar in column 2 once we drop the branch-to-branch competition measure. Hence, the substitution effect seems to dominate the branch-to-branch competition effect in the case of the extensive margin. Results are again flat for branch openings of arm's length lenders (columns 3 and 4). All in all, relational competitors seem to be able to draw away clients from incumbents if they are opened close enough to the firm.

6.4. Robustness tests

Our empirical setup produces estimates of the effect of local competition by jointly estimating the competition itself. Evidently, this

[27] For each firm-to-branch pair we compute the summation of the weighted distance between the firm with precise location information and the competitor branches as explained above.

Table 6
Extensive margin analysis: Substitution.

Decay parameter:	−84 %	−84 %	−1 %	−1 %
Comp - Branches by relational lender	−0.0036			
	(0.0057)			
Subst - Branches by relational lender	−0.0803***	−0.0841***		
	(0.0104)	(0.0083)		
Comp - Branches by arm's length lender			−0.0019	
			(0.0055)	
Subst - Branches by arm's length lender			−0.0008	−0.0026
			(0.0051)	(0.0032)
Firm-Time FE	Y	Y	Y	Y
Bank-Time FE	Y	Y	Y	Y
Bank-Firm FE	Y	Y	Y	Y
N	1,066,661	1,066,661	1,066,661	1,066,661

The table shows substitution results for the extensive margin analysis. The outcome variable is a dummy that equals one if branch *b* granted a new loan to firm *i* in year *t*. The substitution measure, *Subst*, uses the distance between the firm and its incumbent branch's competitors based on the same construction principle used for the branch-to-branch competition measure. The latter is defined as in the previous tables. The decay parameter depends on the lending technology of the entrant: for relational lenders, the parameter is −0.84 while for arm's length lenders it is −0.01. The standard errors in parentheses are clustered at the branch level. *, **, and *** indicate significance at the 10 %, 5 %, and 1 % level, respectively.

requires external validity to an extent that 1) our baseline sample is representative enough to reflect the undergoing dynamics, and 2) our model specification controls for the confounding supply and demand factors that hurt the estimation of the effect itself. As we argue in Section 5, the extensive set of firm-time, bank-time, and firm-bank fixed effects are important for the identification of the effect. However, this creates a trade-off between estimating the decay parameter and the corresponding effect over a sample of firms with frequent borrowing relationships. One way to address this issue is to jointly estimate the decay parameter using the extensive margin sample of firms (1,165,460 observations compared to the 24,186 original observations) with the same setup as introduced before. This approach provides external validity to our decay parameter specification and the robustness of the effect of competition. The estimation yields decay parameters of −0.35 for relational openings and −0.01 percent for arm's length openings. Hence, the former estimate is substantially lower for the larger sample. This result is as expected given the many zeros, i.e., no actual loan observations, in the larger sample, diluting the spatial effect of bank competition. For the decay parameter estimate of arm's length lenders, we do not observe any difference compared to Section 5; branch-to-branch distance still does not play any material role.

Table A2 shows results for relational openings with the lower decay parameter.[28] We still find that branch openings of relational lenders decrease the newly granted loan amounts for both types of incumbents column 1). Again, as in Table 3, despite being statistically insignificant, the sign of the interaction term estimate is reasonable and the magnitude of the coefficient is economically large: while the effect of branch openings of relational lenders decreases loan size at arm's length incumbents by up to 10.48 percent, this decrease appears to be more moderate (−5.62 percent) at relational incumbents (column 2).

Second, we show results for a range of decay parameters to portray a general picture. For lower decay parameters, we decrease the parameter by 50 percent from −0.84 to −0.42 (in case of relational openings) and from −0.01 to −0.005 (in case of arm's length openings). For higher decay parameters, we increase the parameter by 50 percent to −1.26 and −0.015. The results in **Table A3** provide evidence that our main results remain qualitatively similar for the chosen range of decay parameter choices.

Next, we replicate our baseline intensive margin results using a non-parametric competition intensity measure. For that, we count the number of bank branches located in a circular region around the incumbent branch. While our baseline measure of competition intensity is well established in the literature, one may question the parametric assumptions behind the exponential function. To address this concern, we compute the number of competitor branches around the incumbent branch using three circular regions. The radii of the circular regions are computed such that in each region we have 10, 20, and 40 thousand inhabitants, respectively. This competition measure is denoted by *N branches*.

Results in **Table A4** suggest that for relational lenders having an additional relational bank branch in the close vicinity (first circular region) reduces the loan volume by 7.9 percent. This negative effect is also present in the second circular region (−7.5 %) and becomes less pronounced and insignificant in the third circular region. For branch openings by arm's length lenders, we again find no significant effect that distance matters for the intensive margin of lending. We conclude that a non-parametric measure of spatial bank competition also supports our finding.

Fourth, we check whether our results are driven by a change of credit lines. For this test, we add the available credit lines that we approximate with credit card limits. **Table A5** replicates the baseline intensive margin results using the sum of the newly granted loan amount and the existing credit line as the outcome variable (using again the natural logarithm of the resulting sum). We find qualitatively similar results as in Table 3.

Finally, to show the robustness of our results with respect to the cluster level, we reproduced all key results using clustering at the city (and city-time) level. The unreported results are very robust to such an alternative specification and are available upon request from the authors.

[28] We do not display the results for arm's length lenders, since they are unchanged from columns 3 and 4 in Table 3.

6.5. Aggregate analysis on the Firm-level

Our main analysis estimates the effect of competition on the reallocation of credit. However, it is certainly plausible that increased competition may cause an increase in the total amount of credit (Marquez 2002) or the likelihood to receive a loan. Here, we analyze the impact of an increase in local bank competition from the firm's perspective by aggregating the firm-bank-time panel on the firm-time level. Doing so prevents us from running the saturated regression specifications that we use throughout the paper. Specifically, we include firm and city-year fixed effects in the aggregate analysis. The latter aims to control for changes in loan demand from the firm's perspective but we admit that there is likely to remain unobserved heterogeneity within cities. We repeat the intensive margin and extensive margin analysis at the firm level.

The outcome variables for these analyses are the natural logarithm of the sum of newly granted loans from all six major banks to firm i in year t and a dummy variable for any new credit extended for that firm, respectively. The competition measures are also aggregated on the firm level by using the maximum competition measure for firm i in year t. We chose the maximum across existing lenders in order to concentrate on the most competitive bank relationship, which is likely to offer the most favorite loan conditions.

Table 7 provides results for the aggregate analysis. In line with our intuition, the first column shows that openings of relational lenders increase the aggregate loan amount. The effect is economically substantial for a close vicinity branch opening, given that the total loan amount increases by 5.86 percent for a distance of 1 km between incumbent and entrant. In the case of arm's length openings, the new loan size is not significantly altered (column 2). Overall, this result suggests that an increase in local bank competition is increasing the amount of newly granted loans if this change is driven by openings of relational lenders.

If we extend this analysis to any new credit extension over the same period, we again find robust findings in line with our intuition. The results in columns 3 and 4 suggest that increased competition, for both types of lenders, increases the likelihood of a firm obtaining a new loan.

We also investigate whether this credit extension impacts loan performance. Theory suggests that increased competition may result in further risk-taking as it negatively affects an incumbent banks' charter value (Keeley (1990), Hellmann et al. (2000)). Subsequently, banks with lower charter value have more incentives to fund riskier projects, resulting in deteriorating repayment performance. On the other hand, the risk-shifting literature argues that competition lowers loan interest rates, which provides more incentives for borrowers to repay their loans (Boyd & De Nicolo, 2005). In order to investigate the effect of competition-induced credit extension on firm loan performance, we define a dummy variable that equals one when borrower i that is granted the loan at time t was overdue for more than 90 days on any of its loans at some point in the future.[29] Column five results show that increased competition due to openings of relational lenders tends to deteriorate loan performance. While the coefficient is positive for openings by arm's length lenders as well, it is not statistically significant (column 6). All in all, this finding supports the charter value theory, which proposes a positive relationship between competition and risk-taking, in the case of relational lenders.

7. Conclusion

We use detailed transactional data and assess the effect of local bank competition on commercial borrowers and incumbent banks by studying differences within firms in the same geographical area. Our identification does not rely on any assumption about the characteristics of the firms, locations or banks being studied. We characterize the effect of competition by the exponentially weighted distance of all competing branches around the incumbent branch, putting more weight on closer competing branches than on more distant ones. Furthermore, our weighting scheme is less pronounced for branch openings of arm's length lenders that do not gather soft information about their borrowers.

We provide evidence that the effect of competition depends on both the lending technology of the entrant *and* the lending technology of the incumbent. We find that informationally less captured borrowers at arm's length lenders receive smaller loans than borrowers at relational lenders in case of branch openings by relational leaders. In contrast, the entry of an arm's length lender changes neither the loan amount nor the likelihood of extending a new loan by any type of incumbent. These results suggest that relational lenders can use their soft information technology to obtain proprietary information about borrowers and can use this information to capture part of the market. Arm's length entrant lenders only rely on publicly available information and hence represent less of a threat to existing lenders.

Overall, it seems as if relational lenders can win the competition against arm's length lenders. Our results imply a limit to the ongoing disintermediation process, such as peer-to-peer commercial lending, in particular, in (developing financial) markets with less reliable public information.

CRediT authorship contribution statement

Alejandro Drexler: Conceptualization, Methodology, Formal analysis. **Andre Guettler:** Conceptualization, Methodology, Formal analysis. **Ahmet Ali Taskin:** Conceptualization, Methodology, Writing – review & editing.

[29] We also run the loan performance analysis on the firm-branch-year level. Results are reported in Table A6. Not surprisingly, we do not find any significant results. This result implies that firms do not selectively default on some loans only.

Table 7
Aggregate analysis on the firm-year level.

Outcome variable:	ln(initial loan amount)		New loan		Default	
Decay parameter:	−84 %	−1 %	−84 %	−1 %	−84 %	−1 %
Comp - Branches by relational lender	0.1357***		0.0299***		0.0386**	
	(0.0306)	0.0067	(0.0069)	0.0128***	(0.0174)	0.0037
Comp - Branches by arm's length lender						
		(0.0041)		(0.0036)		(0.0023)
Firm FE	Y	Y	Y	Y	Y	Y
City-Time FE	Y	Y	Y	Y	Y	Y
N	12,009	12,009	226,370	226,370	12,009	12,009

The table shows results for aggregated data on the firm-year level. In panel A, the outcome variable is the natural logarithm of the sum of new loans granted by all six major banks to firm i in year t. In panel B, the outcome variable is a dummy that equals one if firm i received a new loan from at least one major bank in year t. In panel C, it is a dummy variable that equals one when borrower i, which was granted the loan at time t, was overdue for more than 90 days on any of its loans from the major banks at some point in the future. The bank competition measure, *Comp*, is applying an exponential weight of the distance in kilometers between branch b in year $t-1$ and all competitor branches. The decay parameter depends on the lending technology of the entrant: for relational lenders, the parameter is -0.84 while for arm's length lenders it is -0.01. The competition measures are calculated separately for all branches by relational, denoted by *Comp - Branches by relational lenders*, and arm's length lenders, *Comp - Branches by arm's length lenders*. For the aggregation on the firm-year level, we use the maximum competition measure across all branches serving firm i in year $t-1$. The standard errors in parentheses are clustered at the firm level. *, **, and *** indicate significance at the 10 %, 5 %, and 1 % level, respectively.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jimonfin.2023.102897.

References

Agarwal, Sumit, and Robert Hauswald, 2008, The choice between arm's-length and relationship debt: Evidence from eloans.
Agarwal, S., Hauswald, R., 2010. Distance and private information in lending. Rev. Finan. Stud. 23, 2757–2788.
Ahlfeldt, G., Redding, S., Sturm, D., Wolf, N., 2015. The economics of density: Evidence from the Berlin wall. Econometrica 83, 2127–2189.
Amore, M.D., Cedric, S., Alminas, Z., 2013. Credit supply and corporate innovation. J. Finan. Econ. 109, 835–855.
Autor, D.H., Palmer, C.J., Pathak, P.A., 2014. Housing market spillovers: Evidence from the end of rent control in Cambridge Massachusetts. J. Polit. Econ. 122, 661–717.
Beck, T., Levine, R., Levkov, A., 2010. Big bad banks? The winners and losers from bank deregulation in the United States. J. Financ. 65, 1637–1667.
Beck, T., Steven, O., Ilkay, S.-Y., 2019. Keep walking? Geographical proximity, religion, and relationship banking. J. Corporate Finance 55, 49–68.
Bertrand, M., Schoar, A., Thesmar, D., 2007. Banking deregulation and industry structure: Evidence from the French banking reforms of 1985. J. Financ. 62, 597–628.
Black, S.E., Strahan, P.E., 2002. Entrepreneurship and bank credit availability. J. Financ. 57, 2807–2833.
Bonfim, D., Nogueira, G., Ongena, S., 2021. Sorry, we're closed: Loan conditions when bank branches close and firms transfer to another bank. Eur. Finan. Rev. 25, 1211–1259.
Boot, A.W.A., Thakor, A.V., 2000. Can relationship banking survive competition? J. Financ. 55, 679–713.
Boyd, J.H., De Nicolo, G., 2005. The theory of bank risk taking and competition revisited. J. Financ. 60, 1329–1343.
Breitenstein, E.C., McGee, J.M., 2015. Brick-and-mortar banking remains prevalent in an increasingly virtual world. FDIC Quarterly 9, 37–51.
Brevoort, K.P., Hannan, T.H., 2006. Commercial lending and distance: Evidence from community reinvestment act data. J. Money Credit Bank. 38, 1991–2012.
Chaney, T., 2014. The network structure of international trade. Am. Econ. Rev. 104, 3600–3634.
Chava, S., Oettl, A., Subramanian, A., Subramanian, K.V., 2013. Banking deregulation and innovation. J. Financ. Econ. 109, 759–774.
Cornaggia, J., Mao, Y., Tian, X., Wolfe, B., 2015. Does banking competition affect innovation? J. Financ. Econ. 115, 189–209.
Dam, L., Koetter, M., 2012. Bank bailouts and moral hazard: Evidence from Germany. Rev. Financ. Stud. 25, 2343–2380.
Davidson, R., MacKinnon, J.G., 2004. Econometric theory and methods. Oxford University Press, New York.
de Haas, R., Liping L., and Steven O., 2021, Clear and close competitors? On the causes and consequences of bilateral competition between banks.
Degryse, H., Ongena, S., 2005. Distance, lending relationships, and competition. J. Financ. 60, 231–266.
Degryse, H., Ongena, S., 2007. The impact of competition on bank orientation. J. Financ. Intermed. 16, 399–424.
Demyanyk, Y., Ostergaard, C., Sørensen, B.E., 2007. US banking deregulation, small businesses, and interstate insurance of personal income. J. Financ. 62, 2763–2801.
Dinc, I.S., 2000. Bank reputation, bank commitment, and the effects of competition in credit markets. Rev. Financ. Stud. 13, 781–812.
Ergungor, O.E., 2006. Bank branch presence and access to credit in low- to moderate-income neighborhoods. J. Money Credit Bank. 42, 1321–1349.
Figueiredo, O., Guimaraes, P., Woodward, D., 2015. Tindustry localization, distance decay, and knowledge spillovers: Following the patent paper trail. J. Urban Econ. 89, 21–31.
Garmaise, M.J., Moskowitz, T.J., 2006. Bank mergers and crime: The real and social effects of credit market competition. J. Financ. 61, 495–538.
Gilje, E.P., Loutskina, E., Strahan, P.E., 2016. Exporting liquidity: Branch banking and financial integration. J. Financ. 71, 1159–1184.
Gissler, S., Ramcharan, R., Edison, Yu, 2020. The effects of competition in consumer credit markets. Rev. Financ. Stud. 33, 5378–5415.
Gropp, R., Gruendl, C., Guettler, A., 2014. The impact of public guarantees on bank risk taking: Evidence from a natural experiment. Eur. Finan. Rev. 18, 457–488.

Gropp, R., Guettler, A., 2018. Hidden gems and borrowers with dirty little secrets: Investment in soft information, borrower self-selection and competition. J. Bank. Financ. 87, 26–39.
Guiso, L., Sapienza, P., Zingales, L., 2004. Does local financial development matter? Q. J. Econ. 119, 929–969.
Hauswald, R., Marquez, R., 2006. Competition and strategic information acquisition in credit markets. Rev. Financ. Stud. 19, 967–1000.
Hellmann, T.F., Murdock, K.C., Stiglitz, J.E., 2000. Liberalization, moral hazard in banking, and prudential regulation: Are capital requirements enough? Am. Econ. Rev. 90, 147–165.
Herpfer, C., Mjosz, A., Schmidt, C., 2021. The causal impact of distance on bank lending. Manag. Sci. forthcoming.
Hertzberg, A., Liberti, J.M., Paravisini, D., 2010. Information and incentives inside the firm: Evidence from loan officer rotation. J. Financ. 65, 795–828.
Hombert, J., Matray, A., 2017. The real effects of lending relationships on innovative firms and inventor mobility. Rev. Financ. Stud. 30, 2413–2445.
Huang, R.R., 2008. Evaluating the real effect of bank branching deregulation: Comparing contiguous counties across US state borders. J. Financ. Econ. 87, 678–705.
Jayaratne, J., Strahan, P.E., 1996. The finance-growth nexus: Evidence from bank branch deregulation. Q. J. Econ. 111, 639–670.
Jimenez, G., Ongena, S., Peydro, J.L., Saurina, J., 2014. Hazardous times for monetary policy: What do twenty-three million bank loans say about the effects of monetary policy on credit risk? Econometrica 82, 463–505.
Keeley, M.C., 1990. Deposit insurance, risk, and market power in banking. Am. Econ. Rev. 80, 1183–1200.
Kerr, W.R., Nanda, R., 2009. Democratizing entry: Banking deregulations, financing constraints, and entrepreneurship. J. Financ. Econ. 94, 124–149.
Khwaja, A.I., Mian, A., 2008. Tracing the impact of bank liquidity shocks: Evidence from an emerging market. Am. Econ. Rev. 98, 1413–1442.
Liebersohn, J., 2021, How effective is antitrust intervention? Evidence from bank mergers.
Marquez, R., 2002. Competition, adverse selection, and information dispersion in the banking industry. Rev. Financ. Stud. 15, 901–926.
Nguyen, H.-L., 2019. Are credit markets still local? Evidence from bank branch closings. Am. Econ. J.: Appl. Econ. 11, 1–32.
Petersen, M.A., Rajan, R.G., 1995. The effect of credit market competition on lending relationships. Quart. J. Econ. 110, 407–443.
Petersen, M.A., Rajan, R.G., 2002. Does distance still matter? The information revolution in small business lending. J. Finance 57, 2533–2570.
Qi, Shusen, Ralph De Haas, Ongena, and Stefan Straetmans, 2021, Move a little closer? Information sharing and the spatial clustering of bank branches.
Rossi-Hansberg, E., Sarte, P.-D., Owens, R.I., 2010. Housing externalities. J. Political Econ. 118, 485–535.
Salop, S., 1979. Monopolistic competition with outside goods. Bell J. Econ. 10, 141–156.
Stein, J., 2002. Information production and capital allocation: Decentralized versus hierarchical firms. J. Finance 57, 1891–1921.
Stiroh, K.J., Strahan, P.E., 2003. Competitive dynamics of deregulation: Evidence from US banking. J. Money, Credit Banking 801–828.
Sussman, Oren, and Joseph Zeira, 1995, Banking and development.