The Choice between Arm's-Length and Relationship Debt: Evidence from eLoans*

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Abstract

The advent of online lending offers the opportunity to clearly identify transactional and relationship debt in terms of the firm's chosen mode of interaction with the bank. Using a unique data set of comparable online and in-person loan transactions, we study the determinants of arm's-length and relationship transactions focusing on the differential information content of each lending mode and the resulting strategic interaction. We find that private information drives relationship-debt transactions whereas public information primarily affects arm's-length lending. Consistent with economic theory the bank's relative reliance on public or private information then determines the predicted trade-off between availability and pricing of credit across loan types. Transactional loans are less readily available but offer lower rates whereas the opposite is true for relationship debt. In their choice of loan type, lender switching, and default behavior firms anticipate the bank's strategic use of information and behave accordingly.

1 Introduction

Banks typically offer two very different types of credit to their corporate customers: relationship loans characterized by inside information and transactional loans for which banks compete on a much more equal informational footing (see, e.g., Rajan, 1992, Inderst and Müller, 2006, or Hauswald and Marquez, 2006). While the theoretical implications of competition between informed and uninformed lenders are well understood much of the empirical work has focused on relationship lending (see, e.g., Petersen and Rajan, 1994, Berger and Udell, 1995, or Elsas, 2005), in part because data on lending relationships is more readily available. Furthermore, private transactional debt with the attributes posited by the theoretical literature is hard to identify in practice. However, recent advances in lending technologies finally make available a large set of credit-market transactions that closely fit the theoretical definition of transactional lending: online loans. Hence, we propose to fill this gap in the literature by analyzing the determinants of online (transactional) and in-person (relationship) credit transactions.

Using a unique sample of all online and in-person loan applications by small businesses to a large US bank over a 15-months period we investigate a firm's choice between transactional and relationship debt in order to better understand the economic forces that shape exchange in these two segments of credit markets. For each loan application we collect the bank's ultimate credit decision and loan terms, its internal credit score, and the eventual loan performance. Although our bank's lending standards are identical across the two modes of origination loan officers can individually adjust internal credit scores for in-person applications that therefore contain a soft, subjective credit-assessment component supplied by branch offices. No such interaction or adjustment takes place for online applications. From credit-bureau reports (Experian) we also know each applicant's Small Business Intelliscore (XSBI) as a measure of publicly available information and can identify firms that refuse the offered loan and switch lenders.

The primary difference between arm's-length and relationship debt revolves around each loan type's information content that determines the availability and pricing of credit. Hence, we first orthogonalize each applicant's bank-internal score with the publicly available XSBI score to obtain its private-information residual as a clean measure of the lender's proprietary intelligence in the screening process. We then follow the typical steps of bank-borrower interaction and estimate

discrete-choice models of the firm's choice of lending channel, the bank's decision to offer credit and the borrower's to accept the loan terms, and linear-regression models of the offered loan's all-in cost. We round off our investigation of the differential information content of arm's length and relationship debt by studying the borrower's decision to switch lenders and the likelihood of credit delinquency across loan types.

The explanatory variables are proxies for public information, the lender's internal score and its private-information residual, and the nature of the lending relationship or absence thereof. We also control for borrower characteristics, loan terms, regional and business-cycle effects, and the prevailing interest-rate environment. Since the choice between transactional and relationship debt might also depend on the local availability of credit we include the number of lenders and their branches in each applicant's zip code to control for competitiveness effects and, similarly, the firm's distance from the bank's branch or online-processing center and from the nearest full-service competitor.

We find that public and private information play very different roles in each lending channel. For borrower decisions, private information primarily matters in relationship lending whereas public information equally affects arm's-length and informed debt transaction. By contrast, the bank clearly matches its use of each information type with a particular lending mode. In its credit decision and pricing, it mainly relies on public information for transactional offers and private information for relationship debt. We also show that these two types of information drive the observed trade-off between the availability and pricing of credit across lending channels. Symmetrically informed banks compete on the basis of public information, which not only drives down the price of transactional debt but also restricts access to credit to minimize adverse-selection costs *ceteris paribus.* Better informed inside lenders use their information advantage to informationally capture borrowers that pay higher rates but also gain easier access to credit.

The impact and statistical significance of our relationship variables confirm these effects across specifications and lending channels. Since online applications do not permit banks to generate much inside knowledge our lender clearly discounts whatever private information is available in transactional lending. By contrast, lending relationships not only offer the opportunity to collect such intelligence but the length and depth of the interaction together with the firm's physical proximity are also good indicators of the information's quality (see also Agarwal and Hauswald,

2006). The presence of established business relationships unsurprisingly enhances the effect of private information on relational transaction but has a much smaller or even insignificant effect on arm's-length transactions.

Interestingly, firms behave in their borrowing decisions as if they anticipate the bank's use of information. For relationship borrowers we interpret this finding as evidence that firms also benefit from close ties to their bank, for instance through better access to credit or intertemporal insurance effects, so that they are willing to assume the consequences of informational capture resulting from the collection of private information. We also find that the local competitiveness of credit markets and the proximity of applicants to competitors affect transactions in each lending channel in a manner consistent with theoretical predictions.

Our main contribution consists in showing how the relative importance of public and private information in credit transactions differs across loan types. We are able not only to clearly identify arm's-length and relationship debt, whose characteristics are virtually indistinguishable except for the chosen mode of bank-borrower interaction and, hence, information content, but also to construct a clean measure of the lender's private information. In a unified econometric framework we establish that the extent to which informational considerations shape the choice of lending mode critically depends on the bank's ability to generate private information and benefit from it. Hence, an additional contribution consists in providing strong new evidence on the importance of information production in credit markets. Finally, we show how technological progress in the form of online banking and credit scoring allows intermediaries to simultaneously engage in transactional and relationship lending, thereby helping them to overcome organizational limitations that in the past led to specialization by market segment (Berger *et al.,* 2005).

To the best of our knowledge, there is no comparative work on the differential effects of private and public information by loan type. While Petersen and Rajan (1994), Berger and Udell (1995), Elsas (2005), and Schenone (2006) have analyzed the importance of relationship banking for the collection of inside information they do not consider the respective use of public and private credit-quality signals across lending modes, which is central to our analysis. An exception are Bharat *et al.* (2006) who also find that information asymmetries induce borrowers to self-select into lending relationship but who do not consider transactional lending. Boot (2000) offers an excellent survey of recent theoretical and empirical work in relationship banking.

The paper also contributes to the nascent literature on the effect of the internet on financial intermediation. Wilhelm (1999, 2001) describes and analyzes the impact of the internet on the structure of banking markets and, especially, relationship banking. Similarly, Petersen (2004) discusses how technology changes the bank-bank borrower interaction and, hence, the operations of financial markets and institutions. Anand and Galetovic (2006) offer empirical predictions on the internet's effect on firm-bank relationships and find that it shifts the balance toward non-relationship modes of interaction. Bonacorsi di Patti *et al.* (2004) investigate demand complementarities between traditional and online provision of banking services and report that e-banking leads to a reduction in per-customer profitability which mirrors our findings on transactional lending. Regarding the importance of online banking Fuentes *et al.* (2006) study the determinants of the decision of U.S. banks to create a transactional website for their customers while DeYoung (2005) investigates the scale economies present in internet banking.

The paper is organized as follows. In the next section we review the theoretical literature on arm's-length and relationship debt and distill pertinent empirical predictions. Section 3 describes our data and estimation strategy. In Sections 4 and 5, we analyze the firm's choice of transactional vs. relationship debt and the bank's decision to offer credit and at what price across lending channels. Section 6 investigates the determinants of the borrower's decision to reject the banks' loan offer and obtain credit from a competitor. In Section 7 we report our findings on credit default across loan types. The last section discusses further implications and concludes. We relegate all tables to the Appendix.

2 Transactional and Relationship Lending

The theoretical literature has typically argued that relationship lending offers particular economic benefits to at least one party, if not both, through the closer ties that banks and borrowers forge. Lending relationships allow intermediaries to gain proprietary information (Rajan, 1992 and Petersen and Rajan, 1994), facilitate renegotiation through the implicit nature of the debt contract (e.g., Sharpe, 1990), and give rise to intertemporal transfers (e.g., Petersen and Rajan, 1995).[1] Hence, the ability to gather proprietary information (Bhattacharya and Chiesa, 1995) and use it

[1]For a recent survey on relationship banking see Boot (2000).

strategically in credit-market competition has become the defining attribute of relationship debt. By contrast, lenders compete on a more equal informational footing for transactional loans, competing away potential rents but at the price of less readily available credit (Broecker, 1990 or Hauswald and Marquez, 2003). Hence, firms face a trade-off between the availability and pricing of credit across the two lending modes: informational capture with rent extraction but more flexibility in financing choices or less readily available credit at lower rates.

In fact, Petersen and Rajan (2002) argue that local banks who collect "soft" proprietary information on small firms over time have an informational advantage over more remote competitors who might not enjoy the same degree of access to local information.[2] Hauswald and Marquez (2006) make this notion precise by letting the quality of a lender's information-generation process be a decreasing function of the distance between bank and borrower to capture the varying degrees of informational expertise present in modern banking. In their framework, relationship and transactional lending coexist and all lenders are active in both segments, albeit for different markets. Each bank carves out a core market in which is engages in informed, i.e., relationship lending, competing against less informed transactional lenders for its captive customers. Outside this core market, lenders compete on an uninformed or symmetrically informed basis by offering arm's-length loans to either other banks' captive clients or by lending on purely transactional terms depending on the density of banks.

Relationship banking allows lenders to strategically acquire proprietary information and to create a threat of adverse selection for their rivals, thereby softening price competition. Several empirical predictions follow. Given a firm's credit quality relationship lending facilitates the access to credit and intertemporal insurance but at the cost of rent extraction. Hence, the more and better proprietary information a bank has, the more willing it should be to approve loan applications but also the higher the interest rate conditional on the applicant's credit quality (von Thadden, 2004 and Hauswald and Marquez, 2006). By contrast, symmetrically informed transactional lenders should charge less and be less willing to grant credit to applicants of comparable credit quality (Broecker, 1990 and Hauswald and Marquez, 2003).

By the same token, competition affects each lending channel differently. In purely transactional

[2] Agarwal and Hauswald (2006) provide strong evidence for this conjecture. See also Berger, Frame and Miller (2005) on the role of soft information in lending decisions and the ability of smaller banks that presumably have a more local focus to collect and process such intelligence.

credit markets symmetrically informed lenders bid less aggressively because more competition worsens their inference problem so that credit becomes less available and interest rates rise (Broecker, 1990). By contrast, when relationship and transactional lending directly compete with each other, e.g., a better informed inside bank against less informed arm's length lenders, entry reduces the incentives for information acquisition so that interest rates fall in both segments and credit availability rises because less informed transactional lenders face a diminished threat of adverse selection (Hauswald and Marquez, 2006).

A subtle difference in the adverse-selection problem that lenders face for each loan type is also behind the respective empirical predictions for borrower switching. In purely transactional credit markets, banks face symmetric adverse-selection threats so that *ceteris paribus* they can compete more aggressively for transactional borrowers who should be more likely to switch. However, when transactional lenders compete against a better informed inside bank, the greater the latter's informational advantage, the greater the threat of adverse selection. As a result, less informed competitors bid less aggressively (higher interest rates and less frequently) so that relationship borrowers are less likely to switch providers of credit. Hence, we expect less borrower switching in relationship lending, the greater the informational advantage of the inside bank is, or the less competitive a local credit market is. At the same time, better credit risks, which are the primary target for rent extraction and, more likely than not, aware of their own creditworthiness, should more easily find credit elsewhere so that public information should also play a role even for relationship borrowers.

Finally, the more private information a lenders has the less likely errors in granting credit should become. Hence, a bank should experience less credit delinquency in relationship than in arm's-length lending. Also, the greater the competition the greater (smaller) adverse-selection problems become in transactional (relationship) lending so that competition should increase the incidence of default in transactional loan markets and decrease it in relationship debt.

From an empirical perspective, the defining features of transactional ("arm's-length") and relationship ("inside") debt then revolve around the generation and strategic use of proprietary information, differential availability and pricing of credit, and the resulting competitive reaction as revealed by borrowers declining credit offers and switching lenders across loan types. While the length and scope of a prior business relationship is thought to reveal the existence of a lending

relationship no such clear-cut identifier has existed for transactional debt in the past. However, the advent of online lending to small businesses without any personal interaction between the parties now allows us to unambiguously identify purely transactional loans. At the same time, lenders often engage in extensive information acquisition through their branch offices so that in-person applications and the resulting interaction with local loan officers define relationship debt.

3 Data Description and Methodology

Our sample consists of all online and in-person applications for new loans over a 15-months span by small firms and sole proprietorships to a large US financial institution with a particular regional focus on New England, the Mid-Atlantic and Florida. During the sample period, this lender ranked among the top five commercial banks and savings institutions according to the FDIC. Since our bank more or less automatically rolls over prior loans on request unless a significant deterioration in creditworthiness has occurred very different considerations drive the decision to grant credit from the one renewing an existing loan. As a result, most information production takes place around the origination of a new loan, explaining our sample selection. All loan applications fall under the definition of small- and medium-sized enterprise lending in the Basel I Accord so that the total obligation of the applying firm is less than $1 million and its sales are below $10 million.

We focus on small-business lending because such firms exhibit just the right degree of informational opacity for our purposes and credit products in this market are typically close substitutes. On the one hand, firms are sufficiently opaque for proprietary information to matter in lending decisions. On the other hand, small businesses are also quite homogeneous so that bank competition is intense, several lending channels coexist, and third parties provide credit-scoring services that we can use to measure the contribution of our bank's own proprietary loan screening to credit decisions.[3] Although the lending standards are identical across online and in-branch origination the resulting transactions differ in their information content because loan officers and branch managers can personally revise applicants' credit scores on the basis of subjective impressions.

[3]Since our bank applies a uniform credit-scoring methodology to assess each loan request we have high confidence that the internal credit score is a consistent and meaningful measure of the bank's proprietary information across applicants, bank branches, and distribution channels.

3.1 Operational Policies

Our small-business loans originate both from personal visits to branch networks and from websites without any personal interaction so that we can clearly identify whether credit is granted on an arm's-length or relationship basis. In case of an in-person application, the firm's representative (e.g., owner/manager) personally visits one of the 1,536 branch offices (out of a total of 1,552) in our sample[4] to supply all the relevant information, submit financial statements and tax data, provide a list of assets, etc. The local loan officer transcribes this information into electronic form and matches it with credit reports for input into the bank's own proprietary credit-scoring model. The whole lending process including the credit decision typically takes four hours to a day from the initial meeting between applicant and loan officer.

The loan officer also uses the branch visit to conduct an in-depth interview with the applicant to gather "soft" information in the sense that it would be hard to verify by a third party. In up to 8% of the cases, the branch will invite the applicant back to follow up on open questions, review discrepancies in submitted information with credit reports, discuss the prospects of the firm, etc. This information allows the branch manager or loan officer to then subjectively adjust the firm's internal score should the applicant deserve credit in their eyes but fail to meet certain commercial, profitability, liquidity or credit-score requirements. It represents the private-information component in the bank's credit score and forms the basis of our analysis.

Each branch office enjoys a considerable amount of autonomy in the assessment, approval, and pricing of loans but can only deviate from bank-wide practices upon detailed justification. As a consequence, credit decisions ultimately reside with branches because local managers can alter credit scores on the basis of a standard set of subjective criteria that the final score reflects. Similarly, they can adapt loan terms including pricing to the specific circumstances of the application. However, branch managers' career prospects and remuneration depend on the overall success of their credit decisions, and local overrides are closely monitored by the bank's overall risk management.

In case of online applications, the applicant submits all the requisite information through a website. The online processing center then requests credit reports, cross-checks the information very much like the branch office, computes the firm's credit score, etc. but does not attempt to

[4]For comparability, the 100 institutions with more than $10 billion in assets in 2002 operated, on average, 364 branch offices. Their average amount of deposits is about a quarter of our data provider's deposit base.

resolve any informational discrepancies. As a matter of operational policy, there is no personal interaction between the bank and an online applicant so that our lender makes credit decision purely based on firm-supplied information, credit reports, and its internal credit score that it does not revise. Similarly, the loan terms, especially interest rates, are purely a function of the firm's credit score, ability to post collateral, third-party guarantees, etc. should the bank extend an offer. Hence, both credit offers and their terms are highly automated in the online market, closely corresponding to the definition of transactional debt.

Most monitoring is automated for both loan types and takes place through the daily tracking of current-account movements or balances (whenever available) and prompt debt service. On a monthly basis, the bank collects new credit reports for the firm and its owner and updates the risk profile of the account. Yearly loan reviews and the treatment of overdue loans, however, differentiate information gathering across lending channels. On each anniversary of the loan's origination, transactional borrowers submit updated financial information online. Relationship borrowers do so in-person at their branch offices that uses the visit to discuss the firm's prospects, state of solvency, funding needs, etc. Similarly, if a payment is between 10 and 20 days late on a relationship loan the account officer will personally visit the firm. If the account becomes more than 20 days overdue, the bank cuts back credit lines to the current balance, i.e., reduces its credit commitment, but can take no such action on term loans that it may only call in after 60 days.

At the same time, the two lending channels effectively compete within the bank because loan officers have no incentive to encourage in-person applicants to also apply online. As a result, the observed lending channel allows us to cleanly sort the credit applications into transactional or relationship loans.

3.2 Sample Selection

Our sample consists of all applications for new loans to our bank that conform to the Basel Accord's SME lending definition between January 2002 to April 2003 (36,723 observations). We match these records with credit-bureau reports to verify the supplied information and delete 2,786 applications with missing data (e.g., Experian credit score), discrepancies, and incomplete or nonexisting addresses that we checked with Yahoo!SmartView and Google Maps.[5] To control for the cost and ease

[5]Our bank engaged in several M&A transactions affecting its branch network. We omit all re-assigned loan records.

of access to credit we rely on the driving and aerial distances between the various parties. Using Yahoo!SmartView we next identify the nearest competitor for all loan applicants and determine the driving distances in miles and minutes as well as the aerial distances between the firm, the bank branch for personal applications or the processing center for online ones, and the competitor's branch from Yahoo!Maps.[6] Since 334 loan requests by applicants with PO Boxes, from rural addresses, or from recent subdivisions do not allow us to uniquely determine driving and aerial distances to their branch or to competitors we also delete these records leaving a total of 7,859 online applications and 25,957 in-person ones.

We find that the driving distances between firms bank branches range from 0 to 3,102 miles, which is clearly too great to conform to standard notions of relationship lending. Hence, we drop outliers with a firm-bank distance in excess of 255 miles to insure that our data closely conforms to theoretical definitions of transactional and relationship lending. Removing these 257 in-person applications (1% of the sample) leaves 33,346 observations that we now analyze.[7]

3.3 Data Description

Table 1 summarizes our data and main variables as a function of the applicant's chosen form of interaction with the bank and reports the P-values of t-tests for the each variable's mean conditional on the lending channel.[8] Approximately 25% of our loan requests originated over the internet whereas the remainder stems from in-person visits to 1,536 branches where applicants personally filled in the necessary forms, provided supporting evidence, and answered loan officers' questions. Since there is no personal interaction between online applicants and bank officers loan offers and terms are strictly a function of the applicant's submitted information, credit reports, and the bank's internal credit assessment.

To analyze informational effects in transactional and relationship lending we rely on the outcome of the bank's own borrower assessment in terms of the internal credit score calculated for

[6] SmartView has the dual advantage that it does not accept sponsored links and draws on the combined yellow-page directories of BellSouth and InfoUSA (Mara, 2004) providing objective and comprehensive bank-branch information. We also tried Microsoft's MapPoint but found that the underlying business directory invariably produced only lenders that paid for having their branches displayed on the map and not necessarily the ones closest to the applicant.

[7] Replicating our analysis with these omitted observations yields virtually identical results presumably because of personal ties between the firm or its owner and the branch office that pre-date the credit request.

[8] For confidentiality reasons, the provider of the data did not allow us to report further descriptive statistics because they could be used to "reverse-engineer" the composition of the loan portfolio.

each loan application. While the methodology is proprietary and subject to confidentiality restrictions, the credit-screening procedure is consistent across all branches, lending channels, and applications, relies on the same approach, and uses a common set of inputs. For in-person applications, our bank's credit scores comprise a subjective element because local branches provide "soft information" through individual adjustments that can over-ride automated lending decision and centralized loan pricing. From periodic surveys of loan officers our bank estimates that 20% to 30% of the in-person score ultimately consists of subjective (soft) information. We use the final scores whose revisions follow bank-wide guidelines and require detailed justification by branches. Internal scores for online applications are not subject to revision and therefore comprise only hard, i.e., independently verifiable, proprietary information, if at all.

Internal scores range from 0 (worst) to 1,850 (best). Their means (medians) are 893 (898) for online applicants and 924 (945) for in-person ones, and the difference is significant at the 10% level (P-value of 5.23%). We also collect the applicant's Small Business Intelliscores (XSBI), which Experian, the leading commercial credit bureau, provides together with its report services, as a measure of publicly available information on each firm's creditworthiness. We reverse the Experian scores that measures the likelihood of "serious delinquency" over the next 12 months and linearly rescale them for comparability with the better known (retail) FICO scores so that the XSBI variable ranges from 300 (worst) to 850 (best). Contrary to the internal score, the average (median) of online applicants' Experian scores is statistically significantly higher: 718 (704) against 713 (702) for in-person applicants (P-value of 0.00%).[9] This discrepancy across loan types stems from the subjective revisions of scores for in-person applicants. It highlights not only the informational value of lending relationships but also how banks incorporate subjective information such as personal impressions of borrower quality into credit decisions.

We also have data on the nature of the lending relationship that facilitates the collection of such borrower-specific information.[10] Our first variable is the number of months that a particular firm has been on the books of the bank, which measures the length of the lending relationship. We see that in our sample online applicants have, on average, obtained a first credit product 27.6

[9]The US mean (median) for comparable consumer FICO scores is currently 678 (723). See Experian (2000, 2006) for further details on the SBI and its ability to forecast credit delinquency.

[10]James (1987), Lummer and McConnell (1989), and Elsas (2005) present evidence suggesting that banks gain access to private information over the course of the lending relationship.

months prior to the loan application whereas in-person applicants have been borrowers for 30.5 months. To measure the existence of a privileged lending relationship we define a binary variable Scope in terms of the balance of the firm's current account (exceeding $5,000) together with prior borrowing, and the purchase of at least one other banking product (Scope: about 20% of online against 30% of in-person applications).

To control for the availability of public information and firm-specific attributes we rely on the months a particular applicant has been in business (63 vs. 103 months for online and in-person applications, respectively), which is a good proxy for informational transparency, and the firm's monthly net income ($64,488 vs. $100,917 for online and in-person applications, respectively) that captures size and profitability effects. We also use 38 industry dummy variables based on the applicants' two-digit SIC codes to account for any industry effects in the data. Table 1 shows that our sample represents a wide cross-section of industries, albeit with a particular emphasis on wholesale and retail trade, personal, business and professional services, and construction. State and quarter dummy variables account for regional and business-cycle effects whereas the number of bank branches and active lenders in a firm's zip code, which we collected from the FDIC's Summary of Deposits data base by year, measures the competitiveness of local credit markets.

In terms of loan characteristics our data contains the requested loan amount (mean of $36,995 and $46,507 for online and in-person applications, respectively, in line with typical small business lending), its maturity (mean: 5.39 and 6.68 years, respectively), and existence of collateral (about 41% for online against 55% for in-person applications). About 17% (36%) of online (in-person) credit requests were personally guaranteed by guarantors with a monthly income of $23,702 ($34,981). 19.52% (28%) of online (in-person) applications are for term loans, the remainder is for credit lines. As a matter of business policy, our bank only offers term loans at fixed rates and credit lines at variable rates so that our Term Loan (vs. credit line) binary variable also captures the nature of the interest rate. Finally, 3.71% of online against 6.35% of in-person applications fall under the terms of the Small-Business Administration (SBA) guarantee program.

To measure the ease and cost of personally transacting with the bank in terms of time and effort we use the driving distance in miles between each firm and their branch office for in-person applications or, for consistency, the processing center for online request, as well as the distance to the closest full-service branch of a competitor. We see that relationship borrowers are on average

located 10.3 (median: 2.8) miles away from their bank branch[11] whereas transactional applicants are 91.6 (median: 31.8) miles away from the bank's online-loan processing center. By contrast, both transactional and relationship applicants are about 1 mile on average (median: 0.5 miles) from the nearest full-service branch of a competing lender. Using driving minutes or aerial distances instead of driving miles leaves our results virtually unchanged so that we rely on driving miles to control for transportation and related transaction costs.

Since banks and their customers might choose to locate in certain areas based on local economic conditions, we include the Case-Shiller Home Price Index (CSHPI: see Case and Shiller 1987 and 1989) to control for potential endogeneities in the parties' choice of location and lending channel. By matching each loan application with the index by zip code and month we also capture loan-transaction effects that are due to the local level of economic activity, differences in affluence across postal zones, and differential levels of urbanization or road infrastructure as reflected in local house prices.

We see that contrary to common perceptions, transactional applicants are typically younger and smaller firms that request smaller loan amounts, offer less collateral and personal guarantees, and are more creditworthy according to publicly available information (XSBI). However, they are less likely to have a prior business relationship with the bank and, if so, the lending relationship is shorter than for in-person applications. As a result, the banks internal score as a proprietary measure of credit quality is higher for relationship borrowers, presumably through subjective revisions that incorporate soft local information into the credit decision.

3.4 Methodology

Our estimation strategy simply retraces the steps of the loan-origination process. First, we specify a logistic model of the firm's choice of loan type as a function publicly available and proprietary information, characteristics of the lending relationship, firm attributes and various control variables. We next investigate the bank's credit decision by estimating a logistic discrete-choice model of the lender's decision to grant or deny credit by lending channel. To get a sense of the degree to which

[11] In terms of medians, our personal applicant-bank distances of 2.80 miles are twice as large as the 1.40 miles borrower-bank distance reported in Degryse and Ongena (2005) which might simply be due to the lower population density of the Eastern US as compared to Belgium. By contrast, our driving distances are roughly in line with the 5 miles median distance that Petersen and Rajan (2002) find for loans made between 1990 to 1993 from the National Survey of Small Business Finance (NSSBF) that covers the entire US.

the pricing of transactional and relationship loans conforms to theoretical predictions, in particular informational capture in the face of very different competitive dynamics across the two lending channels, we then specify a linear model of the offered annual-percentage rate (APR), i.e., the all-in cost of credit taking into account fees and commissions, as a function of loan terms and the same explanatory variables.

Successful loan applicants typically move next by accepting or declining loan offers. Hence, we explore the differential effect of private and public information across lending channels on bank competition as revealed by an applicant's decision to switch lenders. Specifically, we estimate a discrete-choice model of the firm's likelihood to decline the bank's loan proposal in favor of a competing offer as a function of loan-term, information, and control variables. Lastly, the respective informational and competitive dynamics in each lending channels hold different implications for type II errors in credit screens and, hence, default across loan types. We therefore specify a logistic model of borrower delinquency to assess the incidence of debt type on the quality of the bank's public and private information in terms of loan performance.

We focus on the following key variables in our investigation of the differential information production in transactional and relationship lending: Experian's Small Business Intelliscore ($XSBI$) for each applicant firm as a measure of publicly available information, the internal credit score as a measure of the lender's proprietary information, the scope and months-on-book variables measuring the depth of the lending relationship, and the firm-bank and firm-competitor distances as proxies for the cost of personally transacting with the bank or the quality of a lender's local informational advantage and its competitive use (see Agarwal and Hauswald, 2006). Since the bank's proprietary credit assessment might also comprise publicly available information we construct a measure of its pure private information by orthogonalizing the internal and Experian scores.[12] To this end, we estimate the regression

$$\ln\left(IntScore_i\right) = \alpha_p + \beta_p \cdot XSBI_i + 1_{eloan}\left(\alpha_e + \beta_e \cdot XSBI_i\right) + u_i$$

with branch fixed effects (and clustered standard errors) where e and p index the coefficients for the

[12]We distinguish proprietary from private information in credit decisions because the former relies on a mix of public and private intelligence as inputs into the bank's proprietary credit-assessment process. The latter is the purely private component of this process.

in-person and online applications, respectively and 1_{eloan} is a binary variable that takes the value 1 for online applications and 0 otherwise. Incidentally, the R^2 are 0.67 and 0.71 for the online and in-person equations, respectively, which confirms our data provider's contention that up to 30% of the internal score is based on soft, subjective information.[13] We then use the estimated Private-Information Residual $\hat{u}_i$ as a clean measure of the bank's private information in lieu of its internal score. Note that we can also interpret the residual $\hat{u}_i$ as a proxy for the bank's informational advantage over publicly available information.

For the firm's and bank's decisions, we specify logistic discrete-choice models with different equations for each lending channel but in a unified framework so that we can directly test hypotheses, etc. In particular, we estimate the discrete-choice model of a loan offer $Y_i = 1$

$$E\left[Y_i \left| \mathbf{x}_i \right.\right] = E\left[\left(1 - 1_{eloan}\right) Y_i + 1_{eloan} Y_i \left| \mathbf{x}_i \right.\right] = \Pr\left\{Y_i = 1 \left| \mathbf{x}_i \right.\right\} = \Lambda\left(\mathbf{x}_i'\boldsymbol{\beta} + 1_{eloan} \cdot \mathbf{x}_i'\boldsymbol{\gamma}\right)$$

for the logistic distribution function $\Lambda\left(\mathbf{x}_i'\boldsymbol{\beta}\right) = \frac{\exp\left\{\mathbf{x}_i'\boldsymbol{\beta}\right\}}{1+\exp\left\{\mathbf{x}_i'\boldsymbol{\beta}\right\}}$ so that the previously defined binary variable 1_{eloan} is our slope dummy that allows us to report results by lending channel because we have

$$E\left[\hat{Y}_i \left| \mathbf{x}_i \right.\right] = \Lambda\left(\mathbf{x}_i'\hat{\boldsymbol{\beta}} + 1_{eloan} \cdot \mathbf{x}_i'\hat{\boldsymbol{\gamma}}\right) = \begin{cases} \Lambda\left(\mathbf{x}_i'\left(\hat{\boldsymbol{\beta}} + \hat{\boldsymbol{\gamma}}\right)\right) & \text{for eloans } (1_{eloan} = 1) \\ \Lambda\left(\mathbf{x}_i'\hat{\boldsymbol{\beta}}\right) & \text{for in-person loans} \end{cases}$$

We proceed similarly for our linear-regression model of the offered loan rate, i.e., the annual percentage rate (APR) including all fees and commissions, that we specify as follows:

$$r_i = \mathbf{x}_i'\boldsymbol{\beta} + 1_{eloan} \cdot \mathbf{x}_i'\boldsymbol{\gamma} + \varepsilon_i$$

We estimate all our discrete-choice specifications by full-information maximum likelihood and report their pseudo R^2 that is simply McFadden's likelihood ratio index whenever appropriate. To control for systematic effects in self-selection and approval practices across branches and lending channels we estimate all our specifications with branch fixed effects and rely on clustered standard errors that are adjusted for heteroskedasticity across bank branches and autocorrelation within

[13] For confidentiality reasons we cannot provide further details on the orthogonalization nor report any results. The log-linear specification best agrees with the nonlinear nature of Experian's Small Business Intelliscore.

offices including the online-loan processing center. Note that the unique nature of our data set allows us to sidestep endogeneity problems that typically arise in the study of the credit terms on the basis of only booked loans. Since our sample consists of all applications and loan offers potential borrowers have not chosen yet whether to accept or to refuse the lender's terms. The omission of declined loan offers could give rise to the joint endogeneity of borrower characteristics, bank attributes, and loan terms, which we avoid through sample selection by including the 1,284 ultimately declined offers in this part of the analysis. Since several of the variables fit better in logarithms than levels we use the former whenever appropriate.

4 The Choice between Arm's-Length and Relationship Debt

Table 2 reports the estimation results for the firm's decision to seek a transactional loan through an online application. Specification 1 reveals that, contrary to widespread perceptions, the firm's size or profitability, age, and ability to post collateral do not seem to enter into the applicant's choice of loan type: Net Income, Months in Business, and Collateral are all statistically insignificant. Similarly, the competitiveness of the local credit market as measured by the number of competing lenders or branches is not a factor. The most likely explanation is the very homogeneous nature of small businesses so that other considerations such as informational effects or the local availability of credit must determine the firm's decision. In fact, transaction costs as measured by the applicant's proximity to lenders and prior business relationships do matter. The further away the firm is located from the nearest branch office or the online-loan processing center (Firm-Bank Distance), the more likely it will apply for a transactional loan online. Consistent with theoretical predictions, the longer firms have borrowed from the bank (Month on Books) or the broader the range of dealings (Scope) the more likely they are to apply in-person for relationship loans.

Adding our information proxies to the model we see that both the XSBI and Internal Score as, respectively, public and proprietary measures of high credit quality increase the likelihood of a firm applying online (Specification 2, Table 2). However, in terms of economic significance the marginal effect of the XSBI score representing only public information is almost four times that of the internal score, which comprises both private and public information.

To clearly distinguish the respective roles of publicly and privately available information in

borrowers' choice of lending channels we next replace the Internal Score with its orthogonalization in terms of the XSBI, the Private Information Residual (PIR), as a measure of the bank's pure private credit assessment. Comparing Specifications 2 and 3 in Table 2 we see that the distinction between proprietary (Internal Score) and private (PIR) information is crucial. Only when we properly measure the latter as the former's orthogonal complement to public information do we find the predicted sign pattern so that public signals of high credit quality are associated with transactional debt and private signals with relationship lending.

The two overriding factors for the firm's choice of lending channel are now the public credit-quality signal and the Private-Information measure (Specification 3, Table 2). Not only are the marginal effects of roughly similar magnitude their opposite signs also conform to perceived notions of transactional and relationship lending. The better the public assessment of a firm's creditworthiness is the more likely it is to apply online for a transactional loan. Put differently, firms that more likely than not are aware of their Experian scores know that a better public signal improves their access to (cheaper) transactional debt and act accordingly.

Conversely, if a firm has a longstanding business relationship with its bank it can count on being well known and, hence, preferentially treated by its bankers, who, in turn, have access to better inside information. As a result, we would expect the firm's decision and the bank's private credit-quality signal to be correlated. Our results bear out this conjecture: the better the pure private assessment of the firm's credit quality, the more likely the firm will request a relationship loan through an in-person application at a branch office. Since the PIR also measures the inside bank's informational advantage this finding suggest that despite the danger of informational capture better private information actually increases a firm's likelihood of choosing a relationship loan through the promise of preferential treatment or intertemporal transfers.

To further investigate this hypothesis we next add interaction terms between the PIR and relationship variables that facilitate the collection of private information over time (Specification 4, Table 2). The PIR-Months-on-Books and PIR-Scope effects further support our interpretation that despite the danger of informational capture borrowers well known to their bank seek relationship debt. The longer (Months on Books) or broader (Scope) the parties' interaction the more likely the firm will choose relationship debt and the more important the existence of private information becomes for this choice of loan type.

The fact that both the lender's informational advantage and prior borrowing strongly increase the probability of a relationship-loan request provides additional support our conjecture that firms also benefit from special ties to their bank. Firms know that longstanding business ties facilitate the access to credit precisely because loan officers tend to have a better picture of their prospects. Exposed to the danger of informational capture by their bank, applicants of high perceived credit quality might as well benefit from more readily available credit that relationship debt typically offers in such circumstances, a topic that we turn next to.

5 Credit Decision by Lending Channel

In this section, we analyze the availability and pricing of credit by origination mode to determine the differential information content of arm's-length and relationship loans. Table 3 reports summary statistics for the key variables by credit decision and lending channel, in particular loan terms and pricing. Two facts consistent with the theoretical predictions on lending modes stand out: rejection rates are much higher for online applications (about 61% as compared to 50% for in-person requests), and credit spreads are on average much lower for transactional than for relationship loans (277 and 456 basis points, respectively). Credit is much less readily available through transactional channels but, when it is, loan rates are much more favorable.

5.1 Credit Availability

The results for the bank's decision to grant a loan show that transactional debt is much harder to obtain than relationship debt *ceteris paribus*. Both specifications in Table 4 reveal that applying online lowers the probability of a loan offer by up to 11.4%. Lenders know that they compete on a much more equal informational footing in this segment, if not at an outright disadvantage should the firm also be seeking inside credit elsewhere. To avoid potential adverse-selection problems they have to be much more circumspect in their arm's-length lending and refrain from offering credit more often, thereby lowering the probability of an online loan offer (see, e.g., Broecker, 1990 or von Thadden, 2004).

Our findings confirm that different types of information shape each credit-market segment. Specification 1 in Table 4 shows that the likelihood of obtaining transactional credit increases in

both the public and proprietary credit-quality signal (XSBI and Internal Score, respectively): the better the outcome of the credit screen, be it public or bank-internal, the easier access to online loans becomes. However, an increase in the Internal Score has only a small, albeit statistically highly significant, impact on the likelihood of obtaining transactional credit. By contrast, the Experian score (XBSI) is not statistically significant in the relationship-loan equation. Instead, positive proprietary credit assessments containing a mixture of soft private and hard public information primarily decide the access to relationship loans. This finding suggests that not only the origin of the bank's information but also how it processes and interprets its intelligence matters for inside lending.

To carefully separate out private from public information we next replace the Internal Score with its Private-Information Residual (PIR) and add the relationship-PIR interaction terms to the model (Specification 2 in Table 4). The inclusion of this pure private-information measure resoundingly confirms our finding that banks use different types of information for each lending mode. While both the PIR and Experian score are statistically significant in each equation, the relative magnitudes of the variable's marginal effects are reversed across loan types. Transactional-credit decisions primarily rely on public information (XSBI score) whereas private information (PIR) only has a small impact; in fact, the marginal effect of a positive public credit signal is almost 8 times larger than that of a positive private credit-assessment. By contrast, private information is the overriding factor in the decision to offer relationship credit because its marginal effect is almost five times larger than the small positive impact of public information.

Comparing the relative impact of public and private information on credit availability across loan types we see that the marginal effect of positive private information is 15 times greater for relationship than for transactional lending. Interestingly, the importance of a high public credit score does not differ as much across the two lending modes (only 5.5 times lower) and retains its statistical significance at 5% in the relationship-loan equation (Specification 2). In light of the fact that lenders and loan types compete with each other this finding is less surprising than it might otherwise be. The theoretical literature has long argued that good credit risks are the primary targets for informational capture in relationship lending (e.g., von Thadden, 2004 or Hauswald and Marquez, 2006) and, therefore, more likely to switch providers of credit. Hence, banks know that public perceptions of credit quality matter in the competitive response of other lenders that try to

poach borrowers. As a result, the Experian score not only captures credit-quality effects but is also a proxy for the expected intensity of competition for the borrower as is the bank-borrower distance (see Agarwal and Hauswald, 2006).

We conclude from both specifications in Table 4 that, consistent with theoretical predictions, private information primarily determines access to relationship debt whereas public information drives arm's-length lending. Banks specifically gather more costly private information for borrowers that through their chosen mode of interaction with the lender facilitate its collection and signal their willingness to be informationally captured. The differential impact of the length and scope of the lending relationship across loan types confirms this interpretation. Scope and Months on Books are statistically insignificant in the decision to offer arm's-length credit but highly significant both in statistical and marginal terms for relationship-loan offers. Taken together these effects suggest that a prior lending relationship enhances the likelihood of obtaining relationship loans precisely because they facilitate the collection and interpretation of (private) information. Since the bank does not revise its score for online applicants in light of extraneous information any prior interaction seems less relevant for the decision to grant transactional loans.

Similarly, we see that the firm-bank distance is only statistically significant (at around 5%) in the in-person-loan equation. The closer a potential relationship borrower is to a branch office the higher the likelihood of obtaining credit becomes. In fact, the bank-borrower distance is an excellent proxy for the quality of the lender's private information and, hence, informational advantage (see Agarwal and Hauswald, 2006). Petersen and Rajan (2002) argue that soft subjective information, whose collection borrower proximity and prior lending relationships facilitate, is crucial for lending decision. No such opportunity to collect soft information and incorporate it into credit decisions exists in the case of transactional loans, which might explain the statistical insignificance of the relevant variables in the eLoan equation.

A comparison of the two specifications in Table 4 shows that the other effects remain virtually unaffected by the inclusion of the Private-Information variable. The firm's size or profitability (Net Income) and its ability to post collateral or to guarantee the loan raises the likelihood of a loan offer for each lending channel and the marginal effects are very comparable. The local-competitiveness effects closely correspond to theoretical predictions. More competition, i.e., a higher number of competing lenders or branches in the firm's zip code, decreases the likelihood of obtaining a loan

of either type because competition decreases the average quality of the applicant pool (see, e.g., Broecker, 1990) so that banks refrain more often from offering credit.

Our findings suggest that the quality and, hence, use of proprietary intelligence radically differs across lending channels. The limited ability to gather inside information or its high cost in transactional lending forces banks to discount any private knowledge and instead to rely on publicly available signals of credit quality. As a result, banks compete on a much more equal informational footing that borrowers recognize and incorporate into their choice of loan product. By contrast, banks heavily rely on private information gathered through inside lending in relationship-credit decisions. Although banks can use their informational advantage to soften competition through the threat of adverse selection and to extract information rents (Hauswald and Marquez, 2006) it also helps relationship borrowers to obtain credit. By the same token, our results validate the firm's perception of the importance of personal interaction for obtaining relationship loans on the basis of private information.

5.2 Loan Pricing

To investigate differential pricing of credit across lending channels we next estimate linear models of the loan's offered all-in cost (APR) as a function of our previously described explanatory variables. Like the internal score of in-person applicants, branches can adjust both the loan terms and pricing in light of local conditions and information. No such adjustment opportunity exists for eLoans whose price is a simple function of the internal score, the ability to post collateral or personally guarantee the loan, etc. Table 3 provides descriptive statistics for the offered loan terms by credit channel. To control for the interest-rate environment, we rely on the maturity-matched (interpolated) US Treasury yield on the loan date and the difference between the 5-year and 3-months US Treasury yield (Term Spread: yield-curve shape). We estimate the model with the Heckman correction for sample-selection bias to take into account the lender's prior credit decision.

Table 5 shows that transactional debt (eLoan) is up to 135 basis points less expensive than relationship debt. Specification 1 summarizes the effects of relationship variables, firm attributes, loan terms, and various controls on offered loan rates. Adding the informational variables (Specifications 2 and 3), we observe the same relative importance of public, proprietary, and private information in the determination of offered loan rates across lending channels that we found for

the prior credit decision. Even when we use the internal credit score as a measure for proprietary information Specification 2 in Table 5 shows that the impact of the public (XSBI) and internal score on the quoted all-in cost symmetrically varies across lending channels. An increase in the Experian score (XSBI) greatly reduces transactional loan rates whereas bank perceptions of higher credit quality (Internal score) lead to a much more modest reduction in rates. The exact opposite is true for relationship loans whose price is much more affected by a rise in the Internal Score than in the XSBI one. These effects are all the more pronounced that the Experian score is highly nonlinear in implied credit quality whereas the Internal Score is quite linear.

Replacing the bank's credit score with the Private-Information Residual reinforces this conclusion (Specification 3, Table 5). Our measure of private credit assessments now becomes statistically insignificant in the eLoan equation but retains its high statistical significance in the relationship-loan equation. The same is true for the relationship-PIR interaction variables that enhance the private-information effect for relationship loans but are statistically insignificant in the transactional-loan equation. Any pure private information the bank can gather is mostly valuable in inside lending to limit competition and informationally capture relationship borrowers. Its poorer quality for online borrowers does not offer any significant improvement over publicly available signals of creditworthiness. Hence, our bank disregards the purely private component of its credit assessments in the pricing of transactional debt that primarily results from symmetrically informed competition on the basis of public credit-quality signals. We note that distance effects do not seem to significantly figure in the pricing of transactional or relationship loans once we include informational variables. Competition in terms of branch proliferation clearly matters because it reduces APR quotes in both market segments. In fact, the effect is twice as pronounced for relationship debt for which local credit-market conditions are more important than for transactional lending.

Interestingly, the relationship variables Scope and Months on Books (statistically) significantly reduce not only the offered APR of relationship debt but of transactional debt, too. Contrary to the credit decision, the prior purchase of other products from the bank and the length of a prior lending relationship enters the pricing of transactional loans. One possible explanation might revolve around rewarding customer loyalty in the presence of very low switching costs in online lending (see also Schenone, 2006). As a result, prior lending could be a significant factor in banks' pricing policy but less for informational considerations than to retain a customer of proven profitability. Adding the

interaction terms in Specification 3 further reinforces this interpretation. In the eLoan equation, the interaction terms are statistically insignificant whereas the relationship variables retain their significance. In the relationship-loan equation the interaction terms are highly significant so that the relationship variables enhance the beneficial effect of a higher private credit-quality signal. Hence, lending relationships also have an indirect effect on loan rates by improving the quality of a bank's credit assessment that, in turn, places greater weight on its private information in the pricing of inside debt.

It is also worthwhile to point out that a firm's age matters for the pricing of transactional but not relationship debt. Older, more established firms pay less for loans but the effect is statistically significant only for eLoan offers. The opposite is true for firm profitability (Net Income) that only matters for the pricing of relationship debt. Again, informational effects might be at work. The longer a firm has been in existence the more publicly available information exists which is particularly valuable in the pricing of transactional debt. By contrast, financial data such as net income is self-reported in loan applications and, therefore, susceptible to manipulation. It is very costly to follow up on financial information for online applications so that our data provider seems to disregard it in this case. By contrast, loan officers can easily verify such information during the branch visit by in-person applicants (from, e.g., tax filings) and, hence, place more trust in financial statements. The other explanatory variables, especially the collateral and guarantee dummies, have very similar and predictable effects across the two loan types.

Taken together our results provide very strong empirical evidence for the theoretical predictions on the availability and pricing of credit across lending modes. In their choice of loan type, firms face a trade off between easier access to relationship debt and lower priced transactional debt. Furthermore, we establish that different types of information lead to this trade off. The limited ability to gather proprietary information from transactional lending forces banks to rely more on public information that further levels the playing field. Hence, online borrowing combines lower interest rates with a lower probability of receiving credit *ceteris paribus.* By contrast, the bank's ability to collect private information and to strategically use it enhances the likelihood that an in-person applicant receives credit albeit at the price of higher rates and informational capture, a topic we turn to next.

6 Lending Competition and Borrower Choice

By comparing credit offers to actually booked loans and matching the observations with credit-bureau information on competing loan offers we identify 410 transactional and 874 relationship borrowers that decline the bank's terms and seek credit from a competitor around the same time.[14] Table 6 provides summary statistics by lending channel in function of the borrower's decision to accept or to decline the offer. We see that, on average, the declined loan offers are very similar to accepted ones for each lending channel.

When the degree of information asymmetry varies by borrower credit transactions become more contested as the informational advantage of the better informed lender falls. Less precise credit assessments decrease the threat of adverse selection so that less informed competitors can bid more aggressively by offering credit more often and at lower rates, thereby eroding the more informed bank's ability to earn information rents (see, e.g., Hauswald and Marquez, 2006). Hence, the smaller our bank's informational advantage as measured by the PIR becomes the more frequently borrowers should switch lenders. In the limit, when all banks are symmetrically informed, price competition erodes any informational rents and transactional borrowers frequently switch lenders. The implied switching rates in Table 6 bear out this prediction: transactional borrowers are twice as likely as relationship ones to decline a loan offer and seek credit elsewhere (13.34% against 6.82%).

To investigate this hypothesis we next estimate a logistic discrete-choice model of the successful loan applicant's decision to switch lenders. Specification 1 in Table 7 shows that, in line with theoretical predictions, transactional borrowers are about 5% more likely to decline loan offers and seek credit elsewhere. As we conjectured earlier, the public credit-quality signal (XSBI) is by far the most important factor in inducing applicants to decline loan offers. The higher a firm's public score, the easier it becomes to switch lenders explaining the variable's high marginal effect across all equations and specifications. By contrast, private credit-quality signals have a large marginal effect only on the decision of relationship borrowers. The better the bank's own private credit assessment of a borrower the more likely the latter is to switch lenders. Firms rationally anticipate that banks attempt to informationally capture inside borrowers and act accordingly so that the amount and quality of private information predicts switching behavior. As before, using

[14] This decision is very different from borrower's choice of single vs. multiple banking relationships; see Detragiache *et al.* (2000) and Farinha and Santos (2002).

the Private-Information Residual to measure the bank's inside information increases the marginal effect of private information (Specification 2, Table 7).

By contrast, the relationship variables (Scope, Months on Books) reduce the likelihood of refusing the loan offer for both transactional and relationship borrowers. The size of the marginal effects and statistical significance of the relationship-PIR interaction terms in the in–person-loan equation suggest that informational effects are at work. The bank's desire to retain prior customers might explain a similar effect for transactional borrowers. Unsurprisingly, the higher the quoted loan rate the more likely are firms to decline the offer and seek credit elsewhere irrespective of the chosen loan type. Not only is it easier for better credit risks to obtain competing loan offers, they are also the primary targets for rent extraction through loan pricing and, hence, have a larger incentive to switch lenders. Consistent with theoretical predictions the effect is more pronounced for relationship borrowers that face a greater threat of informational capture.

The physical distance from the firm to the branch office or processing center as well as to the nearest competitor have a small but statistically significant effect on borrower switching. The further away from the bank both transactional or relationship borrowers are located the more likely they are to decline a loan offer. Conversely, physical proximity to a competitor increases the likelihood of switching lenders. Informational effects might again explain this pattern. The further away a borrower is located, the less local information comes into play and the smaller is the inside bank's informational advantage. Competitors then face a reduced threat of adverse selection and, therefore, can more aggressively compete for such firms by offering credit more often and at lower rates. Such considerations, however, do not apply to symmetrically informed transactional lenders. Instead, it is the local competitiveness (number of competing lenders) together with the proximity to one of them that induces online borrowers to switch. The online loan-processing center is just too far away from applicants to match prices according to local conditions and looses out on the more distant firms.

Our results are broadly consistent with strategic lending by intermediaries that use private information to informationally capture high-quality relationship borrowers.[15] The better the bank's information, i.e., the higher the quality of its credit screen or the closer a borrower is located to

[15]See also Sharpe (1990), Rajan (1992), or von Thadden (2004) on this point. For evidence on the resulting winner's curse in banking see Shaffer (1998).

a branch, the easier it becomes to extract rents because our lender has a larger informational advantage over its competitors. Such attempts, however, fail in the transactional-loan segment where symmetrically informed competitors can compete more aggressively for online borrowers. As a result, the public perception of credit quality drives a firm's decision to switch providers of credit all the more that they are more likely than not aware of their own Experian scores and act accordingly.

7 Information Production and Credit Delinquency

Our credit-bureau data also allows us to trace type I (denying a loan to a good credit risk) and type II (offering a loan to a bad credit risk) errors in credit screens across loan types. Regarding the former, out of the 4,785 unsuccessful online applicants 3,303 firms (69%) managed to obtain a loan from another source within a month of their loan-application's rejection. By contrast, less than half (6,247 out of 12,664) in-person applicants were able to do so. Although transactional borrowers have a lower *ex ante* probability of obtaining a loan (see Tables 3 and 4) their cost of seeking credit online is lower so that they typically file more loan applications than relationship borrowers and, therefore, have a higher success probability *ex post*.

In terms of type II errors in screening, our sample contains 85 transactional loans and 319 relationship ones that have fallen 60 days past-due, which corresponds to our data provider's internal definition of a non-performing loan, within 18 months of origination.[16] Although the technical definition of default is 180 days past-due most lenders including ours take action after at most 60 days past-due either writing off the loan, selling it off, or assigning it for collection. As a result we do not know which of the delinquent loans ultimately experience default although over 90% of loans that are 60 days overdue eventually do according to our data provider.

We first note that the incidence of credit delinquency is higher in the transactional subsample: approximately 3.2% against 2.7% of relationship loans. To put these default rates into perspective, we also trace the credit delinquency of successful applicants that switched lenders. Their default rates are 3.4% and 2.9% for arm's-length and relationship loans, respectively, which is very comparable to our bank's own loan performance. By contrast, default rates for unsuccessful applicants

[16] We choose this window so that the likelihood of a loan becoming overdue is still related to the initial credit assessment and not to subsequent economic events beyond the bank's control.

that were able to obtain a loan elsewhere are very high but do not vary much by lending channels: 24.63% and 24.52% for online and in-person (denied) applications, respectively. We interpret these default frequencies as evidence that our lender minimizes type II error in credit decisions by trying to avoid lending to bad credit risks. In doing so, the bank is more successful for relationship loans than transactional ones, for which intermediaries generally suffer higher adverse-selection problems.

To investigate the differences in loan performance across transactional and relationship lending we estimate a logistic model of credit delinquency in terms of our usual information, relationship, and control variables by lending channel. Table 8 shows transactional borrowers are up to 2.9% more likely to default than relationship ones *ceteris paribus*. The results also exhibit the usual pattern in information effects across equations. Public information (XSBI score) has by far the largest impact on the likelihood of default for both loan types. Positive private information (internal score, PIR) only affects the performance of relationship loans in an economically significant manner. Again, proprietary intelligence is primarily useful for mitigating credit risk in relationship lending but adds less to the bank's ability to predict the performance of transactional loans.

The marginal effects of the relationship variables that are much larger for in-person than online loans and, especially, the PIR-relationship interaction terms confirm this effect. Banks benefit from lending relationships through better private information that allows them to decrease their borrower-specific credit exposure. Similarly, the Months in Business variable has quite a large and statistically significant marginal effect on decreasing the risk of default across both lending modes presumably because there is more information - private or public - available for older firms. The loan amount has a large negative effect on the likelihood of default that is more or less constant across lending channels and specifications. In contrast to DeYoung *et al.* (2004) who report that the probability of default on small-business loans increases in the distance between borrower and lender we do not find any significant distance effects for either loan type.

The small but highly significant positive marginal effects of the competitiveness measures are consistent with theoretical predictions that more competition implies more adverse selection and, hence, more default. The informational effects, however, suggest that different forces are responsible for each lending channel. In transactional lending, more competition decreases the average quality of the borrower pool so that each lender suffers more adverse selection (Broecker, 1990). When competition increases for relationship borrowers, the informed lender has less of an incentive to

acquire private information and the overall quality of its loan portfolio falls (see Gehrig, 1998 or Hauswald and Marquez, 2006).

8 Conclusion

This paper presents an in-depth comparative analysis of the respective roles of private and public information for transactions in arm's-length and relationship debt. The advent of online lending and banks' distinct operational practices across lending channels offer the opportunity to unambiguously identify transactional loans that match in all other respects traditional in-person loans typically associated with relationship debt. Using an exhaustive sample of online and in-person loan requests by small businesses we are able to determine the relative importance of private and public information for each lending mode. At the same time, our data also allows us to investigate how the chosen form of bank-borrower interaction shapes the lender's information acquisition, its strategic use in credit decisions, and the borrowers' response for each form of debt.

Our results reveal that banks rely on different types of information for each lending mode. Public information primarily drives credit availability and pricing in transactional lending whereas private information determines credit decisions for relationship loans. Since banks have less opportunity to generate borrower-specific information from arm's-length debt they compete on a more symmetrically informed basis and rely more heavily on public information in their transactional credit decisions. The opposite is true for relationship loans. We find strong evidence that banks disregard publicly available information when they have access to better "soft" private information through inside lending that becomes the foundation of their relationship-credit decision and pricing.

By the same token, borrowers base their choice of debt type mainly on public credit-quality information that is readily available to them and provides them with a sense of their success chances in each credit-market segment. Furthermore, we find evidence that, in addition, relationship borrowers anticipate on the existence and consequences of private information. Longstanding business relationships imply more inside information together with preferential treatment so that the likelihood that a firm will seek a relationship loan increases in the lender's private credit-worthiness signal. Similarly, a firm's decision to decline relationship debt or to default on it depends more on the bank's private information than transactional debt although overall public information once

again retains some importance for these choices, too. These findings are consistent with the notion that borrowers recognize the value of lending relationships for banks' ability to acquire proprietary information and to strategically use it.

However, the benefits of a lending relationship must ultimately outweigh the cost of informational capture for firms that otherwise would not selfselect into relationship lending. Hence, our findings also provide support for the contention that relationship borrowers benefit from the closer ties with their banks. The fact that in-person loan applicants have, on average, a much longer and deeper relationship with their bank than online applicants lends additional credence to this interpretation. Such benefits typically revolve around intertemporal transfers between the parties, i.e., the notion that banks are more willing to finance borrowers that would otherwise not be able to find funding if they can recover the initial costs through future rent extraction or better loan performance. To directly investigate the existence of such benefits, however, one would need panel data on bank-borrower interaction over a longer time period. We leave this question for future research.

Table 1: **Descriptive Statistics for All Loan Applications**

Lending Channel	**Online Application**			**In-Person Application**			***t*-Test**
Variable	Mean	Median	Std Dev	Mean	Median	Std Dev	*P*-val
Loan Amount	$36,995	$34,230	$125,232	$46,507	$39,687	$42,755	0.0000
Maturity (years)	5.39	5.14	2.05	6.68	6.14	5.39	0.0000
Term Loan (vs. Credit-Line)	19.52%		38.04%	28.05%		47.15%	0.0000
Collateral	41.53%		41.90%	54.85%		48.68%	0.0000
Primary Guarantor	16.98%		40.00%	36.45%		47.99%	0.0000
Primary Guarantor's Monthly Salary	$23,702	$20,644	$107,508	$34,981	$31,958	$88,955	0.0000
SBA Guarantee	3.71%		14.65%	6.35%		16.00%	0.0000
Internal Credit Score	893.55	898.06	739.49	924.24	945.28	1340.88	0.0523
Public (XSBI) Credit Score	718.16	704.63	55.93	713.79	702.50	57.90	0.0000
Private-Information Residual	0.0059	0.0003	0.5018	0.0003	0.0005	0.6359	0.4740
Scope of Banking Relationship	19.73%		35.15%	30.29%		43.78%	0.0000
Months on Books	27.61	23.21	48.75	30.49	22.49	43.29	0.0000
Monthly Deposit Account Balance	$12,636	$10,736	$16,071	$14,282	$10,940	$42,042	0.0007
Months in Business	63.71	54.11	41.66	103.21	88.73	103.30	0.0000
Firm's Monthly Net Income	$64,488	$58,028	$77,855	$100,917	$89,614	$316,001	0.0000
Case-Shiller House Price Index	167.00	150.93	36.33	166.36	153.57	31.43	0.1274
Firm-Bank Distance (miles by car)	91.62	31.84	81.08	10.29	2.80	25.17	0.0000
Firm-Comp Distance (miles by car)	0.89	0.54	1.17	1.02	0.51	1.53	0.0000
Firm-Bank Time (minutes by car)	77.21	72.63	73.12	11.79	7.36	22.19	0.0000
Firm-Comp Time (minutes by car)	1.44	1.32	2.36	2.15	1.12	4.75	0.0000
Firm-Bank Aerial Distance (miles)	94.35	31.73	82.55	8.08	2.21	20.41	0.0000
Firm-Comp Aerial Distance (miles)	0.88	0.52	1.32	0.71	0.36	1.37	0.0000
State CT	8.26%		10.34%	12.77%		35.28%	0.0000
State MA	23.34%		41.35%	15.18%		35.86%	0.0000
State ME	2.30%		14.37%	3.12%		17.30%	0.0001
State NH	2.85%		16.50%	2.57%		15.78%	0.1707
State NJ	16.29%		34.94%	24.52%		43.01%	0.0000
State NY	35.31%		45.89%	35.43%		47.75%	0.8483
State PA	0.27%		5.11%	3.05%		17.19%	0.0000
State RI	4.81%		21.42%	3.20%		17.58%	0.0000
Other States	2.00%		1.77%	0.17%		4.01%	0.0000
Q1 2002	17.01%		34.90%	18.19%		38.77%	0.0158
Q2 2002	15.04%		36.30%	18.54%		39.08%	0.0000
Q3 2002	17.43%		36.11%	17.37%		37.71%	0.8930
Q4 2002	20.46%		38.01%	19.00%		38.90%	0.0035
Q1 2003	23.94%		35.15%	26.91%		33.25%	0.0000
SIC 0: Agriculture, Forestry, Fishing	2.18%		14.59%	3.00%		17.04%	0.0001
SIC 1: Mining, Construction	9.92%		27.80%	13.24%		33.90%	0.0000
SIC 2: Manufacturing (Consumer)	2.79%		15.63%	2.40%		15.23%	0.0455
SIC 3: Manufacturing (Industrials)	3.37%		17.13%	3.03%		17.08%	0.1190
SIC 4: Transport., Comm., Gas, Elect.	4.26%		19.37%	4.94%		21.67%	0.0122
SIC 5: Wholesale and Retail Trade	25.71%		42.31%	30.76%		46.15%	0.0000
SIC 6: Finance, Insurance, Real Estate	4.44%		20.14%	3.31%		17.68%	0.0000
SIC 7: Personal & Business Services	19.53%		37.88%	19.16%		39.34%	0.4635
SIC 8: Professional Services	13.56%		31.34%	13.20%		33.36%	0.3965
SIC 9: Administration	0.30%		5.50%	0.12%		3.52%	0.0006
Number of Branches	4.48	2.76	4.53	4.78	3.00	5.41	0.0000
Number of Institutions	3.56	2.56	4.19	3.54	2.98	3.38	0.6355
Number of Observations		7,859			25,487		33,346

This table presents summary statistics for the variables described in Section 3 for our full sample of 33,346 data points in function of the firm's choice of lending channel. The last column indicates the *P*-values of a two-sided *t*-test for the equality of the variables' mean conditional on the loan's type (wherever appropriate).

Table 2: **The Choice of Lending Channel and Loan Type**

Specification	**1**			**2**			**3**			**4**		
Variable	Coeff	P-val	Marg	Coeff	P-val	Marg	Coeff	P-val	Marg	Coeff	P-val	Marg
Constant	-2.0883	0.0001		-2.0318	0.0001		-2.0567	0.0001		-2.0408	0.0001	
ln(1+XSBI)				0.4571	0.0001	14.30%	0.4498	0.0001	14.45%	0.4483	0.0001	14.40%
ln(1+Internal Score)				0.3534	0.0001	3.86%						
Private-Info. Res.							-0.8881	0.0001	-9.85%	-0.8856	0.0001	-9.79%
Scope	-0.2292	0.0001	-1.76%	-0.1184	0.5392	-0.02%	-0.1178	0.7938	-0.03%	-0.1177	0.7929	-0.03%
ln(1+M. on Books)	-0.7118	0.0001	-6.58%	-0.6812	0.0001	-6.31%	-0.6850	0.0001	-7.24%	-0.6794	0.0001	-7.17%
Scope·PIR										-0.3518	0.0348	-2.58%
ln(1+MOB)·PIR										-0.0998	0.1202	-1.82%
ln(1+M. in Business)	0.1009	0.8992	-0.11%	0.1046	0.8993	-0.10%	0.1083	0.9176	-0.17%	0.1081	0.9103	-0.17%
ln(1+Net Income)	-0.0717	0.4480	-1.01%	-0.0746	0.4920	-1.02%	-0.0777	0.5052	-1.00%	-0.0771	0.5038	-1.00%
ln(1+CSHPI)	-0.0999	0.9580	-0.69%	-0.0994	0.9403	-0.71%	-0.1030	0.9373	-0.82%	-0.1020	0.9993	-0.81%
ln(1+F-B Dist)	1.2160	0.0001	7.88%	0.9948	0.0001	1.94%	1.0062	0.0001	1.93%	1.0021	0.0001	1.93%
ln(1+F-C Dist)	-0.4612	0.0001	-3.26%	-0.2628	0.0001	-0.95%	-0.2860	0.0001	-1.07%	-0.2832	0.0001	-1.07%
Collateral	-0.2065	0.6284	-0.77%	-0.2148	0.6403	-0.75%	-0.2311	0.693	-0.73%	-0.2292	0.6902	-0.73%
Primary Guarantor	-0.0445	0.7838	-0.03%	-0.0474	0.7488	-0.01%	-0.0476	0.9284	-0.01%	-0.0472	0.9202	-0.01%
SBA Guarantee	-0.0740	0.0001	-0.43%	-0.0764	0.0001	-0.38%	-0.0828	0.0138	-0.35%	-0.0821	0.0138	-0.35%
Term Loan	-0.0775	0.9488	-0.02%	-0.0816	0.9502	-0.09%	-0.0814	0.9866	-0.09%	-0.0807	0.9902	-0.09%
ln(1+# Branches)	0.1983	0.6902	0.05%	0.2128	0.7024	0.03%	0.2059	0.7857	0.03%	0.2048	0.7832	0.03%
ln(1+# Competitors)	0.1002	0.6582	0.01%	0.1003	0.6358	0.02%	0.1086	0.6441	0.02%	0.1076	0.6382	0.02%
4 Quarterly Dum.		Yes			Yes			Yes			Yes	
8 State Dummies		Yes			Yes			Yes			Yes	
38 SIC Dummies		Yes			Yes			Yes			Yes	
Number of Obs		33,346			33,346			33,346			33,346	
Pseudo R^2		3.03%			5.30%			5.21%			5.22%	

This table reports the results from estimating a logistic discrete-choice model of the firm's choice of loan type by full-information maximum likelihood for our full sample (33,346 observations). The dependent variable is the firm's decision to apply online for a transactional loan ($Y = 1$: 7,859 observations) or in-person for a relationship loan ($Y = 0$: 25,487 observations). We estimate the specification $\Pr\{Y_i = 1 \,|\mathbf{x}_i\} = \Lambda\left(\mathbf{x}_i'\boldsymbol{\beta} + 1_{eloan} \cdot \mathbf{x}_i'\boldsymbol{\gamma}\right)$, where $1_{eloan} = 1$ for online applications and 0 otherwise and Λ is the logistic distribution function $\Lambda\left(\mathbf{x}_{ik}'\boldsymbol{\beta}_k\right) = \frac{\exp\{\mathbf{x}_{ik}'\boldsymbol{\beta}_k\}}{\sum_n \exp\{\mathbf{x}_{in}'\boldsymbol{\beta}_n\}}$, with branch fixed effects and compute clustered standard errors that are adjusted for heteroskedasticity across branch offices and correlation within.

The explanatory variables are our proxies for public (Experian's Small Business Intelliscore $XSBI$), proprietary (Internal Score) and private (Private-Information Residual) information, bank-borrower relationship characteristics (Scope, Months on Books abbreviated "MOB" in the interaction terms), firm attributes, the competitiveness of local credit markets (number of competing lenders and competing branches), proxies for the ease of transacting with lenders (firm-bank and firm-competitor distances abbreviated F-B and FC Dist, respectively), and control variables for local economic conditions (Case-Shiller house-price index abbreviate CSHPI), the business cycle (quarterly dummies), state, and firm's industry (see Section 3 for a description of the variables).

The Private-Information Residual (abbreviated "PIR" in the interaction terms) measures the bank's pure private information that we obtain from orthogonalizing the internal and Experian scores. Specifically, the PIR for each observation is the residual $\hat{u}_i$ of the branch fixed-effects regression $\ln\left(IntScore_i\right) = \alpha_p + \beta_p \cdot XSBI_i + 1_{eloan}\left(\alpha_e + \beta_e \cdot XSBI_i\right) + u_i$.

We report the coefficients ("Coeff"), their P-values ("P-val"), and marginal effects ("Marg") for the decision to apply online ($Y = 1$) but suppress the results for the business-cycle, state, and industry control variables in the interest of readability. Since the probabilities of applying online or in person sum to 1 the marginal effects for the choice of a relationship loan are simply the opposite of the reported ones. We obtain the marginal effects by simply evaluating $\frac{\partial \Pr}{\partial x_j} = \Lambda'\left(\mathbf{x}_i'\boldsymbol{\beta}\right)\beta_j$ at the regressors' sample means and coefficient estimates $\hat{\boldsymbol{\beta}}$. The pseudo-R^2 is McFadden's likelihood ratio index $1 - \frac{\log L}{\log L_0}$.

Table 3: **Descriptive Statistics for the Credit Decision by Lending Channel**

Panel A: Online Loan Applications

Loan-Application Outcome	**Accept**			**Reject**			***t*-Test**
Variable	Mean	Median	Std Dev	Mean	Median	Std Dev	*P*-val
Loan Rate (APR: all-in cost of loan)	6.86%	6.80%	1.94%	N/A	N/A	N/A	N/A
Loan Amount	$36,995	$34,230	$125,232	N/A	N/A	N/A	N/A
Maturity (years)	5.39	5.14	2.05	N/A	N/A	N/A	N/A
Term Loan (vs. Credit-Line)	14%		34%	23.27%		40.62%	0.0000
Collateral	50%		32%	35.79%		48.16%	0.0000
Primary Guarantor	26.72%		34.57%	10.73%		43.49%	0.0000
SBA Guarantee	0.79%		2.39%	5.58%		22.53%	0.0000
Internal Credit Score	1032.84	1018.39	807.30	804.06	820.76	695.93	0.0000
Public (XSBI) Credit Score	724.99	714.93	48.18	713.77	698.02	60.91	0.0000
Private-Information Residual	0.0287	0.0179	0.4792	-0.0183	-0.0098	0.5824	0.0002
Scope of Banking Relationship	21.95%	0.00%	30.43%	18.31%	0.00%	38.18%	0.0000
Months on Books	38.25	30.31	54.34	20.77	18.65	45.17	0.0000
Monthly Deposit Account Balance	$13,871	$11,991	$15,520	$11,843	$9,931	$16,425	0.0000
Months in Business	73.19	60.21	43.92	57.62	50.19	40.21	0.0000
Firm's Monthly Net Income	$80,800	$74,776	$102,736	$54,009	$47,270	$61,871	0.0000
Firm-Bank Distance (miles by car)	81.60	31.16	82.91	98.06	32.27	79.90	0.0000
Firm-Comp Distance (miles by car)	0.94	0.50	1.25	0.85	0.56	1.12	0.0022
Maturity-Matched UST Yield	4.09%	3.71%	2.36%	N/A	N/A	N/A	N/A
5Y - 3M UST Yield Spread (bpts)	201.32	195.94	55.91	N/A	N/A	N/A	N/A
Number of Observations		3,074			4,785		7,859

Panel B: In-Person Loan Applications

Loan-Application Outcome	**Accept**			**Reject**			***t*-Test**
Variable	Mean	Median	Std Dev	Mean	Median	Std Dev	*P*-val
Loan Rate (APR: all-in cost of loan)	8.46%	8.12%	2.73%	N/A	N/A	N/A	N/A
Loan Amount	$46,507	$39,687	$42,754	N/A	N/A	N/A	N/A
Maturity (years)	6.68	6.14	5.39	N/A	N/A	N/A	N/A
Term Loan (vs. Credit-Line)	22.44%		47.02%	33.73%		47.28%	0.0000
Collateral	60.03%		48.30%	49.59%		49.07%	0.0000
Primary Guarantor	34.03%		47.23%	38.89%		48.75%	0.0000
SBA Guarantee	0.56%		4.70%	12.21%		27.45%	0.0000
Internal Credit Score	1036.35	1042.44	1393.24	810.72	846.89	1287.87	0.0000
Public (XSBI) Credit Score	716.79	706.97	57.99	710.75	697.98	57.81	0.0000
Private-Information Residual	0.0379	0.0112	0.7224	-0.0349	-0.0106	0.5830	0.3135
Scope of Banking Relationship	35.14%		44.03%	25.38%		43.52%	0.0000
Months on Books	43.17	30.50	56.68	17.66	14.38	29.74	0.0000
Monthly Deposit Account Balance	$16,983	$11,834	$62,777	$11,549	$10,035	$21,047	0.0000
Months in Business	115.39	96.34	107.28	90.88	81.03	99.28	0.0000
Firm's Monthly Net Income	$110,367	$94,724	$256,941	$91,350	$84,441	$375,803	0.0000
Firm-Bank Distance (miles by car)	9.91	2.62	21.44	10.67	2.98	28.94	0.0171
Firm-Comp Distance (miles by car)	1.10	0.55	1.59	0.93	0.48	1.48	0.0000
Maturity-Matched UST Yield	3.89%	3.83%	1.96%	N/A	N/A	N/A	N/A
5Y - 3M UST Yield Spread (bpts)	218.92	209.24	57.65	N/A	N/A	N/A	N/A
Number of Observations		12,823			12,664		25,487

This table reports descriptive statistics for the key variables described in Section 3 in terms of the lending channel (7,859 online applications in Panel A and 25,487 in-person ones in Panel B) and the bank's decision to offer or to deny credit. The last column indicates the *P*-values of a two-sided *t*-test for the equality of the variables' mean conditional on the bank's decision (wherever appropriate). For summary statistics of the control variables by lending channel see Table 1.

Table 4: **The Credit Decision by Loan Type**

Specification	**1**						**2**					
Loan Type	eLoans			In-Person Loans			eLoans			In-Person Loans		
Variable	Coeff	*P*-val	Marg	Coeff	*P*-val	Marg	Coeff	*P*-val	Marg	Coeff	*P*-val	Marg
Constant				-1.6245	0.0001					-1.5853	0.0001	
eLoan ($1_{eloan}=1$)	-2.0678	0.0001	-9.39%				-2.0886	0.0001	-11.39%			
ln(1+XSBI)	0.4238	0.0001	20.36%	0.2529	0.1489	0.25%	0.4006	0.0001	18.82%	0.2594	0.0402	3.45%
ln(1+Internal Score)	0.1403	0.0047	2.67%	0.1677	0.0001	11.57%						
Private-Info. Res.							0.1922	0.0428	1.04%	0.6351	0.0001	15.83%
Scope	0.2672	0.2239	0.27%	0.9148	0.0001	2.55%	0.2524	0.3074	0.33%	0.8662	0.0001	2.33%
ln(1+M. on Books)	0.3751	0.8044	0.12%	0.9131	0.0001	1.68%	0.3536	0.8104	0.13%	0.8460	0.0001	1.81%
Scope·PIR							0.0631	0.4583	0.43%	0.1472	0.0658	1.74%
ln(1+MOB)·PIR							0.2972	0.3993	0.24%	0.0415	0.0001	1.63%
ln(1+M. in Business)	0.9068	0.0001	0.68%	0.3702	0.0001	2.73%	0.8748	0.0001	0.68%	0.3588	0.0001	2.79%
ln(1+Net Income)	0.6855	0.0001	1.39%	0.8888	0.0001	1.17%	0.6537	0.0001	1.68%	0.8714	0.0001	1.02%
ln(1+CSHPI)	0.0879	0.1327	0.23%	1.0210	0.0392	0.53%	0.0894	0.0983	0.23%	0.9512	0.0148	0.19%
ln(1+F-B Dist)	-0.4220	0.8480	-0.02%	-0.8598	0.0522	-1.15%	-0.4230	0.8383	-0.02%	-0.8954	0.0448	-1.00%
ln(1+F-C Dist)	0.0891	0.4239	0.02%	0.6375	0.6882	0.22%	0.0884	0.3884	0.02%	0.5984	0.6382	0.24%
Collateral	0.5384	0.0001	2.45%	0.5922	0.0001	2.01%	0.5471	0.0001	2.83%	0.5817	0.0001	1.88%
Primary Guarantor	0.0504	0.0148	0.19%	0.6456	0.0001	4.19%	0.0504	0.0134	0.25%	0.5550	0.0001	4.10%
SBA Guarantee	-0.3676	0.9292	-0.34%	-0.1244	0.4393	-0.41%	-0.3405	0.9293	-0.36%	-0.1186	0.5382	-0.32%
Term Loan	-0.0263	0.0794	-0.07%	-0.4973	0.0001	-0.67%	-0.0259	0.0849	-0.07%	-0.4574	0.0001	-0.65%
ln(1+# Branches)	-1.2598	0.0001	-1.15%	-0.5457	0.0348	-1.61%	-1.2613	0.0001	-1.21%	-0.4643	0.0393	-1.77%
ln(1+# Competitors)	-1.0159	0.0001	-1.08%	-0.0694	0.0086	-2.11%	-0.9845	0.0001	-1.18%	-0.0638	0.0075	-1.99%
4 Quarterly Dum.		Yes			Yes			Yes			Yes	
8 State Dummies		Yes			Yes			Yes			Yes	
38 SIC Dummies		Yes			Yes			Yes			Yes	
Number of Obs	33,346						33,346					
Pseudo R^2	12.06%						12.02%					

This table reports the results from estimating a logistic discrete-choice model of the bank's credit decision by loan type for our full sample (33,346 observations) using maximum likelihood. We estimate the specification $\Pr\{Y_i=1\,|\mathbf{x}_i\}=\Lambda\left(\mathbf{x}_i'\boldsymbol{\beta}+1_{eloan}\cdot\mathbf{x}_i'\boldsymbol{\gamma}\right)$, where $1_{eloan}=1$ for online applications and 0 otherwise and Λ is the logistic distribution function, with branch fixed effects and compute clustered standard errors that are adjusted for heteroskedasticity across branch offices and correlation within. The dependent variable is the bank's decision to offer ($Y=1$: 3,074 and 12,823 observations for online and in-person loans, respectively) or to deny ($Y=0$: 4,785 and 12,664 observations for online and in-person loans, respectively) credit. The explanatory variables are our proxies for public, proprietary, and private information, bank-borrower relationship characteristics, firm attributes, measures of the local credit market's competitiveness and various control variables. See Section 3 for a description of the variables and the notes to Table 2 for further methodological details.

Table 5: **Determinants of the Offered Loan Rate**

Specification	**1**				**2**				**3**			
Loan Type	eLoans		In-Person Loans		eLoans		In-Person Loans		eLoans		In-Person Loans	
Variable	Coeff	*P*-val	Coeff	*P*-val	Coeff	*P*-val	Coeff	*P*-val	Coeff	*P*-val	Coeff	*P*-val
Constant			7.7290	0.0001			7.2580	0.0001			7.5396	0.0001
eLoan ($1_{eloan}=1$)	-1.3216	0.0001			-1.2517	0.0001			-1.3533	0.0001		
ln(1+XSBI)					-1.2189	0.0001	-0.6380	0.0001	-1.2602	0.0001	-0.6662	0.0001
ln(1+Internal Score)					-0.2592	0.0001	-1.6423	0.0001				
Private-Info. Res.									-0.1449	0.2789	-0.4710	0.0001
Scope	-0.4792	0.0001	-0.3211	0.0001	-0.4536	0.0001	-0.2940	0.0001	-0.4215	0.0014	-0.3008	0.0001
ln(1+M. on Books)	-0.7606	0.0466	-0.3678	0.0001	-0.7140	0.0480	-0.3528	0.0001	-0.7327	0.0347	-0.3742	0.0001
Scope·PIR									-0.0303	0.7992	-0.1950	0.0001
ln(1+MOB)·PIR									-0.0516	0.7268	-0.1258	0.0192
ln(1+M. in Business)	-0.8765	0.0901	-0.1433	0.3054	-0.8052	0.1854	-0.1360	0.3829	-0.8227	0.0574	-0.1426	0.4012
ln(1+Net Income)	-0.3107	0.2974	-0.7575	0.0001	-0.3013	0.3227	-0.7429	0.0001	-0.2928	0.3916	-0.7397	0.0001
ln(1+CSHPI)	-0.5227	0.0602	-0.6217	0.0001	-0.5042	0.0974	-0.5686	0.0001	-0.5363	0.1381	-0.5811	0.0001
ln(1+F-B Dist)	-1.7061	0.0011	-1.8434	0.0013	-1.1215	0.5329	-1.0413	0.4766	-1.0706	0.6060	-1.0445	0.5337
ln(1+F-C Dist)	0.6924	0.0001	0.9568	0.0054	0.1899	0.9614	0.5382	0.2487	0.1850	0.9307	0.5954	0.4315
Collateral	-2.2923	0.0001	-2.3612	0.0001	-2.2672	0.0001	-2.1995	0.0001	-2.3511	0.0001	-2.0545	0.0001
Primary Guarantor	-0.7984	0.0298	-0.2951	0.001	-0.7353	0.0471	-0.2764	0.0013	-0.7060	0.0258	-0.2749	0.0003
SBA Guarantee	0.4412	0.3183	0.3203	0.0251	0.4160	0.3966	0.3044	0.0269	0.3953	0.3870	0.3154	0.0291
Term Loan	1.2915	0.0383	0.3528	0.0001	1.2184	0.0419	0.3476	0.0001	1.2112	0.0504	0.3149	0.0001
ln(1+Maturity)	-0.3887	0.0001	-0.7169	0.0001	-0.3697	0.0001	-0.6768	0.0001	-0.2973	0.0001	-0.5867	0.0001
ln(1+# Branches)	-0.1833	0.891	-0.0526	0.7755	-0.1707	0.9210	-0.0500	0.9169	-0.1656	0.9172	-0.0534	0.9290
ln(1+# Competitors)	-0.3236	0.9463	-0.3423	0.3983	-0.3093	0.9197	-0.3209	0.5078	-0.2931	0.9914	-0.3017	0.4789
UST Yield	0.2595	0.0001	0.2877	0.0001	0.2453	0.0001	0.2706	0.0001	0.2611	0.0001	0.2933	0.0001
Term Spread	0.2744	0.0001	0.4287	0.0043	0.2646	0.0001	0.4081	0.0083	0.2682	0.0001	0.4465	0.0004
Lambda	0.6440	0.0472	-0.3739	0.0063	0.5769	0.2468	-0.2890	0.4724	0.5794	0.2564	-0.2873	0.4739
4 Quarterly Dum.	Yes		Yes		Yes		Yes		Yes		Yes	
8 State Dummies	Yes		Yes		Yes		Yes		Yes		Yes	
38 SIC Dummies	Yes		Yes		Yes		Yes		Yes		Yes	
Number of Obs	15,897				15,897				15,897			
Adjusted R^2	14.06%				17.27%				17.15%			

This table reports the results from estimating linear models of the offered loan rate (APR: all-in cost of the loan) of the form $r_i = \mathbf{x}_i'\boldsymbol{\beta} + 1_{eloan} \cdot \mathbf{x}_i'\boldsymbol{\gamma} + \varepsilon_i$, where $1_{eloan} = 1$ for online applications and 0 otherwise, by OLS with branch fixed effects and clustered standard errors that are adjusted for heteroskedasticity across branch offices and correlation within. The explanatory variables are our proxies for public, proprietary, and private information, bank-borrower relationship characteristics, firm attributes, and various control variables. See Section 3 for a description of the variables.

Table 6: **Descriptive Statistics for Accepted and Declined Credit Offers**

Panel A: Online (Transactional) Loan Offers

Loan-Offer Decision	**Accept**			**Decline**			***t*-Test**
Variable	Mean	Median	Std Dev	Mean	Median	Std Dev	*P*-val
Loan Rate (APR: all-in cost of loan)	6.76%	6.59%	1.84%	7.53%	8.15%	2.54%	0.0000
Loan Amount	$37,680	$34,500	$123,281	$32,543	$32,475	$137,906	0.4398
Maturity (years)	5.33	5.10	1.99	5.77	5.34	2.49	0.0001
Term Loan (vs. Credit-Line)	14%		33%	13%		41%	0.6400
Collateral	53%		31%	-33.98		0.38	0.0000
Primary Guarantor	28.10%		33.53%	18%		41%	0.0000
SBA Guarantee	0.75%		2.31%	1.07%		2.85%	0.0105
Internal Credit Score	1041.89	1012.98	783.08	974.01	1053.55	964.67	0.1140
Public (XSBI) Credit Score	727.97	715.09	46.74	705.62	713.86	57.57	0.0000
Private-Information Residual	0.0272	0.0160	0.4578	0.0319	0.0190	0.5524	0.8509
Scope of Banking Relationship	22.90%		29.52%	16%		36%	0.0000
Months on Books	37.30	30.32	52.71	44.40	30.21	64.93	0.0141
Monthly Deposit Account Balance	$13,841	$11,904	$15,055	$14,065	$12,556	$18,546	0.7856
Months in Business	75.87	60.22	42.60	55.79	60.13	52.48	0.0000
Firm's Monthly Net Income	$80,345	$74,744	$99,654	$83,756	$74,981	$122,762	0.5326
Firm-Bank Distance (miles by car)	82.72	31.11	80.42	74.33	31.53	99.07	0.0570
Firm-Comp Distance (miles by car)	0.95	0.50	1.21	0.86	0.52	1.49	0.1814
Maturity-Matched UST Yield	4.28%	3.63%	2.29%	2.89%	4.22%	2.82%	0.0000
5Y - 3M UST Yield Spread (bpts)	203.98	193.35	54.24	184.00	212.76	66.81	0.0000
Number of Observations		2,664			410		3,074

Panel B: In-Person (Relationship) Loan Offers

Loan-Offer Decision	**Accept**			**Decline**			***t*-Test**
Variable	Mean	Median	Std Dev	Mean	Median	Std Dev	*P*-val
Loan Rate (APR: all-in cost of loan)	8.50%	8.11%	2.59%	8.46%	8.15%	2.72%	0.6843
Loan Amount	$46,485	$39,375	$42,624	$48,585	$40,790	$56,344	0.1702
Maturity (years)	6.20	6.13	5.36	6.42	6.18	5.34	0.2403
Term Loan (vs. Credit-Line)	21.93%		47.02%	29.35%		37.23%	0.0000
Collateral	61.35%		48.49%	60.89%		45.24%	0.7873
Primary Guarantor	34.91%		47.67%	32.87%		45.24%	0.2216
SBA Guarantee	0.51%		4.50%	1.37%		3.43%	0.0000
Internal Credit Score	1034.78	1041.90	1401.33	1039.92	1048.98	837.67	0.9147
Public (XSBI) Credit Score	724.99	714.93	48.18	716.79	706.97	57.99	0.0000
Private-Information Residual	0.0364	0.0103	0.6802	0.0398	0.0123	0.7385	0.8890
Scope of Banking Relationship	35.57%		43.63%	34.83%		41.25%	0.6246
Months on Books	43.39	30.23	58.00	45.87	30.92	47.89	0.2172
Monthly Deposit Account Balance	$17,913	$11,724	$65,236	$19,179	$11,899	$48,457	0.5737
Months in Business	117.38	96.02	110.56	103.05	97.13	92.38	0.0002
Firm's Monthly Net Income	$112,234	$94,329	$268,615	$114,821	$95,294	$175,624	0.7792
Firm-Bank Distance (miles by car)	9.93	2.62	21.78	9.91	2.15	23.40	0.9806
Firm-Comp Distance (miles by car)	1.10	0.54	1.60	1.11	0.38	1.70	0.9142
Maturity-Matched UST Yield	3.39%	3.31%	1.15%	3.80%	3.64%	1.03%	0.0000
5Y - 3M UST Yield Spread (bpts)	214.35	206.24	54.57	239.89	210.92	60.39	0.0000
Number of Observations		11,949			874		12,823

This table provides summary statistics for key variables described in Section 3 as a function of the *borrower's* decision to accept (online and in-person applications: 2,664 and 11,949 observations, respectively) or to decline (410 and 874 observations, respectively) the bank's loan offer by lending channel. The last column indicates the *P*-values of a two-sided *t*-test for the equality of the variables' mean conditional on the applicant's decision.

Table 7: **The Decision to Decline Loan Offers**

Specification	**1**						**2**					
Loan Type	eLoans			In-Person Loans			eLoans			In-Person Loans		
Variable	Coeff	P-val	Marg	Coeff	P-val	Marg	Coeff	P-val	Marg	Coeff	P-val	Marg
Constant				-4.4008	0.0001					-4.8284	0.0001	
eLoan ($1_{eloan}=1$)	1.0843	0.0001	4.82%				1.0966	0.0001	4.25%			
ln(1+XSBI)	1.6332	0.0001	22.73%	0.7707	0.0001	25.23%	1.6306	0.0001	26.72%	0.7670	0.0001	30.11%
ln(1+Internal Score)	0.2818	0.0001	2.73%	0.5785	0.0001	8.63%						
Private-Info. Res.							0.3728	0.0204	3.63%	0.5323	0.0001	10.56%
Scope	-2.5574	0.0001	-4.91%	-1.0014	0.0244	-3.90%	-2.4597	0.0001	-4.88%	-0.9850	0.0391	-3.17%
ln(1+M. on Books)	-1.5441	0.0001	-3.52%	-1.8169	0.0001	-4.10%	-1.6714	0.0001	-3.63%	-1.7895	0.0001	-4.08%
Scope·PIR							0.1284	0.6993	0.44%	0.6049	0.0001	3.58%
ln(1+MOB)·PIR							0.0617	0.9788	0.23%	0.7186	0.0001	3.29%
ln(1+M. in Business)	-0.2579	0.3885	-0.29%	-0.3064	0.0211	-0.20%	-0.2730	0.3044	-0.34%	-0.3263	0.0291	-0.22%
ln(1+Net Income)	2.3189	0.0001	1.69%	1.9390	0.0001	2.46%	2.3088	0.0001	2.58%	1.9406	0.0001	2.40%
ln(1+CSHPI)	0.9215	0.0089	0.65%	0.0259	0.9592	0.31%	0.9867	0.0005	0.64%	0.0273	0.9382	0.33%
ln(1+F-B Dist)	2.1060	0.0001	1.82%	2.0407	0.0001	0.95%	2.0485	0.0001	1.63%	2.0166	0.0001	0.84%
ln(1+F-C Dist)	-1.0740	0.0001	-0.30%	-1.0715	0.0001	-0.27%	-1.0418	0.0001	-0.35%	-1.0398	0.0001	-0.25%
Collateral	0.0414	0.9943	0.14%	0.1759	0.5593	0.20%	0.0429	0.9372	0.15%	0.1783	0.7822	0.28%
Primary Guarantor	2.0299	0.0001	3.90%	2.1144	0.0001	4.90%	2.0179	0.0001	3.99%	2.1663	0.0001	4.94%
SBA Guarantee	1.2209	0.0001	0.03%	0.2663	0.0252	0.11%	1.2239	0.0001	0.08%	0.2589	0.0292	0.11%
Term Loan	-0.7117	0.0001	-0.37%	-0.0121	0.995	-0.03%	-0.6672	0.0001	-0.34%	-0.0115	0.9392	-0.07%
APR	0.2648	0.0001	9.36%	0.3901	0.0001	12.61%	0.2567	0.0001	9.50%	0.3740	0.0001	11.79%
ln(1+Loan Amount)	-2.0321	0.0001	4.05%	-2.0021	0.0001	-2.25%	-2.1059	0.0001	4.56%	-1.9401	0.0001	-2.61%
ln(1+Maturity)	-0.1750	0.0001	-0.95%	-0.2953	0.0001	-1.36%	-0.1775	0.0001	-0.99%	-0.2720	0.0001	-1.66%
ln(1+# Branches)	0.4371	0.492	0.16%	0.4803	0.045	0.35%	0.3978	0.7902	0.17%	0.4816	0.0205	0.33%
ln(1+# Competitors)	0.6048	0.0224	0.28%	0.0236	0.9335	0.13%	0.6399	0.0233	0.26%	0.0249	0.9782	0.18%
UST Yield	0.8418	0.0001	2.36%	1.1379	0.0001	3.43%	0.8449	0.0001	2.66%	1.1694	0.0001	3.76%
Term Spread	-1.0387	0.0302	-1.67%	-1.0071	0.0001	-2.60%	-1.0031	0.0482	-1.63%	-0.9805	0.0001	-2.78%
4 Quarterly Dum.		Yes			Yes			Yes			Yes	
8 State Dummies		Yes			Yes			Yes			Yes	
38 SIC Dummies		Yes			Yes			Yes			Yes	
Number of Obs	15,897						15,897					
Pseudo R^2	6.70%						6.82%					

This table reports the results from estimating a logistic discrete-choice model of the borrower's decision to refuse the bank's loan offer and to seek credit elsewhere by full-information maximum likelihood for the subsample of successful loan applications (15,897 observations). As before, we use branch fixed effects and clustered standard errors that are adjusted for heteroskedasticity across branch offices and correlation within. The dependent variable is the applicant's decision to decline ($Y=1$: 1,284 observations) or to accept ($Y=0$: 14,613 observations) the bank's offer; the explanatory variables are our usual proxies for public, proprietary, and private information, bank-borrower relationship characteristics, firm attributes, and various control variables. See Section 3 for a description of the variables and the notes to Table 2 for further details.

Table 8: **The Likelihood of Credit Delinquency**

Specification	**1**						**2**					
Loan Type	eLoans			In-Person Loans			eLoans			In-Person Loans		
Variable	Coeff	P-val	Marg	Coeff	P-val	Marg	Coeff	P-val	Marg	Coeff	P-val	Marg
Constant				-1.1658	0.0001					-1.1803	0.0001	
eLoan ($1_{eloan}=1$)	1.1327	0.0001	2.68%				1.1510	0.0001	2.92%			
ln(1+XSBI)	-1.8185	0.0001	-19.65%	-0.9359	0.0001	-21.01%	-1.7390	0.0001	-22.71%	-0.8927	0.0001	-20.05%
ln(1+Internal Score)	-0.2719	0.0001	-4.46%	-0.4442	0.0001	-9.74%						
Private-Info. Res.							-0.2646	0.0001	-4.06%	-0.1022	0.0001	-12.68%
Scope	-0.4912	0.0001	-1.05%	-0.7506	0.0001	-2.77%	-0.5095	0.0001	-1.19%	-0.7492	0.0001	-2.90%
ln(1+M. on Books)	-0.9613	0.0290	-0.96%	-0.2962	0.0001	-3.48%	-1.0345	0.0001	-0.90%	-0.3199	0.0001	-3.18%
Scope·PIR							-0.5702	0.0001	-1.81%	-0.3452	0.0001	-3.33%
ln(1+MOB)·PIR							-0.4826	0.3522	-0.31%	-0.2093	0.0144	-1.62%
ln(1+M. in Business)	-0.8759	0.0583	-2.82%	-0.0165	0.8632	-3.21%	-0.8469	0.0792	-3.46%	-0.0171	0.8902	-3.80%
ln(1+Net Income)	-0.5371	0.0001	-2.18%	-0.0835	0.0001	-1.94%	-0.5705	0.0001	-2.57%	-0.0917	0.0001	-1.80%
ln(1+CSHPI)	-0.8313	0.0001	-0.62%	-0.0694	0.0001	-0.48%	-0.8964	0.0072	-0.69%	-0.0734	0.0001	-0.46%
ln(1+F-B Dist)	0.2800	0.5492	0.11%	0.2338	0.3773	0.12%	0.2629	0.6922	0.12%	0.2503	0.2032	0.19%
ln(1+F-C Dist)	-0.7279	0.3943	-0.04%	-0.2164	0.5782	-0.04%	-0.6946	0.6633	-0.04%	-0.2281	0.4902	-0.08%
Collateral	-0.5383	0.0001	-1.41%	-0.1898	0.0001	-1.88%	-0.5774	0.0001	-1.81%	-0.1966	0.0001	-2.31%
Primary Guarantor	-0.3830	0.0001	-2.77%	-0.5430	0.0001	-1.29%	-0.3937	0.0001	-2.45%	-0.5329	0.0001	-1.63%
SBA Guarantee	2.8745	0.0001	0.33%	0.5651	0.0001	2.90%	3.0091	0.0001	0.23%	0.5513	0.0001	3.15%
Term Loan	0.2586	0.0001	0.42%	0.6415	0.0001	0.25%	0.2715	0.0001	0.58%	0.6707	0.0001	0.34%
APR	2.0535	0.0001	4.94%	1.1068	0.0193	7.05%	1.9347	0.0001	4.89%	1.1145	0.0122	6.91%
ln(1+Loan Amount)	-0.9619	0.0001	-8.52%	-1.5484	0.0001	-9.77%	-1.0235	0.0001	-10.85%	-1.4787	0.0001	-9.31%
ln(1+Maturity)	-0.4388	0.0001	-1.08%	-0.8018	0.0001	1.42%	-0.4898	0.0001	-1.28%	-0.7931	0.0001	-1.58%
ln(1+# Branches)	2.6732	0.0001	0.20%	0.1063	0.0001	0.37%	2.6960	0.0001	0.24%	0.1135	0.0001	0.41%
ln(1+# Competitors)	3.6903	0.0001	0.51%	0.1631	0.0001	0.12%	3.7995	0.0001	0.47%	0.1669	0.0001	0.15%
UST Yield	0.4680	0.2884	0.46%	0.4656	0.0001	0.71%	0.4471	0.3402	0.42%	0.4380	0.0001	0.74%
Term Spread	1.1915	0.0001	1.46%	1.8429	0.0001	1.42%	1.2187	0.0001	1.69%	1.8283	0.0001	1.08%
4 Quarterly Dum.		Yes			Yes			Yes			Yes	
8 State Dummies		Yes			Yes			Yes			Yes	
38 SIC Dummies		Yes			Yes			Yes			Yes	
Number of Obs	14,613						14,613					
Pseudo R^2	12.39%						12.08%					

This table reports the results from estimating a logistic model of the likelihood that a loan becomes 60 days overdue within 18 months of origination by full-information maximum likelihood for the subsample of actual loans booked by the bank (14,613 observations). Again, we use branch fixed effects and clustered standard errors that are adjusted for heteroskedasticity across branch offices and correlation within. The dependent variable is the performance status of the loan during its first 18 months: at most 60 days overdue (corresponding to our bank's internal definition of a delinquent loan $Y = 1$: 404 observations), or current ($Y = 0$: 14,209 observations). The explanatory variables are our proxies for public, proprietary, and private information, bank-borrower relationship characteristics, firm attributes, and various control variables; see Section 3 for a description of the variables and the notes to Table 2 for further details.

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