Information Asymmetries between Lenders and the Availability of Competitive Outside Offers

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ABSTRACT:

Existing lenders to firms tend to have private information about firms that is not available to other potential lenders. Due to this information disadvantage, outside lenders face an adverse selection problem. One might assume that greater firm transparency would increase outside lending, but such a conclusion may be premature. This paper solves a benchmark model of information asymmetries in lending and finds the opposite effect. Although an increase in firm transparency causes the outsider to win *more good firms*, the outsider also wins *fewer bad firms* because it faces less of a "winner's curse." An analytical solution shows that greater firm transparency leads to a net *decrease* in the likelihood of a firm receiving a competitive outside loan offer. The prediction is tested using a sample of small business firms that borrow either from an existing lender or a new lender. The evidence generally suggests that transparent firms are less likely to borrow from a new lender.

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1. Introduction

Markets differ in the degree of information known to market participants. The financially-intermediated loan market, in particular, is considered to be a market with information asymmetries, because lenders often face some measure of uncertainty about the credit quality of borrowers.[1] This paper provides a theoretical prediction for how firm transparency affects the availability of competitive offers from lenders with limited information about a firm. The prediction is then tested using data on small business lending.

Information asymmetries can arise in various places within a market and between different participants. Akerlof (1970) shows how information asymmetries between buyers and sellers affect market outcomes. However, information asymmetries between market participants *on the same side of the market* can have different implications. The Sharpe (1990) model analyzes the competition between an informed "inside" lender with private information about a firm and a less informed "outside" lender. When one bidder knows more about the value of an asset than another bidder, the less informed bidder faces a "winner's curse." Von Thadden (2004) shows that the outside lender faces a winner's curse and solves the equilibrium bidding strategies in the case where the uninformed lender has no information about the quality of the individual firm.

This paper builds on the work of Sharpe and von Thadden by varying the quality of the outside signal and exploring the empirical predictions. The advantage of this more general approach is that the predictions can be compared across different *degrees* of information asymmetry between lenders. For transparent firms, the information available to outside lenders is greater relative to inside lenders and, consequently, this will influence the availability of competitive outside loan offers. The central question is the following: how does the transparency of a firm affect the likelihood of a firm borrowing from an outside lender?

An analytical solution reveals the surprising finding that firms with greater transparency are *less* likely to borrow from an outside lender. This result is driven simply by the opposing effects of greater transparency for good and bad firms. The outside

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[1] Lending in the presence of information asymmetries is one of the aspects that makes bank lending "special" relative to other forms of finance.

lender can win *more good firms*, because better information allows the outsider to bid more competitively. However, the outside lender wins *fewer bad firms*, because it stops bidding low for firms that are perceived as bad. Results show that the net effect on total outside lending is negative because the likelihood of the outside lender winning bad firms decreases more than the likelihood of winning good firms increases.

To test this prediction of the model, we use the 2003 Survey of Small Business Finance (SSBF). This survey is ideal for testing the theory, because it has information on firms' existing and new lenders, which can be used to proxy for inside and outside lenders. The empirical section uses measures of firm transparency to identify how information asymmetry is related to the likelihood of a firm borrowing from a new rather than an existing lender.

The empirical results generally support the predictions of the model. Overall, the findings indicate that firms with greater transparency are less likely to borrow from a new lender. In particular, larger firms are less likely to borrow from a new lender than an existing lender. Additionally, firms that use audited financial statements are less likely to borrow from a new lender than firms that use unaudited financial statements. Although these measures are rough proxies for the degree of information asymmetry between lenders, it is interesting to see that the empirical results are consistent with a counterintuitive prediction from a model of information-based lending.

The contribution of the paper is to clarify the predictions for credit availability and switching in an information-based model of lending. The literature on relationship lending often cites the Sharpe (1990) model (e.g., Bharath et al. 2007) and Ionnidou and Ongena (forthcoming) relate the model to their finding that firms which switch lenders pay a lower interest rate at the time of switching. However, the predictions for the probability of borrowing from a new lender have not been previously established. This paper fills that gap and also finds empirical results consistent with the predictions. Interestingly, the results are similar to Gopalan et al. (forthcoming) who find that the most transparent firms are more likely to borrow from their relationship bank. This suggests that the theoretical and empirical results of the paper may not be as surprising in the future as further research is done in this area.

Section 2 describes the model and equilibrium bidding functions. Section 3 shows the probabilities of winning for the inside and outside banks. Section 4 describes the data used to test a prediction of the model and provides some descriptive statistics. Section 5 explains the empirical methodology and Section 6 describes the results. Section 7 concludes.

2. The Model

The quality of a firm is either high or low, denoted by $q = H, L$, with corresponding probabilities of project success, $p_H > p_L$. The proportion of high quality firms is θ. The values of p_H, p_L, and θ are public information; therefore, for the pool of borrowers, the probability of success is known to be $p = \theta p_H + (1-\theta) p_L$, such that $p_H > p > p_L$.

The model has two-periods and, in each period, banks bid to make a loan to a firm and the firm chooses the lowest rate offered by a bank.[2] Banks bid for loans to firms in the first period based on public information about the borrower pool and all bids are identical, because there are no differences among banks. After the bidding process in the first period, one bank makes a loan to the firm and becomes the "inside bank" (or "insider"). This inside bank receives a private signal γ about the quality of the firm, where γ is a perfect signal indicating the firm's performance on the first loan. If the firm succeeds on the first loan, the inside bank receives a signal of *S*, and if the firm fails on the first loan, the inside bank receives a signal of *F*. This private information received by the inside bank allows the inside bank to distinguish between "good" firms (an *S* signal) and "bad" firms (an *F* signal). The probability of a success in the second period conditional on success in the first period is $p(S) = p_H \text{prob}(H \mid S) + p_L (1 - \text{prob}(H \mid S))$, where $\text{prob}(H \mid S) = \theta p_H / p$. Likewise, conditional on failure in the first period, the probability of success in the second period is $p(F)$. These conditional probabilities of success can be expressed in simplified form as

[2] The firm does not know its own type, so its choice is non-strategic.

$$p(S) = \frac{\theta p_H^2 + (1-\theta) p_L^2}{p}$$

$$p(F) = \frac{\theta(1-p_H)p_H + (1-\theta)(1-p_L)p_L}{1-p}.$$

Every bank other than the inside bank is an "outside bank" (or "outsider"). Outside banks get a signal $\tilde{\gamma}$, which is a noisy signal of γ, defined as:

$$\Pr(\tilde{\gamma} = \tilde{S} \mid S) = \Pr(\tilde{\gamma} = \tilde{F} \mid F) = \frac{1+\phi}{2},$$

with $0 \leq \phi < 1$. The following solution is based on the assumption that the inside bank observes $\tilde{\gamma}$.

When $\phi = 0$, the outsider's signal contains no information about the quality of the firm ($\tilde{\gamma}$ is orthogonal to γ). Therefore, an increase in ϕ is an increase in the quality of the outsider's signal relative to the insider's signal, which implies that an outside signal of $\tilde{S}$ is more likely to indicate a good firm and an outside signal of $\tilde{F}$ is more likely to indicate a bad firm.

The parameter ϕ captures the difference between the information set of the inside bank and the outside bank. Therefore, an increase in ϕ is a reduction in the information asymmetry between the inside and outside bank brought about by an increase in the information available to the outside bank. In the remainder of the paper, a larger ϕ is interpreted as a firm with greater transparency. This interpretation in terms of firm transparency captures the idea that the information of the outside bank improves relative to the insider. It is also consistent with the assumption that the information available to the outside bank is observable to the inside bank.

The conditional probabilities of success based on the outsider's information set are:

$$p(\tilde{S}) = \frac{(1-\phi)p + 2\phi p(S)p}{(1-\phi) + 2\phi p}$$
$$p(\tilde{F}) = \frac{(1-\phi)p + 2\phi p(F)(1-p)}{(1-\phi) + 2\phi(1-p)}.$$

This yields the following ordering in probabilities of success:

$$p(F) < p(\tilde{F}) < p < p(\tilde{S}) < p(S).$$

As ϕ increases, $p(\tilde{S})$ increases to $p(S)$ and $p(\tilde{F})$ decreases to $p(F)$. The break-even loan rates for each of these probabilities of success are:

$$1 + r_p = \frac{1+\overline{r}}{p}, \qquad 1 + r_S = \frac{1+\overline{r}}{p(S)}, \qquad 1 + r_F = \frac{1+\overline{r}}{p(F)},$$
$$1 + r_{\tilde{S}} = \frac{1+\overline{r}}{p(\tilde{S})}, \qquad 1 + r_{\tilde{F}} = \frac{1+\overline{r}}{p(\tilde{F})}.$$

Clearly, the interest rate ordering is:

$$r_S < r_{\tilde{S}} < r_p < r_{\tilde{F}} < r_F.$$

In von Thadden (2004), the solution to the equilibrium bidding functions are solved for the inside and outside bank in the second period of the model for the case where $\phi = 0$ (the outside bank has no information).[3] In Proposition 1, I remove this restriction and provide the solution for the equilibrium bidding functions under the more general case of $\phi \in [0,1)$.

[3] von Thadden assumes one outside bank, which is maintained here.

Proposition 1:

The inside bank's equilibrium strategy is to offer $r(F) = r_F$ with certainty and to offer atomless distributions on $\left[r_{\tilde{S}}, r_F\right]$ for $\gamma = S$ and $\tilde{\gamma} = \tilde{S}$, with density

$$h_i^{S,\tilde{S}}(r) = \left(\frac{p(S)}{\Psi}\right)\frac{p(S)(1+r_{\tilde{S}})-(1+\overline{r})}{\left(p(S)(1+r)-(1+\overline{r})\right)^2}$$

and on $\left[r_{\tilde{F}}, r_F\right]$ for $\gamma = S$ and $\tilde{\gamma} = \tilde{F}$, with density

$$h_i^{S,\tilde{F}}(r) = \left(\frac{p(S)}{\Xi}\right)\frac{p(S)(1+r_{\tilde{F}})-(1+\overline{r})}{\left(p(S)(1+r)-(1+\overline{r})\right)^2},$$

where subscript i indicates the inside bank, $\Psi = \dfrac{p(S)}{p(S)+\left(\dfrac{1-\phi}{1+\phi}\right)(1-p(S))}$, and

$$\Xi = \frac{p(S)}{p(S)+\left(\dfrac{1+\phi}{1-\phi}\right)(1-p(S))}.$$

The outside bank's equilibrium strategy for $\tilde{\gamma} = \tilde{S}$ has a point mass of $1-\Psi$ at $r = r_F$ and an atomless distribution on $[r_{\tilde{S}}, r_F)$ with density $h_o^{\tilde{S}}(r) = \Psi h_i^{S,\tilde{S}}(r)$, where subscript o indicates the outside bank. The outside bank's equilibrium strategy for $\tilde{\gamma} = \tilde{F}$ has a point mass of $1-\Xi$ at $r = r_F$ and an atomless distribution on $[r_{\tilde{F}}, r_F)$ with density $h_o^{\tilde{F}}(r) = \Xi h_i^{S,\tilde{F}}(r)$.

Proof: See Appendix.

Two main aspects of these bidding functions will be important for the following analysis. First, *when the outsider's information is better, the outsider is more likely to* *bid low for firms that it believes to be good*. The insider always bids low (either from $h_i^{S,\tilde{S}}(r)$ or $h_i^{S,\tilde{F}}(r)$) for good firms, but the outsider does not always bid low (from $h_o^{\tilde{S}}(r)$) even when it receives a signal of $\tilde{S}$. The outsider will "hedge its bets" due to the possibility that the firm could be bad. With better outside information, the probability of the outsider bidding low when it receives a signal of $\tilde{S}$ increases, because its signal is more likely to correspond to the firm's true quality. Second, *when the outsider's information is better, the outsider is more likely to bid high for firms that it believes to be bad*. The insider always bids r_F for bad firms, but the outsider sometimes bids low (from $h_o^{\tilde{F}}(r)$) even when it receives a signal of $\tilde{F}$. The outsider will "take a chance" by bidding low, because the firm could be good. With better outside information, the probability of the outsider bidding low when it receives a signal of $\tilde{F}$ decreases.

It is also important to note that the insider's bidding strategy depends on the quality of the outsider's information. With better outside information, the insider bids lower for good firms that the outsider believes to be good ($r_{\tilde{S}}$ is decreasing in ϕ). Therefore, the insider can not extract as many rents from these firms. On the other hand, with better outside information, the insider bids higher for good firms that the outsider believes to be bad ($r_{\tilde{F}}$ is increasing in ϕ). Ironically, the insider can extract even more rents from these firms, because the outsider believes these firms to be bad and increases its bid accordingly.

3. The Availability of Competitive Outside Offers

This section analyzes the model's implications for the availability of competitive outside offers. The derivation is done in terms of each bank's probability of "winning" a bid, because a bank that offers a lower interest rate will be chosen by the firm. The signals received by the banks affect their willingness to make a competitive offer, so the probabilities of winning are first shown conditional on whether the firm is a good firm (S) or a bad firm (F). These probabilities are then combined to show the unconditional probability of winning for the inside and outside bank.

Conditioning only on the insider's signal, γ, the probabilities of the inside and outside bank making a winning offer for each firm type are the following:

$$\Pr_i(win\,|\,S) = 1 - \left\{\left(\frac{1+\phi}{2}\right)\Psi + \left(\frac{1-\phi}{2}\right)\Xi\right\}\left(\frac{1}{2}\right)$$

$$\Pr_i(win\,|\,F) = \frac{1}{2} - \left\{\left(\frac{1+\phi}{2}\right)\Xi + \left(\frac{1-\phi}{2}\right)\Psi\right\}\left(\frac{1}{2}\right)$$

$$\Pr_o(win\,|\,S) = \left\{\left(\frac{1+\phi}{2}\right)\Psi + \left(\frac{1-\phi}{2}\right)\Xi\right\}\left(\frac{1}{2}\right)$$

$$\Pr_o(win\,|\,F) = \frac{1}{2} + \left\{\left(\frac{1+\phi}{2}\right)\Xi + \left(\frac{1-\phi}{2}\right)\Psi\right\}\left(\frac{1}{2}\right)$$

Derivation: See Appendix.

Each term in the equations can be explained intuitively. For instance, $\Pr_o(win\,|\,S)$ is the probability of the outsider making a winning offer to a good firm. In this equation, the term $(1+\phi)/2$ is the probability of the outsider perceiving the firm to be good (receiving a signal of $\tilde{S}$) and, based on this belief, the term Ψ is the probability of the outsider offering a low interest rate. This joint probability is increasing in ϕ – the outsider is more likely to perceive a good firm as being good and is more likely to bid competitively – so that, for this joint probability, greater firm transparency increases the availability of competitive outside offers to good firms. The remaining terms simply capture the possibility of the outsider mistakenly perceiving the firm to be bad (a signal of $\tilde{F}$) and bidding accordingly. In contrast, the equation for $\Pr_o(win\,|\,F)$ is the outsider's probability of making a winning offer conditional on the firm being bad, where the term $(1+\phi)/2$ is the probability that the outsider perceives the firm to be bad (receives a signal of $\tilde{F}$) and Ξ is the probability that the outsider offers a high interest rate. For this joint component, greater firm transparency decreases the availability of competitive outside offers to bad firms. The remaining terms capture bidding when the outsider mistakenly perceives the firm to be good .

As explained, the effect of the outsider's information on the probability of the outsider making a winning offer depends on the firm's type. The following proposition formally establishes the effect of ϕ (firm transparency) on the probability of the outside bank winning good and bad firms.

Proposition 2:

The probability of an outside lender lending to a good firm increases with greater firm transparency. Conversely, the probability of an outside lender lending to a bad firm decreases with greater firm transparency.

Proof: See Appendix.

The inverse of Proposition 2 applies to the insider. The probability of an inside bank winning a good (bad) firm decreases (increases) with firm transparency.

Proposition 2 shows that firm transparency increases the availability of competitive outside offers for good firms, but decreases the availability for bad firms. With better public information, the outsider can offer lower interest rates to firms it perceives to be good, making the outsider's offers to good firms more competitive. As intuition would suggest, an improvement in the outsider's information allows the outside lender to win more good firms, which adds to the total number of firms won by the outside bank. In contrast, with better public information, the outsider offers higher interest rates to firms that it believes to be bad because a signal of $\tilde{F}$ is more likely to indicate a bad firm. Therefore, with better information, the outside lender wins fewer bad firms. Intuitively, as the information asymmetry lessens, the outside lender faces less of a "winner's curse," which reduces its proportion of bad firms won relative to good firms.

The total effect of firm transparency on the availability of competitive outside offers depends on the combination of the effects for good and bad firms. With greater firm transparency, the outsider wins more good firms and fewer bad firms, so the combined effect is not yet clear. Solving for the unconditional probability of winning for the inside and outside lender requires using the joint probabilities of the insider and outsider signal. The insider perceives the firm to be good if the firm repays, which occurs with probability p, and bad if the firm fails to repay, which occurs with probability 1-p. Therefore, a firm is the S type with probability p and an F type with probability $1-p$. The outsider's signal is positively correlated with the insider's signal, such that the outsider gets the "right" signal with probability $\frac{1+\phi}{2}$ and the "wrong" signal with probability $\frac{1-\phi}{2}$. It follows that the probability of each signal combination occurring is:

$$\Pr(\gamma = S \text{ and } \tilde{\gamma} = \tilde{S}) = p\left(\frac{1+\phi}{2}\right)$$

$$\Pr(\gamma = S \text{ and } \tilde{\gamma} = \tilde{F}) = p\left(\frac{1-\phi}{2}\right)$$

$$\Pr(\gamma = F \text{ and } \tilde{\gamma} = \tilde{S}) = (1-p)\left(\frac{1-\phi}{2}\right)$$

$$\Pr(\gamma = F \text{ and } \tilde{\gamma} = \tilde{F}) = (1-p)\left(\frac{1+\phi}{2}\right)$$

The probability of each bank winning, unconditional on signals, can be calculated by combining the probability of winning, conditional on signal combinations, with the probability of each signal combination. This yields the total probability of winning for the insider and outsider:

$$\begin{aligned}
\Pr_i(win) &= \Pr(S)\Pr_i(win \mid S) + \Pr(F)\Pr_i(win \mid F) \\
&= p\Pr_i(win \mid S) + (1-p)\Pr_i(win \mid F) \\
&= \frac{1}{2} + \frac{1}{2}p - \frac{1}{2}\left\{\begin{array}{c} p\left\{\left(\frac{1+\phi}{2}\right)\Psi + \left(\frac{1-\phi}{2}\right)\Xi\right\} \\ +(1-p)\left\{\left(\frac{1+\phi}{2}\right)\Xi + \left(\frac{1-\phi}{2}\right)\Psi\right\} \end{array}\right\}
\end{aligned}$$

$$\begin{aligned}
\Pr_o(win) &= \Pr(S)\Pr_o(win \mid S) + \Pr(F)\Pr_o(win \mid F) \\
&= p\Pr_o(win \mid S) + (1-p)\Pr_o(win \mid F) \\
&= \frac{1}{2} - \frac{1}{2}p + \frac{1}{2}\left\{ \begin{array}{c} p\left\{\left(\frac{1+\phi}{2}\right)\Psi + \left(\frac{1-\phi}{2}\right)\Xi\right\} \\ +(1-p)\left\{\left(\frac{1+\phi}{2}\right)\Xi + \left(\frac{1-\phi}{2}\right)\Psi\right\} \end{array} \right\}.
\end{aligned}$$

With $\phi = 0$, $\Pr_i(win) = \frac{1}{2} + \frac{1}{2}p - \frac{1}{2}p(S)$ and $\Pr_o(win) = \frac{1}{2} - \frac{1}{2}p + \frac{1}{2}p(S)$, as shown in Black (2008).

The equations for $\Pr_i(win)$ and $\Pr_o(win)$ yield the following proposition.

Proposition 3:

The probability of an outside lender lending to a firm decreases with greater firm transparency.

In mathematical terms, Proposition 2 states that $\frac{\partial \Pr_o(win)}{\partial \phi} < 0$.

Proof: See Appendix.

Like Proposition 2, Proposition 3 can also be stated in terms of the inside lender. The probability of the inside lender lending to a firm increases with greater firm transparency.

This proposition states that firms of greater transparency are less likely to receive a low outside offer. This is counter to the intuition that transparent firms tend to borrow from an outside lender while opaque firms tend to borrow from an inside lender. The result is counter-intuitive because the common intuition tends to not consider how the bidding functions of the lenders change with the transparency of the firm. As intuition would suggest, the outside lender is able to win more good firms when firms are more transparent; however, it is also able to win fewer bad firms by offering higher interest rates to firms that are perceived to be bad. In the current model, an increase in the transparency of the firm reduces the likelihood of the outside lender winning a bad firm at a faster rate than it increases the likelihood of the outside lender winning a good firm.

This implies that, as the transparency of the borrower pool increases, the proportion of firms that borrow from the outside lender decreases.

The intuition for Proposition 3 simply follows from the individual components of inside and outside lending. As shown in Proposition 2, as the transparency of a firm increases, the probability of the outside lender lending to a good firm increases, and the probability of the outside lender lending to a bad firm decreases. Therefore, the improvement in the outsider's information clearly reduces the adverse selection problem. However, the adverse selection problem does not provide clear intuition for the *total* number of firms won by the outside lender. In the current model, as the winner's curse lessens for the outside lender, the reduction in bad firms won is greater than the increase in good firms won, causing the total number of firms won to *decrease* with firm transparency.

Figure 1 shows numerical results that illustrate how the insider and outsider probabilities of winning change with an increase in firm transparency (an increase in ϕ). Figure 1a shows the insider's probability of winning conditional on firm type, $\Pr_i(win|S)$ and $\Pr_i(win|F)$, and the insider's unconditional probability of winning, $\Pr_i(win)$. Figure 1b shows the same probabilities of winning for the outside lender. For both panels of Figure 1, the parameters are set at $p_H = 0.8$, $p_L = 0.2$, and $\theta = 0.5$ and ϕ varies from 0 to 1. The "winner's curse" is quickly observable in the stylized fact that the inside lender wins more than half the good firms and the outside lender wins more than half the bad firms.

The numerical examples in Figure 1 are consistent with the prior analytical results identifying how bidding outcomes change with firm transparency. As shown in Figure 1a, as the transparency of a firm increases, the probability of the inside lender winning a good firm decreases ($\partial \Pr_i(win|S)/\partial\phi < 0$), and the probability of the inside lender winning a bad firm increases ($\partial \Pr_i(win|F)/\partial\phi > 0$). The net effect shows that the probability of the inside lender winning the firm increases ($\partial \Pr_i(win)/\partial\phi > 0$). As shown in the mirror image of Figure 1b, as the transparency of a firm increases, the probability of the outside lender winning a good firm increases ($\partial \Pr_o(win|S)/\partial\phi > 0$), and the probability of the outside lender winning a bad firm decreases (

$\partial \Pr_o(win \mid F) / \partial\phi < 0$). These results illustrate the general result in Proposition 2. The net effect shows that the probability of the outside lender winning the firm decreases with greater firm transparency ($\partial \Pr_o(win) / \partial\phi < 0$), which illustrates the general result in Proposition 3.

Because the prediction about total outside lending is based on observable equilibrium outcomes of the model, the prediction in Proposition 3 can be tested empirically. The remainder of the paper describes an approach to testing the prediction in Proposition 3 using small business data.

4. Data and Summary Statistics

The data used for the analysis are from the 2003 Survey of Small Business Finance (SSBF), which was conducted by the Board of Governors of the Federal Reserve System and covers over 4000 small businesses (non-farm entities with 500 employees or less). The data are ideal for analyzing the theory, because the SSBF includes information about all of a firm's creditors, including more specific information about the firm's most recent loan acceptance and/or denial. The data on creditors identifies the institution type, such as commercial bank or finance company, as well as the loan type, which includes new lines of credit, mortgages, motor vehicle loans, equipment loans, "other" loans, and line-of-credit renewals.[4]

In the survey, firms are asked to report information about their most recent loan if they received a loan in the last three years. This is a critical piece of information for the analysis, because it identifies the most recent loan among other pre-existing loans. The sample is first reduced to the 1761 firms which reported a "most recent loan." Among the most recent loans, the 2003 SSBF also includes line-of-credit renewals as a separate category. Renewals are not a new loan, which does not fit the model as directly, so they are excluded from the analysis despite being almost half of the most recent loans. Excluding renewals reduces the sample to 943 firms.

Although the SSBF also includes information about loan denials (whether the firm was denied in the last three years), the analysis below focuses only on firms without

[4] The data used here exclude loans from individuals, the owner of the firm, a 401K/retirement plan, and the government.

a denial. This removes some of the possibility that firms borrow from a new lender because they were denied by an existing lender. It is also difficult to do an analysis on firms with a denial, because only 202 firms among all the firms in the 2003 SSBF report a denial. Focusing on firms that had an acceptance and no denial reduces the sample further to 925 firms.

An important aspect of the data for the current analysis is the identification of whether the most recent loan was from a new or existing lender. Because this distinction is not explicitly available in the data, the status of the most recent lender – whether it was an existing lender at the time of the most recent loan – requires some imputation. The data include balance sheet information about a firm's lenders as well as the identity of the most recent lender, but it is not clear in every case whether the firm's balance sheet includes the most recent loan. An institution can easily be identified as a new lender if the most recent loan differs in type from any loan that already is held at the institution, but, if the most recent loan is of the same type as a previous loan, some imputation is necessary. The definition of existing lender used in this case is as follows: the institution is an existing lender if the existing balance of the loan on the firm's balance sheet is greater than the amount of the most recent loan of the same type. All of the results shown use this definition. Alternatively, we also consider an approach in which the institution is identified as a new lender if the firm has only one loan of the same type at the institution where it received the most recent loan.[5] The overall results are generally robust to this alternative measure (not shown).

Using this definition of new lender, the sample is narrowed to the firms which had an existing loan at the time when their most recent loan was accepted. This step is important, because it aligns the sample specifically with the situation in which a firm has an existing lender, which is the proxy for "inside" lender. It is important to exclude firms without an existing loan, because firms receiving their first loan are also borrowing from a new lender.[6] This would measure a different effect than firms choosing between an existing lender and an outside lender. Reducing the sample to firms with an existing

[5] This assumes that the firm has not paid off pre-existing loans of the same type or other types.

[6] Degryse and van Cayseele (2000) do not have information on loans from other banks. A non-MAIN borrower could be a new borrower that has not yet established a relationship with any bank

lender results in a group of 712 firms based on the definition of new lender. Data cleaning results in a final sample size of 701 firms.[7]

Definitions for the variables are given in Table 1. The main variable of interest, "New Lender," is a dummy variable indicating whether the lender is an existing lender or a new lender. The new lender variable is equal to 1 if the loan is at a new lender (no existing loan with the lending institution at the time of the most recent loan) and 0 if the loan is at an existing lender.

The other variables include the characteristics of the firm, the market, the loan, and the firm's lenders. Among the firm characteristics, firm size is often a good proxy for default risk and the transparency of a firm. Size is measured as the natural log of a firm's total assets. For small firms, the information asymmetry between borrower and lender can be significant due to lack of public information. However, as firms grow in size, more public information generally becomes available about the firm. Firm age, measured as the natural log of a firm's age in months at the time of its most recent loan, is another proxy for risk and public information.[8] As firms survive the start-up years, their probability of failure decreases and the information publicly available about them increases.

Some of the firm characteristics relate to the legal and accounting characteristics of the firm. An indicator for whether the firm is a corporation (versus a proprietorship or partnership) helps differentiate firms based on their form of organization. The SSBF also includes questions about the financial accounting statements firms may have used to answer the survey. Firms are asked whether they used financial statements to answer the survey and, if so, whether the statements are audited. The "financial statements" indicator is used for all firms that have financial statements, so the indicator for "audited financial statements" specifically differentiates the quality of the information. Firms with audited financial statements should be more transparent than otherwise due to the verification of the auditing process.

[7] Observations are deleted for which the constructed age at the time of the most recent loan is negative, assets are non-positive, the interview date is missing, or the Dun and Bradstreet score is missing.
[8] Firm age is measured at the time of the most recent loan (age at the time of the interview minus the length of time since the most recent loan).

Additional firm characteristics include the firm's credit score, industry, leverage, and profitability. The Dun and Bradstreet (DNB) score, which is included in the SSBF survey, is a form of small business credit score based primarily on trade credit.[9] The score from zero to 100 (100 being high) is included in the regressions as a measure of each firm's credit quality. Firm industry is included, but, due to limited degrees of freedom, industry is included only as an indicator of whether the firm is in the service industry (SIC code > 599). Additionally, the profitability of a firm is included as return on assets (ROA) and leverage controls for the amount of a firm's liabilities relative to assets. Both ROA and leverage are winsorized at the 1% and 99% levels.

Differentiating loan types is important, because different loan types rely on different sources of information. In the SSBF, loans are categorized as a line of credit, a lease, a mortgage, a motor vehicle loan, an equipment loan, or "other." Berger and Udell (1995) point out that loan types have different informational characteristics and, consequently, the authors focus on lines of credit for analyzing relationship lending. Berger and Udell (2006) provide an overview of different lending technologies as it relates to different loan types. Loan size is another loan characteristic which might be related to borrowing from an insider versus an outsider. I have included loan size in the regressions as a robustness exercise and it has similar effects to firm size (results not shown).

The market characteristics include the local Herfindahl index of banks and whether the firm is in an MSA. The Herfindahl index is a measure of bank concentration that is often used as a measure of bank competition. The MSA indicator differentiates urban from rural markets, which likely differ in their competitiveness of bank lending.

The lender characteristics include the characteristics of the firm's most recent lender and its existing lenders. The variable "Bank Lender" identifies whether the most recent lender is a bank. "Bank" is used here in the strict sense of the lender being a commercial bank and does not include other types of depositories such as thrifts and credit unions. This controls for the possibility that bank lending differs from non-bank lending in its information characteristics. The first characteristic considered for the

[9] DNB, a private firm, collects information on firms' credit performance and uses the information to derive a credit score for each firm. Lenders can use the DNB credit score to assess the creditworthiness of potential borrowers.

existing lenders is simply the number of existing lenders. Previous papers have considered the number of a firm's lenders using the SSBF (e.g., Petersen and Rajan, 1994); however, these papers have not identified whether the measure includes the number of lenders prior to the most recent loan or after the most recent loan. In this paper, the number of existing lenders is the number of lenders prior to the most recent loan. To allow for differences in lender type, the number of existing lenders is also split by bank/non-bank. Lastly, the measure of the firm's existing bank lenders is considered as an indicator variable of whether the firm has an existing bank lender.[10]

Table 2 shows the sample means and standard deviations for the total sample of firms, as well as the subsamples of firms that borrow from an existing lender and firms that borrow from a new lender. Each panel shows the mean and standard deviation for the characteristics of the firm, loan, market, etc. The empirical methodology will test the probability of borrowing from a new lender in a multivariate framework.

The differences show how firms that borrow from a new lender differ from firms that borrow from an existing lender. Based on the descriptive statistics, it appears that firms that borrow from a new lender tend to be significantly smaller and younger. If firm size and firm age are correlated with firm transparency, then this would appear to support the prediction that opaque firms are more likely to borrow from a new lender rather than an existing lender. The remaining firm characteristics do not differ significantly across firms that borrow from an existing lender vs. firms that borrow from a new lender.

The loan types show that lines of credit are significantly more likely to be at a new lender than an existing lender and equipment loans are significantly less likely to be at a new lender than an existing lender. This finding for lines of credit is surprising given that much of the small business lending literature has focused on lines of credit as a form of relationship lending. As a caveat, the analysis excludes line of credit renewals, which would be at an existing lender. The data show that new lines of credit are more likely to be opened at a new lender. If lines of credit are generally less transparent than equipment loans, this finding supports Proposition 3. In contrast, equipment loans are considered asset-based lending, so they are likely more transparent than other forms of lending. This

[10] The length of the relationship between the lender and borrower is not used, because, by construction, the length of relationship at new lenders is less than that at existing lenders.

suggests that their greater likelihood of being at an existing lender would support Proposition 3 as well. Only the finding for motor vehicle loans (under the second definition of new lender) does not appear to support Proposition 3.

The market characteristics have the expected differences across firms borrowing from existing lenders vs. new lenders. Firms in MSAs are more likely to borrow from a new lender than firms in rural areas. This is likely due to the greater presence of other lenders to compete for the firm's business. Under the second definition of new lender, firms that borrow from a new lender tend to be in bank markets with a relatively low Herfindahl index. This also suggests that firms are more likely to receive a competitive outside offer in areas where lender concentration is lower.

Most of the significant differences between firms that borrow from an existing lender and those that borrow from a new lender are in the characteristics of the firms' lenders. Interestingly, firms that borrow from a new lender tend to have more non-bank lenders. As a caveat, this may be due to the fact that the sample only includes firms with an existing lender. Firms that borrow from a new lender are more likely to have no existing bank lender and one existing non-bank lender.

Table 3 shows the breakdown of firms by the number of existing bank- and non-bank lenders. Each cell contains the percentage of firms in the sample with the corresponding number of existing bank or non-bank lenders. Column 1 shows the percentage of firms broken out from the full sample. For example, under the first definition of new lender, 59 percent of firms in the full sample had a single existing bank lender. Columns two and three show the percentage breakouts for firms that borrow from an existing lender and those that borrow from a new lender.

There are several important patterns revealed by the numbers in Table 3. First, only 10 percent of the firms that borrow from an existing lender have no bank lender at all and over 65 percent of these firms have a single existing bank lender. Thus, as has been shown in the literature, most firms seem to have their needs met by a single bank. In contrast, 43 percent of the firms that borrow from a new lender have no existing bank lender and 44 percent of these firms have a single bank lender. The difference between these two groups suggests that a number of the firms that borrow from a new lender may do so because they do not have an existing bank lender. Second, the number of existing non-bank lenders does not appear to differ significantly across firms that borrow from an existing lender and those that borrow from a new lender. The only main difference is that the firms that borrow from an existing lender are most likely to have no existing non-bank lenders whereas firms that borrow from a new lender are most likely to have one existing non-bank lender.

5. Empirical Methodology

The empirical distinction between existing and new lender closely fits the theoretical distinction between inside and outside lender. It reflects the assumption that an existing lender has learned private information about the firm by having already made a loan to the firm and it closely matches the bidding game in the second stage of the model, where one of the lenders has already made a loan to the firm in the first stage. For the purpose of testing the prediction of the model, "existing lender" and "new lender" will be used as proxies for "inside bank" and "outside bank," respectively.[11]

The main goal of the empirical model is to identify which types of firms are more likely to borrow from an outside lender. This analysis compares the empirically predicted probability that a firm borrows from an existing lender with the empirically predicted probability that a firm borrows from a new lender. To do so, the methodology analyzes the observable factors predicting the outcome. The empirical model is the following:

$$\begin{aligned} \textit{new lender}_j = f\{ & \textit{firm characteristics}_j, \textit{loan types}_j, \\ & \textit{market characteristics}_j, \textit{lender characteristics}_j \} \end{aligned}$$

The dependent variable is the dummy variable indicating whether a firm's most recent loan was from a new lender. The explanatory variables include firm characteristics, loan types, market characteristics, and lender characteristics. The model is estimated using a logit specification with survey weights from the SSBF.

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[11] Alternatively, Degryse and Van Cayseele (2000) use a scope measure to proxy for whether a bank is an inside lender.

Proposition 3 predicts that transparent borrowers are less likely to receive a competitive loan offer from an outside lender, which is equivalent to saying the transparent borrowers are less likely to borrow from an outside lender. Therefore, for firm characteristics associated with transparency, the theory would predict a negative coefficient, and for firm characteristics associated with opacity, the theory would predict a positive coefficient. To test these predictions, the firms' relative transparency or opacity must be measured using proxies in the SSBF data.

Some of the firm characteristics proxy for firm transparency, which then yields empirical predictions based on the theory. In particular, prior literature has used firm size as a proxy for transparency (e.g., Gopalan et al., forthcoming). Larger and older firms tend to have more public information available about their quality and default history. If firm size and age are correlated with transparency, these firm characteristics should be negatively related with the probability of a firm borrowing from a new lender. Likewise, firms that are corporations may be more transparent than non-incorporated firms. Based on these presumptions, the model would predict negative coefficients for each of these three variables.

The variables which are perhaps most related to transparency are the variables about the use of financial statements. Firms that used financial statements to answer the survey questions are more likely to be transparent, because financial statements can be used by banks to evaluate the quality of the firm. Therefore, the theory predicts that the use of financial statements should be negatively related with the probability of borrowing from a new lender. A new feature of the 2003 SSBF is that it also asks respondents whether the financial statements were audited. Audited financial statements should provide an even greater level of certification regarding the firm's quality. This implies that firms that use audited financial statements should be even less likely to borrow from a new lender than firms that use unaudited financial statements.

A firm's Dun and Bradstreet credit score is based on a record of the firm's payment performance history on trade credit. To the extent that the score reflects the firm's observable credit risk, it may or may not be related to the probability of the firm borrowing from a new lender. However, for firms that do not use trade credit extensively, a higher score can also reflect uncertainty about the firm's credit risk. To the extent that the score reflects the firm's observable credit risk, higher scores should be correlated with greater likelihood of borrowing from a new lender.

Firms may differ in their propensity to borrow from a new lender depending on their industry. For instance, small businesses in the service industry tend to have limited tangible assets which can be used as collateral for loans. To control for industry at an aggregated level, the service dummy captures these broad differences between service firms and non-service firms. If service firms tend to be less transparent than firms in other industries, then being in the service industry should be positively correlated with the probability of borrowing from a new lender.

It is not clear whether a firm's return on assets and leverage are related to its informational transparency. Therefore, there is not a clear prediction for these firm characteristics. They are included primarily because they may be related to the probability of a firm borrowing from a new lender for other reasons.

Although the firm characteristics are the most direct test of the theoretical predictions, some of the other control variables are also related to information asymmetry. The loan types include lines-of-credit, mortgage loans (residential and commercial), equipment loans, motor vehicle loans, leases, and "other." Under the premise that these loan types represent different lending technologies (Berger and Black, 2010), relevant information asymmetries between lenders may be unique to specific sources of information. Asset-based lending tends to be based more on the value of the asset than the quality of the firm. Therefore, all else equal, asset-based loans tend to be more transparent than non-asset-based loans. This would suggest that non-asset-based loans are more likely to be made by a new lender.

The market characteristics include the local banking market Herfindahl and an indicator of whether the firm is headquartered in an MSA. Controlling for market characteristics is important, because it captures the likelihood of an existing lender facing competition from an outside lender. A smaller Herfindahl is often used as a proxy for greater competition and MSA markets tend to be more competitive than rural markets. Therefore, the probability of a firm borrowing from a new lender should be greater in MSAs and markets with a lower Herfindahl.

Lastly, the likelihood of a firm receiving a competitive outside loan offer may also depend on the lender characteristics. The first two variables control for the source of the most recent loan. This includes an indicator for whether the most recent loan was at a bank or a non-bank and an indicator for whether the most recent loan was at a captive finance company. The last four variables characterize the firm's existing lenders at the time of the most recent loan. First, there is the number of existing lenders – a firm with more existing lenders is more likely to borrow a new loan from an existing lender. This number is also broken out by the type of the existing lender according to bank and non-bank. Previous research on the SSBF shows that banks offer a number of services which are not offered by non-banks. Therefore, firms without an existing bank may borrow a new loan from a new bank in order to access these additional services. To address this hypothesis more closely, the number of bank lenders is summarized by an indicator of whether the firm has an existing bank.

6. Results

The regression results are shown in Table 4. To better assess the economic significance of the results, the coefficients are reported as odds ratios, which are simply the regression coefficients exponentiated. A value greater than one indicates higher odds of a firm borrowing from a new lender, and a value less than one indicates lower odds of a firm borrowing from a new lender. One can interpret the percentage change in odds of borrowing from a new lender to be 100*(odds ratio - 1).

The four columns shown in Table 4 differ in the inclusion of lender characteristics. The first column contains the results without any lender characteristics included. The second column adds the lender characteristics which do not distinguish the type of existing lenders, and the third and fourth columns add the variables characterizing existing bank lenders.

The first proxy for firm transparency is firm size. Firm size has an odds ratio of less than one that is significant at the one percent level in each specification, which suggests that an increase in firm size reduces the odds of borrowing from a new lender. Specifically, the odds ratio of 0.724 in the fourth column suggests that a $1 increase in log of assets will reduce the odds of borrowing from a new lender by 27.6 percent. Given that large firms tend to be more transparent than small firms, this finding supports the prediction of Proposition 3 that more transparent firms are less likely to borrow from a new lender. This result is consistent with the Gopalan et al. (forthcoming) finding for the largest firms as well.

The other main proxy for firm transparency is the use of financial statements. The odds ratio associated with the use of financial statements is significantly greater than one, indicating that firms which used financial statements to answer the survey were more likely to borrow from a new lender than firms which did not use financial statements. This finding does not appear to be consistent with the prediction in Proposition 3, because it indicates that firms with greater transparency were more likely to borrow from an outside lender.

The analysis is taken a step further by analyzing audited financial statements. The odds ratios associated with audited financial statements are significantly less than one, indicating that firms which used audited financial statements were less likely to borrow from a new lender than firms which used unaudited financial statements. The odds ratio for the audited statements of 0.38 in the fourth column suggests that the use of audited financial statements reduces the odds that a firm will borrow from a new lender by an estimated 62 percent relative to a firm that uses unaudited financial statements. Because audited financial statements are more transparent than unaudited financial statements, this implies that as transparency increases the probability that a firm will borrow from a new lender also increases. This finding supports the prediction in Proposition 3.

The other firm characteristics do not appear to be significantly correlated with whether a firm borrows from a new lender. The firm's credit score, industry, leverage, and ROA are all insignificant in each of the specifications. In the context of the model, this may indicate that these variables are not correlated with unobserved firm heterogeneity. If insider banks and outsider banks do not differ in their private information as it relates to these characteristics, the characteristics would not be predicted to effect whether a firm borrows from a new lender or an existing lender.

The results for different loan types indicate the likelihood of each loan type being originated by a new lender. The most interesting comparison is likely with lines of credit, which are often considered to be loans with the least transparency. In each specification, equipment loans are the excluded category. Column 4 shows that the odds ratio for lines of credit is greater than one at 4.18, such that the odds of a new line of credit being at a new lender is more than three times greater than for an equipment loan. As in the descriptive statistics, if the removal of renewals does not overly bias the result, the result would appear to be in support of Proposition 3.

The market characteristics results relate lender competition and the probability of firms borrowing from a new lender. The market Herfindahl is not significant in any of the specifications, which could potentially imply that competition is not an important factor in inside versus outside lending. However, the indicator of whether the firm is in an MSA may be a better measure of competition. The odds ratio for the indicator of whether the firm is in a MSA is 3.88, indicating that being located in a MSA more than doubles the odds that the firm will borrow from a new lender. This makes sense as firms in MSAs are much more likely to have an outside lending option than firms in rural areas.

The lender characteristics are included in columns two through four of Table 4. The first characteristic is whether the most recent lender was a bank lender. The result in the fourth column suggests that this variable is insignificant, which may be driven mostly by the fact that a number of firms do not have an existing bank lender. The other characteristic of the most recent lender is an indicator of captive finance companies. The odds ratio for this variable is greater than one and significant at the five percent level, indicating higher odds that captive finance companies are a new lender when they lend to small businesses. This supports the intuition that captive finance companies provide lending specific to their product when it is purchased.

The remaining lender characteristics relate to the firm's existing lenders at the time of its most recent loan. Column 3 differentiates the existing lenders by non-banks and banks. In other words, the total number of existing lenders is replaced by the separate numbers of non-bank lenders and bank lenders. The results indicate that the number of non-bank lenders is not significant; therefore, the prior result for the number of existing lenders does not appear to be a mechanical effect driven simply by the firm having more existing lenders from which to choose. In contrast, the odds ratio for the number of bank lenders is less than one (0.23) and significant at the one percent level, which implies that an increase in the number of existing bank lenders decreases the odds that a firm will borrow from a new lender by 77 percent. This result is slightly beyond the scope of the theoretical model, but Detragiache et al. (2000) explore the theory of multiple banking.

In column 4, the analysis focuses directly on the presence of an existing bank lender. The variable for the number of existing bank lenders is replaced with a simple indicator of whether the firm had an existing bank lender at the time of its most recent loan. The odds ratio for this indicator variable is 0.091 and significant at the one percent level, implying that having an existing bank lender decreases the odds that a firm will borrow from a new lender by 91 percent. Perhaps banks offer firms other services which are not available through normal non-bank finance.

7. Conclusion

This paper explores the effect of borrower transparency on competition between inside and outside lenders. When firms have limited transparency, the outsider faces a "winner's curse" — the outside lender is more likely to win bad firms than good firms when it bids against the inside lender. Therefore, one might expect that greater firm transparency would increase the availability of competitive outside offers. However, this paper shows that this is not the prediction of a benchmark model of information–based lending. In the model, firms with more transparency are *less* likely to receive a competitive outside offer. The intuition is that greater transparency of the firm causes the outside lender to win *more good firms*, but also *fewer bad firms*. An analytical result shows that the net effect is negative, such that the total amount of outside lending decreases with firm transparency.

The prediction of the model is tested using a sample of firms from the 2003 Survey of Small Business Finance (SSBF). Firms in the survey report all of their loans and the institutions from which they are currently borrowers. This provides the information about which institutions are the firm's existing lenders, which proxies for inside lenders. The firms also report the source of their most recent loan. Therefore, the data have sufficient information to reasonably identify whether the firm borrowed from a new lender or an existing lender. If the firm borrowed from a new lender, then it must have received a competitive outside offer from that institution.

The results generally indicate that firms with greater transparency are less likely to borrow from a new lender. Larger firms, which tend to be more transparent, are less likely than smaller firms to borrow from a new lender. Additionally, firms with audited financial statements are less likely to borrow from a new lender than firms with unaudited financial statements. These results appear to be consistent with the prediction of the model. The empirical results also control for the number of existing lenders so that the comparison holds for firms with similar existing lender characteristics.

The theoretical and empirical results of the paper provide an interesting new perspective on issues of transparency and external finance. Small firms, in particular, can have difficulty raising external finance due to lack of public information about their credit quality. This paper shows that some of these firms may actually be more likely to borrow from a non-existing lender. Although outside lenders face an adverse selection problem, competitive bidding strategies lead to more firm switching under greater information asymmetry. This provides an interesting counterpoint to the common intuition about the availability of outside offers for firms with limited transparency.

References

Akerlof, G., 1970. The market for "lemons": Quality uncertainty and the market mechanism. The Quarterly Journal of Economics, Vol. 84, No. 3, 488-500.

Berger, A., Black, L., 2010. Bank size, lending technologies, and small business finance. Journal of Banking and Finance, forthcoming.

Berger, A., Udell, G., 1995. Relationship lending and lines of credit in small firm finance. Journal of Business 68, 351-381.

Berger, A., Udell, G., 2006. A more complete conceptual framework for SME finance. Journal of Banking and Finance 30, 2945-2966.

Bharath, S., Dahiya, S., Saunders, A., and Srinivasan, A., 2007. So what do I get? The bank's view of lending relationships. Journal of Financial Economics 85, 368-419.

Black, L., 2008. Insider rates vs. outsider rates. Board of Governors of the Federal Reserve System, Finance and Economics Discussion Series: Working paper.

Degryse, H., Van Cayseele, P., 2000. Relationship lending within a bank-based system: Evidence from European small business data. Journal of Financial Intermediation 9, 90-109.

Detragiache, E., Garella, P., and Guiso, L., 2000. Multiple versus single banking relationships: Theory and evidence. Journal of Finance 55, 1133-1161.

Gopalan, R., Udell, G., and Yerramilli, V., 2010. Why do firms form new banking relationships? Journal of Financial and Quantitative Analysis, forthcoming.

Ioannidou, V., Ongena, S., 2010. "Time for a change": Loan conditions and bank behavior when firms switch. Journal of Finance, forthcoming.

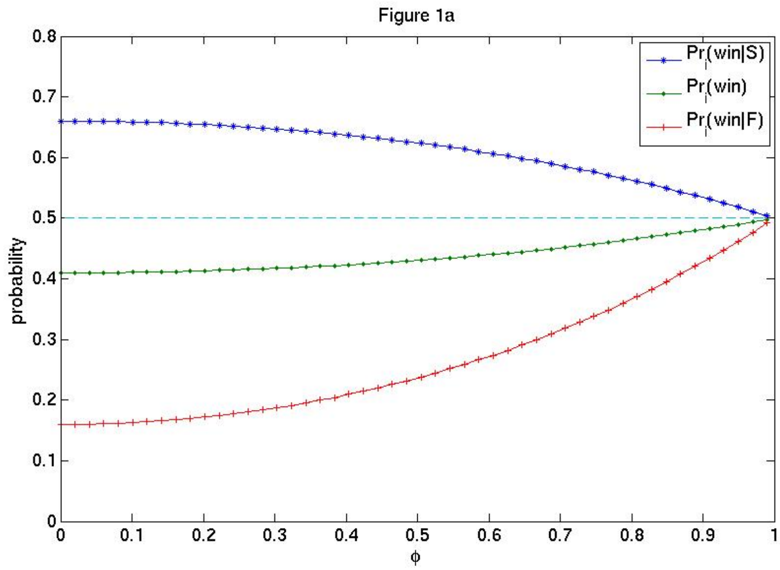
Petersen, M., Rajan, R., 1994. The benefits of lending relationships. Journal of Finance 49, 1994.

Sharpe, S., 1990. Asymmetric information, bank lending and implicit contracts: A stylized model of customer relationships. Journal of Finance 45, 1069-1087.

von Thadden, E.-L., 2004. Asymmetric information, bank lending and implicit contracts: the winner's curse. Finance Research Letters 1, 11-23.

Figure 1: The Probabilities of the Insider or Outsider Winning

Figure 1 shows the probability of the insider or outsider winning the bid for a loan to a firm and how these probabilities change with firm transparency. The figure depicts a numerical example based on the results in Propositions 2 and 3, where $p_H = 0.8$, $p_L = 0.2$, $\theta = 0.5$ and ϕ varies from 0 to 1. The parameter ϕ is a measure of firm transparency.



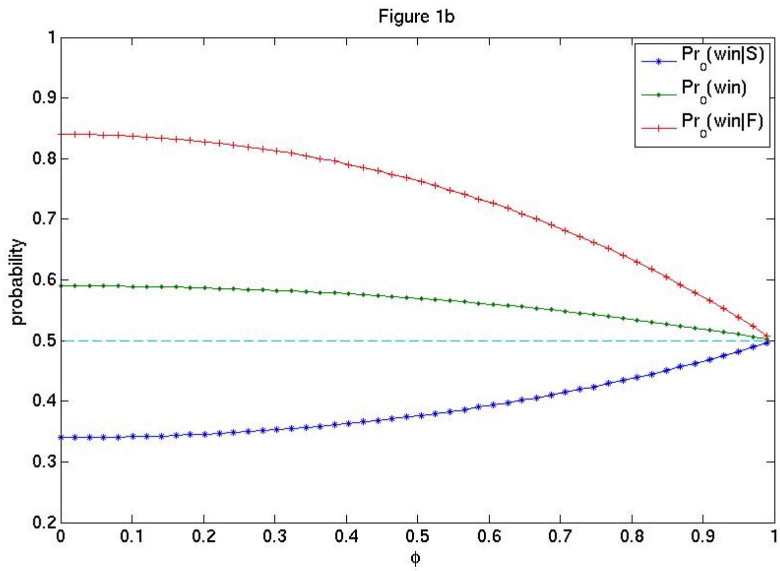


Table 1: Variable Definitions

New vs. Existing Lender	
New Lender	Dummy variable equal to 1 if the firm borrowed from a new lender
Firm Characteristics	
Ln(Assets)	Log of total assets
Ln(Age)	Log of age in months (+1) at the time of the most recent loan
Corporation	Dummy variable equal to 1 if the firm is a corporation
Firm Used Financial Statements	Dummy variable equal to 1 if the firm used financial statements to answer the survey*
Firm Used Audited Financial Statements	Dummy variable equal to 1 if the firm used audited financial statements to answer the survey
Dun & Bradstreet Score	Dun & Bradstreet continuous credit score of 0 to 100
Service Industry	Dummy variable equal to 1 if the firm's SIC code is greater than 599
Leverage	Total Liabilities / Total Assets
ROA	Return on Assets: Profit / Total Assets
Loan Types	
Line of Credit	Dummy variable equal to 1 if the most recent loan is a line of credit
Lease	Dummy variable equal to 1 if the most recent loan is a lease
Mortgage	Dummy variable equal to 1 if the most recent loan is a mortgage
Motor vehicle	Dummy variable equal to 1 if the most recent loan is a motor vehicle loan
Equipment	Dummy variable equal to 1 if the most recent loan is an equipment loan
Other	Dummy variable equal to 1 if the most recent loan is an "other" loan
Market Characteristics	
Market Herfindahl	The 2003 Herfindahl index of bank deposits in the firm’s market
Firm in MSA	Dummy variable equal to 1 if the firm is in an MSA
Lender Characteristics	
Bank Lender	Dummy variable equal to 1 if the most recent lender is a bank
Captive Finance Lender	Dummy variable equal to 1 if the most recent lender is a captive finance company
Number of Existing Lenders	Number of the firm's existing lenders at the time of the most recent loan
Number of Existing Non-Bank Lenders	Number of the firm's existing non-banklenders at the time of the most recent loan
Number of Existing Bank Lenders	Number of the firm's existing bank lenders at the time of the most recent loan
Firm Has a Bank Lender	Dummy variable equal to 1 if the firm has an existing bank lender

* Includes both unaudited and audited financial statements

Table 2: Descriptive Statistics

Table 2 shows the mean and standard deviation of each variable (using survey weights) for a sample of firms in the 2003 Survey of Small Business Finance (SSBF). The sample is also separated into firms that borrowed from an existing lender and those that borrowed from a new lender. Existing lender is defined as a lender that is not a new lender. Standard errors are shown in brackets with *, **, and *** indicating significance at 10%, 5%, and 1%, respectively.

	Full Sample		Existing Lender		New Lender		New - Existing	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Difference	T-Test
Firm Characteristics								
Ln(Assets)	12.36	0.09	12.67	0.10	11.83	0.18	-0.848	[0.201]***
Ln(Age)	4.79	0.06	4.87	0.07	4.65	0.10	-0.219	[0.124]*
Corporation	0.56	0.03	0.58	0.04	0.53	0.05	-0.047	[0.062]
Firm Used Financial Statements	0.20	0.02	0.18	0.03	0.23	0.04	0.056	[0.049]
Firm Used Audited Financial Statements	0.05	0.01	0.06	0.02	0.04	0.01	-0.026	[0.022]
Dun & Bradstreet Score	57.57	1.74	58.21	2.04	56.51	3.13	-1.703	[3.733]
Service Industry	0.45	0.03	0.42	0.04	0.48	0.05	0.058	[0.060]
Leverage	0.87	0.08	0.80	0.09	0.98	0.14	0.179	[0.168]
ROA	0.71	0.12	0.58	0.16	0.93	0.17	0.357	[0.236]
Loan Types								
Line of Credit	0.29	0.03	0.25	0.03	0.35	0.05	0.104	[0.057]*
Lease	0.02	0.01	0.01	0.01	0.02	0.01	0.008	[0.013]
Mortgage	0.19	0.02	0.20	0.03	0.17	0.04	-0.032	[0.047]
Motor Vehicle Loan	0.20	0.02	0.19	0.03	0.22	0.04	0.037	[0.048]
Equipment Loan	0.19	0.02	0.23	0.03	0.13	0.03	-0.099	[0.044]**
Other	0.12	0.02	0.12	0.02	0.11	0.03	-0.019	[0.042]
Market Characteristics								
Market Herfindahl	0.21	0.01	0.22	0.01	0.20	0.01	-0.021	[0.013]
Firm in MSA	0.68	0.03	0.63	0.04	0.78	0.04	0.156	[0.057]***
Lender Characteristics								
Bank Lender	0.72	0.03	0.78	0.03	0.61	0.05	-0.173	[0.056]***
Captive Finance Lender	0.08	0.01	0.04	0.01	0.13	0.03	0.087	[0.035]**
Number of Existing Lenders	1.91	0.06	2.03	0.09	1.69	0.08	-0.340	[0.121]***
Number of Existing Non-Bank Lenders	0.96	0.05	0.87	0.07	1.12	0.09	0.248	[0.111]**
Number of Existing Bank Lenders	0.95	0.04	1.17	0.05	0.58	0.06	-0.589	[0.081]***
Firm Has a Bank Lender	0.73	0.03	0.88	0.02	0.49	0.05	-0.385	[0.055]***
Observations	701		493		208			

Table 3: Number of Existing Bank and Non-Bank Lenders

Table 3 shows the percentage breakdown of the existing bank- and non-bank lenders for each firm in the sample. Each cell in the table contains the percentage of firms with a given number of bank lenders and non-bank lenders. As in Table 2, the full sample of firms are split into those firms that borrow from an exisitng lender and those that borrow from a new lender. The percentages shown are based on the total in each respective sample.

	(1)	(2)	(3)
	Full Sample	Existing Lender	New Lender
	Total = 710	Total = 493	Total = 208
Number of Existing Bank Lenders			
0	20%	10%	43%
1	59%	65%	44%
2	16%	19%	8%
3	4%	4%	3%
4	1%	1%	1%
5	0%	0%	0%
6	0%	0%	0%
Number of Existing Non-Bank Lenders			
0	35%	40%	25%
1	35%	30%	47%
2	17%	17%	15%
3	7%	8%	7%
4	3%	2%	3%
5	2%	2%	2%
6	1%	1%	0%
9	0%	0%	0%
10	0%	0%	0%

Table 4: Probability of Firm Borrowing from a New Lender

Logit regressions in which the dependent variable is a dummy variable indicating that the firm borrowed from a new lender. To indicate economic significance, coefficiants and standard errors are displayed as odds ratios. See Table 1 for variable definitions. Equipment loans are the excluded loan type. Standard errors are shown in brackets with *, **, and *** indicating significance at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)
Firm Characteristics				
Ln(Assets)	0.712	0.749	0.738	0.724
	[0.061]***	[0.066]***	[0.069]***	[0.070]***
Ln(Age)	0.864	0.898	0.947	0.952
	[0.119]	[0.129]	[0.129]	[0.135]
Corporation	0.871	0.986	1.125	1.108
	[0.253]	[0.299]	[0.345]	[0.349]
Firm Used Financial Statements	2.428	2.379	2.519	2.506
	[0.805]***	[0.754]***	[0.774]***	[0.795]***
Firm Used Audited Financial Statements	0.346	0.354	0.355	0.376
	[0.204]*	[0.202]*	[0.232]	[0.223]*
Dun & Bradstreet Score	0.999	0.999	1.003	1.005
	[0.005]	[0.005]	[0.005]	[0.005]
Service Industry	0.944	0.927	0.867	0.863
	[0.260]	[0.265]	[0.266]	[0.275]
Leverage	0.921	0.928	0.942	0.937
	[0.087]	[0.094]	[0.119]	[0.127]
ROA	0.992	1.016	1.035	1.005
	[0.064]	[0.069]	[0.062]	[0.060]
Loan Types				
Line of Credit	2.771	3.574	3.682	4.18
	[1.134]**	[1.541]***	[1.668]***	[2.003]***
Lease	2.964	3.408	9.635	6.446
	[2.468]	[2.505]*	[9.550]**	[6.031]**
Mortgage	1.606	1.92	1.961	2.224
	[0.733]	[0.903]	[0.978]	[1.171]
Motor Vehicle Loan	1.931	1.535	2.239	2.543
	[0.810]	[0.659]	[1.029]*	[1.229]*
Other	1.47	1.747	1.614	1.781
	[0.864]	[1.084]	[1.022]	[1.118]
Market Characteristics				
Market Herfindahl	1.309	0.969	0.539	0.977
	[1.585]	[1.217]	[0.759]	[1.403]
Firm in MSA	2.493	2.206	2.476	3.288
	[0.886]**	[0.809]**	[0.899]**	[1.247]***
Lender Characteristics				
Bank Lender		0.523	1.059	1.278
		[0.174]*	[0.461]	[0.595]
Captive Finance Lender		2.532	3.168	3.872
		[1.253]*	[1.879]*	[2.512]**
Number of Existing Lenders		0.824		
		[0.099]		
Number of Existing Non-Bank Lenders			1.22	1.03
			[0.183]	[0.134]
Number of Existing Bank Lenders			0.231	
			[0.076]***	
Firm Has a Bank Lender				0.091
				[0.036]***
Observations	701	701	701	701

Appendix

Proof of Proposition 1:

Let $H_i^{\gamma,\tilde{\gamma}}(r),\ \gamma \in \{S,F\},\ \tilde{\gamma} \in \{\tilde{S},\tilde{F}\}$, denote the c.d.f. of the equilibrium mixed strategy of the inside bank, given its information γ and $\tilde{\gamma}$, and $H_o^{\tilde{\gamma}}(r),\ \tilde{\gamma} \in \{\tilde{S},\tilde{F}\}$, the c.d.f. of the equilibrium strategy of the outside bank, given its information $\tilde{\gamma}$. Let

$$l_i^{\gamma,\tilde{\gamma}} = \inf\left\{r \mid H_i^{\gamma,\tilde{\gamma}}(r) > 0\right\}, \qquad \gamma \in \{S,F\},\ \ \tilde{\gamma} \in \{\tilde{S},\tilde{F}\}$$

$$u_i^{\gamma,\tilde{\gamma}} = \sup\left\{r \mid H_i^{\gamma,\tilde{\gamma}}(r) < 1\right\}, \qquad \gamma \in \{S,F\},\ \ \tilde{\gamma} \in \{\tilde{S},\tilde{F}\}$$

$$l_o^{\tilde{\gamma}} = \inf\left\{r \mid H_o^{\tilde{\gamma}}(r) > 0\right\}, \qquad \tilde{\gamma} \in \{\tilde{S},\tilde{F}\}$$

$$u_o^{\tilde{\gamma}} = \sup\left\{r \mid H_o^{\tilde{\gamma}}(r) < 1\right\}, \qquad \tilde{\gamma} \in \{\tilde{S},\tilde{F}\}.$$

Each bank's expected payoff for any interest rate quoted, given the mixed strategy of the other:

$$P_i^{\gamma,\tilde{\gamma}}(r) = (1 - H_o^{\tilde{\gamma}}(r^-))\left[p(\gamma)(1+r) - (1+\bar{r})\right], \qquad \gamma \in \{S,F\}, \tilde{\gamma} \in \{\tilde{S},\tilde{F}\} \tag{A.5}$$

$$\begin{aligned} P_o^{\tilde{\gamma}}(r) = {} & prob(\gamma = S \mid \tilde{\gamma})(1 - H_i^{S,\tilde{\gamma}}(r))\left[p(S)(1+r) - (1+\bar{r})\right] \\ & + prob(\gamma = F \mid \tilde{\gamma})(1 - H_i^{F,\tilde{\gamma}}(r))\left[p(F)(1+r) - (1+\bar{r})\right], \qquad \tilde{\gamma} \in \{\tilde{S},\tilde{F}\}. \end{aligned} \tag{A.6}$$

Based on the structure of the model, the probabilities of firm type conditional on the outsider's signal are

$$prob(\gamma = S \mid \tilde{S}) = \frac{p\left(\dfrac{1+\phi}{2}\right)}{p\left(\dfrac{1+\phi}{2}\right) + (1-p)\left(\dfrac{1-\phi}{2}\right)}$$

$$prob(\gamma = F \mid \tilde{S}) = \frac{(1-p)\left(\frac{1-\phi}{2}\right)}{p\left(\frac{1+\phi}{2}\right)+(1-p)\left(\frac{1-\phi}{2}\right)}$$

$$prob(\gamma = S \mid \tilde{F}) = \frac{p\left(\frac{1-\phi}{2}\right)}{p\left(\frac{1-\phi}{2}\right)+(1-p)\left(\frac{1+\phi}{2}\right)}$$

$$prob(\gamma = F \mid \tilde{F}) = \frac{(1-p)\left(\frac{1+\phi}{2}\right)}{p\left(\frac{1-\phi}{2}\right)+(1-p)\left(\frac{1+\phi}{2}\right)}.$$

If $\phi = 0$, then $prob(\gamma = S \mid \tilde{S}) = prob(\gamma = S \mid \tilde{F}) = p$ and $prob(\gamma = F \mid \tilde{S}) = prob(\gamma = F \mid \tilde{F}) = 1-p$.

Therefore, for the outside bank, conditional on its signal type:

$$P_o^{\tilde{S}}(r) = \left[\frac{p\left(\frac{1+\phi}{2}\right)}{p\left(\frac{1+\phi}{2}\right)+(1-p)\left(\frac{1-\phi}{2}\right)}\right](1-H_i^{S,\tilde{S}}(r))\left[p(S)(1+r)-(1+\overline{r})\right]$$
$$+\left[\frac{(1-p)\left(\frac{1-\phi}{2}\right)}{p\left(\frac{1+\phi}{2}\right)+(1-p)\left(\frac{1-\phi}{2}\right)}\right](1-H_i^{F,\tilde{S}}(r))\left[p(F)(1+r)-(1+\overline{r})\right]$$

$$P_o^{\tilde{F}}(r) = \left[\frac{p\left(\frac{1-\phi}{2}\right)}{p\left(\frac{1-\phi}{2}\right)+(1-p)\left(\frac{1+\phi}{2}\right)}\right](1-H_i^{S,\tilde{F}}(r))\left[p(S)(1+r)-(1+\overline{r})\right]$$
$$+\left[\frac{(1-p)\left(\frac{1+\phi}{2}\right)}{p\left(\frac{1-\phi}{2}\right)+(1-p)\left(\frac{1+\phi}{2}\right)}\right](1-H_i^{F,\tilde{F}}(r))\left[p(F)(1+r)-(1+\overline{r})\right].$$

The following proof is similar to the proof in von Thadden (2004), with each step generalized to the case of $\phi \in [0,1)$.

Step 1:

$l_i^{\gamma,\tilde{\gamma}} \geq r_\gamma$ for $\gamma \in \{S,F\}$ and $\tilde{\gamma} \in \{\tilde{S},\tilde{F}\}$.

Proof: An inside bank would lose money if it knowingly offered a firm an interest rate below the firm's break-even rate.

Step 2:

$l_o^{\tilde{\gamma}} \geq r_{\tilde{\gamma}}$ for $\tilde{\gamma} \in \{\tilde{S},\tilde{F}\}$

Proof: Because $r_F > r_{\tilde{F}}$, any offer $r < r_{\tilde{F}}$ attracts, by Step 1, the *F*-firm. Therefore, the pool of applicants has at best success probability $r_{\tilde{F}}$. The corresponding statement is true for $r_{\tilde{S}}$ as well.

Step 3:

$l_i^{\gamma,\tilde{\gamma}} \geq r_{\tilde{\gamma}}$ for $\gamma \in \{S,F\}$ and $\tilde{\gamma} \in \{\tilde{S},\tilde{F}\}$.

Proof: By Step 2, putting mass to the left of $r_{\tilde{S}}$ when $\tilde{\gamma} = \tilde{S}$ or to the left of $r_{\tilde{F}}$ when $\tilde{\gamma} = \tilde{F}$ cannot be optimal. (The inside bank makes strictly positive profits on the *S*-firm.)

Step 4:

$u_o^{\tilde{\gamma}} \geq u_i^{S,\tilde{\gamma}}$ for $\tilde{\gamma} \in \{\tilde{S},\tilde{F}\}$.

Proof: Suppose that $u_o^{\tilde{S}} < u_i^{S,\tilde{S}}$. Then the inside bank makes zero expected profits on all offers $r(S) \in (u_o^{\tilde{S}}, u_i^{S,\tilde{S}}]$. However, by Step 3, the inside bank makes strictly positive expected profits on the *S*-firm. The same logic holds for the supposition that $u_o^{\tilde{F}} < u_i^{S,\tilde{F}}$. In other words, for good firms, it is never profit maximizing for the inside bank to intentionally bid higher than the outside bank.

Step 5:

$H_i^{S,\tilde{\gamma}}$ is continuous on $[l_i^{S,\tilde{\gamma}}, u_i^{S,\tilde{\gamma}})$ for $\tilde{\gamma} \in \{\tilde{S}, \tilde{F}\}$.

Proof: Suppose that there is a $\hat{r} \in [l_i^{S,\tilde{\gamma}}, u_i^{S,\tilde{\gamma}})$, $\tilde{\gamma} \in \{\tilde{S}, \tilde{F}\}$ at which $H_i^{S,\tilde{\gamma}}$ is discontinuous, i.e., with $H_i^{S,\tilde{\gamma}}\left(\hat{r}^-\right) < H_i^{S,\tilde{\gamma}}\left(\hat{r}\right)$, $\tilde{\gamma} \in \{\tilde{S}, \tilde{F}\}$. Then, by Eq. (A.6), $P_o^{\tilde{\gamma}}(\hat{r}^-) > P_o^{\tilde{\gamma}}(\hat{r})$, because $p(S)(1+r)-(1+\overline{r}) > 0$ on $[l_i^{S,\tilde{\gamma}}, u_i^{S,\tilde{\gamma}})$ for $\tilde{\gamma} \in \{\tilde{S}, \tilde{F}\}$ by Step 3.

By the right-hand continuity of $H_i^{\gamma,\tilde{\gamma}}$, $\gamma \in \{S, F\}$, $\tilde{\gamma} \in \{\tilde{S}, \tilde{F}\}$, there is an $\varepsilon > 0$ such that $H_o^{\tilde{\gamma}}\left(\hat{r}^-\right) = H_o^{\tilde{\gamma}}\left(\hat{r}\right)$ = constant on $\left[\hat{r}, \hat{r}+\varepsilon\right]$ for $\tilde{\gamma} \in \{\tilde{S}, \tilde{F}\}$. Hence, $H_i^{S,\tilde{\gamma}}$ can have no mass on $\left[\hat{r}, \hat{r}+\varepsilon\right]$, which implies that $H_i^{S,\tilde{\gamma}}\left(\hat{r}^-\right) = H_i^{S,\tilde{\gamma}}\left(\hat{r}\right)$. Contradiction.

Step 6:

$u_i^{S,\tilde{\gamma}} \geq l_i^{F,\tilde{\gamma}}$ for $\tilde{\gamma} \in \{\tilde{S}, \tilde{F}\}$.

Proof: Analogous to von Thadden (2004) Step 6.

Step 7:

$u_i^{F,\tilde{\gamma}} \leq u_o^{\tilde{\gamma}}$ for $\tilde{\gamma} \in \{\tilde{S}, \tilde{F}\}$.

Proof: Analogous to von Thadden (2004) Step 7.

Step 8:

$u_i^{F,\tilde{\gamma}} = r_F$ for $\tilde{\gamma} \in \{\tilde{S}, \tilde{F}\}$.

Proof: Clearly, $u_i^{F,\tilde{\gamma}} \geq r_F$ for $\tilde{\gamma} \in \{\tilde{S}, \tilde{F}\}$. Step 8 implies that $r_i(F, \tilde{\gamma}) = r_F$ for $\tilde{\gamma} \in \{\tilde{S}, \tilde{F}\}$.

Step 9:

$u_o^{\tilde{\gamma}} = u_i^{S,\tilde{\gamma}} = r_F$ for $\tilde{\gamma} \in \{\tilde{S}, \tilde{F}\}$.

Proof: Suppose that $u_o^{\tilde{\gamma}} > r_F$ for $\tilde{\gamma} \in \{\tilde{S}, \tilde{F}\}$. Contradiction.

Step 10:

The outside bank makes zero expected profits.

Proof: By Steps 8 and 9, Eq. (A.6) simplifies to

$$\begin{aligned} P_o^{\tilde{\gamma}}(r) = {} & prob(\gamma = S \mid \tilde{\gamma})(1 - H_i^{S,\tilde{\gamma}}(r^-))\left[p(\tilde{\gamma})(1+r) - (1+\overline{r}) \right] \\ & + prob(\gamma = F \mid \tilde{\gamma})\left[p(\tilde{\gamma})(1+r) - (1+\overline{r}) \right], \qquad \tilde{\gamma} \in \{\tilde{S}, \tilde{F}\} \end{aligned}$$

on $[l_o^{\tilde{\gamma}}, u_o^{\tilde{\gamma}})$.

Step 12:

$H_o^{\tilde{\gamma}}(r)$ is continuous on $[r_{\tilde{\gamma}}, r_F)$ for $\tilde{\gamma} \in \{\tilde{S}, \tilde{F}\}$.

Proof: Suppose $H_o^{\tilde{S}}(r)$ and $H_o^{\tilde{F}}(r)$ are not continuous. This contradicts the continuity of P_o (which follows from Step 5 and Eq. (A.8)).

Step 13:

$H_i^{S,\tilde{\gamma}}(r)$ and $H_o^{\tilde{\gamma}}(r)$ are strictly increasing on $[r_{\tilde{\gamma}}, r_F]$ for $\tilde{\gamma} \in \{\tilde{S}, \tilde{F}\}$.

Proof: Suppose that $H_i^{S,\tilde{\gamma}}$ is constant on some interval $\left[\alpha, b\right] \subset \left[r_p, r_F \right]$. Let $\left[a, b\right] \supseteq \left[\alpha, b\right]$ be the maximal such interval. By Step 5 and the definition of $l_i^{S,\tilde{\gamma}}$, $a > r_p$.

Then $P_o^{\tilde{\gamma}}$ is strictly increasing on $[a,b]$, hence, $H_o^{\tilde{\gamma}}$ constant on $[a,b)$. By the continuity of $H_o^{\tilde{\gamma}}$, $P_i^{S,\tilde{\gamma}}$ is strictly increasing on $[a,b]$, a contradiction to the maximality of $[a,b]$.

The last step implies that $P_i^{S,\tilde{S}}$ and $P_o^{\tilde{S}}$ are constant on $[r_{\tilde{S}}, r_F]$ and $P_i^{S,\tilde{F}}$ and $P_o^{\tilde{F}}$ are constant on $[r_{\tilde{F}}, r_F]$. By the continuity of $H_o^{\tilde{S}}$ (Step 11) and $H_i^{S,\tilde{S}}$

Outcome:

$$P_i^{S,\tilde{\gamma}}(r) = (1-H_o^{\tilde{\gamma}}(r^-))\left[p(S)(1+r)-(1+\overline{r})\right] = c_{\tilde{\gamma}}, \qquad \tilde{\gamma} \in \{\tilde{S},\tilde{F}\} \tag{A.9}$$

$$\begin{aligned} P_o^{\tilde{S}}(r) = &\left\{\frac{p\left(\frac{1+\phi}{2}\right)}{p\left(\frac{1+\phi}{2}\right)+(1-p)\left(\frac{1-\phi}{2}\right)}\right\}(1-H_i^{S,\tilde{S}}(r))\left[p(S)(1+r)-(1+\overline{r})\right] \\ &+\left\{\frac{(1-p)\left(\frac{1-\phi}{2}\right)}{p\left(\frac{1+\phi}{2}\right)+(1-p)\left(\frac{1-\phi}{2}\right)}\right\}\left[p(F)(1+r)-(1+\overline{r})\right] = 0 \end{aligned} \tag{A.10a}$$

$$\begin{aligned} P_o^{\tilde{F}}(r) = &\left\{\frac{p\left(\frac{1-\phi}{2}\right)}{p\left(\frac{1-\phi}{2}\right)+(1-p)\left(\frac{1+\phi}{2}\right)}\right\}(1-H_i^{S,\tilde{F}}(r))\left[p(S)(1+r)-(1+\overline{r})\right] \\ &+\left\{\frac{(1-p)\left(\frac{1+\phi}{2}\right)}{p\left(\frac{1-\phi}{2}\right)+(1-p)\left(\frac{1+\phi}{2}\right)}\right\}\left[p(F)(1+r)-(1+\overline{r})\right] = 0 \end{aligned} \tag{A.10b}$$

Straightforward manipulation of Eqs. (A.9), (A.10a), and (A.10b) yields

$$H_i^{S,\tilde{S}}(r) = \left(\frac{p(S)}{\Psi}\right)\frac{r - r_{\tilde{S}}}{p(S)(1+r)-(1+\overline{r})}$$
$$H_i^{S,\tilde{F}}(r) = \left(\frac{p(S)}{\Xi}\right)\frac{r - r_{\tilde{F}}}{p(S)(1+r)-(1+\overline{r})}$$

$$H_o^{\tilde{S}}(r) = p(S)\frac{r - r_{\tilde{S}}}{p(S)(1+r)-(1+\overline{r})} = \Psi H_i^{S,\tilde{S}}(r)$$
$$H_o^{\tilde{F}}(r) = p(S)\frac{r - r_{\tilde{F}}}{p(S)(1+r)-(1+\overline{r})} = \Xi H_i^{S,\tilde{F}}(r)$$

for $r \in [r_{\tilde{\gamma}}, r_F)$.

When $\phi = 0$, $p(S) + \left(\frac{1-\phi}{1+\phi}\right)(1-p(S)) = p(S) + \left(\frac{1+\phi}{1-\phi}\right)(1-p(S)) = 1$

and $\Psi = \Xi = p(S)$. Therefore, when $\phi = 0$, $H_o^{\tilde{S}}(r) = H_o^{\tilde{F}}(r) = H_o(r)$ and $H_i^{S,\tilde{S}}(r) = H_i^{S,\tilde{F}}(r) = H_i(r)$. This shows that the proposition is identical to the more specific case of von Thadden's Proposition 2 when $\phi = 0$.

Derivation of $\Pr_i(win \mid S)$, $\Pr_i(win \mid F)$, $\Pr_o(win \mid S)$, and $\Pr_o(win \mid F)$:

The derivation begins with the probabilities of each bank winning conditional on both the insider's signal, γ, and the outsider's signal, $\tilde{\gamma}$. The inside bank's probabilities of winning, conditional on the four possible signal combinations of γ and $\tilde{\gamma}$, are:

$$\Pr_i(win \mid S, \tilde{S}) = \Psi(1/2) + (1-\Psi)$$
$$\Pr_i(win \mid S, \tilde{F}) = \Xi(1/2) + (1-\Xi)$$
$$\Pr_i(win \mid F, \tilde{S}) = (1-\Psi)(1/2)$$
$$\Pr_i(win \mid F, \tilde{F}) = (1-\Xi)(1/2)$$

where the subscript *i* indicates the inside bank.

The outside bank's probabilities of winning, conditional on the four possible signal combinations of γ and $\tilde{\gamma}$, are:

$$\Pr_o(win \mid S, \tilde{S}) = \Psi(1/2)$$

$$\Pr_o(win \mid S, \tilde{F}) = \Xi(1/2)$$

$$\Pr_o(win \mid F, \tilde{S}) = \Psi + (1-\Psi)(1/2)$$

$$\Pr_o(win \mid F, \tilde{F}) = \Xi + (1-\Xi)(1/2)$$

where the subscript *o* indicates the outside bank.

The derivatives of these probabilities with respect to ϕ (transparency) show that, conditional on the outsider receiving a signal of $\tilde{S}$, the insider's probability of winning either firm type is decreasing in ϕ whereas the outsider's probability of winning either firm type is increasing in ϕ. This occurs because the outsider bids lower when it receives a signal indicating that the firm is a good firm. On the other hand, conditional on the outsider receiving a signal of $\tilde{F}$, the insider's probability of winning either firm type is increasing in ϕ whereas the outsider's probability of winning either firm type is decreasing in ϕ. When the outsider receives a signal indicating that the firm is a bad firm, it bids higher.

Proof of Proposition 2:

The statement of Proposition 2 can be rewritten in mathematical terms as:

a) $\dfrac{\partial \Pr_o(win \mid S)}{\partial \phi} > 0$, and

b) $\dfrac{\partial \Pr_o(win \mid F)}{\partial \phi} < 0$

To prove (a), I show that $\frac{\partial \Pr_i(win \mid S)}{\partial \phi} < 0$. It follows that $\frac{\partial \Pr_o(win \mid S)}{\partial \phi} > 0$.

Proof that $\frac{\partial \Pr_i(win \mid S)}{\partial \phi} < 0$:

$$\frac{\partial \Pr_i(win \mid S)}{\partial \phi} = -\left\{ \frac{\partial\left[\dfrac{\left(\frac{1+\phi}{2}\right)}{p(S)+\left(\frac{1-\phi}{1+\phi}\right)(1-p(S))}\right]}{\partial \phi} + \frac{\partial\left[\dfrac{\left(\frac{1-\phi}{2}\right)}{p(S)+\left(\frac{1+\phi}{1-\phi}\right)(1-p(S))}\right]}{\partial \phi} \right\} p(S)\left(\frac{1}{2}\right)$$

$$\frac{\partial\left[\dfrac{\left(\frac{1+\phi}{2}\right)}{p(S)+\left(\frac{1-\phi}{1+\phi}\right)(1-p(S))}\right]}{\partial \phi} = \frac{\frac{1}{2} + \dfrac{1-p(S)}{(1+\phi)p(S)+(1-\phi)(1-p(S))}}{p(S)+\left(\frac{1-\phi}{1+\phi}\right)(1-p(S))}$$

$$\frac{\partial\left[\dfrac{\left(\frac{1-\phi}{2}\right)}{p(S)+\left(\frac{1+\phi}{1-\phi}\right)(1-p(S))}\right]}{\partial \phi} = -\left\{\frac{\frac{1}{2} + \dfrac{1-p(S)}{(1-\phi)p(S)+(1+\phi)(1-p(S))}}{p(S)+\left(\frac{1+\phi}{1-\phi}\right)(1-p(S))}\right\}$$

$$\frac{\partial\left[\dfrac{\left(\frac{1+\phi}{2}\right)}{p(S)+\left(\frac{1-\phi}{1+\phi}\right)(1-p(S))}\right]}{\partial \phi} + \frac{\partial\left[\dfrac{\left(\frac{1-\phi}{2}\right)}{p(S)+\left(\frac{1+\phi}{1-\phi}\right)(1-p(S))}\right]}{\partial \phi}$$

$$
= \left\{ \begin{array}{l} \frac{1}{2}\left[p(S) + \left(\frac{1+\phi}{1-\phi}\right)(1-p(S)) \right] + (1-p(S))\left[\frac{p(S) + \left(\frac{1+\phi}{1-\phi}\right)(1-p(S))}{(1+\phi)p(S) + (1-\phi)(1-p(S))} \right] \\ -\frac{1}{2}\left[p(S) + \left(\frac{1-\phi}{1+\phi}\right)(1-p(S)) \right] - (1-p(S))\left[\frac{p(S) + \left(\frac{1-\phi}{1+\phi}\right)(1-p(S))}{(1-\phi)p(S) + (1+\phi)(1-p(S))} \right] \end{array} \right\}
$$

$$
\times \frac{1}{\left[p(S) + \left(\frac{1+\phi}{1-\phi}\right)(1-p(S)) \right]\left[p(S) + \left(\frac{1-\phi}{1+\phi}\right)(1-p(S)) \right]}
$$

$$
= \left\{ \frac{2\phi}{(1+\phi)(1-\phi)} + \left[\frac{p(S) + \left(\frac{1+\phi}{1-\phi}\right)(1-p(S))}{(1+\phi)p(S) + (1-\phi)(1-p(S))} - \frac{p(S) + \left(\frac{1-\phi}{1+\phi}\right)(1-p(S))}{(1-\phi)p(S) + (1+\phi)(1-p(S))} \right] \right\}
$$

$$
\times \frac{(1-p(S))}{\left[p(S) + \left(\frac{1+\phi}{1-\phi}\right)(1-p(S)) \right]\left[p(S) + \left(\frac{1-\phi}{1+\phi}\right)(1-p(S)) \right]}
$$

$$
= \left\{ \begin{array}{l} (1-\phi)\left[p(S) + \left(\frac{1+\phi}{1-\phi}\right)(1-p(S)) \right]^2 + 2\phi\left[p(S) + \left(\frac{1+\phi}{1-\phi}\right)(1-p(S)) \right]\left[p(S) + \left(\frac{1-\phi}{1+\phi}\right)(1-p(S)) \right] \\ -(1+\phi)\left[p(S) + \left(\frac{1-\phi}{1+\phi}\right)(1-p(S)) \right]^2 \end{array} \right\}
$$

$$
\times \frac{(1-p(S))}{(1+\phi)(1-\phi)\left[p(S) + \left(\frac{1+\phi}{1-\phi}\right)(1-p(S)) \right]^2 \left[p(S) + \left(\frac{1-\phi}{1+\phi}\right)(1-p(S)) \right]^2}
$$

Let

$$
x = p(S) + \left(\frac{1+\phi}{1-\phi}\right)(1-p(S))
$$

$$
y = p(S) + \left(\frac{1-\phi}{1+\phi}\right)(1-p(S))
$$

Then

$$\frac{\partial\left[\dfrac{\left(\dfrac{1+\phi}{2}\right)}{p(S)+\left(\dfrac{1-\phi}{1+\phi}\right)(1-p(S))}\right]}{\partial\phi}+\frac{\partial\left[\dfrac{\left(\dfrac{1-\phi}{2}\right)}{p(S)+\left(\dfrac{1+\phi}{1-\phi}\right)(1-p(S))}\right]}{\partial\phi}$$

$$=\left[(1-\phi)x^2+2\phi xy-(1+\phi)y^2\right]\cdot\left[\frac{(1-p(S))}{(1+\phi)(1-\phi)xy}\right]$$

$$=\left[(1-\phi)x+(1+\phi)y\right]\cdot\left[x-y\right]\cdot\left[\frac{(1-p(S))}{(1+\phi)(1-\phi)xy}\right]>0$$

It follows that

$$\frac{\partial \Pr_i(win\,|\,S)}{\partial\phi}<0.$$

To prove (b), I show that $\frac{\partial \Pr_i(win\,|\,F)}{\partial\phi}>0$. It follows that $\frac{\partial \Pr_o(win\,|\,F)}{\partial\phi}<0$.

Proof that $\frac{\partial \Pr_i(win\,|\,F)}{\partial\phi}>0$:

$$\frac{\partial \Pr_i(win\,|\,F)}{\partial\phi}=-\left\{\frac{\partial\left[\dfrac{\left(\dfrac{1+\phi}{2}\right)}{p(S)+\left(\dfrac{1+\phi}{1-\phi}\right)(1-p(S))}\right]}{\partial\phi}+\frac{\partial\left[\dfrac{\left(\dfrac{1-\phi}{2}\right)}{p(S)+\left(\dfrac{1-\phi}{1+\phi}\right)(1-p(S))}\right]}{\partial\phi}\right\}p(S)\left(\frac{1}{2}\right)$$

$$\frac{\partial\left[\dfrac{\left(\dfrac{1+\phi}{2}\right)}{p(S)+\left(\dfrac{1+\phi}{1-\phi}\right)(1-p(S))}\right]}{\partial\phi}=\frac{\dfrac{1}{2}-\dfrac{\left[\left(\dfrac{1+\phi}{(1-\phi)^2}\right)1-p(S)\right]}{p(S)+\left(\dfrac{1+\phi}{1-\phi}\right)(1-p(S))}}{p(S)+\left(\dfrac{1+\phi}{1-\phi}\right)(1-p(S))}$$

$$\frac{\partial\left[\dfrac{\left(\dfrac{1-\phi}{2}\right)}{p(S)+\left(\dfrac{1-\phi}{1+\phi}\right)(1-p(S))}\right]}{\partial\phi} = -\left\{\frac{\dfrac{1}{2} - \dfrac{\left[\left(\dfrac{1-\phi}{(1+\phi)^2}\right)1-p(S)\right]}{p(S)+\left(\dfrac{1-\phi}{1+\phi}\right)(1-p(S))}}{p(S)+\left(\dfrac{1-\phi}{1+\phi}\right)(1-p(S))}\right\}$$

$$\frac{\partial\left[\dfrac{\left(\dfrac{1+\phi}{2}\right)}{p(S)+\left(\dfrac{1+\phi}{1-\phi}\right)(1-p(S))}\right]}{\partial\phi}+\frac{\partial\left[\dfrac{\left(\dfrac{1-\phi}{2}\right)}{p(S)+\left(\dfrac{1-\phi}{1+\phi}\right)(1-p(S))}\right]}{\partial\phi}$$

$$= \left\{\begin{array}{l} \dfrac{1}{2}\left[p(S)+\left(\dfrac{1-\phi}{1+\phi}\right)(1-p(S))\right]-\left(\dfrac{1+\phi}{(1-\phi)^2}\right)(1-p(S))\left[\dfrac{p(S)+\left(\dfrac{1-\phi}{1+\phi}\right)(1-p(S))}{p(S)+\left(\dfrac{1+\phi}{1-\phi}\right)(1-p(S))}\right] \\ -\dfrac{1}{2}\left[p(S)+\left(\dfrac{1+\phi}{1-\phi}\right)(1-p(S))\right]+\left(\dfrac{1-\phi}{(1+\phi)^2}\right)(1-p(S))\left[\dfrac{p(S)+\left(\dfrac{1+\phi}{1-\phi}\right)(1-p(S))}{p(S)+\left(\dfrac{1-\phi}{1+\phi}\right)(1-p(S))}\right] \end{array}\right\}$$

$$\times\frac{1}{\left[p(S)+\left(\dfrac{1+\phi}{1-\phi}\right)(1-p(S))\right]\left[p(S)+\left(\dfrac{1-\phi}{1+\phi}\right)(1-p(S))\right]}$$

$$
=\left\{-\frac{2\phi}{(1+\phi)(1-\phi)}-\left(\frac{1+\phi}{(1-\phi)^2}\right)\left[\frac{p(S)+\left(\frac{1-\phi}{1+\phi}\right)(1-p(S))}{p(S)+\left(\frac{1+\phi}{1-\phi}\right)(1-p(S))}\right]+\left(\frac{1-\phi}{(1+\phi)^2}\right)\left[\frac{p(S)+\left(\frac{1+\phi}{1-\phi}\right)(1-p(S))}{p(S)+\left(\frac{1-\phi}{1+\phi}\right)(1-p(S))}\right]\right\}
$$

$$
\times\frac{(1-p(S))}{\left[p(S)+\left(\frac{1+\phi}{1-\phi}\right)(1-p(S))\right]\left[p(S)+\left(\frac{1-\phi}{1+\phi}\right)(1-p(S))\right]}
$$

$$
=\left\{\begin{array}{l}(1-\phi)^3\left[p(S)+\left(\frac{1+\phi}{1-\phi}\right)(1-p(S))\right]^2\\ -2\phi(1+\phi)(1-\phi)\left[p(S)+\left(\frac{1+\phi}{1-\phi}\right)(1-p(S))\right]\left[p(S)+\left(\frac{1-\phi}{1+\phi}\right)(1-p(S))\right]\\ -(1+\phi)^3\left[p(S)+\left(\frac{1-\phi}{1+\phi}\right)(1-p(S))\right]^2\end{array}\right\}
$$

$$
\times\frac{(1-p(S))}{(1+\phi)^2(1-\phi)^2\left[p(S)+\left(\frac{1+\phi}{1-\phi}\right)(1-p(S))\right]^2\left[p(S)+\left(\frac{1-\phi}{1+\phi}\right)(1-p(S))\right]^2}
$$

Using the previous definition for *x* and *y*:

$$
\frac{\partial\left[\frac{\left(\frac{1+\phi}{2}\right)}{p(S)+\left(\frac{1+\phi}{1-\phi}\right)(1-p(S))}\right]}{\partial\phi}+\frac{\partial\left[\frac{\left(\frac{1-\phi}{2}\right)}{p(S)+\left(\frac{1-\phi}{1+\phi}\right)(1-p(S))}\right]}{\partial\phi}
$$

$$
=\left[(1-\phi)^3x^2-2\phi(1+\phi)(1-\phi)xy-(1+\phi)^3y^2\right]\cdot\left[\frac{(1-p(S))}{(1+\phi)^2(1-\phi)^2xy}\right]
$$

$$
=\left[(1-\phi)^2x-(1+\phi)^2y\right]\cdot\left[(1-\phi)x+(1+\phi)y\right]\cdot\left[\frac{(1-p(S))}{(1+\phi)^2(1-\phi)^2xy}\right]
$$

$$
=\left[-4\phi p(S)\right]\cdot\left[(1-\phi)x+(1+\phi)y\right]\cdot\left[\frac{(1-p(S))}{(1+\phi)^2(1-\phi)^2xy}\right]\;<\;0
$$

It follows that

$$\frac{\partial \Pr_i(win \mid F)}{\partial \phi} > 0 \ .$$

Proof of Proposition 3:

The statement of Proposition 3 can be rewritten in mathematical terms as:

$$\frac{\partial \Pr_o(win)}{\partial \phi} < 0 .$$

To prove Proposition 3, I show that $\frac{\partial \Pr_i(win)}{\partial \phi} > 0$. It follows that $\frac{\partial \Pr_o(win)}{\partial \phi} < 0$.

Proof that $\frac{\partial \Pr_i(win)}{\partial \phi} > 0$:

$$\frac{\partial \Pr_i(win)}{\partial \phi} = p \frac{\partial \Pr_i(win \mid S)}{\partial \phi} + (1-p) \frac{\partial \Pr_i(win \mid F)}{\partial \phi}$$

$$\frac{\partial \Pr_i(win)}{\partial \phi} = -\left\{ \begin{array}{c} p\left(\dfrac{\partial \left\{ \left[\dfrac{\left(\frac{1+\phi}{2}\right)}{p(S)+\left(\frac{1-\phi}{1+\phi}\right)(1-p(S))} \right] + \left[\dfrac{\left(\frac{1-\phi}{2}\right)}{p(S)+\left(\frac{1+\phi}{1-\phi}\right)(1-p(S))} \right] \right\}}{\partial \phi} \right) \\ +(1-p)\left(\dfrac{\partial \left\{ \left[\dfrac{\left(\frac{1+\phi}{2}\right)}{p(S)+\left(\frac{1+\phi}{1-\phi}\right)(1-p(S))} \right] + \left[\dfrac{\left(\frac{1-\phi}{2}\right)}{p(S)+\left(\frac{1-\phi}{1+\phi}\right)(1-p(S))} \right] \right\}}{\partial \phi} \right) \end{array} \right\} \frac{1}{2} p(S)$$

$$= -\left\{ \begin{array}{c} p\left(\dfrac{[(1-\phi)x+(1+\phi)y][x-y]}{(1+\phi)(1-\phi)xy} \right)(1-p(S)) \\ +(1-p)\left(\dfrac{[(1-\phi)^2 x-(1+\phi)^2 y][(1-\phi)x+(1+\phi)y]}{(1+\phi)^2(1-\phi)^2 xy} \right)(1-p(S)) \end{array} \right\} \frac{1}{2} p(S)$$

$$= -\left\{ \begin{array}{c} p[x-y] \\ +(1-p)\left[\left(\frac{1-\phi}{1+\phi}\right)x - \left(\frac{1+\phi}{1-\phi}\right)y \right] \end{array} \right\} \frac{1}{2}\left(\frac{p(S)(1-p(S))[(1-\phi)x+(1+\phi)y]}{(1+\phi)(1-\phi)xy} \right)$$

Let

$$c = \frac{1}{2}\left(\frac{p(S)(1-p(S))[(1-\phi)x+(1+\phi)y]}{(1+\phi)(1-\phi)xy} \right) > 0$$

such that

$$\frac{\partial \Pr_i(win)}{\partial \phi} = -\left\{ \begin{array}{c} p[x-y] \\ +(1-p)\left[\left(\frac{1-\phi}{1+\phi}\right)x - \left(\frac{1+\phi}{1-\phi}\right)y \right] \end{array} \right\} \cdot c \,.$$

Substituting back in for the values of *x* and *y*:

$$\frac{\partial \Pr_i(win)}{\partial \phi} = -\left\{ \begin{aligned} & p(1-p(S))\left[\left(\frac{1+\phi}{1-\phi}\right)-\left(\frac{1-\phi}{1+\phi}\right)\right] \\ & +(1-p)p(S)\left[\left(\frac{1-\phi}{1+\phi}\right)-\left(\frac{1+\phi}{1-\phi}\right)\right] \end{aligned} \right\} \cdot c$$

$$= -\left\{ (p-p(S))\left[\left(\frac{1+\phi}{1-\phi}\right)-\left(\frac{1-\phi}{1+\phi}\right)\right] \right\} \cdot c > 0$$