INFORMATION SHARING IN BANKING:
AN ANTI-COMPETITIVE DEVICE?
Key words: Information sharing, Poaching, Switching costs, Credit markets, Banking

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Thomas Gehrig & Rune Stenbacka

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Library
Swedish School of Economics and Business Administration
P.O.Box 479
00101 Helsinki
Finland

Phone: +358-9-431 33 376, +358-9-431 33 265
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Information Sharing in Banking: An Anti-Competitive Device?

Thomas Gehrig**

and

Rune Stenbacka***

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Abstract: We analyse the institution of information sharing in a model of repeated banking competition. In the presence of switching costs we find that information sharing renders poaching more profitable in future rounds of competition, since the poaching activities can be targeted to creditworthy borrowers. Thus borrower poaching may occur even when it would not be profitable without information sharing. At the same time information sharing reduces relationship benefits, and competition for initial market shares is weakened. Overall we find that information sharing enhances equilibrium profits weakly in general and strictly in the presence of switching cost.

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** Institut zur Erforschung der Wirtschaftlichen Entwicklung, Universität Freiburg, D-79085 Freiburg, Germany. E-mail: gehrigt@vwl.uni-freiburg.de.

*** Swedish School of Economics, P.O. Box 479, 00101 Helsinki, Finland. E-mail: Rune.Stenbacka@shh.fi.
1. **Introduction**

Credit bureaus and credit registers play an important role in communicating credit histories of borrowers to lenders, and, thus, as is widely asserted, contribute to more efficiency in credit markets\(^1\). Recent contributions in the literature have substantiated this view by presenting models with socially beneficial implications of information sharing (Japelli and Pagano (1999), Pagano and Japelli (1993), as well as Padilla and Pagano (1997, 2000). While this literature is largely concerned with the cost of lending and the probability of default of funded projects, it raises little concern about potential anti-competitive implications of information exchange among lenders.

To the extent that information exchange coordinates informational asymmetries in the future this literature tends to separate strategic concerns about future lending from current lending decisions. We show that this property may significantly reduce the intensity of competition in the present lending markets. Information sharing is, in fact, a commitment to reduce informational asymmetries between banks in future lending and thus will relax price competition among banks in the first stage when customer relationships are formed. In the absence of information sharing the prospects of extracting future informational rents from established customer relationships enhances current competition among lenders.

We present a two-period model of a banking duopoly with switching costs. In period 1 ex-ante identical banks compete for borrowers. At this stage the competition is symmetric since banks have access to the same general pool information. In period 2 banks can effectively benefit from a lending relationship established in period 1, because they learn the type of their customers during period 1.

In period 2 competition is asymmetric because banks enjoy an informational advantage with respect to their own borrowers and an informational disadvantage with respect to the clients of the rival bank. Consequently, banks can price discriminate according to the borrowers histories. Moreover, due to switching costs banks enjoy some degree of market power with respect to their captive clientele. Accordingly, they can price discriminate in period 2. Banks want to keep and protect their creditworthy borrowers on one hand and poach the creditworthy borrowers of their rivals on the other hand.

In our model, we find that banks can secure the profits they would earn if they entered in period 2 only, i.e. they can secure the hypothetical period-2 poaching profit if they attempted to
poach the whole market in period 2. Any additional revenues are eliminated by ex-ante competition in period 1. In fact, competition in period 1 eliminates any revenues that are related to market shares in period 1. Hence, banks discount the expected relationship benefits by pricing even below costs.\(^2\)

The institution of information sharing enhances the profitability of poaching, because with information sharing banks can focus their poaching offers in period 2 exclusively to creditworthy borrowers. As poaching profits rise relationship benefits decline. However, the reduction of relationship benefits does not affect inter-temporal equilibrium profits, since these incumbency advantages are eliminated by ex-ante competition in period 1. Consequently, with information sharing period 1-discounts by banks are reduced and period-1 competition for market share is weakened.

Without information sharing the pool acquired through poaching will be adversely selected, which reduces the returns from poaching. Consequently, without information sharing the returns from acquiring customers in period 1 are larger as the rival’s returns from poaching decrease. Thus, without information sharing banks have incentives to offer larger period-1 discounts in equilibrium. In this respect the institution of information sharing can be regarded as an anti-competitive device.

The anti-competitive effect of information sharing results from the emergence of relationship information after the first period of lending and the existence of switching costs that enable banks to earn positive poaching revenues. Information sharing enhances poaching revenues, and, thus, the profitability of the whole banking industry.

There is ample evidence that relationship information is relevant and empirically significant in banking markets. For the U.S. Petersen and Rajan (1994) and Berger and Udell (1995) find that lending terms are improved in lending relationships. Similarly Hoshi, Kashyap and Scharfstein (1990) document benefits of relationships for Japan and Elsas and Krahnen (1998) for Germany. Switching costs in banking have been estimated by Shy (2001 (Chapter 8), 2002) for Finland and documented by Farinha and Santos (2001) for Portugal. In fact, Shy concludes from real-life data originating from the Finnish deposit market in 1997 that switching costs account for between 0 % and 11 % of the average balance a depositor maintains with a

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\(^1\) For a systematic characterization of these institutions in an international context we refer to Jappelli and Pagano (1999).

\(^2\) Equilibrium initial discounts in general duopoly models with switching costs and price discrimination have also been observed by Chen (1997).
bank. Kim, Kliger and Vale (1999) investigate the Norwegian loan market during the period 1988-1996. They estimate average switching costs to be 4.1%, which approximatively equals one-third of the market average interest on loans in Norway during that time interval.\(^3\)

Similar to our model Petersen and Rajan (1995) also find that banks initially charge low rates in early lending periods. However, in contrast to that study, in our model banks charge low rates in order to build up markets shares rather than to contain entrepreneurial moral hazard. In contrast to the early papers on lending relationships (e.g. Haubrich, 1989, Sharpe, 1990) our model does allow for effective ex-post competition. Due to differentiated switching costs our model generates equilibrium switching despite the existence of relationship information. Moreover, equilibrium switching does occur in pure strategies rather than mixed strategies as in von Thadden (2002).

Virtually all the recent literature on information exchange in credit markets stresses the value of communication among lenders in reducing default probabilities of borrowers in situations of limited strategic interaction among lenders. We show that the supposedly beneficial consequences of information sharing are a consequence of the lack of ex ante competition for the establishment of relationships generating informational rents in those models. Typically, in this literature, informational advantages are arbitrarily assigned at an initial stage of the lending market interaction between rival banks. By enriching the market structure to allow for potential interaction of rival lenders in each period, we show that information sharing should rather be viewed as an anti-competitive device since it reduces the competitiveness of current lending markets drastically. We provide a model in which the future gains associated with information sharing are more than offset by the losses of current competitiveness.

Padilla and Pagano (1997) demonstrate advantages of information sharing in the context of a two-period model, in which banks are informational monopolists in both periods. Banks observe the true risk classes of their clientele but not those of their competitors’. Hence, in the absence of information sharing banks can extract all the project returns accruing to borrowers, thus reducing the incentives for entrepreneurs to invest in project-specific and ability-enhancing technologies that increase repayment probabilities. Binding ex ante agreements to share information at the end of period 1 commit the banks to compete in the credit market in stage 2 under conditions of symmetric information. This implies a commitment to more effective competition and, thus, to share period-2 surplus with the entrepreneurs. Accordingly, information

\(^3\) See also Tarkka (1995) and Sharpe (1997) for further studies of switching costs in the banking industry.
sharing will increase the incentives into development of entrepreneurial ability and thereby the repayment probabilities. In particular, Padilla and Pagano prove that credit markets may operate under a regime of information sharing, while it would collapse without communication.

We show that this argument breaks down when lenders are symmetrically informed initially. Like Padilla and Pagano we consider constellations in which banks will become informational monopolists at stage 2. However, we generalize their framework by allowing banks to compete in a genuine sense for clients in period 1. In this situation the prospect of future rents intensifies competition in period 1. Using a simple banking model with borrower switching costs we find that lenders’ overall profits are highest when they can commit to share information. At the same time entrepreneurial incentives to increase repayment probabilities are lowest under information sharing. Hence, we have good reasons to interpret information sharing in credit markets as a potentially anti-competitive device. Thus, policy conclusions regarding information exchange between lenders should be drawn quite carefully as the welfare implications are sensitive to the precise nature of the strategic mechanisms whereby banks can create informational advantages relative to their rivals.

Finally, our analysis is related to a large body of literature on information sharing. Prominent examples of this literature include Shapiro (1986) and Gal-Or (1985, 1986), which focus on the incentives for oligopolists to exchange private information concerning common market conditions or firm-specific efficiency. These models are two-stage games of the following character. Prior to the actual observation of the private information the firms have to make binding commitments whether to reveal their private information or to keep it private. At the second stage market competition (based on Cournot and Bertrand competition) takes place. This literature generally finds that the direction of the ex ante incentives for information exchange depends on the nature of market competition (Bertrand or Cournot) and on the type of uncertainty (uncertainty concerning common demand conditions or firm-specific costs). This literature tends to agree, however, that information sharing increases social surplus in many cases. However, concerns about anti-competitive conduct by information sharing agreements are not explicitly addressed in this research approach.

The model of a two-period banking duopoly is introduced in section 2. Section 3 presents the market equilibrium of the basic credit market. The role of information sharing is explored in

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4 See Raith (1996) for a comprehensive survey.
Section 4. Section 5 compares full and partial information sharing and section 6 concludes. Some technical details and mathematical proofs are delegated to the Appendix.

2. A Two-Period Model of Bank Lending

Consider a simple two-period model of competition between two lenders, which we will, for convenience, henceforth call banks, A and B. The banks compete for borrowers with a horizon of two periods, \( t=1 \) and \( t=2 \), by offering short term credit contracts. The lending rates may potentially differ across periods.\(^5\) For simplicity, we assume the banks’ opportunity costs of funding \( R_0 \) to be constant over time.

In line with Padilla and Pagano (1997, 2000) we identify borrowers with entrepreneurs, who require external funding of one (monetary) unit as they have no funds of their own. There are two types of entrepreneurs, talented and untalented ones. Only talented entrepreneurs can generate positive cash flows. These entrepreneurs have access to a project that yields a return of \( v \) with probability \( \pi \) and 0 with probability \( 1 - \pi \). Untalented entrepreneurs never generate any positive cash flow but they derive positive utility from controlling a project.\(^6\) The proportion of talented entrepreneurs is commonly known to be \( 0 < \lambda < 1 \). Entrepreneurs are risk neutral.

Banks initially have no specific information about borrowers’ types. Their knowledge is restricted to the general characteristics of the pool of applicants. In period 1 banks compete for borrowers by announcing lending rates \( R_{1i} \), \( i = A, B \).\(^7\) At the end of the period they observe the types of their customers. The banks also make project-specific observations of whether these customers have been successful or not. We can make the interpretation whereby this information has been generated within the framework of the customer relationship in period 1 (see e.g. Sharpe, 1990). It is private and relationship-specific information of the bank, but it may be communicated between banks under a regime of information sharing. Without information sharing, however, competition at stage 2 takes place under conditions of asymmetric information across banks. Accordingly, in period 2 a bank will find it optimal to charge different prices to clients with different histories and announce lending rates \( (R_{2i}, Q_{2i}), i = A, B \), for existing good-
type borrowers belonging to its period-1 customers and new borrowers, respectively. We can make the interpretation of $Q^i_2$ as a poaching price, whereby bank $i$ tries to attract entrepreneurs belonging its rival’s period-1 clientele.

We assume that it is costly for at least some borrowers to switch lender in period 2. More precisely, we assume that an entrepreneur has to incur an idiosyncratic switching cost $s$ to break its period-1 customer relationship and switch to a competing lender in period 2. These switching costs may capture for example the cost associated with another application procedure at a less known bank, or simply the financial cost of transferring financial accounts from one bank to another. In the case of bundled financial services offered by banks the switching costs could also capture costs to entrepreneurs associated with distributing account changes to established long-term customers in the product market. The switching costs may be relatively low for some borrowers and substantially higher for others. In fact, the evidence reported in Shy (2001 (Chapter 8), 2002) as well as Kim, Kliger and Vale (1999) is consistent with customers being differentiated according to their switching costs. These studies report as an empirical regularity that switching costs tend to rise with the size of the bank in deposit markets, whereas switching costs tend to decline as a function of bank size in loan markets.

The borrower-specific switching costs are private information of these borrowers. In the present analysis we assume that the heterogeneity in switching costs across borrowers can be summarized by a distribution function $F(s)$ on a support $[0, \bar{s}]$. In the central part of our analysis we will concentrate on the case of switching costs that are uniformly distributed on an interval $[0, \bar{s}]$. Additionally, we assume that borrowers are not aware of their idiosyncratic switching cost realizations until period 2. Thus, the initial choice between banks is particularly simple as it cannot be conditioned on borrower-specific switching costs.

Following Sharpe (1990) and Padilla and Pagano (2000) we assume that successful entrepreneurs will consume their period-1 revenues at the end of period 1. Hence all

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7 To be precise the lending rate specifies the repayment including interest and principal.
8 In fact, the development of the information technology has dramatically improved the ability of firms to condition prices on purchase histories (see, Acquisti and Varian (2001)). Recent studies by Villas-Boas (1999, 2001) as well as Fudenberg and Tirole (2000) have explored a number of interesting features of pricing dynamics in models with customer recognition.
9 In the case of deposit accounts Shy (2001, 2002) has recently estimated substantial average switching costs in the order of 0-11% of the average balance a depositor maintains with a bank, whereas Kim, Kliger and Vale (1999) find the average switching costs to constitute one-third of the market average interest rates in Norwegian loan markets.
10 The uniform distribution will allow us to simplify the algebraic analysis. In principle, we could allow for more general distributions including distributions with a positive mass on zero switching costs.
entrepreneurs are in equal funding needs at the beginning of period 2, i.e. they all demand loans of the same size.\footnote{This assumption is not critical. In an earlier version of the paper we maintained the assumption that successful entrepreneurs could actually fund second period projects from their period 1 revenues. In that case the overall project quality is reduced in period 2. Nevertheless, the basic results are not qualitatively affected.}

In summary, the credit market opens twice. At stage 1 banks compete for unattached borrowers by announcing lending rates $iR^1$. At stage 2 banks announce lending rates $(R^2_2, Q^2)$ to period-1 customers of its own and of its rival, respectively, and the attached borrowers decide whether they want to switch and incur the associated switching costs. At the end of the second period cash flows are realized and the market winds down.

Entrepreneurs are protected by limited liability. Moreover, we assume period-end information available to banks to be verifiable, and, therefore, that it can be used to enforce the contractual arrangements immediately.

For the sake of comparability, our setup resembles the model of Padilla and Pagano (1997) with the exception that we start with a symmetric distribution of information at the beginning of stage 1. Thus, informational market power in period 2 emerges endogenously as a consequence of strategic pricing in period 1. In contrast, Padilla and Pagano (1997) assume that banks, for reasons which are not explained, are endowed with an informational monopoly already in period 1. As in their model, banks will, however, end up with asymmetric information at the end of period 1. The banks enjoy superior information about the past performance of their clients, which strengthens the competitive position in period 2. This informational asymmetry has far-reaching consequences for the banking equilibrium as the next section develops in detail.

3. Credit Market Equilibrium

In the multi-stage credit market delineated above equilibrium is determined in the standard way by backward induction. Thus, initially we solve for the price game in period 2 for given borrower histories and for a given configuration of market shares inherited from period 1. The individual histories are relevant because in period 2 banks want to price discriminate between known and unknown customers. The banks try to keep known talented borrowers and attract the rival’s unknown customers as long as poaching is profitable. Hence, typically, period-2 prices will
depend on market shares inherited from period 1. These market shares result from the period-1 prices, the determination of which we analyze subsequently.

**Equilibrium in period 2**

Denote the market shares acquired by bank \( i \) \((i=A,B)\) in period 1 as \( 0 \leq \mu_i \leq 1 \). These market shares represent the outcome of period-1 competition, and, are, hence, fixed for the determination of equilibrium in period 2.

Each bank has an informational advantage on its captive clientele, since it observes the true types, whereas in the absence of information sharing rivals only have access to statistical pool information for unknown borrowers. Hence the returns from lending to captive clients are \( \pi R_2^i - R_0 \), \( i = A,B \). The returns from poaching associated with talented clients are \( \pi Q_2^i - R_0 \), \( i = A,B \), whereas those associated with untalented ones are \( -R_0 \). Since the poaching bank attracts all the untalented entrepreneurs from its rival’s pool it faces an adverse selection problem, and, thus, a cost disadvantage relative to the incumbent banks.\(^{12}\)

In addition to the informational advantage informational insiders enjoy a competitive advantage due to switching costs. Borrowers will only accept a poaching offer, if poaching prices undercut the incumbent’s quote by a sufficient margin so as to overcome the switching cost barrier. More precisely, a talented entrepreneur with switching cost \( s \) will switch to the rival lender if and only if \( \pi Q_2^i + s < \pi R_2^i \). This condition immediately implies that poachers will always charge lower rates. Moreover, poaching will only attract entrepreneurs with sufficiently low switching costs, whereas incumbents can profit from charging higher prices to borrowers with less elastic demand due to sufficiently high switching costs. We denote by \( \hat{s}_j \) a period-1 customer of bank \( i \) indifferent between maintaining its customer relationship with bank \( i \) at lending rate \( R_2^i \) and switching to bank \( j \) at poaching rate \( Q_2^j \). Formally, this critical borrower is defined by the condition \( \pi Q_2^j + \hat{s}_j = \pi R_2^i \).

Untalented entrepreneurs will always want to switch after period 1. We assume that their private benefits exceed the maximal costs of switching.

\(^{12}\) Related adverse selection effects in banking contexts have earlier been analysed by Gehrig (1998) and Dell’Arricia, Friedman and Marquez (1999).
In the presence of borrowers differentiated by their switching costs the existence of an equilibrium in pure strategies\(^{13}\) can be guaranteed. In order to show this we let \(f(s)\) denote the density of switching costs on the interval \([0, \bar{s}]\). Accordingly, bank \(i\) can profit from its incumbency advantage by 
\[
\mu_i \lambda \left( \pi R_i^1 - R_0 \right) \int_{s_i}^{\bar{s}} dF(s).
\]
Moreover, bank \(i\) realises poaching profits of 
\[
\mu_j \lambda \left( \pi Q_j^2 - R_0 \right) \int_{0}^{s_i} dF(s) - \mu_j \left( 1 - \lambda \right) R_0. 
\]
Here the first term is the profit earned on the talented entrepreneurs successfully poached from rival \(j\). The second term measures the costs caused by the unknown untalented entrepreneurs, which in the absence of information sharing cannot be detected by bank \(i\). Thus, the period-2 profits of bank \(i\) add up to:
\[
G_i^2 = \mu_i \lambda \left( \pi R_i^2 - R_0 \right) \int_{s_i}^{\bar{s}} dF(s) + \mu_j \lambda \left( \pi Q_j^1 - R_0 \right) \int_{0}^{\pi \left[ k_j - Q_j^1 \right]} dF(s) - \mu_j \left( 1 - \lambda \right) R_0, \quad i, j = A, B, i \neq j.
\]

It is easy to see that period-2 revenue functions are quasi-concave when the distribution of switching costs satisfies 
\[
\frac{f'(s)}{f(s)} \leq 2, \quad \text{where} \quad f(s) = \frac{dF(s)}{ds}.
\]
This condition is met e.g. when \(f''(s) \geq 0\) and for distributions with positive probability mass at 0. Now we can formulate

**Proposition 3.1 (Credit Market Equilibrium)** Let the distribution of switching costs satisfy 
\[
\frac{f'(s)}{f(s)} \leq 2. 
\]
Then for any allocation of initial market shares \(\mu_i, \ i = A, B\), there is a pure strategy Nash equilibrium in period-2 prices. Equilibrium prices exhibit the property that poaching prices never exceed incumbency prices, i.e. \(R_i^2 \geq Q_j^1, \ j \neq i\).

Proof: Standard and omitted.

Note that Proposition 3.1. also holds for distributions with positive mass on zero switching costs. While, in equilibrium poaching may not always occur, presumably the most interesting cases arise, when switching does occur in equilibrium. This will happen, for example, when in equilibrium poachers attract positive market shares and earn positive poaching profits. In

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\(^{13}\) Standard switching cost models typically impose a common level of switching costs for all customers. Such
that case one readily verifies that equilibrium revenues in period 2 necessarily exceed those hypothetical revenues that could be obtained if the firm under consideration were to inherit a zero-market share (no customers) from period 1. Accordingly, period-2 profits exceed
\[ \lambda(\pi Q_2^i - R_0) \int_0^{\lambda} dF(s) - (1 - \lambda)R_0. \]

**Proposition 3.2 (Period-2 Profits)** Assume that the distribution of switching costs \( F(s) \) satisfy
\[ f'(s) \leq \frac{2}{s}, \text{ that poaching is profitable, and that } \int_0^{\pi[Q_1^i - Q_1^j]} dF(s) > 0. \] Then the period-2 profits of bank \( i \) (\( i=A,B \)) are positive and (weakly) exceed \( \lambda(\pi Q_2^i - R_0) \int_0^{\lambda} dF(s) - (1 - \lambda)R_0. \)

The conditions of Proposition 3.2 require that the informational disadvantage of poachers is sufficiently small to make profitable switching by high-quality borrowers with low switching costs feasible, i.e. \( \lambda \geq \frac{R_0}{R_0 + (\pi Q_2^i - R_0) \int_0^{\lambda} dF(s)} \). Under this condition both incumbents and poachers will earn positive profits in period 2.

In order to analyse the qualitative features of the credit market equilibrium in period 1, we impose additional structure on the period-2 profits. Proposition 3.3 characterises period-2 equilibrium for the special case of uniformly distributed switching costs, i.e. a density function \( f(s) = \frac{1}{\pi} \). As long as poaching is profitable for each bank, i.e. \( \lambda \geq \frac{9R_0}{9R_0 + \pi} \) we can make use of straightforward calculations to explicitly characterise the period-2 equilibrium. The condition of profitable poaching is met as long as the informational disadvantage of the poaching institution is limited.

models, however, typically have no Nash equilibrium in pure price strategies (see Klemperer 1995).
Proposition 3.3 (Uniform Switching Costs) Let \( f(s) = \frac{1}{\bar{s}} \) and \( \lambda \geq \frac{9R_0}{9R_0 + \bar{s}} \). Then there is a unique period-2 price equilibrium in pure strategies. This equilibrium is characterised by equilibrium lending rates \( R_2^A = R_2^B = \frac{R_0}{\pi} + \frac{2}{3\pi} \bar{s} \) applied to customers in the bank’s installed base as well as poaching rates \( Q_2^A = Q_2^B = \frac{R_0}{\pi} + \frac{1}{3\pi} \bar{s} \) applied to customers of the rival bank.

The critical borrowers have switching costs \( \bar{s}_{ij} = \frac{1}{3\bar{s}} \), \( i,j=A,B \), \( i \neq j \).

Proof: See Appendix

Proposition 3.3 requires that the informational advantage of incumbents is limited. Under this assumption poaching is profitable and with the uniform distribution 1/3 of the customers switch in equilibrium. Clearly, when the period-1 lending relationship generates a more substantial informational advantage, incumbents can, in equilibrium, charge higher premiums relative to poachers and earn higher period-2 profits up to the point where poaching becomes ineffective. The higher is the dispersion of switching costs the more likely it is for poaching activities to be profitable. Conversely, given the ex ante proportion of creditworthy projects, for sufficiently low differentiation of the switching costs the banks will refrain from poaching and equilibrium switching of customers will not occur.\(^{14}\)

Equilibrium prices are monotonic in the dispersion of the switching costs as measured by \( \bar{s} \). Moreover, equilibrium profits in period 2 are monotonic in \( \bar{s} \). Hence, the dispersion \( \bar{s} \) can also be viewed as a measure inversely related to the intensity of price competition. The more concentrated the distribution of switching cost, i.e. the smaller \( \bar{s} \), the higher is the intensity of competition and the lower are equilibrium profits.

Finally, from a methodological point of view it may be interesting to note that Proposition 3.3 provides an example where an equilibrium in pure strategies exists in the presence of switching costs. The literature\(^{15}\) largely concentrates on the case of a given level of switching costs.

\(^{14}\) Gehrig, Stenbacka (2001) focus on the case, which excludes equilibrium switching. As a referee raised concerns about the validity of this assumption, in this analysis we concentrate on the case, where equilibrium switching will actually occur. In any case, the results do not qualitatively depend on the particular regime of „high“ or „low“ switching costs.

\(^{15}\) See Klemperer (1995) for a survey. Our result is in line with Chen (1997).
costs common to all customers, which typically implies mixed strategies in equilibrium. Contrary to such an environment we have demonstrated the existence of a unique pure strategy equilibrium in our model as a consequence of unobserved heterogeneity in borrower switching costs and the possibility of third degree price discrimination (i.e. poaching) in period 2.

**Proposition 3.4 (Period-2 Profits)** Assume that \( f(s) = \frac{1}{s} \) and \( \lambda \geq \frac{9R_0}{9R_0 + \frac{9}{s}} \). Then the bank’s equilibrium profit in period 2 is

\[
G'_i = \mu_i \lambda \left( \frac{4}{9} - \frac{1}{9} s \right) + \left( 1 - \mu_i \right) \left( \lambda \frac{1}{9} - (1 - \lambda)R_0 \right), \quad i=A,B.
\]

Proof: Straightforward and omitted.

Observe that equilibrium revenues in period 2 are linear functions of period-1 market shares. This property is an implication of assuming a uniform distribution of switching costs. For general distributions the relationship between period-1 market shares and period 2 revenues will typically be more complex. Nevertheless, the result that each bank can secure a positive revenue in period 2 independently of period-1 market shares is a rather general one.

The period-2 profits can be rewritten as

\[
G'_i = \mu_i \lambda \left( \frac{4}{9} - \frac{1}{9} s \right) + \left( 1 - \mu_i \right) \left( \lambda \frac{1}{9} - (1 - \lambda)R_0 \right),
\]

which shows that the period-2 profit is increasing in the bank’s installed base in period 1. This feature reflects the fact that the period-2 revenues associated with locked-in customers exceed those associated with poaching. This property will affect competition for market shares in period 1. Furthermore, from the profit formulation above we can infer that the sensitivity of period-2 revenues with respect to the installed customer base is reduced with increasing profitability of poaching.

Since the poaching revenues are always smaller than those associated with informational incumbency, each bank can at least secure the revenues it would acquire, if it started period 2 with no installed base of customers, a zero market share. In other words, each bank can secure the revenues it would earn, if it could poach the entire market in period 2. We will refer to the constant fraction of the period-2 profits, \( \lambda \frac{1}{9} - (1 - \lambda)R_0 \), as the reservation profit. Note that the
reservation profit is generated by the period-2 poaching activity alone. This observation will be central for our arguments concerning information sharing in section 4.

*Equilibrium in period 1*

How are the market shares $\mu_A$ and $\mu_B$ determined in stage 1? Rational borrowers anticipate that switching costs may restrict their mobility between banks in period 2. The precise level of individual switching costs is not known initially, as we have assumed that the idiosyncratic switching costs are not realized until period 2. Hence borrowers’ initial decision will only depend on current lending rates and not on the precise level of switching costs. Thus, entrepreneurs strictly prefer lower period-1 lending rates. They are rational and forward-looking, however, to the extent that they know the statistical distribution of switching costs from which their own realization is drawn in period 2.\(^\text{16}\)

Hence, at the beginning of period 1 banks compete symmetrically for entrepreneurs from the general pool of applicants. At this stage they do not possess any informational privileges. Their discounted intertemporal profit functions are $G^i = G^i_1 + \delta G^i_2$, $i = A, B$, where the period-1 profit is $G^i_1 = (\lambda \pi^i_1 - R_0)\mu_i$, whereas the period-2 equilibrium profit was characterized in Proposition 3.4. The parameter $\delta$ denotes the discount factor assumed to be common for all the lenders and borrowers. The discounted intertemporal profit functions are linear in period-1 market shares $\mu_i$, $i = A, B$, since by Proposition 3.4 the period-2 profits have this linearity property.

From the perspective formed in period 1 banks are engaged in Bertrand competition in a homogenous market. For that reason each bank will undercut any period-1 price of their rival that would generate a positive margin in the discounted intertemporal payoff function. Hence, due to the Bertrand nature of competition, in the unique equilibrium the market shares acquired in period 1 cannot contribute positively to overall profits. This is stated next in Proposition 3.5.

\(^{16}\) Without this assumption borrowers could be willing to pay slightly higher period-1 charges in order to benefit from poaching offers in period 2. Such strategic play is excluded when switching costs are not known in period 1. This assumption largely simplifies the analysis without substantially changing results.
Proposition 3.5 (Lending Rate Equilibrium in Period 1) Let \( f(s) = \frac{1}{\bar{s}} \) and \( \lambda \geq \frac{9R_0}{9R_0 + \bar{s}} \).

Then the credit market has a unique symmetric subgame perfect lending rate equilibrium in period 1. This equilibrium rate is given by

\[
R^*_1 = \frac{1}{\delta \pi} \left( R_0 - \delta \left( \frac{1}{3} \bar{s} + (1 - \lambda)R_0 \right) \right).
\]

Proposition 3.5 illustrates the equilibrium pattern of pricing over time. Banks have incentives to compete very aggressively for customers in period 1 in order to acquire locked-in customers and these can be exploited in period 2 up to a limit determined by the switching costs. As Proposition 3.3 demonstrates, banks profit from their captive clientele in period 2 because of the information they acquire during the lending relationship in period 1. For that reason banks grant substantial discounts at \( \delta \left( \frac{1}{3} \bar{s} + (1 - \lambda)R_0 \right) \) below the fair rate in period 1.

As can directly be seen, this period-1 discount is higher the larger is the discount factor, because with a larger discount factor the bank pays a higher valuation on future rents from captive clients and these rents are precisely eroded by the period-1 competition. We can also infer that the period-1 discount is increasing in the dispersion of the period-2 switching costs facing captured customers. Again, this feature is a reflection of the fact that the equilibrium profits in period 2 are increasing in the dispersion of the switching costs. Finally, the period-1 discount depends positively on the period-2 cost savings associated with incumbent customers relative to customers poached from the rival. This cost saving, captured by \( (1 - \lambda)R_0 \), is a measure of the period-2 value of the informational advantage associated with customers acquired in period 1.

As Proposition 3.3 demonstrates, banks benefit from their captive clientele in period 2 because of the information they acquire during the lending relationship in period 1. Overall, however, these discounted benefits are competed away in period 1. The only profit component surviving the stage of intense period-1 competition is the reservation profit banks earn from poaching in period 2. This is stated in the next Proposition.

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17 Equilibrium prices are unique. The allocation of borrowers across banks is irrelevant in equilibrium, since banks do not earn positive margins on their installed bases in the two-period game.
Proposition 3.6 (Banks’ overall Equilibrium Profits) Let \( f(s) = \frac{1}{\bar{s}} \) and \( \lambda \geq \frac{9 R_0}{9 R_0 + \bar{s}} \). Then

banks overall equilibrium profits are given by

\[
G' = \delta \left( \lambda \frac{1}{9} \bar{s} - (1 - \lambda)R_0 \right) \geq 0.
\]

Proof: Straightforward and omitted.

Overall profits are increasing in the dispersion of switching costs. Essentially, increasing heterogeneity among borrowers reduces the intensity of period-2 competition and, thus, increases banks’ period-2 profits. As shown in Proposition 3.6, the period-2 profits associated with surviving customer relationships are eliminated by period-1 competition, but the profits associated with poaching survive and these profits are increasing as a function of the differentiation with respect to the switching costs. In this respect, the banks have a collective interest in establishing raising switching costs unless the costs for the creation of substantial switching costs are excessively high. The discounted two-period profits also depend on the discount rate, since they are related to the benefits of future rents generated through poaching.

It should be emphasized that ex ante competition among homogeneous banks is not able to drive the discounted two-period profits to zero, because the poaching profits cannot be competed away through discounts in period 1. The survival of the poaching profits is a consequence of the inability to make credible commitments to future prices. In fact, this is a property of crucial significance for our conclusions. Namely, if the banks were restricted to two-period binding commitments with respect to the lending rates, then homogeneous ex ante competition among homogenous banks at period 1 would eliminate any positive discounted two-period profits.

Finally, overall profits are positively related to \( \lambda \), because the profitability of poaching increases as the informational disadvantage of the poacher is reduced. This observation begs the question, whether information sharing would be a mechanism to indirectly generate the profit-maximizing pool composition \( \lambda = 1 \).
4. The Role of Information Sharing

Under an information sharing agreement banks commit to share project-specific information completely. With such information sharing only talented entrepreneurs will receive funding in period 2. Thus, with information sharing banks can reduce their financing costs associated with lending to unknown, and possibly unprofitable, customers. On the other hand, banks become more vulnerable to poaching themselves. Consequently, it seems very natural to ask the following question. How will an institution of information sharing affect banks conduct, and, finally, profits?

We view the information sharing agreement as a long-term decision, which requires the design of irreversible institutional arrangements to take place prior to the entrepreneurs’ investment decisions. For instance, under information sharing the infrastructure of a credit bureau, in terms of information acquisition and communication, has to be designed. Likewise the operation of such a credit bureau requires long-term investments into the establishment of the necessary human capital. While empirically there are variations in the type and amount of information communicated by credit bureaus (see e.g. Japelli and Pagano, (1999)), we here follow Padilla and Pagano (1997) by assuming that banks exchange information only about the borrowers’ types. We shall relax this assumption in section 5.

In line with the dominant approach in the literature focusing on the consequences of information sharing we will also abstract from issues related to strategic information transmission in the communication process by assuming that the information exchanged is verifiable and so at no cost. Thus, information sharing yields homogeneous information structures for the banks at the beginning of period 2. Consequently, in the presence of an arrangement for information sharing competition takes place under conditions of symmetric information in both periods. This being the case, the equilibrium in the repeated credit market is then readily established.

Equilibrium in period 2

Consider period 2 first. This is the period where information sharing will directly impact on banks’ strategic behavior. Information sharing essentially means that banks will learn for free the types of unknown borrowers. Hence only talented entrepreneurs will receive loans. Thus banks face the following period-2 revenue functions
Comparing this revenue function with that of the competitive case in section 3 we find that information sharing reduces the adverse selection costs of poaching. Those costs, however, are fixed costs for the banks in period 2. Hence they do not affect the pricing incentives in period 2.

Proposition 4.1 (Period 2 Prices with Complete Information Sharing) Let \( f(s) = \frac{1}{\tilde{s}} \).

(a) Under an information sharing agreement in the credit market, equilibrium lending rates in period 2 are determined by \( \hat{R}_2^A = \hat{R}_2^a = \frac{R_0}{\pi} + \frac{2\tilde{s}}{3\pi} \) and \( \hat{Q}_2^A = \hat{Q}_2^B = \frac{R_0}{\pi} + \frac{\tilde{s}}{3\pi} \).

(b) Moreover in period 2 the aggregate default rate under information sharing is \( \pi \). It is lower than \( \lambda \pi + 1 - \lambda \), which would be the default rate in the absence of information sharing.

Proof: See the proof of Proposition 3.3. Information sharing reduces the fixed effect of adverse selection costs, but it does not affect the individual first order conditions in period 2. ♦

Equilibrium prices reflect the fact that essentially untalented entrepreneurs are eliminated. Accordingly, the benefit from an established customer relationship is reduced to the strategic advantage associated with switching costs. Protected by switching costs, incumbents can sustain a higher margin than poachers in equilibrium.

Moreover, under a regime of information sharing the returns from poaching improve. In fact, with information sharing poaching will occur for any initial pool composition, i.e. for any \( \tilde{\lambda} > 0 \). In this sense, information sharing does not affect pricing incentives in stage 2, but it does affect participation in poaching activities, and, hence period-1 pricing.

As before, for uniformly distributed switching costs the period-2 equilibrium profits are linear in the initial market shares \( \mu_i, \ i = A, B \).
Proposition 4.2 (Period-2 Profits under Complete Information Sharing)

Let \( f(s) = \frac{1}{s} \). Under complete information sharing banks’ equilibrium profits in period 2 are

\[
\hat{G}_2^\alpha = \mu_\lambda \frac{4}{9} \frac{1}{9 - \lambda} \text{ and } \hat{G}_2^\beta = \mu_\beta \frac{4}{9} \frac{1}{9 - \lambda}.
\]

Not surprisingly, period-2 revenues under information sharing exceed those under uncoordinated competition since information sharing eliminates the costs associated with adverse selection in period 2. These adverse selection costs take the form of a fixed cost for the poaching bank.

More interestingly, however, a bank’s reservation profit is higher under information sharing, because it can attain a period-2 profit level of \( \frac{\lambda}{9} \) independently of the market share inherited from period 1. In the absence of information sharing, the reservation profit, which was found to be \( \frac{\lambda}{9} - (1 - \lambda)R_0 \), is lower for any \( \lambda < 1 \). This observation is important, since it is precisely this hypothetical reservation profit in period 2 that will survive ex-ante competition.

Equilibrium in period 1

Bertrand competition in period 1 forces banks to discount any future rents they can achieve as consequences of their period-1 decisions. Otherwise the competitor could undercut in order to secure those rents for itself. Accordingly, in equilibrium any margins related to market shares acquired in period 1 are eliminated. In other words, in equilibrium the period-1 prices perfectly discount any expected benefit from future customers. Thus, in equilibrium the banks are completely indifferent with respect to the installed bases, i.e. the period-1 market shares.
Proposition 4.3 (Lending Rate Equilibrium in Period-1) Let $f(s) = \frac{1}{s}$. Then under complete information sharing the credit market has a unique symmetric subgame perfect lending rate equilibrium in period 1. Equilibrium rates are given by

$$R_1^j = \frac{1}{\lambda \pi} \left( R_0 - \frac{\delta}{3} \delta \right).$$

Proof: The proof is similar to the proof of Proposition 3.5 taking into account the modified algebraic expression of period-2 revenues. ♦

Observe that the period-1 discount is smaller under information sharing relative to the competitive case (Prop. 3.5). With information sharing period-1 competition is relaxed, because it makes poaching in period 2 more profitable and period-2 revenues become less sensitive to initial market shares. Accordingly, the intensity of competition is relaxed in period 1 and the equilibrium discounts are lower.

The higher profitability of poaching also translates into an increase in overall profits, since, as in the competitive case, banks can always secure the hypothetical profits of poaching the whole market in period 2 under conditions of information sharing.

Proposition 4.4 (Banks’ overall Equilibrium Profits) Let $f(s) = \frac{1}{s}$. Under complete information sharing the banks’ discounted intertemporal equilibrium profits are given by

$$\hat{G}^j = \frac{\lambda \delta}{9}.$$

Proof: The proof follows the proof of Proposition 3.6 taking into account the modified period-2 revenues. ♦

We have now established all the necessary steps to state the main result of this study.

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18 Equilibrium prices are unique. The allocation of borrowers across banks is irrelevant in equilibrium, since banks do not earn positive margins on their clientele in the two-period game.
Proposition 4.5 (Profitability of Information Sharing) Let \( f(s) = \frac{1}{s} \) and consider any pool composition \( \lambda < 1 \). With information sharing the total discounted intertemporal equilibrium profits exceed those associated with uncoordinated competition by an amount equal to the discounted adverse selection cost for the full market \( \delta(1-\lambda)R_0 \) for each bank \( i = A, B \). Accordingly, information sharing increases industry-wide banking profits by a multiple that doubles the social savings on adverse selection costs.

While we have presented the result for a particularly simple distribution of switching costs, it should be clear, however, that the underlying economic mechanism is a rather general one. As long as the informational advantage acquired through a customer relationship does not preclude poaching, these poaching profits are the only rents that are not eliminated by ex-ante competition in period 1. Information sharing is an institutional mechanism that enhances the profitability of poaching. Consequently, the institution of information sharing contributes to enhance oligopoly rents caused by switching costs, whenever positive rents arise. Since equilibrium profits of each bank are increased by the discounted adverse selection cost for the full market, \( \delta(1-\lambda)R_0 \), the increases in aggregate profits exceed the social cost savings due to information sharing. In this sense the institution of information sharing can be regarded as a anti-competitive device.

Finally note also that even in the case, when poaching is not profitable, and when equilibrium revenues from poaching are absent, ex-ante competition in period 1 will still annihilate ex-post revenues of period 2. This occurs a fortiori in the limiting case of no switching costs.

Proposition 4.6 (Absence of Switching Costs) As the switching costs approach zero, i.e. \( \overline{x} = 0 \), the total intertemporal equilibrium profits under information sharing are equal to those of uncoordinated competition for any \( \lambda < 1 \). Accordingly, in the absence of switching costs information sharing does not affect banks’ aggregate intertemporal profits.

Accordingly, in the absence of switching costs, the efficiency enhancing effect of information sharing emphasized by Padilla and Pagano (1997, 2000) does already arise in competitive markets with effective ex-ante competition. With effective period-1 competition
generating zero oligopoly rents, the institution of information sharing becomes a matter of indifference. Thus, the potentially beneficial implications of information sharing on entrepreneurial ex-ante investment incentives emphasized by Padilla and Pagano (1997, 2000) are driven by the absence of ex-ante competition insofar as these authors assume that an informational monopoly already prevails in period 1. As we show, in the absence of switching costs ex-ante competition is enough to prevent market breakdowns in the credit market.

So far we have concentrated on the case where banks communicate the true type of their customers under information sharing. Of course, one might also be interested in cases, where banks share less than full information about their borrowers. For example, banks might only share information about the borrowers’ payment histories.

5. Partial Information Sharing

Typically credit registers only communicate partial information about their borrowers such as certain aspects of the borrowers’ past payment histories. The sharing of black information is most common. Black information essentially is negative information such as information about past defaults and arrears. White information, which is less widely shared, includes information about the credit standing and positive borrower characteristics, i.e. line of credit, assets etc. Since, typically, payment information is less precise than information about borrower types, we will refer to partial information sharing when we discuss the sharing of payment information.

In our framework we cannot distinguish between default (black) information and information about successes (white information). The communication of white information always means that successful talented entrepreneurs are identified directly, while black information identifies precisely those borrowers that are not identified by white information. So in our framework the partitions of borrowers are exactly the same when white or black information is communicated. In both cases, however, less information is shared than under complete information sharing.

We maintain the assumption that during the period-1 lending relationship incumbents do observe the true type, even though they may not communicate their full information.

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19 Again we refer to Japelli and Pagano (1999) for a cross-country comparison of different regimes of information sharing.

20 E.g. in our model good entrepreneurs may end up with a „bad“ payment history after a bad draw in period 1.
When white/black information is communicated, poachers will still attract the full pool of unsuccessful and untalented entrepreneurs if they decide to poach all borrowers. If they decide to poach the identified talented entrepreneurs only, they can avoid the adverse selection cost. In this case the poaching revenues of bank $i$ are given by $\mu \lambda \pi (\pi Q_2 - R_0) \int_0^{R_2 Q_2} ds$. Accordingly, period-2 prices will be the same as in Propositions 3.3 or 4.1. Period-1 discounts, however, are larger than under complete information sharing and smaller than those associated with competition with no information sharing.

**Proposition 5.1 (Sharing of White/Black Information)**

Let $f(s) = \frac{1}{s}$ and let $\pi$ be sufficiently large.

(a) Then under sharing of white/black information the credit market has a unique symmetric subgame perfect lending rate equilibrium in period 1. Equilibrium rates are given by $\tilde{R}_i = \frac{1}{\lambda \pi} \left( R_0 - \frac{\delta}{3} \lambda \pi \frac{s}{s} \right)$ and equilibrium profits are $\tilde{G}_i = \delta \lambda \pi \frac{s}{3} < G_i$.

(b) The period-2 default rates under partial information sharing are $\pi$, and, hence, less than $\lambda \pi + 1 - \lambda$, which is the default rate in the absence of information sharing.

Proof: When $\pi$ is sufficiently large, poaching the full market is dominated by poaching only identified talented entrepreneurs. The joint pool of unlucky talented and untalented entrepreneurs gets increasingly adversely selected as $\pi \rightarrow 1$. In this case equilibrium prices in period 2 are determined as in Propositions 4.1 and 3.3. Accordingly, period-2 revenues are $\tilde{G}_i = \mu \lambda \pi \frac{4}{9} \frac{s}{s} + (1 - \mu_i) \lambda \pi \frac{1}{9}$. Since in period-1 equilibrium the return on market shares acquired in period 1 is driven to zero the equilibrium discount is given by $\Delta \lambda \pi \frac{1}{3} \frac{s}{s}$ and equilibrium profits are determined by the constant part of $\tilde{G}_i$. The statement (b) is obvious, since by conditioning on a positive payment history, banks commit to poach a subset of talented entrepreneurs in period 2 only. They have to forego business with unlucky but talented entrepreneurs. ♦
Accordingly, partial information sharing does not affect our overall argument about information sharing. The communication of white information is less informative to poachers. Therefore, equilibrium profits are lower relative to complete information sharing and equilibrium discounts in period 1 are larger, because overall profits are more sensitive with respect to market share. Consequently, the overall intertemporal equilibrium profits belong to the interval determined by the competitive case and the case of complete information sharing.

6. Concluding Comments

This paper challenges the general view in the literature about the social desirability of information exchange among banks. We show that information exchange will never increase the competitiveness of lending markets and, thus, generally provide worse repayment incentives for entrepreneurs. The crucial feature of our model, which distinguishes it from the existing literature, is that we consider banking markets that initially are informationally symmetric among competitors, while the existing literature concentrates on markets with arbitrary a priori heterogeneity of information that drastically affects strategic interaction. Thus, the existing literature concentrates on the potentially positive consequences of informational exchanges in fundamentally segmented banking markets, whereas we focus on competitive banking markets, where each informational advantage is achieved endogenously by strategic actions. Hence, in our framework future informational rents may be a strong stimulus to current competition. This stimulus is reduced by information exchange.

In this paper we have shown that information sharing enhances the profits of banks by relaxing price competition among banks in the first stage when customer relationships are formed within the framework of a banking model where oligopoly rents are generated by switching costs. We can allow for rather general models of switching costs and also for positive mass of borrowers with zero switching costs. Information sharing will magnify industry rents, whenever they exist. Otherwise, in the absence of industry rents, information sharing does neither affect overall industry profits nor entrepreneurial ex-ante investment decisions. In earlier work we have shown qualitatively identical results in a model of spatial competition (Gehrig and Stenbacka, (2001)) with parameter configurations such that poaching does not take place in equilibrium. Hence the result that information sharing will magnify oligopoly rents seems to be a fairly robust
phenomenon. In particular, we have demonstrated that information sharing will magnify oligopoly rents irrespectively of whether these are generated by switching costs or horizontal product differentiation.

Our analysis has immediate implications for competition policy. In competitive loan markets the institution of information sharing is a matter of irrelevance, and, therefore, of little concern. When banks have market power information sharing in lending markets magnifies any existing industry rents. On the other hand, and outside the scope of our argument, to the degree that information sharing reduces aggregate default risk it may contribute to a reduction of potential systemic risks. Accordingly, prudential supervisory concerns for the stability of the banking system may well override the anti-competitive concerns raised in this analysis. Ultimately, the relative importance of our anti-competitive concerns depend on the degree of market power in the specific loan market, and, thus, depend on the characteristics of the lending market.

Finally, in their cross-country analysis Japelli and Pagano (1999) find that countries with a higher intensity of information sharing are characterized by a relatively larger share of bank lending as well as weakly lower aggregate default rates and loan loss provisions. While our model predicts lower default rates for countries with information sharing institutions it also predicts that the amount of overall bank lending should be reduced under information sharing. Especially, since the empirical macro-evidence on default rates is rather weak it seems to us that in order to understand the empirical findings it would be important to control for the quality of information shared and to analyze banks’ initial incentives to acquire information. The first micro-evidence on information acquisition for German banks by Fischer (2000) seems to suggest that the quality of information acquired by banks and the availability of credit is higher in regionally concentrated banking markets. If this finding would also apply to the data of Japelli and Pagano their finding would imply that the positive correlation between information sharing and bank lending should be related to market power rather than information sharing. On the basis of our model we would expect information sharing to be more prevalent in countries with concentrated lending markets. However, to empirically substantiate such a hypothesis further empirical research is required.

21 These results confirm the theoretical arguments of Gehrig (1998) about endogenous information acquisition in banking markets.
References


Appendix

Proof of Proposition 3.3:

The proof is constructive. Consider the segment of entrepreneurs initially borrowing from bank A. These customers are measured by $\mu_A$. In period 2 bank A can exploit its incumbency advantage by attracting especially those borrowers with high switching costs. The revenues associated with this market segment are affected by A’s choice of $R^A_2$, while $Q^B_2$ affects the poaching revenues earned from inducing bank B’s former borrowers to switch. In order to determine $R^A_2$ bank A solves:

$$\max_{R^A_2} \mu_A \lambda (\pi R^A_2 - R_0) \frac{1}{S} \int_{s}^{T} ds .$$

Bank B tries to attract the borrowers with low switching costs by offering poaching rates $Q^B_2$. Since bank B cannot separate talented entrepreneurs from untalented ones it also attracts all the untalented entrepreneurs that are denied further funding from the incumbent. Hence, bank B solves

$$\max_{Q^B_2} \mu_A \lambda (\pi Q^B_2 - R_0) \frac{1}{S} \int_{0}^{s} ds - \mu_A (1 - \lambda) R_0 .$$

The reaction functions (first order conditions) can be written as
\[ \pi \begin{pmatrix} 2 & -1 \\ -1 & 2 \end{pmatrix} \begin{pmatrix} R_2^A \\ Q_2^B \end{pmatrix} = \begin{pmatrix} \bar{s} + R_0 \\ R_0 \end{pmatrix}, \]

as long as the poaching revenues are positive. We will verify below that the lower bound on the proportion of creditworthy projects, \( \lambda \geq \frac{R_0}{R_0 + \bar{s}/9} \), guarantees positive poaching revenues. Accordingly, under this assumption (hypothetical) equilibrium prices are uniquely determined by

\[ \begin{pmatrix} R_2^A \\ Q_2^B \end{pmatrix} = \frac{1}{3\pi} \begin{pmatrix} 2\bar{s} + 3R_0 \\ \bar{s} + 3R_0 \end{pmatrix}. \]

Thus, the poaching profits are \( G_2^A(B) = (1 - \mu_A) \left( \lambda \frac{1}{\bar{s}} \left( \frac{1}{3} \right)^2 - (1 - \lambda)R_0 \right) \), which verifies that the pool restriction above guarantees the profitability of poaching. Accordingly, these prices are the unique equilibrium prices.

The argument for the remaining \( \mu_B = 1 - \mu_A \) borrowers runs analogously and determines \( Q_2^A \) and \( R_2^B \).

**Proof of Proposition 3.4:**

Using the equilibrium rates derived in Proposition 3.3 we first calculate the incumbency profits of bank A in period 2. By substitution we find that A will make the profit

\( G_2^A(A) = \mu_A \lambda \frac{1}{\bar{s}} \left( \frac{2}{3} \right)^2 \) by charging its period-1 customers the equilibrium rate \( R_2^A \). Likewise the period-2 profits associated with poaching are \( G_2^A(B) = (1 - \mu_A) \left( \lambda \frac{1}{\bar{s}} \left( \frac{1}{3} \right)^2 - (1 - \lambda)R_0 \right) \).

Hence, overall period-2 profits are \( G_2^A = G_2^A(A) + G_2^A(B) \), which yields the expression of Proposition 3.4. Analogously for \( G_2^B \).  

\[ \Box \]
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