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# Borrower Poaching and Information Display in Credit Markets.

by

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DISCUSSION
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# Borrower Poaching and Information Display in Credit Markets [1]

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**Abstract**

The Riegle-Neal Act in the US and the Economic and Monetary Union in Europe are recent initiatives to stimulate financial integration. These initiatives allow new entrants to "poach" the incumbents' clients by offering them attractive loan offers. We show that these deregulations may be insufficient since asymmetric information seriously hampers the integration of credit markets. This asymmetry stems from the informational advantage incumbent banks have about their current clients *vis-à-vis* potential entrants. Moreover, banks may *strategically* display some information hindering entry when asymmetric information is moderate. We also show that voluntary information sharing emerges only when asymmetric information is low.

JEL: D43, L13, G21

Keywords: financial integration; banking competition; asymmetric information; barriers to entry.

# 1 Introduction

Recent history shows substantial deregulatory initiatives to realize financial integration in the United States and Europe. In the US, Congress passed in 1994 the Riegle-Neal Interstate and Branching Efficiency Act allowing the creation of region-wide or nation-wide banks. The implementation of the Economic and Monetary Union since 1999 illustrates the continuation of financial integration in Europe (see e.g. Neven (1992) for details on the regulatory reform in the European Community). However, Danthine et al. (1999) report that cross-border banking activity in Europe remains limited whereas the success of interstate consolidation in the US stems mainly from diversification gains. Our paper points at asymmetric information as a possible cause for this low level of banking market integration. In particular we study the relationship between competition, entry, and display of information in credit markets. The role of displaying borrowers' credit histories on competition between banks started to receive some attention in the recent literature (see e.g. Klein (1992), Pagano and Jappelli (1993), Padilla and Pagano (1997, 2000), and Gehrig and Stenbacka (2000)). Also in the credit market, it has been shown that adverse selection can be an effective informational barrier to entry (see e.g. Broecker (1990), Dell'Ariccia et al. 1999, Gehrig (1998), and Marquez (2000)). Yet, the effect of communicating information between banks on competition and entry has so far not yet been studied. The implementation of the Riegle-Neal act on interstate banking in the US and the ongoing financial integration in Europe call for a deeper understanding of such an important topic.

Our model looks at interest rate competition between lenders. We start from a protected market to capture historical market segmentation and study entry, if any, when markets open up for competition. Banks compete for borrowers who can be either high or low ability entrepreneurs. Every incumbent bank knows the borrowers' characteristics on its own market. We allow banks to price discriminate between their current and new borrowers. That is, banks can target their rivals' borrowers and offer them a significant interest rate discount. The discount may make some of the rival's borrowers switch to the targeting bank. In other words, we allow banks to engage in "poaching" activities.

We show that entry takes place when banks unilaterally provide their rivals with information about their borrowers' types. This display of "full" information removes

informational based barriers to entry. As a consequence, borrower poaching always occurs. In contrast, incumbent banks may retain a monopoly when they do not display information. This happens when adverse selection is sufficiently harsh. In other words, borrower poaching becomes a loss-making activity whenever the proportion of low ability borrowers is significant. If the proportion of low ability borrowers is moderate, however, entry takes place. Poached borrowers enjoy a lower interest rate when the "average" borrower incurs a switching cost. Otherwise, the entering bank sets a higher interest rate than the incumbent.

When there is a small cost associated with information display, we find that full information display never arises endogenously. However a bank may have an individual incentive to *strategically* display information about project outcomes, or "partial" information. The incumbent bank then reduces the rival's scale of entry. Banks may also *mutually* agree to exchange information, that is "share" information. Endogenous full information sharing results whenever entry occurs, or when asymmetric information is not too important. Otherwise, full information sharing happens when the fixed cost savings from entry outweigh the increased competition in the incumbent's first-period market. Partial information sharing takes place if entry deterrence for unsuccessful high ability borrowers is credible. Full information display is socially optimal when the average borrower enjoys a switching gain. Banks may also optimally reduce the scale of entry when they communicate partial information. This happens when entry would take place without information sharing and borrowers incur switching costs. Finally, without information display and absent entry, welfare is maximized where there are switching costs.

This paper adds to the literature on informational barriers to entry in the following respects. Dell'Ariccia (1998) and Dell'Ariccia et al. (1999) use the incumbent-entrant set-up to demonstrate the important consequences of adverse selection on entry possibilities. In these models, incumbent or "inside" banks enjoy informational advantages over potentially entering lenders. This advantage occurs because of existing relationships with their current borrowers applying for another unit of credit. They show that entry is already blockaded by two incumbent banks. Our paper also focuses on adverse selection as a barrier to entry in the credit market. However, we analyze a symmetric situation where banks enjoy a local monopoly position in the first period of the game. Each bank,

therefore, has an incumbency position as a result of historical market segmentation. The second period of the game, then, looks at the role of informational barriers to entry. Our results indicate that banks will prevent entry in their incumbent market when adverse selection is sufficiently harsh. Moreover we also show that banks will enter if asymmetric information becomes sufficiently moderate. Marquez (2000) finds that specific skills in processing new borrowers ease entry. We show that the type of displayed information between banks may fundamentally determine entry.

Our paper also contributes to the literature on information sharing in the credit market. Information sharing between banks often occurs through credit registers. Some registers mainly collect information about default behavior. This is referred to as "black" information. Other registers only report information about outstanding loans. The registration of outstanding loans is known as "white" information. Jappelli and Pagano (1999) offer an extensive and detailed overview of existing credit registers in an international perspective. Pagano and Jappelli (1993) look at the role of information exchange between banks in an adverse selection model. Banks have information about residential borrowers but not about immigrant borrowers. That is, an *exogenous* inflow of new borrowers produces adverse selection because of asymmetric information about borrowers' types. The adverse selection problem, then, disappears when banks decide to pool information about their local borrowers. As a result, the default rate decreases. Our paper, in contrast, looks at the role of information exchange between banks when they consider entering their rival's market. Thus, our paper focuses on *endogenous* inflow of new borrowers. In two other papers Padilla and Pagano (1997, 2000) look at the effects of information sharing on banking competition when moral hazard and adverse selection arise. In their papers, endogenous information sharing stems from a reduction in moral hazard. In our paper, display of partial information prevents the rival bank from poaching part of the high ability borrowers. Finally, Gehrig and Stenbacka (2000) show that information sharing may act as a collusive device: a reduction in future informational rents dampens current competition. Our model, in contrast, studies banks' pricing behavior when markets open up for competition.

Customer poaching has been analyzed by Fudenberg and Tirole (2000).[1] In a two-period model without asymmetric information, they study equilibrium based brand

[1] See also Shaffer and Zhang (2000).

switching. Their results show that prices decrease over time since poaching is always optimal. Our results corroborate theirs only when asymmetric information is not too harsh. However, when asymmetric information is severe, equilibrium poaching is no longer observed. von Thadden (1998) analyzes a model of corporate borrowing under asymmetric information. He shows that in equilibrium switching of both good and bad borrowers occurs. Our paper confirms this result. However, we find that switching behavior crucially depends on the nature of the information sharing mechanism. First, low ability borrowers switch only without information display and entry. Second, high ability poached borrowers also switch when there is full information display. Finally, poached borrowers pay lower interest rates where there are switching costs. Chen (1997) studies the practice of offering discounts to new customers in markets with switching costs. Price discrimination between old and new customers ultimately yields a prisoners' dilemma situation and generates costly equilibrium switching of consumers. Our paper confirms this socially inefficient switching in the presence of switching costs.[2] In contrast, our paper starts from historically segmented markets. Moreover it incorporates asymmetric information and shows that entry does not always take place.

There is empirical evidence about the importance of adverse selection and the magnitude of borrower switching behavior. Shaffer (1998) presents evidence on the winner's curse in banking in the US. In particular, she finds that *de novo* banks experience substantially higher loan chargeoff rates during their third through ninth year. Farinha and Santos (2000) report that some Portuguese firms switch banks. The European context shows however that borrower switching is becoming an increasingly important issue. Mortgage borrowers in Europe are increasingly searching for lending possibilities across the borders. Countries like Germany, France, Italy, Spain, Belgium, Austria, and Portugal are currently taking actions to coordinate the exchange of information about their resident borrowers. In a related context, Krigman, Shaw and Womack (2000) provide evidence about firms switching underwriters. In particular, they show that in the mid-1990s about 30% of firms completing a seasoned equity offering within three years of their initial public offering switched lead underwriter.

The paper is organized as follows. Section 2 discusses the model. The analysis

[2]Klemperer (1995) reviews the literature on markets with switching costs. In this literature, no equilibrium switching takes place.

takes place in Section 3. Endogenous display of information is discussed in Section 4. Information sharing is considered in Section 5 and welfare comparisons are made in Section 6. Section 7 contains a discussion of our results. Finally, Section 8 concludes.

# 2 The Model

Consider a market where bank $A$ has a protected monopoly in period one. Its total market size is normalized to one. At the beginning of period two the market opens up for competition. Bank $A$'s first-period borrowers incur zero visiting costs when they remain with their bank in period two. However, first-period borrowers incur switching costs in the action of visiting an entering bank $B$. The switching costs of bank $A$'s first-period borrowers are uniformly distributed on $[\underline{s}, \overline{s}]$. In what follows we restrict the parameters of the model to satisfy the assumptions that $\overline{s} > 2\underline{s}$ and $\overline{s} > 0$. That is, the borrowers differ sufficiently in terms of switching costs. Moreover, at least some borrowers have positive switching costs. We do not exclude that some borrowers may enjoy "gains" from switching. For instance, borrowers living close to a state-border may prefer to be served in another state. Borrowers are risk-neutral and demand at most one unit of credit per period with one bank. Credit applications with several banks within the same period are too costly for borrowers. This assumption prevents borrowers from applying with two banks per period.

There are two types of borrowers: a proportion $0 \leq \mu \leq 1$ of *high ability* borrowers executing projects that succeed with probability $0 \leq \pi \leq 1$. A project returns $q$ if successful and 0 in case of failure. We assume that $q$ is large enough so that in equilibrium both banks want to serve all high ability credit applicants and every borrower wants to apply for credit. The remaining proportion $1 - \mu$ contains *low ability* borrowers. These borrowers execute unsuccessful projects with certainty.[3] They apply for credit whenever possible since they enjoy non-pecuniary private benefits from having access to a credit line. That is, low ability borrowers always default and are insensitive with respect to the interest rates. We assume that the non-pecuniary benefits from getting one unit of credit

[3]Alternatively, low ability borrowers cannot identify successful projects. Or, they never execute a project since they have such a large marginal disutility of effort (see Padilla and Pagano (2000)). This assumption could be relaxed as long as the expected return on low ability borrowers is negative. This does not qualitatively affect our results.

sufficiently compensate for the associated switching costs low ability borrowers make. Both types of borrowers are uniformly distributed on $[\underline{s}, \overline{s}]$. Each borrower consumes the revenues of his successful projects at the end of every period.[4] In the event of an unsuccessful project, the lender forgives the borrower's debt at the end of the current period.[5] Consequently, every borrower's initial wealth is zero at the beginning of every period.[6] The bank's cost of funding per project equals $R_0 \geq 1$.

The situation in period one is exogenously given. Since we are interested in the effects of the opening up of markets we will not explicitly model this first period. We assume that bank $A$ enjoys a local monopoly, charges the monopoly price, and serves its whole market. Moreover, the conditions are such that the monopolist makes profits. Bank $A$ has no information about the borrowers' preferences and characteristics at the beginning of the first period. However, it enjoys an *incumbency advantage* in the second period from serving its customers on its first-period monopoly market. At the end of this period bank $A$ privately observes whether a borrower executed a successful project or defaulted. At the end of the first period the incumbent bank $A$ also discovers its own borrowers' types: high or low ability. This assumption captures the notion of "relationship banking" (Rajan (1992)). For example, banks, in contrast with arm's length financiers, observe whether the entrepreneur invested in assets or not. Summarizing, we assume that output and type are privately *observable*.

When the market opens up for competition, the entering bank can engage in "poaching" the incumbent's first-period borrowers. We are interested in the competitive and welfare effects of three cases. The first analyzes the case where banks fully display the types of their first-period customers. The second treats the opposite case where banks do not engage in information display about their customers. Finally, there is the intermediary case where banks only communicate information about project outcomes. We will call this "partial" information display. The displayed information only contains "hard"

[4] Alternatively, the remaining output of a successful project cannot be stored (see Padilla and Pagano (2000)).

[5] An alternative interpretation is that the proceeds of only the executed project in the current period serve as a claim for the lender's loan.

[6] We assume that borrowers have no incentives to strategically hide their type. Thus low ability borrowers have no incentive to strategically behave as high ability borrowers in the first period and behave as low ability types in period two. Similarly, high ability types have no incentives to behave as low ability borrowers in the second period. Consequently banks observe their borrowers' true types.

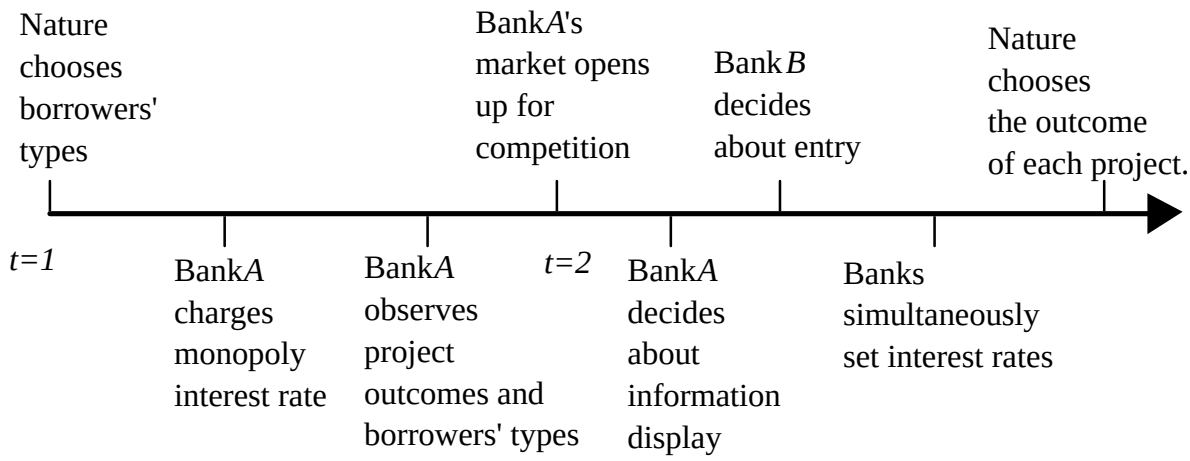


Figure 1: The timing of the game.

data such as detailed repayment schemes or audit reports. In addition we assume that if information about project outcomes or types is publicly displayed, it is *verifiable*. This assumption guarantees truthful revelation of information. We allow banks to enter the market for successful entrepreneurs only or for all types of entrepreneurs. Where possible, banks can discriminate between types of borrowers and between successful and unsuccessful borrowers. Banks may endogenize the institutional setting. Alternatively, the informational environment can be exogenously given, for instance via regulation.

The timing of the game is as follows and its main components are illustrated in Figure 1. Nature chooses borrowers' types in the beginning of period one. Bank $A$ charges the monopoly interest rate to all borrowers. The incumbent bank observes the project outcomes and its borrowers' types. At the start of period two, bank $A$'s market opens up for competition. Bank $A$ displays some information about its first-period borrowers or not. Bank $B$ decides whether to enter or not. Banks *simultaneously* set interest rates when entry takes place. Absent entry, the incumbent bank charges the monopoly interest rate. Finally, Nature chooses the outcome of each project.

# 3 Analysis

We will show that for each case discussed there exists a range where bank $B$ has an incentive to poach some of bank $A$'s first-period borrowers. The different settings about

information display will alter these poaching incentives. In what follows, we solve for the perfect Bayesian Nash equilibrium of the model outlined in Section 2 for each informational setting. Since the outcome of the first stage equals the monopoly price for bank $A$, we only solve for the second period of the game. Bank $A$ offers an interest rate $R$ to its high ability first-period borrowers. If bank $B$ does not enter, it has zero profits. Bank $A$ then enjoys a local monopoly and will set $R = q$ and its second-period profits become $\mu(\pi q - R_0)$. If bank $B$ enters, it offers an interest rate $\rho$ to bank $A$'s first-period borrowers. Since bank $A$ knows first-period borrowers' types, it will not offer loans to its first-period low ability borrowers.

This Section discusses bank $B$'s decision about entry. Section 3.1 starts with full information display. Afterwards we turn to the no and partial information display settings in Sections 3.2 and 3.3, respectively.

## 3.1 Full information display

### 3.1.1 Demand Analysis

A high ability borrower in the second period is indifferent between continuing her relationship at bank $A$ and switching relationship to bank $B$ if her switching cost $s$ is such that

$$\pi R = \pi\rho + s.$$

Borrowers with a switching cost higher than $s$ continue their relationship with bank $A$. In contrast, borrowers with a switching cost lower than $s$ switch to bank $B$. Bank $A$'s market share $a$ of high ability borrowers then is defined as

$$a \equiv \frac{\overline{s} - s}{\overline{s} - \underline{s}}.$$

Bank $A$'s second-period demand curve of high ability borrowers can now be defined as

$$D_A(R, \rho) \equiv \begin{cases} 0 & \text{if } (\pi\rho + \overline{s})/\pi < R \\ \mu a & \text{if } (\pi\rho + \underline{s})/\pi \leq R \leq (\pi\rho + \overline{s})/\pi \\ \mu & \text{otherwise.} \end{cases} \quad (1)$$

The first part of Eq. (1) shows that for high enough $R$, bank $A$ does not attract any of the high ability borrowers. Part two displays that for intermediate values of bank $A$'s interest rate, some of the high ability borrowers switch bank whereas others continue their relationship in the second period. Finally, part three presents that where an interest rate $R$ is sufficiently low, bank $B$ is not able to poach high ability borrowers.

### 3.1.2 Best-response analysis

Bank $A$ displays information about borrower types at the beginning of the second period. As a result both banks are completely informed in the second period about all borrowers' types. Low ability borrowers are denied access to the credit market in the second period. Since all high ability borrowers have independent and identical probabilities of success they are equally valuable to both banks. Consequently, bank $A$'s profit equals

$$\Pi_A^f(R,\rho) \equiv D_A[\pi R - R_0] \tag{2}$$

where the superscript $f$ refers to full information display and $D_A \equiv D_A(R,\rho)$. The right-hand side of Eq. (2) refers to bank $A$'s profit from its "loyal" high ability borrowers. That is, the borrowers with the highest switching costs stay with bank $A$. Similarly, bank $B$'s profit from poaching bank $A$'s first-period customers becomes

$$\Pi_B^f(R,\rho) \equiv (\mu - D_A)[\pi\rho - R_0]. \tag{3}$$

Banks simultaneously set their interest rates. Accordingly, bank $A$'s best-response looks like

$$R = \begin{cases} R_0/\pi & \text{if } (R_0 - \overline{s})/\pi > \rho \\ (R_0 + \overline{s} + \pi\rho)/2\pi & \text{if } (R_0 - \overline{s})/\pi \leq \rho \leq (R_0 + \overline{s} - 2\underline{s})/\pi \\ (\pi\rho + \overline{s})/\pi & \text{otherwise.} \end{cases} \tag{4}$$

Similarly, bank $B$'s best-response function equals

$$\rho = \begin{cases} R_0/\pi & \text{if } (R_0 + \underline{s})/\pi > R \\ (R_0 - \underline{s} + \pi R)/2\pi & \text{if } (R_0 + \underline{s})/\pi \leq R \leq (R_0 + 2\overline{s} - \underline{s})/\pi \\ (\pi R - \overline{s})/\pi & \text{otherwise.} \end{cases} . \tag{5}$$

As profit functions are quasi-concave, Eqs. (4) and (5) yield the following unique solution

$$R = \frac{3R_0 + 2\overline{s} - \underline{s}}{3\pi}; \rho = \frac{3R_0 + \overline{s} - 2\underline{s}}{3\pi}. \tag{6}$$

Bank $A$'s and $B$'s market shares equal

$$D_A = \frac{\mu(2\overline{s} - \underline{s})}{3(\overline{s} - \underline{s})}; D_B = \frac{\mu(\overline{s} - 2\underline{s})}{3(\overline{s} - \underline{s})}, \tag{7}$$

respectively. The profits then become

$$\Pi_A^f = \frac{\mu(2\overline{s} - \underline{s})^2}{9(\overline{s} - \underline{s})}; \Pi_B^f = \frac{\mu(\overline{s} - 2\underline{s})^2}{9(\overline{s} - \underline{s})}. \tag{8}$$

Notice that our assumptions ensure that both banks enjoy a positive market share and are able to set an interest rate above the actuarially fair interest rate $R_0/\pi$.

### 3.1.3 Entry or no entry

Bank $B$ will enter as long as its profits of entering are non-negative. That is, entry occurs whenever $\Pi_B^f \geq 0$. This condition is always guaranteed since we assumed that $\overline{s} > 2\underline{s}$. The results for full information display are summarized in the following Proposition.

**Proposition 1** *Display of full information always results in entry. Poached borrowers receive a lower loan rate when the "average" switching cost is positive. Otherwise, the entering bank is able to charge a higher interest rate since borrowers have on average a higher "preference" for that bank.*

In conclusion, with full information display, entry always occurs since all informational barriers to entry disappear. Competition between banks though remains imperfect because borrowers are heterogeneous with respect to switching costs. The relative interest rates charged by both banks depends on the average switching costs or gains. If, on average, borrowers have a positive switching cost ($\overline{s} + \underline{s} \geq 0$) the incumbent bank has more market power than the entrant. That is, borrowers have on average a preference for the incumbent bank. Of course, this happens when all borrowers incur positive switching costs. However, when the average borrower has a preference for the entrant bank, that bank has more market power than the incumbent bank. This happens when on average borrowers enjoy a switching gain ($\overline{s} + \underline{s} < 0$).

## 3.2 No information display

In this setting, bank $A$ does not display information. Thus bank $B$ has neither information on project outcomes nor on borrower types. This severely impacts its opportunities to poach bank $A$'s first-period borrowers. Low ability borrowers optimally switch banks as their type is revealed to bank $A$. This contrasts with full information display where low ability borrowers are denied access to the credit market.

The analysis is similar to full information display if bank $B$ has entered the market. The demand analysis for high ability borrowers coincides exactly. Low ability borrowers turn to bank $B$. Summarizing, bank $A$'s profits can be written as

$$\Pi_A^n(R,\rho) \equiv D_A(\pi R - R_0) \tag{9}$$

and

$$\Pi_B^n(R,\rho) \equiv (\mu - D_A)[\pi\rho - R_0] - (1-\mu)R_0$$

for bank $B$. The superscript $n$ refers to no information display. Thus the low ability borrowers enter the poaching bank's profit as a *fixed cost.* This differs from full information display where the entering bank $B$ recognizes low ability borrowers. The best-responses mimic those of full information display and the equilibrium interest rates are as in Eq. (6) since fixed costs do not influence the pricing behavior of both banks. The profits can now be written as

$$\Pi_A^n = \frac{\mu(2\overline{s} - \underline{s})^2}{9(\overline{s} - \underline{s})}; \Pi_B^n = \frac{\mu(\overline{s} - 2\underline{s})^2}{9(\overline{s} - \underline{s})} - (1-\mu)R_0. \tag{10}$$

Bank $B$'s profits are lower compared to full information display. The intuition is that bank $B$ faces an adverse selection problem as it serves all low ability entrepreneurs.

We now consider whether or not entry will take place. For convenience, define

$$\mu^* \equiv \frac{9R_0(\overline{s} - \underline{s})}{9R_0(\overline{s} - \underline{s}) + (\overline{s} - 2\underline{s})^2}. \tag{11}$$

The results for no information display are summarized in the following Proposition.

**Proposition 2** *When bank A does not display information, bank B enters if adverse selection is not too harsh, i.e. if* $\mu > \mu^*$. *Otherwise, bank B does not enter and bank*

*A enjoys a monopoly. The critical level $\mu^*$ above which bank B enters decreases in the highest switching cost and increases in the lowest switching cost. Thus markets with "loyal" borrowers are less prone to entry.*

Bank $B$ will enter as long as its expected profits are positive. That is, if $\Pi_B^n > 0$ or $\mu > \mu^*$. Otherwise $B$ will not enter leaving bank $A$ a monopoly. The impact from changes in maximum and minimum switching costs can be gauged from $\partial\mu^*/\partial\overline{s} < 0$ and $\partial\mu^*/\partial\underline{s} > 0$. The incumbent bank prices less aggressively if some borrowers become more attached to the incumbent bank. This raises bank $B$'s profits inducing entry even with more adverse selection problems.

The next subsection describes the results for display of partial information.

## 3.3 Partial information display

A bank may also display information about project outcomes. This stands in contrast with full information display where a bank reports borrowers' types. Information about project outcomes, or "partial" information thus only reveals whether a project was successful or not. In our model, information about defaulters or "black" information coincides with partial information.[7]

Partial information display, then, has two important properties. First, banks know whether a credit applicant was successful or not. Consequently, the possibility to poach the rival's successful high ability borrowers occurs just like with full information display. Second, poaching of unsuccessful high ability borrowers is much more severe. The fixed cost from low ability entrepreneurs must now be covered by the gains from unsuccessful high ability entrepreneurs only. In other words display of partial information eases the poaching of successful borrowers. The informational barrier to entry for unsuccessful borrowers however has increased with partial information display since they are pooled with low ability borrowers. Bank $A$ may now price discriminate between borrowers of its own first-period market: successful and unsuccessful high ability borrowers. The reason is that the successful borrowers can always be poached separately whereas the second pool is poached together with the low ability borrowers. It will turn out that bank $A$

[7] In our model, "white" information equals no information display; with debtforgiveness at the end of the first period, there are no outstanding loans in the next period.

may offer two different interest rates: (i) an interest rate to all high ability borrowers or successful high ability borrowers only, and (ii) a monopoly rate to unsuccessful high ability borrowers.

We will assume that bank $B$ can opt to enter for successful high ability borrowers only ("small-size" entry), or to enter for all borrowers ("large-size" entry). The analysis of entry for successful high ability borrowers coincides with full information display. Poaching successful high ability borrowers is always profitable as project outcomes are displayed. Therefore small-size entry takes place for any degree of asymmetric information. Consequently we concentrate our analysis to "large-size" entry for all borrower types.

Denote by $\rho_u$ and $R_u$ bank $B$'s poaching interest rate for borrowers with unsuccessful project outcomes and bank $A$'s interest rate for unsuccessful high ability borrowers, respectively. The analysis resembles the one with full information display. The profits under partial information display and full entry on borrowers with unsuccessful project outcomes are

$$\Theta_A^{pu}(\cdot) \equiv (1-\pi)\, D_A(\pi R_u - R_0) \tag{12}$$

for bank $A$ and

$$\Theta_B^{pu}(\cdot) \equiv (1-\pi)\,(\mu - D_A)[\pi\rho_u - R_0] - (1-\mu)R_0, \tag{13}$$

for bank $B$, respectively. The superscripts $p$ and $u$ refer to partial information display and unsuccessful high ability borrowers, respectively. Moreover we use $\Theta_i^{pu}(\cdot)$ to denote profits from unsuccessful borrowers only, with $i = A, B$.

The best-response functions, interest rates and market shares coincide with full information sharing. The intuition is that unsuccessful high ability borrowers behave in exactly the same way and are as profitable as successful high ability borrowers. The profits on unsuccessful borrowers become

$$\Theta_A^{pu} = \frac{\mu(1-\pi)(2\overline{s} - \underline{s})^2}{9(\overline{s} - \underline{s})}; \Theta_B^{pu} = \frac{\mu(1-\pi)(\overline{s} - 2\underline{s})^2}{9(\overline{s} - \underline{s})} - (1-\mu)R_0. \tag{14}$$

Bank $B$'s profits on successful high ability borrowers are positive if revenues from these borrowers cover the losses from low ability borrowers. Bank $B$'s profits decrease

in the success probability $\pi$. That is less high ability borrowers have to make up for the low ability borrowers.

We now consider when large-size entry will take place. For convenience, define

$$\mu^{**} \equiv \frac{9R_0(\overline{s}-\underline{s})}{9R_0(\overline{s}-\underline{s})+(1-\pi)(\overline{s}-2\underline{s})^2} \tag{15}$$

and

$$q^* \equiv \frac{R_0+\underline{s}+2\sqrt{R_0\mu(1-\mu)(1-\pi)(\overline{s}-\underline{s})}}{\pi}. \tag{16}$$

Moreover assume that bank $B$ can commit to enter for successful high ability borrowers only. We summarize our main findings in the following Proposition.

**Proposition 3** *When bank A displays partial information, small-size entry always occurs. Full-size entry only happens if adverse selection is not too important, i.e. if $\mu > \mu^{**}$. Otherwise, bank A enjoys a monopoly for unsuccessful high ability borrowers. Finally $\mu^{**} > \mu^*$.*

Bank $B$ considers large-size entry if its expected profits are positive. This happens when $\Theta_B^{pu} > 0$ or equivalently $\mu > \mu^{**}$. Otherwise there is small-size entry leaving bank $A$ a monopoly for unsuccessful high ability borrowers. Comparison of Eqs. (11) and (15) learns that $\mu^{**} > \mu^*$. The intuition is that low ability borrowers enter as a fixed cost. Large size entry hinges on revenues $\Theta_B^{pu}$ accruing from unsuccessful high ability borrowers only. Consequently the critical proportion $\mu^{**}$ generating non-negative revenues must be higher than $\mu^*$. The impact from changes in the highest and lowest switching cost can again be seen from $\partial\mu^{**}/\partial\overline{s} < 0$ and $\partial\mu^{**}/\partial\underline{s} > 0$.

In the previous discussion, we assumed that bank $B$ *can* commit to only "small-size" entry. However, this may not be credible. This happens if the monopoly price $q$ set by the incumbent bank for the unsuccessful high ability borrowers is higher than $q^*$. The critical value $q^*$ is bank $A$'s equilibrium interest rate $R$ if $\mu = \mu^{**}$. For all values of $q \leq q^*$ the maximum profit from also serving unsuccessful high ability borrowers are negative due to attracting low ability borrowers. In the remainder of this paper, we assume that $q \leq q^*$ so that commitment is credible. Furthermore, commitment may also be credible when it is sufficiently costly for the entering bank to substitute "large-size" for "small-size" entry. For instance, installing a screening technology may be a costly exercise. If

$q > q^*$, bank $A$ anticipates that bank $B$ will enter with "large-size" scale, i.e. for all borrowers and the information on project outcomes will not be used.

# 4 Endogenous Display of Information

Padilla and Pagano (1997) endogenize information communication among lenders producing a trade off between two forces. First, information communication diminishes asymmetric information between banks and borrowers. This disciplines borrowers and therefore reduces moral hazard and adverse selection. Second, this reduction in asymmetric information enhances competition. The net effect of these two forces determines whether banks will spontaneously distribute their private information to their competitors. Our framework also allows us to endogenize information display. That is bank $A$ decides on full, partial, or no information display. Proposition 4 summarizes our results.

**Proposition 4** *Bank A will not display information if adverse selection is harsh ($\mu < \mu^*$). For intermediate degrees of adverse selection ($\mu^* \leq \mu \leq \mu^{**}$) bank A endogenously provides bank B with partial information if $q \leq q^*$. Otherwise, bank A's profits do not hinge on (the degree of) information display.*

The first part of proposition 4 states that bank $A$ does not want to provide information about borrowers' types or project outcomes if $\mu < \mu^*$. This action would encourage entry and lower bank $A$'s profits. The intuition is that an entering bank no longer faces barriers to entry since information about types or project outcomes is revealed. Proposition 4 however shows that endogenous display of partial information arises for *strategic* reasons if $\mu^* \leq \mu \leq \mu^{**}$ and $q \leq q^*$. Display of partial information does not affect bank $A$'s profits from successful high ability borrowers. The intuition is that bank $B$ will always target this group of borrowers at the same interest rate. Since the cost of entry from low ability borrowers remains constant, partial information display prevents bank $B$ from profitably poaching unsuccessful high ability borrowers. The incumbent bank therefore maximizes its profits by displaying information about project outcomes. This prevents the rival bank from poaching bank $A$'s unsuccessful high ability borrowers. Finally, if adverse selection is sufficiently low ($\mu^{**} < \mu$) or intermediate ($\mu^* \leq \mu \leq \mu^{**}$ together with $q > q^*$) bank $B$ enters irrespective of its information about borrowers. In other words

if the display of partial or full information is costless bank $A$'s profits are not altered. Otherwise, bank $A$ strictly prefers to retain the information about its borrowers.

Thus our model explains that bank $A$ can only decrease its profits by showing information about borrowers' types. Moreover, when adverse selection is moderate bank $A$ can increase its profits by strategically displaying partial information.

Our results complement Padilla and Pagano's (1997) findings. In their paper, endogenous information transmission results from a reduction in moral hazard. Without moral hazard, communicating information is unambiguously profit reducing. Our model explains partial information display in equilibrium without moral hazard. The driving force is that the communication of partial information prevents the entering bank from poaching unsuccessful high ability borrowers.

# 5 Information Sharing

Our analysis sofar exclusively focused on entry of bank $B$ into bank $A$'s first-period market. Consequently, display of information was one-way. When both banks' markets open up for competition, information communication can be two-way. This section will therefore also consider the case where bank $A$ enters bank $B$'s first-period market and deals with the role of information *sharing* between banks when two segmented markets open up for competition. We define information sharing between banks as a situation where all banks mutually agree to exchange information for free about their borrowers' types or project outcomes. Empirical evidence shows that information exchange between banks is based on the principle of reciprocity. That is, access to information about borrowers is only available to suppliers of such information. Typically, the access price is fairly small (see Padilla and Pagano (1997), and Jappelli and Pagano (1999)). We capture this empirical regularity by assuming free access.

The purpose of this section is first to discuss when *endogenous* information sharing between banks will arise. Afterwards we turn to the analysis where information sharing is imposed. That is information sharing is *exogenous*.

Denote by $\mu_i$ the degree of adverse selection in market $i$ with $i = A, B$. The next Proposition summarizes the main findings for endogenous information sharing.

**Proposition 5** *Suppose banks' first-period markets face a similar degree of adverse se-*

*lection. Full information sharing only takes place if adverse selection in all markets is low. Partial information sharing results for intermediate adverse selection. Otherwise no information sharing will occur. When adverse selection differs substantially between markets, full information sharing takes place if the cost of entry from low ability borrowers in B's market outweighs the reduction in profits from increased competition in its own market.*

The first part of Proposition 5 considers the case where every $\mu_i$ belongs to the same segment of the interval. Suppose first that $\mu_i \leq \mu^*$. Although both banks prefer to receive information about the rival's first-period market, information sharing will not take place. The reason is that both banks loose their monopoly profits when sharing information. Second, consider $\mu^* < \mu_i < \mu^{**}$. Partial information sharing results when $q \leq q^*$. Proposition 3 shows that it is not optimal to provide the rival bank with information about borrower types. However, every bank individually profits from communicating information about project outcomes. Therefore partial information sharing will occur. When $q > q^*$ large-size entry occurs in both markets. Anticipating entry in their own market each bank prevents low ability borrowers from entering its customer base when sharing information about borrowers' types. Finally when $\mu_i \geq \mu^{**}$ we are back in the previous case where banks' profits in their home market are not affected when sharing information. Full information sharing endogenously happens as this eliminates adverse selection.

The second part of Proposition 5 describes the situations where adverse selection differs substantially between markets. Suppose that $\mu_A \leq \mu^*$ and $\mu_B \geq \mu^{**}$. Bank $B$ benefits from an information sharing agreement: $A$'s market can be profitably entered and $B$'s profits on its incumbent market remain unaffected. Bank $A$ however only engages in full information sharing when the cost of entry from low ability borrowers in $B$'s market outweighs the reduction in profits from increased competition in its own market. This is more likely the larger country $B$ and the smaller country $A$. Otherwise no information sharing results.

Consider the case where $\mu^* < \mu_A < \mu^{**}$ and $\mu_B \geq \mu^{**}$. Suppose $q \leq q^*$. Again bank $B$ is willing to step into full information sharing: it generates additional profits in bank $A$'s first-period market. Bank $A$ wants to fully share information if eliminating adverse

selection in bank $B$'s market outweighs the reduction in profits from unsuccessful high ability borrowers in its incumbent market. Otherwise, bank $A$ displays partial information and bank $B$ keeps its information private. If $q > q^*$ full information sharing results. Banks' profits in their home market are not affected when sharing information. Full information sharing endogenously happens as this eliminates adverse selection problems.

Finally, $\mu_A \leq \mu^*$ and $\mu^* < \mu_B < \mu^{**}$. First suppose $q \leq q^*$. Partial information sharing is profit reducing for bank $A$. Full information sharing induces entry in both markets. Banks only consider to fully share information if the gains from entering the rival's market outweigh the losses in the incumbent market. This condition cannot be satisfied simultaneously for both banks. Thus display of partial information by bank $B$ results. If $q > q^*$ bank $B$ prefers full information sharing. Bank $A$ only steps into full information sharing if the reduction in profits in its incumbent market outweighs the losses from low ability borrowers in $B$'s market. Otherwise no information sharing results.

Next to endogenous information sharing, governments or supranational bodies may exogenously regulate information sharing. This does not necessarily imply that banks use the information freely made available by other banks. First consider the case of exogenous full information sharing. Banks will always use this information since it reveals borrower types allowing adverse selection problems to disappear. Consequently, large-size entry happens. Second, consider the case of partial information sharing. This allows banks to always poach successful high ability borrowers. However, suppose bank $B$ wants to enter bank $A$'s first-period market and $\mu^* < \mu_A < \mu^{**}$ and $q > q^*$. Then, bank $B$ enters $A$'s market for both successful and unsuccessful high ability borrowers. Therefore, bank $B$ enters as a large sized bank and neglects the information provided on project outcomes.

# 6 Welfare Analysis

Two forces drive the results of our welfare analysis. The first force refers to credit access. Display of full information denies credit to low ability borrowers. Partial and no information display with full-size entry however do not block loans to low ability borrowers. With or without small-size entry, low ability borrowers do not obtain a loan in the second period. High ability borrowers always enjoy credit access.

The second force refers to switching costs or benefits. Poaching is socially inefficient when all poached borrowers incur switching costs. This event happens when $\underline{s} > 0$. However when some borrowers enjoy switching gains, some poached borrowers switch to their most preferred bank. If the average borrower enjoys switching gains, all poached borrowers switch to their most preferred bank.

No information display without entry improves on full information when all borrowers incur switching costs. High ability borrowers stick to their first-period bank. Moreover since no entry happens, low ability borrowers are denied credit. Entry however reverses this result since low ability borrowers switch bank. From a welfare point of view bank $A$ may optimally deter entry by displaying partial information. This happens when entry would take place without information display and when borrowers incur switching costs.

We summarize the main welfare insights in the following Proposition.

**Proposition 6** *No information display without entry unambiguously maximizes welfare when borrowers incur switching costs. Full information sharing maximizes welfare when the average borrower enjoys a switching gain. Bank A optimally displays partial information when this prevents entry from taking place and when borrowers incur switching costs.*

# 7 Discussion

This section discusses and relaxes some of the main assumptions, and illustrates the robustness of our results.

We considered binary choices of information display between banks. That is all information about project outcomes is revealed or not, or all information about borrower types is displayed or not. However, one can imagine situations where banks may truthfully display only part of project outcomes or part of borrower types. In other words banks could control the degree of partial or full information display. Revealing only part of the information might be a profit maximizing strategy. Partial information display offers a specific example of such a strategy: displaying only a proportion of its borrowers' types, the incumbent bank strategically deters entry for its unsuccessful high ability borrowers.

In our analysis, it is assumed that entry precedes price competition. Padilla and Pagano (1997, 2000) discuss a Stackelberg setting in a model without switching costs or other frictions. In particular, two banks compete sequentially in interest rates with the incumbent bank as leader. Two remarks are warranted. First, our results remain qualitatively the same when adopting this approach. In the Stackelberg setting, the incumbent bank prices aggressively to deter entry. Moreover, strategic display of partial information also may appear as a profit maximizing strategy for the incumbent bank to protect its unsuccessful high ability borrowers from being poached. Second, competition with simultaneous interest rate setting may be more appropriate. The Stackelberg assumption has the inherent credibility problem of prices as a commitment variable. This credibility problem is not present in our model.

Information display happens in our model at no cost. In other words, information is displayed for strategic reasons. In addition, information might be sold to the rival at a certain price. Information *sharing* is a specific example of this. Information is revealed in exchange for information about your rivals' borrower base. On top of sharing information, there are clearly opportunities to unilaterally sell information. Consider first the cases where large-size entry occurs. That is, $\mu_A \geq \mu^{**}$ and $\mu^* < \mu_A < \mu^{**}$ together with $q > q^*$. Bank $B$ then has a willingness to pay for "full" information equal to the losses caused by low ability borrowers. A Nash-bargaining outcome might divide the available surplus. All other cases cannot lead to gains from trade since total duopoly profits never exceed the incumbent's monopoly surplus.

Firms often enjoy the option to choose between bank lending or arm's length financing in the first period. This financing choice determines the information obtained by the first-period lenders. In particular, banks may observe the borrower's type over the course of their relation. On the contrary, only the project outcome may be publicly available with arm's length finance. In choosing arm's length finance in the first period, high ability firms face the risk of being denied credit in the second period if unsuccessful since they may be pooled with low ability entrepreneurs. In an environment where banks observe borrower types in a credible way, building up a relationship is a mechanism to avoid the risk of being denied credit in the second period. This result compares to Diamond (1991). He shows that if moral hazard is sufficiently widespread firms build up a reputation by being monitored via bank lending. In our model however high ability entrepreneurs opt

for bank lending to avoid the possibility of being pooled with low ability entrepreneurs in the next period. Accordingly, adverse selection drives the result.

# 8 Conclusions

The opening up of historically segmented banking and financial markets in the United States and Europe is assumed to drastically impact both economies. Our analysis considers potential consequences of opening up banking markets in a model where we allow for price discrimination and borrower poaching. A particular ingredient of banking competition concerns asymmetric information between banks about borrowers' types and project outcomes. Banks enjoy an informational incumbency advantage with respect to their current borrowers' characteristics. We analyze opening up of markets and consider endogenous information display. The provision of full information eliminates informational barriers to entry. In other words, entry occurs and some borrowers switch their bank-firm relationship. No information display poses an adverse selection problem and severely hampers poaching behavior. Partial information display generates quite different implications for successful borrowers versus unsuccessful borrowers. Successful borrowers are spotted and are able to switch banks in a similar fashion as with full information sharing. Unsuccessful high ability and low ability borrowers are pooled and thus face most difficulties in switching banks.

Banks have no incentives to individually display full information. Display of project outcomes however may strategically arise when adverse selection is not too important. Partial information display then results in a monopoly on unsuccessful high ability borrowers and increases informational rents. A mutual agreement between banks to exchange information about borrowers somehow modifies the results. Partial information sharing still arises when adverse selection is moderate. However, full information sharing between banks endogenously happens in situations where adverse selection is mild. This strategic view on information display provides an additional explanation for the existence of private credit bureaus.

From a welfare point of view we find that no information display without entry unambiguously maximizes welfare when borrowers incur switching costs. High ability borrowers stick to their first-period bank. Moreover the absence of entry denies low ability

borrowers access to the credit market. From a policy perspective, we find that information sharing aimed at stimulating competition may take place at a cost: switching towards a less preferred bank is clearly inefficient. Full information sharing maximizes welfare when the average borrower shows a switching gain.

This paper shows that asymmetric information may severely reduce poaching possibilities. In line with the existing literature we find that poaching behavior results when adverse selection problems are mild. In contrast, no entry may result when adverse selection problems are considerable. Thus adverse selection dampens poaching behavior. The opening up of financial markets may be insufficient for borrowers to switch. In particular adverse selection may be too harsh to induce entry. Borrower switching then calls for actions that dampen asymmetric information. Full information sharing may serve this purpose.

Danthine et al. (1999) show that diversification gains may stimulate banking market integration. Our model explains that entry only takes place when asymmetric information is not too important. Thus, we offer a complementary argument at explaining the degree of cross-border banking activity.

Asymmetric information is an important ingredient of financial markets. Poaching behavior in an asymmetric information environment however also applies to other markets. Insurance markets are a first example. Insurance companies may enter new markets at the risk of selecting the most risky consumers. Information sharing in insurance markets then becomes an important issue. Labor markets are yet another example. Employers hiring new employees face the risk of attracting "bad employees." Adverse selection then may be dampened by systems like letters of reference or good conduct and morals certificates.

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