Securitization and the intensity of competition*

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Abstract

This article analyzes the motivation of loan securitization. We show that loan securitization can be used as a strategic tool to soften loan market competition. In a two - period loan market competition model where banks strategically decide whether they acquire information about borrowers, banks' strategic acquisition of information prevents future competition by increasing informational asymmetry between relationship bank and external banks, on the one hand, but increases *ex ante* competition for banks to obtain more market share, on the other hand. In this environment, banks can use securitization as a tool to commit to reduce or even not to do monitoring in order to soften *ex ante* competition. We demonstrate that securitization can make banks collectively better off by increasing overall profit to the detriment of overall loan market efficiency.
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1. Introduction

In the modern literature on financial intermediation, the problem of informational asymmetry between borrowers and investors is the central issue to understand the role of financial intermediaries. Monitoring borrowers is considered as an essential role of financial intermediaries to solve this problem and as their *raison d'être*. (Boyd and Prescott, 1986, Diamond, 1984, Ramakrishnan and Thakor, 1984) On the other hand, the assets monitored by banks are supposed to be illiquid in order that banks may have more incentive to monitor. If banks were to sell their loans, they would have less incentive to monitor diligently and their buyers would incur monitoring costs again, duplicating the cost. This implies that by selling their loans banks waives their cost advantage of intermediation. Diamond (1984), thus, mentioned that "[this] will mean that there are not active markets for these assets (market for loan sale)".

However, during the last couple of decades, secondary markets for loans has been remarkably increasing in terms of securitization as well as of single name loan sales (Figure 1,2. See also BIS (2003; 2008).) This phenomenon is even referred as the shift of banks' business model, in other words, from the "originate-to-hold" to the "originate-to-distribute" model (Buiter, 2007). Spectacular impact of recent U.S. subprime crisis paradoxically demonstrates well the extent to which banking sector has been engaged in this activity.

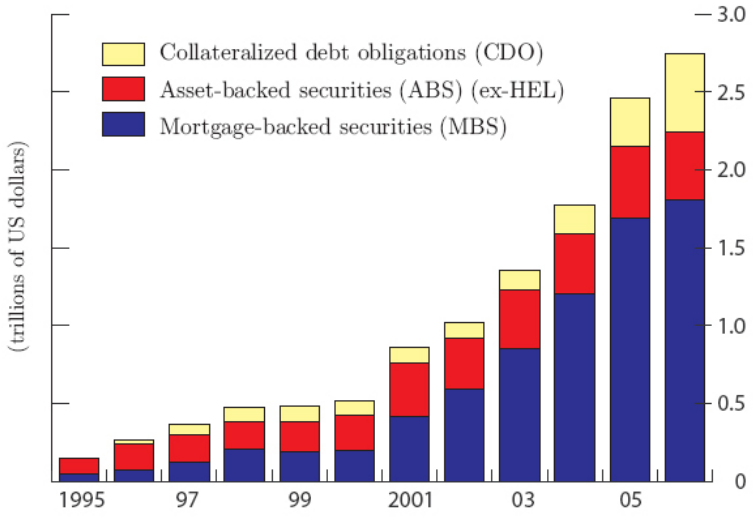

Figure 1: Securitization in Banking sector. (*Source: Duffie (2007)*)

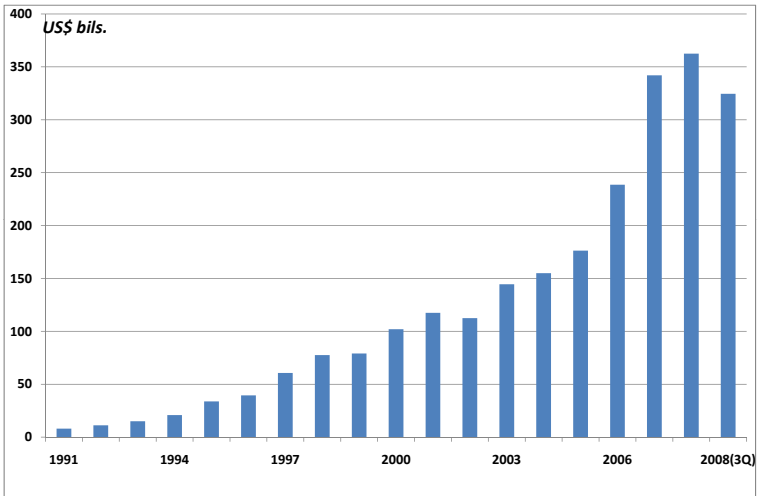

Figure 2: Single name loan sales in the US (*Source: Reuters LPC Traders Survey*)

In this paper, we attempt to explain this contradiction between theoretical expectation and empirical facts. In particular, we develop a novel explanation according to which an increase in securitization is a response of banks facing more fierce competition in loan markets. During the last two decades, the landscape of banking sectors has dramatically changed following liberalization and deregulation of financial sector. In the US, Riegle-Neal Act of 1994 abolished the geographical barrier to entry between states. Gramm-Leach-Bliley Act of 1999 terminated the separation between commercial banking and investment banking business. EU area introduced single banking license since 1993, which enable a bank obtaining a license for banking business in a member country to open their branches in another member country without extra permission. Interbank competition has been dramatically increasing as several studies remarked. (See for example, Boot and Schmeits, 2006)

We try to link the increases in securitization with the increases in loan market competition. More precisely, we show that banks can strategically use loan securitization to soften the effect of loan market competition, suggesting that securitization might be a consequence of increasing competition. Incidentally, we also show that under certain conditions, securitization increases banks' profits but worsens overall loan quality and loan market efficiency.

For this purpose, we consider a simple duopoly model of loan market where banks compete for borrowers over two periods, inspired by Gehrig and

Stenbacka (2007), Bouckaert and Degryse (2004). Contrary to their models in which information acquisition is automatic and given, in our model, banks choose strategically the degree of information acquisition about their borrowers during the first period (monitoring). Information acquired by the first period lending bank (in what follows, we refer it as the relationship bank) renders informational advantage in the second period when a bank competes with the outside bank that tries to poach its first period clients. More information banks decide to acquire, less profit they earns from poaching rival's clients because of more acute informational asymmetry between relationship bank and outside bank. In turn, *ex ante* (the first period) competition becomes more important in order to have more market share in the first period. This renders *ex ante* competition fierce and reduces overall profit of banks.

In this environment, banks can collectively earn more profit if they can commit to reduce the degree of monitoring about their borrowers because this makes poaching be more profitable, which in turn mitigates *ex ante* competition. As banks know that they can poach their rival's borrowers in the future round of competition, *ex ante* market share becomes less important.

We will show that loan portfolio securitization can be used as a tool to commit to monitor less. The intuition is as follows. We refer to loan securitization as selling the cash-flow that will be generated by (a fraction of) loan portfolio. This operation reduces the first period payoff generated by monitoring the projects and there is a level of securitization in which monitoring with securitization is not any more profitable. As such, securitization of this fraction of loan portfolio can be considered as a commitment not to monitor. Securitization makes banks better off in terms of their profit whereas it may have negative effect on overall loan market efficiency. It is because less monitoring incurs a loss associated with not controlling investment projects in the first period and a loss associated with less precise public information, which allows to finance low quality project that might otherwise be rejected in the second period.

Our study is obviously related to the literature on loan securitization. One of the commonly held idea concerning the motivation of securitization is bank's risk management view, according to which banks use securitization for transferring or diversifying credit risks.(Allen and Carletti, 2006, Wagner and Marsh, 2006, etc.). Another well-known argument is a regulatory arbitrage associated with capital requirement (Calomiris and Mason, 2004, Carlstrom and Samolyk, 1995, Duffee and Zhou, 2001, Nicolo and Pelizzon, 2008). Given that capital is more costly than debt, the retention of a proportion of capital for loans in balance sheet is a cost for banks. By taking this loan off from their balance sheet, banks can save their capital. A third argument is related to a more efficient recycling of banks' fund (Parlour and Plantin, 2008). With a constraint of funds, retaining a loan till matu-

rity bears an opportunity cost if banks have other more profitable lending opportunities. By securitization, banks can recuperate their funds earlier and redeploy them for another investment projects. However, there are few articles that analyze explicitly the link between loan market competition and securitization. Our article offers a novel explanation about why banks securitize their loans in focusing on loan market competition.

On the other hand, our analysis is related to the literature on the relationship between securitization and bank's monitoring incentive. Morrison (2005), Parlour and Plantin (2008), Hakenes and Schnabel (2008) showed that securitization reduces banks' incentive to monitor their borrowers when there is informational asymmetry between loan selling banks and buyers, which is harmful in terms of social welfare. In our article, we demonstrate similar result concerning monitoring incentive and social welfare. However, reduction of incentive to monitoring is not derived from the moral hazard or from the informational asymmetry between loan sellers and buyers as their models but from purpose of softening competition in the future.

Secondly, this article is related to the literature concerning link between relationship banking and loan market competition. Peterson and Rajan (1995) show that banks have more incentive to develop their relationship with new borrowers when loan market are less competitive and more concentrated. Boot and Thakor (2000) show that banks may refocus on relationship lending to survive in the face of interbank competition because this allows bank to shield their rent better. However, we show that relationship banking orientation can increase *ex ante* competition to capture more new clientele to extract rent in the future, in turn reduces overall profit. We hence add dynamic perspective of link between relationship banking and the loan market competition.

Our analysis also contributes to the literature on the strategic use of information in imperfectly competitive credit markets. Hauswald and Marquez (2006) analyze banks' strategic use of information acquisition as barrier to entry. In our environment with competition over multiple periods, banks strategically reduce information acquisition to mitigate the consequences of entry. In a related environment, Gehrig and Stenbacka (2007) and Bouckaert and Degryse (2004) show that when the initial lender automatically obtain proprietary information about former clients, banks can use information sharing to soften *ex ante* competition. When banks' monitoring decision is considered, committing (via securitization) to stay uninformed can serve the same purpose.

The rest of article proceeds as follows. Section 2 presents the general environment of the model. Then, we analyze competition without securitization in section 3 and 4. We analyze the use of securitization as a commitment mechanism and discuss its effect on the loan market efficiency in section 5 and 6. Section 7 concludes.

2. Environment

Consider a two-period duopoly model by two banks, say A and B. They compete in two subsequent periods in loan rate (Bertrand price competition) by offering short-term loan contracts. The lending rate can differ across periods.

2.1. Borrowers

Borrowers have two consecutive investment projects that require an initial outlay of 1 in each period. They should find external funding as they have no funds of their own. They can be of two types: $\theta \in \{G, B\}$. Borrowers know their own type, which is, however, not known to banks. In period 1, a type θ project yields Y with probability of p_θ, and 0 otherwise. We assume the following

$$1 > p_G > p_B > 0. \tag{A1}$$

In period two, a type G always succeeds, and a type B always fails.[1] We assume that controlling a project allows borrowers to derive positive private benefit that lender cannot extract (Holmstrom and Tirole, 1997). As a result, under limited liability, the type B borrowers will undertake the project in the second period even though they know that they will be bankrupt with certainty. Riskless interest is normalized to 0. Furthermore, it will be assumed that

$$p_G Y - 1 > 0 > p_B Y - 1, \tag{A2}$$

$$\nu p_G Y + (1-\nu)\, p_B Y - 1 > 0, \tag{A3}$$

$$\frac{\nu\,(1-p_G)}{\nu\,(1-p_G) + (1-\nu)\,(1-p_B)} Y < 1 \tag{A4}$$

where ν denotes the prior probability of a type G. Define $\bar{p} := \nu p_G + (1-\nu)\, p_B$. (A2) implies that G (B, respectively) makes *ex ante* positive (negative, resp.) net return. Making a loan in the first period is *ex ante* efficient (A3) whereas making a loan to a project that fails in period 1 is never profitable (A4). (A1) - (A4) are the information known to public.

2.2. Banks

Banks initially have no specific information about borrowers' type. The first period results are publicly observable (say, by a credit bureau in which

[1] The assumption that a type B borrower's second project fails w.p. 1 is made for analytical convenience. If we use also p_B for the second project, the result are unaffected but the math becomes (even more) tedious.

default record of borrowers are registered and is accessible to banks) Banks can use these information to evaluate the type of borrowers by Baysian revision. On the other hand, banks can produce private information by monitoring. During the first period, the initial lender can learn its borrowers' type, at a cost $c > 0$. It is a relationship-specific information of lending bank, which is neither verifiable by others nor transferable to others (soft information). If the borrower is of a type G, monitoring bank can raise the probability of success by $\Delta p > 0$ (say, by preventing the borrower from mismanaging the project). We assume $p_G + \Delta p = 1$ for the simplicity. Banks decide strategically whether they monitor or not.

2.3. Switching Costs

Borrowers can switch their banks in the second period but it incurs switching cost. We consider this switching cost to be heterogeneous among borrowers assuming that they incur idiosyncratic switching cost (s) distributed uniformly on $[0, \bar{s}]$ (for tractability). They learn their individual switching cost only at the end of the first period and it is not observable by others including banks. As a consequence, banks cannot make a contract conditional on individual switching costs. This allows banks to make positive profit in the Bertrand price competition. Given relatively good quality of borrowers in average, the heterogeneity and private character of switching costs render poaching rival's borrowers to be profitable. A fraction of high quality borrowers, whose switching cost is low, will have an incentive to switch their bank if loan rate offer by outside banks is more attractive.

The assumption about switching cost is rather natural to the extent that borrowers' satisfaction or dissatisfaction about a bank can be different according to individual preference to banks' services and borrowers can measure them exactly only after having the relationship. Switching costs may capture direct cost of closing an account with one bank and opening it elsewhere, the cost associated with another application procedures with other banks but also loss of relationship benefit between borrower and his former bank.[2]

2.4. Timing

The sequence of the game is described as follows: Two banks simultaneously offer a first period loan rate, R_1^i. Borrowers accept one of them and execute their project. Banks decide whether they monitors their own borrowers. If they decide to monitors, they learn their borrower's type and

[2]See Kim et al. (2003), Stango (2002) for empirical evidences for switching cost in banking and credit card sector.

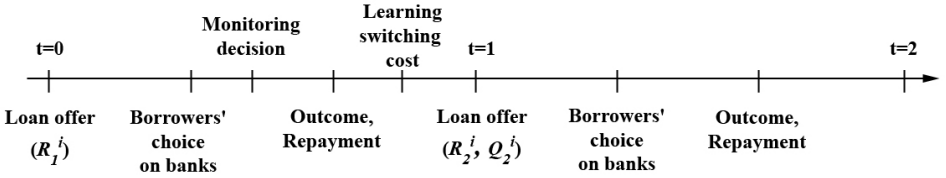

Figure 3: Timing

control the G type projects in order to increase their success probability. They observe the projects' return and borrowers repay their loan in the case of success. Borrowers learn their switching cost. Each bank makes a loan offer for second period projects to his own borrowers, R_2^i and his rival's borrowers, Q_2^i. Q_2^i is the poaching rate whereby bank i tries to attract entrepreneurs belonging to its rival's period 1 clientele. If borrowers receive an offer from both banks, they decide whether they continue their relationship with first period bank or change their bank. The rest is similar to the first period. The timing is summarized in Figure 3.

3. Baseline model: Exogenous Choice on Monitoring

In this section, we characterize the outcome of competition when banks have no choice on their monitoring decision. We analyze the two cases: 1/ the case where banks do not have monitoring technology and have no private information, on the one hand; 2/the case where banks always monitor their client and obtain private information, on the other. These two extreme cases offer useful benchmark to analyze the role of private information production by monitoring of banks in the context of dynamic competition.

3.1. Competition with Public Information Based Lending

In this subsection, we assume that banks cannot produce their private information and can use only public information (borrowers' first period default record collected by credit bureau).

Second-period Competition We firstly characterize the outcome of second period competition. We take as given first period market shares, (μ_A, μ_B). Let R^A (respectively Q^A) the interest offered by bank A to borrowers in its clientele (respectively, in bank B's clientele). Analogously, denote bank B's strategy by $\left(R^B, Q^B\right)$.
Loan contract offering: As a bank has no private information about his

own clientele nor about his rival's clientele, his offering decision exclusively depends on the default record in the first period. He never offers a loan contract to the unsuccessful borrowers in the first period due to (A4).
Borrowers' decision on switching: Borrowers learn their switching cost s at the end of period 1. The type G - borrowers that succeeded in period 1 (successful type G) will have an offer from both banks. A successful type G borrower in bank i switches whenever

$$\left(Y - R_2^i\right) < \left(Y - Q_2^{-i}\right) - s,$$

This yields a switching threshold

$$s = R_2^i - Q_2^{-i}$$

The type B- borrowers that succeeded in period 1 (lucky type B) also receive an offer from both banks. However, they do not change their bank because of their switching cost. Given the limited liability, their expected payoff is always 0 irrespective of the loan rate whereas they have to incur their switching cost when they change their bank. The best response of each bank yields (See Appendix A for details):

$$\pi^{i/i} = \nu \frac{4}{9} p_G \bar{s} - (1-\nu)\, p_B, \tag{1}$$

$$\pi^{j/i} = \nu \frac{1}{9} p_G \bar{s}. \tag{2}$$

where $\pi^{i/i}$ ($\pi^{j/i}$, respectively) is the profit of bank i (j, respectively) on the period 1 clientele of bank i when i has no private information. Note that the poaching is always profitable from (2) when rival has no private information.

First-period Equilibrium At the beginning of the first period, no banks have private information and thus they compete only by period 1 - loan rate. As a result, first period market shares obey

$$\mu^A = 1 - \mu^B = \begin{cases} 0 & \text{if } R_1^A > R_1^B, \\ \frac{1}{2} & \text{if } R_1^A = R_1^B, \\ 1 & \text{if } R_1^A < R_1^B. \end{cases}$$

Using (1) and (2), bank A's overall (discounted) profits can be rewritten as a function of first period interest rate policies:

$$\begin{aligned} \Pi^A &= \mu_A \left(\bar{p} R_1^A - 1\right) + \delta \left(\mu_A \pi^{A/A} + (1-\mu_A)\, \pi^{A/B}\right), \\ &= \mu_A \left[\bar{p} R_1^A - 1 + \delta \left(\nu \frac{1}{3} \bar{s} - (1-\nu)\, p_B\right)\right] + \delta \pi^{A/B}, \end{aligned} \tag{3}$$

where δ is banks' common discount rate. Analogously B's profit is rewritten by:

$$\Pi^B = \mu_B \left[\bar{p} R_1^B - 1 + \delta \left(\nu \frac{1}{3} \bar{s} - (1-\nu) p_B \right) \right] + \delta \pi^{B/A}.$$

Undercutting is no longer profitable when $R_1^A = R_1^B = R_1^*$, with

$$\bar{p} R_1^* - 1 + \delta \left(\nu \frac{1}{3} \bar{s} - (1-\nu) p_B \right) = 0. \tag{4}$$

When banks do not monitor, equilibrium in the credit market is therefore characterized by offers and profits

$$R_1^* = \frac{1 - \delta \left(\nu \frac{1}{3} \bar{s} - (1-\nu) p_B \right)}{\bar{p}}, \tag{5}$$

$$\Pi^* = \delta \pi^{i/j} = \delta \nu p_G \frac{1}{9} \bar{s}. \tag{6}$$

3.2. Competition with Private Information Based Lending

In order to assure that banks always monitor given our environment, we assume simply $c = 0$. We will soften this assumption in the following section.

Second-period Competition *Loan Contract Offering:* Given that a bank has a private information about the type of his own clients, he makes an offer only to the G-type projects. On the other hand, his offering decision on his rival's clients depends always on the default record in the first period as is in the previous case.
Borrowers' Decision on Switching: the type G - borrowers that failed in period 1 (unlucky type G) receive an offer from its own bank and they will remain. The type B- borrowers that succeeded in period 1 (lucky type B) receive an offer from the outside bank and they will accept it and changes their bank. As a consequence, an outside bank faces more problem of adverse selection than when they compete without private information. The type G - borrowers that succeeded in period 1 (successful type G) will have an offer from both banks and make same decision on switching as they do in the above case. Following similar calculation in the above subsection (See Appendix A for details), we can write per borrower expected profit on bank i 's clientele when bank i monitors as:

$$\bar{\pi}^{i/i} = \nu \frac{4}{9} \bar{s}, \tag{7}$$

$$\bar{\pi}^{j/i} = \nu \frac{1}{9} \bar{s} - (1-\nu) p_B. \tag{8}$$

First-period Equilibrium Given that both banks monitor, bank A's overall (discounted) profits as a function of first period interest rate policies are

$$\begin{aligned}\Pi^A &= \mu_A\left(\left(\bar{p}+\nu\Delta p\right)R_1^A-1\right)+\delta\left(\mu_A\bar{\pi}^{A/A}+\left(1-\mu_A\right)\bar{\pi}^{A/B}\right),\\ &= \mu_A\left[\left(\bar{p}+\nu\Delta p\right)R_1^A-1+\delta\left(\nu\frac{1}{3}\bar{s}+\left(1-\nu\right)p_B\right)\right]+\delta\bar{\pi}^{A/B}, \qquad (9)\end{aligned}$$

Analogously, B's profit is written by:

$$\Pi^B = \mu_B\left[\left(\bar{p}+\nu\Delta p\right)R_1^B-1+\delta\left(\nu\frac{1}{3}\bar{s}+\left(1-\nu\right)p_B\right)\right]+\delta\bar{\pi}^{B/A}. \qquad (10)$$

From (9) and (10), it follows that a bank will undercut its rival's interest offer as long as $R_1 > \bar{R}_1^*$, where

$$\left(\bar{p}+\nu\Delta p\right)\bar{R}_1^*-1+\delta\left(\nu\frac{1}{3}\bar{s}+\left(1-\nu\right)p_B\right)=0.$$

This yields equilibrium rate $\left(\bar{R}_1^*\right)$ and profits $\left(\bar{\Pi}^*\right)$ as follows;

$$\bar{R}_1^* = \frac{1-\delta\left(\nu\frac{1}{3}\bar{s}+\left(1-\nu\right)p_B\right)}{\bar{p}+\nu\Delta p}, \qquad (11)$$

$$\bar{\Pi}^* = \delta\bar{\pi}^{i/j} = \delta\left[\nu\frac{1}{9}\bar{s}-\left(1-\nu\right)p_B\right]. \qquad (12)$$

3.3. Private Information and Dynamic Competition

First of all, consider the expected overall profit upon period 1- loan rate, (3) and (9). It is noteworthy that the sensitivity of initial market share on period 2 profit is higher when banks compete each other with private information(*i.e.* when they monitor during the first period) than when they have no private information. In other words,

$$\delta\left(\nu\frac{1}{3}\bar{s}+\left(1-\nu\right)p_B\right) > \delta\left(\nu\frac{1}{3}\bar{s}-\left(1-\nu\right)p_B\right).$$

It is resulted from the worsening of winner's curse problem in period 2. Monitoring creates the informational asymmetry between the first period lending bank and the external bank. If period 1 banks monitored and learned the type of borrowers, they would not offer a loan to B type. Only external bank offers a loan to lucky B type clientele, which worsens adverse selection problem when banks try to poach rival's clients. each bank would take all lucky B type clientele. For this reason, banks are less affected by rival's B type clientele when they do not monitor. This effect renders poaching in

period 2 more profitable and, in turn, renders period 1 market share being less important when they have no private information. It results in less fierce competition in the first period in the case of no monitoring. To the contrast, when they monitor, the winner's curse problem becomes important and poaching becomes less profitable. This makes the first period market share more important and thus banks makes more aggressive bidding in the first period competition wasting more profit, otherwise, they could realize. As a result of this aggressive competition in the first period, banks can even make less profit than they have private information by monitoring.

This mitigation of winner's curse problem is represented in the second term of (13), *i.e.*, the difference between the profit when banks do not monitor and the profit when banks monitor in the first period.

$$\Pi^* - \bar{\Pi}^* = \delta\left(1-\nu\right)p_B - \delta\nu\frac{1}{9}\Delta p\bar{s} \tag{13}$$

However, it is noteworthy that there exists another countervailing effect when banks do not monitor. Monitoring by banks increases success probability of type G borrowers, which ameliorate the quality of the applicants pool in the second period since the poaching bank will offer loans only to borrowers that succeeded in period 1. Absence of monitoring prevents banks from benefitting this positive effects. Accordingly, the average quality of the borrowers that succeeded in period 1 is lower when banks do not monitor. This effect is captured in the second term of (13).

Which effect is dominating depends on ν, the proportion of the G borrowers. This yields the following proposition.

Lemma 1. *Banks can collectively make more profit when they do not produce private information by monitoring and are only based on public information, if* $\nu < \hat{\nu}$*,*

$$\textit{where} \quad \hat{\nu} = \frac{p_B}{\frac{1}{9}\Delta p\bar{s} + p_B}.$$

Proof. It is straightforward from $\Pi^* - \bar{\Pi}^* > 0$. □

If the average quality of borrowers, ν is not too high, the effect from the mitigation of winner's curse always dominates the pool worsening effect. In this case, banks can collectively make more profit when they have no private information.

4. Endogenous Choice on Monitoring without Securitization

In this section, we endogenize banks' choice on monitoring. For this purpose, we introduce the monitoring cost, $c(>0)$. Just after the borrowers' choice on banks and banks' loan granting, each bank can choose whether he monitor his borrowers or not. We will characterize subgame perfect Nash

equilibria (SPNE) by backward induction as is previous case. The difference from the previous case lies in the fact that another strategic variable is added. Upon banks' choice on monitoring (s_i), we can have four different scenarios;

$$S = (s_A, s_B) \in \{(M, M), (M, noM), (noM, M), (noM, noM)\}$$
$$\text{where} \quad \begin{cases} M & \text{is} \quad \text{monitoring} \\ noM & \text{is} \quad \text{no monitoring} \end{cases}$$

We restrict our attention on symmetric equilibria, *i.e.* the equilibrium with monitoring by both banks (M, M) and that without monitoring (noM, noM).

Given that both banks monitor, bank i's overall discounted profits as a function of first period interest rate (9) can be rewritten as:

$$\Pi^i = \mu_i \left[(\bar{p} + \nu\Delta p) R_1^i - 1 - c + \delta \left(\nu \frac{1}{3} \bar{s} + (1 - \nu) p_B \right) \right] + \delta \bar{\pi}^{i/j}$$

Equilibrium loan rate (11) can be rewritten as:

$$\bar{R}_1^* = \frac{1 - \delta \left(\nu \frac{1}{3} \bar{s} + (1 - \nu) p_B \right) + c}{\bar{p} + \nu\Delta p}$$

Equilibrium profit (12) is unchanged, which implies that lemma 1 always holds.

4.1. Equilibrium with Monitoring

Monitoring by both banks is an equilibrium if and only if no bank has an incentive to deviate from monitoring. We show in the appendix B that this arises if and only if it holds that

$$c < \underbrace{\nu\Delta p \bar{R}_1^*}_{\text{period 1 (private) gain}} + \underbrace{\delta \left(\bar{\pi}^{i/i} - \pi^{i/i} \right)}_{\text{period 2 (private) gain}} \tag{14}$$

$$< \nu\Delta p \bar{R}_1^* + \delta \left(\nu \frac{4}{9} \Delta p \bar{s} + (1 - \nu) p_B \right) \tag{15}$$

Condition (14) has a straightforward interpretation. It states that monitoring is an equilibrium whenever the private value of monitoring covers the cost c. The private value of monitoring (right hand side) comprises the first period gain from increasing average repayment, and the gain that proprietary information delivers in second period competition.

The following result summarizes the discussion:

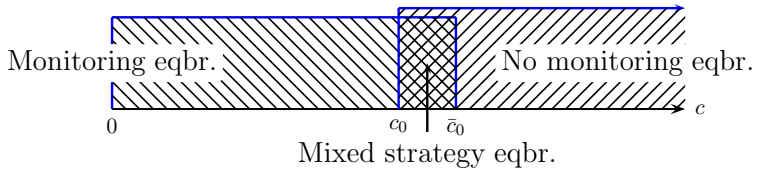

Figure 4: Equilibria without securitization

Proposition 1. *Monitoring by both banks can be an equilibrium that is characterized by* $\left(\bar{R}_1^*, \bar{\Pi}^*\right)$ *if* $c < \bar{c}_0$ *where*

$$\bar{c}_0 = \frac{\nu\Delta p}{\bar{p}}\left[1 - \delta\left(\nu\frac{1}{3}\bar{s} + (1-\nu)\,p_B\right)\right] + \frac{\bar{p} + \nu\Delta p}{\nu\Delta p}\delta\left(\nu\frac{4}{9}\Delta p\bar{s} + (1-\nu)\,p_B\right).$$

Proof. Straightforward from (11) and (15). □

4.2. Equilibrium without Monitoring

No monitoring by both banks constitutes an equilibrium whenever no bank has an incentive to monitor. This arises whenever the private value of monitoring does not cover the cost (see appendix A for details):

$$c > \underbrace{\nu\Delta p R_1^*}_{\text{period 1 (private) gain}} + \underbrace{\delta\left(\bar{\pi}^{i/i} - \pi^{i/i}\right)}_{\text{period 2 (private) gain}} \tag{16}$$

$$> \nu\Delta p R_1^* + \delta\left(\nu\frac{4}{9}\Delta p\bar{s} + (1-\nu)\,p_B\right) \tag{17}$$

Proposition 2. *No monitoring by both banks can be an equilibrium that is characterized by* $\left(R_1^*, \Pi^*\right)$ *if* $c > c_0$ *where*

$$c_0 = \frac{\nu\Delta p}{\bar{p}}\left[1 - \delta\left(\nu\frac{1}{3}\bar{s} - (1-\nu)\,p_B\right)\right] + \delta\left(\nu\frac{4}{9}\Delta p\bar{s} + (1-\nu)\,p_B\right)$$

Proof. Follows from (5) and (17). □

4.3. Characterization of Equilibria

As $c_0 < \bar{c}_0$, the two above propositions yields 3 different possible equilibria upon monitoring cost c, which is presented in Figure 4.

It is noteworthy that, for $\nu < \hat{\nu}$, banks always make more profit in no monitoring equilibrium whereas it is not always attainable. In particular, no

monitoring equilibrium is never attainable for small monitoring cost, $c < c_0$. Even though banks could make more profit if they were able to coordinate between them, it is not possible because the private gain from the deviation to monitor is always higher when monitoring cost is small.

5. Choice of Monitoring with Securitization

In this section, we will analyze the effect of the introduction of securitization on banks' decision on monitoring. We will show that banks can use loan securitization as a tool to commit not to monitor when no monitoring equilibrium is more profitable than monitoring equilibrium.

Securitization Assume that at date $t = 0^+$, each bank securitizes its loans. That is, a fraction $\tau \in [0, 1]$ of the revenue of each loan goes to outside investors, at a fair price (viz, equal to the expected value of the loans). This implies that there is no informational opacity in loan sale market, in other words, there is no informational asymmetry between loan sellers (banks in our model) and loan buyers. This can be considered as an extreme assumption as several existing literatures emphasize the informational asymmetry in loan sale market (Parlour and Plantin, 2008, Hakenes and Schnabel, 2008). We simply intend to show that the result that our analysis proceeds is not related to the informational asymmetry. Securitization arises *before* the monitoring decision.

We will demonstrate that securitization softens the condition for the existence of the no monitoring equilibrium. Accordingly, we consider the equilibrium without monitoring.

If the bank obtains a fair price it does not affect its profit under no monitoring. Specifically, given no monitoring the bank sells a fraction τ of the revenues for the price $P\left(\tau, R_1^A\right) = \bar{p}\tau R_1^A$, and its profit is written by

$$\Pi^A = \mu_A \left(P\left(\tau, R_1^A\right) + \bar{p}\left(1-\tau\right) R_1^A - 1 + \delta\left(\pi^{A/A} - \pi^{A/B}\right)\right) + \delta\pi^{A/B}.$$

Now, we have to check that it does not pay the bank to learn the type to make profits in period two given that its rival does not have any informational advantage (equilibrium play). If, say, bank A deviates to monitoring (and first period offer $\hat{R}_1^A$), expected profit from deviation is

$$\hat{\Pi}^A = \mu_A \left(P\left(\tau, R_1^A\right) + \left(\bar{p} + \nu\Delta p\right)\left(1-\tau\right)\hat{R}_1^A - 1 - c + \delta\left(\bar{\pi}^{A/A} - \pi^{A/B}\right)\right) + \delta\pi^{A/B}.$$

Straightforward algebra delivers the following condition for existence of the no monitoring equilibrium:

$$\tilde{\Delta}_{dev} = \nu\Delta p\left(1-\tau\right) R_1^* + \delta\left(\nu\frac{4}{9}\Delta p\bar{s} + \left(1-\nu\right) p_B\right) - c < 0 \qquad (18)$$

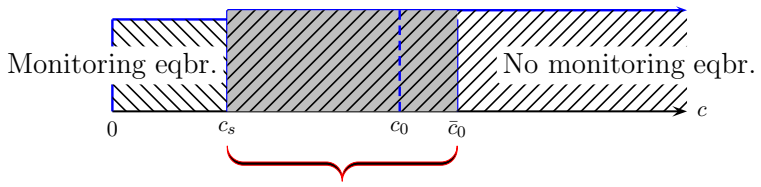

Figure 5: Equilibria with securitization

This yields

$$c > \underbrace{\nu \Delta p \left(1-\tau\right) R_1^*}_{\text{period 1 (private) gain}} + \underbrace{\delta \left(\nu \frac{4}{9} \Delta p \bar{s} + \left(1-\nu\right) p_B \right)}_{\text{period 2 (private) gain}} \tag{19}$$

It is noteworthy that the securitization reduces the period 1 private gain from deviation to monitoring comparing to the case without securitization (17). Accordingly, no monitoring equilibrium is easier to be attained. Accordingly, by securitization banks renounce publicly a part of private gain that they could obtain if they deviate to monitor in period 1. As such, securitization plays a role as a commitment not to monitor. In particular, with full securitization (19) becomes

$$c > \delta \left(\nu \frac{4}{9} \Delta p \bar{s} + \left(1-\nu\right) p_B \right) = c_s.$$

Figure 5 describes the changes in no monitoring equilibrium zone when banks securitize their full loan portfolio. As $c_s < c_0$, securitization can lead to emerge no monitoring equilibrium whereas monitoring by both banks could be an equilibrium without securitization for the monitoring cost $c_s < c < c_0$. On the other hand, no monitoring can be emerged as a pure strategy equilibrium for the monitoring cost $c_0 < c < \bar{c}_0$ where it was a part of mixed strategy in equilibrium without securitization.

Proposition 3. *Securitization can lead to the emergence of the no monitoring equilibrium while no monitoring could not be an equilibrium without securitization when* $c_s < c < \bar{c}_0$.

As such, banks commit to monitor less (or not to monitor at all) their first period borrowers by engaging the securitization. It reduces informational asymmetry between the first period relationship bank and outside bank, which makes poaching in the future more profitable. As a result, it can soften initial competition for initial market share.

6. Securitization and Loan Market Efficiency

Even though securitization increases banks' profit by softening initial competition in loan market, it worsens loan market efficiency. Consider the difference between the wealth created by bank loan when banks do not monitor, i.e. equilibrium with securitization and the wealth created by bank loan when banks monitor their loan portfolio, *i.e.* equilibrium without securitization.

$$\Delta W = W^{noM} - W^{M} = c - [\nu \Delta p Y + \delta \nu (1 - p_G) Y] < 0. \qquad (20)$$

No monitoring allows to economize the monitoring cost (c) whereas the economy cannot benefit from the amelioration of projects' performance through monitoring by banks. Monitoring makes better off by two-fold positive effects. On the one hand, it improves the performance of G type project by controlling in period 1. This effect is captured by the first term in (20). On the other hand, monitoring allows to finance unlucky G type projects that might otherwise be rejected in period 2. Thus, securitization committing not to monitor softens competition in the first period by reducing winner's curse effect in the second period to the detriment of loan market efficiency.[3]

Similar to the our result, Morrison (2005), Parlour and Plantin (2008), Hakenes and Schnabel (2008) showed that securitization reduces banks' incentive to monitor their borrowers and is harmful in terms of social welfare. However, the decrease in monitoring incentive in their model is derived from informational asymmetry between loan selling banks and buyers. In our model, reduction of incentive to monitoring is not derived from the moral hazard or from the informational asymmetry between loan sellers and buyers as their models but from purpose of softening competition in the future.

7. Concluding Remarks

In this article, we analyzed the motivation of loan securitization. We have shown that loan securitization can be used as a strategic tool to soften loan market competition. In a two - period loan market competition model where banks strategically decide whether they acquire information about borrowers, banks' strategic acquisition of information prevents future competition by increasing informational asymmetry between relationship bank and external banks, on the one hand, but increases *ex ante* competition for

[3]There are some empirical evidences that loan sales diminish the incentive to monitor. Keys et al. (2008) show that the securitization led to lax monitoring using a dataset on securitized subprime mortgage loan contracts in the US. Gaul and Stebunovs (2008) show that loan ownership provides more incentive to monitor in the corporate loan market.

banks to obtain more market share, on the other hand. In this environment, banks can use securitization as a commitment mechanism not to acquire private information to soften *ex ante* competition. As we have demonstrated, securitization can make banks collectively better off by increasing overall profit to the detriment of overall loan market efficiency.

Appendix

A. Solving the Game in the Second Period

Competition with Public Information Based Lending We can write per borrower expected profit on bank i 's clientele when bank i has only public information;

$$\pi^{i/i} = \nu p_G \int_{R_2^i - Q_2^j}^{\bar{s}} \left(R_2^i - 1\right) \frac{1}{\bar{s}} ds - (1-\nu)\, p_B,$$
$$\pi^{j/i} = \nu p_G \int_0^{R_2^i - Q_2^j} \left(Q_2^j - 1\right) \frac{1}{\bar{s}} ds,$$

where $\pi^{i/i}$ ($\pi^{j/i}$, respectively) is the profit of bank i (j, respectively) on the period 1 clientele of bank i when i has no private information. Now we consider the best response of each bank.

$$BR_i\left(Q_2^j\right) = \underset{R_2^i}{\arg\max}\, \pi^{i/i} : R_2^i = \frac{1}{2}\left(Q_2^j + \bar{s} + 1\right),$$
$$BR_j\left(R_2^i\right) = \underset{Q_2^i}{\arg\max}\, \pi^{j/i} : Q_2^j = \frac{1}{2}\left(R_2^i + 1\right),$$

from which

$$R_2^* = 1 + \frac{2}{3}\bar{s},$$
$$Q_2^* = 1 + \frac{1}{3}\bar{s}.$$

Substituting R_2, Q_2 yields

$$\pi^{i/i} = \nu \frac{4}{9} p_G \bar{s} - (1-\nu)\, p_B,$$
$$\pi^{j/i} = \nu \frac{1}{9} p_G \bar{s}.$$

Competition with private information based lending We can write per borrower expected profit on bank i 's clientele when bank i monitors as

$$\bar{\pi}^{i/i} = \nu \int_{R_2^i - Q_2^j}^{\bar{s}} \left(R_2^i - 1\right) \frac{1}{\bar{s}} ds$$

$$\bar{\pi}^{j/i} = \nu \left(p_G + \Delta p\right) \int_0^{R_2^i - Q_2^j} \left(Q_2^j - 1\right) \frac{1}{\bar{s}} ds - (1-\nu) p_B$$

The similar calculation yields

$$\begin{aligned} \bar{\pi}^{i/i} &= \nu \frac{4}{9} \bar{s}, \\ \bar{\pi}^{j/i} &= \nu \frac{1}{9} \left(p_G + \Delta p\right) \bar{s} - (1-\nu) p_B \\ &= \nu \frac{1}{9} \bar{s} - (1-\nu) p_B \end{aligned}$$

B. Conditions for no Profitable Deviations

Note that the formulae (1), (2), (7, and (8) allow to compute any continuation payoff as a function of first period market share (μ_A, μ_B) and information distribution. For instance, if only bank A monitors, second period profits are given by

$$\begin{aligned} \Pi_2^A &= \mu_A \bar{\pi}^{A/A} + \mu_B \pi^{A/B}, \\ \Pi_2^B &= \mu_A \bar{\pi}^{B/A} + \mu_B \pi^{B/B}. \end{aligned}$$

We consider first the Nash equilibrium with monitoring. Assume that one bank, say A, deviates to a no monitoring. Let $\hat{R}_1^A$ denotes its first period offer, and $\hat{\mu}_A$ the associated market share. Given that A's deviation will be known by B at the end of period 1, second period competition yields

$$\hat{\Pi}_2^A = \hat{\mu}_A \pi^{A/A} + (1 - \hat{\mu}_A) \bar{\pi}^{A/B}, \tag{21}$$

and overall profit for the deviating bank write

$$\hat{\Pi}^A = \hat{\mu}_A \left(\bar{p} \hat{R}_1^A - 1\right) + \delta \left(\hat{\mu}_A \pi^{A/A} + (1 - \hat{\mu}_A) \bar{\pi}^{A/B}\right) \tag{22}$$

$$= \hat{\mu}_A \left(\bar{p} \hat{R}_1^A - 1 + \delta \left(\pi^{A/A} - \bar{\pi}^{A/B}\right)\right) + \delta \bar{\pi}^{A/B}. \tag{23}$$

Now, given B's equilibrium offer in period one ($\bar{R}_1^*$), A's market share is given by[4]

$$\hat{\mu}^A = \begin{cases} 0 & \text{if } \hat{R}_1^A > \bar{R}_1^*, \\ \frac{1}{2} & \text{if } \hat{R}_1^A = \bar{R}_1^*, \\ 1 & \text{if } \hat{R}_1^A < \bar{R}_1^*. \end{cases} \tag{24}$$

[4]Here, we implicitly assume that borrowers' acceptance behavior (even out-of-equilibrium) depends only on the comparison of interest offers.

From (23) and (24), one easily sees that $\hat{\Pi}^A > \bar{\Pi}^* = \delta\bar{\pi}^{A/B}$ if and only if $\bar{p}\hat{R}_1^A - 1 + \delta\left(\pi^{A/A} - \bar{\pi}^{A/B}\right) > 0$ and $\hat{R}_1^A \leq \bar{R}_1^*$. A necessary and sufficient condition for absence of profitable deviation is thus

$$\bar{p}\bar{R}_1^* - 1 + \delta\left(\pi^{A/A} - \bar{\pi}^{A/B}\right) < 0. \tag{25}$$

Now, using

$$\left(\bar{p} + \nu\Delta p\right)\bar{R}_1^* - 1 - c + \delta\left(\bar{\pi}^{A/A} - \bar{\pi}^{A/B}\right) = 0,$$

condition (25) can be rewritten as condition (14) in the text.

We now consider the Nash equilibrium without monitoring. Assume that A deviates to monitoring, and offers $\hat{R}_1^A$ in period 1. Its profits write

$$\hat{\Pi}^A = \hat{\mu}_A\left(\left(\bar{p} + \nu\Delta p\right)\hat{R}_1^A - 1 - c + \delta\left(\bar{\pi}^{A/A} - \pi^{A/B}\right)\right) + \delta\pi^{A/B},$$

from where it easily follows that a necessary and sufficient condition for $\hat{\Pi}^A < \Pi^* = \delta\pi^{A/B}$ is

$$\left(\bar{p} + \nu\Delta p\right)R_1^* - 1 - c + \delta\left(\bar{\pi}^{A/A} - \pi^{A/B}\right) < 0.$$

Using the equilibrium interest offer

$$\bar{p}R_1^* - 1 + \delta\left(\pi^{A/A} - \pi^{A/B}\right) = 0,$$

we get the equivalent condition

$$\nu\Delta pR_1^* + \delta\left(\bar{\pi}^{A/A} - \pi^{A/A}\right) - c < 0. \tag{26}$$

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