Securitization, Competition and Efficiency[☆]

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Abstract

This article analyzes the motivation of loan securitization and its effect on loan market efficiency. We consider a two-period loan market competition model where period 2-competition is affected by the winner's curse. It increases *ex ante* competition for greater initial market share. Given that the securitization transfers a part of return from loans to other investors, banks can use it as a tool to signal that they will reduce monitoring for the purpose of softening *ex ante* competition. Thus, securitization adversely affects loan market efficiency while it leads banks to increases collectively their profits. This effect is driven by primary loan market competition, not by exploitation of informational asymmetries in the secondary market for loans.

Keywords: securitization, loan sales, banking competition, informational asymmetries

[☆]We thank Vincent Bignon, Jean Cartelier, Bertrand Gobillard, Antoine Martin, Bruno Parigi, Guillaume Plantin, Jean-Charles Rochet, Jean-Paul Pollin and Laurence Scialom for helpful discussions. We also thank the participants of the 58th Congress of French Economic Association (Paris, Sep. 2009), the 24th Congress of the EEA, the the 14th SMYE (Istanbul, April 2009), 2nd International Financial Research Forum (Paris, March 2009), the 17th International Tor Vergata Conference on Banking and Finance (Rome, Dec. 2008), the 40th MMF annual conference (London, Sep. 2008), the 25th Symposium on Money, Banking and Finance (Luxembourg, June 2008) as well as the seminar at the Univ. of Orléans (Feb. 2009) and the Univ. of Paris 10 (Jan. 2009). The usual disclaimer applies. The opinions expressed in this paper are those of the authors and do not necessarily reflect the views of the Banque de France or the Eurosystem.

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March 2010

JEL: G21, L12, L13

1. Introduction

The recent financial crisis triggered by the US subprime mortgage sector during mid 2007 demonstrated unprecedented negative impacts on real economy as well as on banking sector. The use of the securitization is considered as a central issue and has provoked a number of discussions among the community of practitioners, academics as well as regulators about the remedies for the financial markets related to the securitization.

Several recent theoretical and empirical studies have made an emphasis on informational asymmetries between sellers and buyers of securitization markets, which they consider as the main cause of moral hazard of sellers such as lazy monitoring or screening (Berndt and Gupta, 2009, Dell'Ariccia et al., 2008, Mian and Sufi, 2009, Keys et al., 2010, Purnanandam, 2009). In this literature, informational asymmetry in securitization market is blamed for inefficiency of the banking sector. Following this line of analysis, current discussions on the regulation on the securitization markets exclusively focus on the reductions of the informational asymmetries in such markets as remedies. For example, prohibitions of complex products, an increase in transparency, and aligning incentive. (See for example American Securitization Forum et al., 2008, ECB, 2008, Franke and Krahnen, 2008, .)

However, is informational asymmetry the only root of evil on the disastrous impact of securitization? In this article, we attempt to show an alternative channel through which banks are motivated to use the securitization, which in turn generates an effect on the efficiency of the banking sector. In particular, we develop a novel explanation according to which an increase in securitization and a reduction in banking sector efficiency are interpreted as a response of banks to fiercer competition in loan markets. During the last two decades, the landscape of banking sectors has dramatically changed following the liberalization and deregulation of the financial sector. In the United States, the Riegle-Neal Act of 1994 abolished the geographical barrier to entry between states. The Gramm-Leach-Bliley Act of 1999 terminated the separation between the commercial banking and investment banking business. The EU area introduced the single banking license in 1993, which enables a bank obtaining a banking license in one member country to open their branches in another member country without further permission. Interbank competition has thus dramatically increased, as several studies have remarked. (See for example, Boot and Schmeits, 2006) During the same period, secondary markets for loans have increased remarkably in terms of securitization as well as in terms of single name loan sales

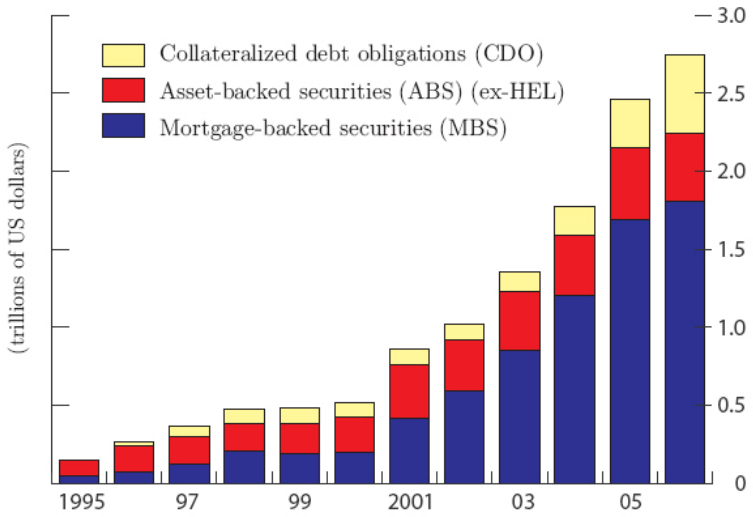

Figure 1: Securitization in banking sector (*Source: Duffie (2007)*)

(Figures 1 and 2. See also BIS (2003; 2008).). This phenomenon is even referred to as the shift in the banks' business model; in other words, from the "originate-to-hold" to the "originate-to-distribute" model (BIS, 2008, Buiter, 2007, Hellwig, 2008).

We try to link the increases in securitization with the increases in loan

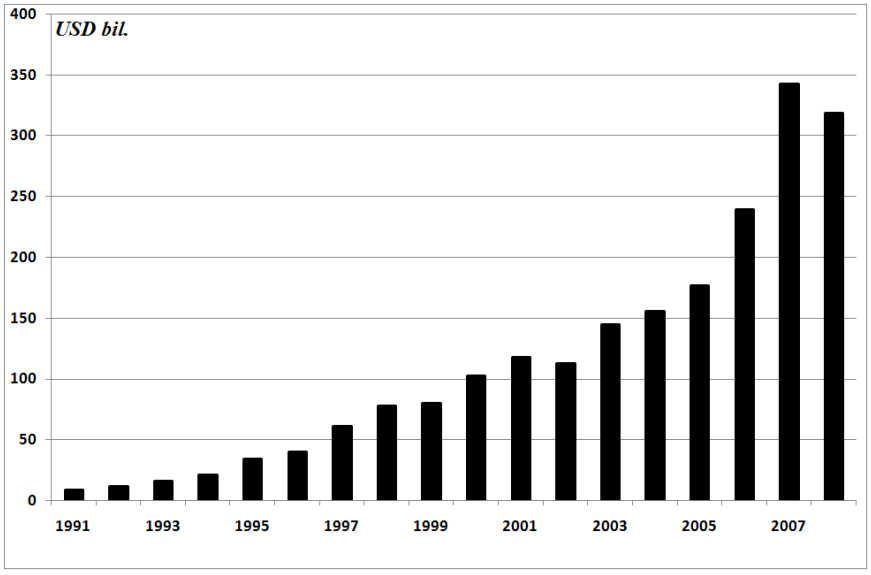

Figure 2: Single name loan sales in th US (*Source: Reuters LPC Traders Survey*)

market competition. More precisely, we show that banks can strategically use loan securitization to soften the effect of the 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, even without informational asymmetry in secondary markets for loans

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 strategically choose the intensity of information acquisition on their borrowers during the first period (monitoring). Information acquired by the first-period lending bank (in what follows, we refer to it as the relationship bank) produces an informational advantage in the second period when the bank competes with the outside bank that tries to poach its first-period clients. The more information banks decide to acquire, the less profit they earn from poaching their rival's clients because of more acute informational asymmetry that there exists between the relationship bank and the outside bank. In turn, *ex ante* (the first period) competition becomes more important since banks seek to acquire a greater market share in the first period. This causes fiercer *ex ante* competition and reduces the overall profit of the banks.

In this environment, banks can collectively earn more profit if they can signal reducing the intensity with which they monitor their borrowers because this makes poaching more profitable, which in turn mitigates *ex ante* competition. As banks know that they can poach their rival's borrowers in a future round of competition, the *ex ante* market share becomes less important.

We will show that loan portfolio securitization can be used as a tool to signal that they reduce the intensity of monitoring. The intuitive argument runs as follows. We refer to loan securitization as selling the cash-flow that will be generated by (a fraction of) the loan portfolio. This operation reduces the first period payoff generated by monitoring the projects and there is a level of securitization which renders monitoring with securitization is no longer profitable. As such, securitization of this fraction of the loan portfolio can be considered as signaling the withdrawal of monitoring. Securitization makes banks better off in terms of their profit whereas it may have a negative effect on overall loan market efficiency. It is because reduced monitoring incurs a loss associated with not controlling investment projects in the first period and a loss associated with less precise public information, which entails the financing of low quality projects that might otherwise be rejected in the second period.

First of all, our analysis is related to the literature on the relationship between securitization and banks' monitoring incentives. Parlour and Plantin (2008) and Hakenes and Schnabel (2010) showed that securitization reduces banks' incentives to monitor their borrowers when there is informational asymmetry between loan selling banks and buyers, a situation that is harmful in terms of social welfare. In our article, we demonstrate similar results regarding monitoring incentives and social welfare. However, the reduction of incentives to monitor is not derived from the moral hazard or from the informational asymmetry between loan sellers and buyers as explained in their models, but from the intention to soften competition in the future. Our analysis thus shed lights on the current discussion on regulations on securitization market, suggesting a new dimension that policy makers have to consider.

On the other hand, our study is also obviously related to the literature on the motivation of loan securitization. One of the commonly held ideas concerning the rationale for securitization is bank's perspective on risk management, 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 that of regulatory arbitrage, associated with capital requirements (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 a balance sheet is a cost for banks. By taking this loan off their balance sheet, they can save their capital. A third argument is related to a more efficient recycling of bank funds (Gorton and Pennacchi, 1995, Parlour and Plantin, 2008). With a constraint on funds, retaining a loan until maturity 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 project. However, there are few articles that explicitly analyze 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.

Thirdly, this article is related to the literature concerning the link between relationship banking and loan market competition. Peterson and Rajan (1995) show that banks have a greater incentive to develop their relationship with new borrowers when loan markets 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 banks to shield their rent better. However, we show that relationship banking orientation can increase *ex ante* competition to capture more new clientele so as to extract rent in the future, in turn reducing overall profit. We

hence add a dynamic perspective to the link between relationship banking and 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 a 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 obtains proprietary information about former clients, banks can use information sharing to soften *ex ante* competition. When the banks' monitoring decision is considered, committing (via securitization) to stay uninformed can serve the same purpose.

The rest of this 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 signaling tool and discuss its effect on the loan market efficiency in Section 5. To conclude, we discuss some empirical implication of our analysis in Section 7.

2. Environment

Consider a two-period duopoly model with two banks, say A and B. They compete in two subsequent periods over loan rates (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 have to find external funding as they have no funds of their own. These can be of two types: $\theta \in \{H, L\}$. Borrowers know their own type, which is, however, not known to the banks. In period 1, a type θ project yields Y with probability of p_θ, and 0 otherwise. We assume the following

$$1 > p_H > p_L > 0. \tag{A1}$$

In period two, a type H always succeeds, and a type L always fails.[1] We assume that controlling a project allows borrowers to derive positive non-pecuniary private benefit that the lender cannot extract (Holmstrom and

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

Tirole, 1997). As a result, under limited liability, the type L borrowers will undertake the project in the second period even though they know that they will be bankrupt with certainty. Riskless net interest rate is normalized to 0. Furthermore, it will be assumed that

$$p_H Y - 1 > 0 > p_L Y - 1, \tag{A2}$$

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

$$\frac{\nu (1-p_H)}{\nu (1-p_H) + (1-\nu)(1-p_L)} Y < 1 \tag{A4}$$

where ν denotes the prior probability of a type H. Define $\bar{p} = \nu p_H + (1-\nu) p_L$. (A2) implies that H (L, 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 informations known to the public.

2.2. Banks

Banks initially have no specific information about the borrowers' type. The first period results are publicly observable (say, by a credit bureau or a credit registry in which the default record of borrowers are registered and which are accessible to banks) Banks can use this information to evaluate the type of borrowers by Bayesian 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 the lending bank, which is neither verifiable by others nor transferable to others (soft information). If the borrower is of type H, the monitoring bank can raise the probability of success by $\Delta p > 0$ (Dewatripont and Maskin, 1995).[2] We assume $p_H + \Delta p = 1$ for simplicity. Banks decide strategically whether they monitor or not. We note by $\sigma_A, \sigma_B \in \{0, 1\}$, the strategy on monitoring, $\sigma_i = 1$ implying bank i monitors its clientele.

2.3. Switching Costs

Borrowers can switch their banks in the second period but this incurs a switching cost. We consider this switching cost to be heterogeneous among borrowers assuming that they incur an idiosyncratic switching cost (s) distributed uniformly on $[0, \bar{s}]$ (for tractability). They learn their individual

[2]Alternatively, we can consider monitoring as preventing the borrower from doing opportunistic behaviour which saves borrower's private effort but harmful to the project *à la* Diamond (1991), Holmstrom and Tirole (1997), Parlour and Winton (2008).

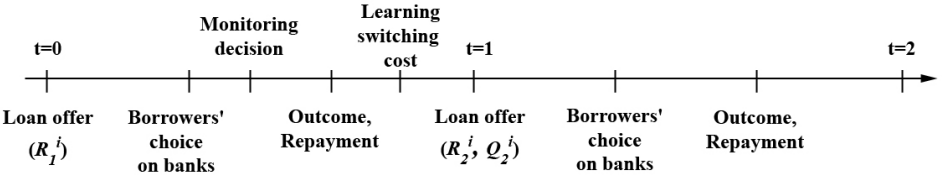

Figure 3: Timing

switching cost only at the end of the first period, and it is not observable by others parties 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. The heterogeneity and private character of switching costs render poaching a 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 the loan rate offer made by outside banks is more attractive.

The assumption about the switching cost is quite natural to the extent that borrowers' satisfaction or dissatisfaction about a bank can be different depending on the individual preference to the banks' services, and borrowers can only measure them exactly once they have had a relationship. Switching costs may capture the direct cost of closing an account with one bank and opening it elsewhere; the cost associated with a different application procedure with other banks; but also the loss of relationship benefit between the borrower and his former bank.[3]

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 the banks and execute their project. Banks decide whether they monitor their own borrowers. If they decide to monitor, they learn their borrower's type and control the H type projects in order to increase their success probability. They observe the projects' return, and the 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 first-period clientele. If borrowers receive an offer from both banks, they decide whether they continue their relation-

[3]See Kim et al. (2003), Stango (2002) for empirical evidence on switching costs in the banking and credit card sector.

ship with the 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: Choice on Monitoring without Securitization

In this section, we analyze the outcome of competition when banks do not have possibility to securitize their loan portfolio. In this section, banks hold their loans in their balance sheet until the maturity ("*Originate-to-Hold*"). We take this case as a benchmark and will endogenize the decision on securitization in the next section. We solve this game by backward induction. We focus our analysis on pure strategy equilibria. Existence of such equilibria is ensured by the following condition:

$$\frac{1}{9}\nu\bar{s} \geq (1-\nu)p_L \text{ and } p_H \geq \frac{1}{4} \tag{1}$$

3.1. Second-period Competition

We firstly characterize the outcome of second-period competition. We take as given first-period market shares (μ^A,μ^B). In the second period, banks compete for two groups of borrowers, *i.e.*, their own clientele and the rival's in the first period. Let R^A (respectively Q^A) be the interest rate offered by bank A to borrowers within its clientele (respectively, within bank B's clientele). Analogously, denote bank B's strategy by $\left(R^B, Q^B\right)$.

3.1.1. Competition without monitoring

Consider firstly the case where bank i does not monitor ($\sigma^i = 0$). As no banks have private information about bank i's clientele, banks' offering decision on them exclusively depends on the public information, *i.e.*, period 1-default record. Given (A4), no banks offer a loan contract to unsuccessful borrowers in the first period (unlucky borrowers) independent from their type. Only the borrowers that succeeded in the first period (lucky borrowers) will have an offer from both banks.

A lucky type G borrower within bank i's clientele switches whenever

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

This yields a switching threshold

$$s = R_2^i - Q_2^j$$

Lucky type B borrowers also receive an offer from both banks. However, they do not change their bank due to their switching cost. In other words, given 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. Given the condition (1), we can obtain a unique Nash equilibrium associated to the competition on bank i's clientele:

Lemma 1. *For $\sigma^i = 0$, Period-2 competition on i's clientele results in the interest rate*

$$R_2^i = 1 + \frac{2}{3}\bar{s}, \quad Q_2^j = 1 + \frac{1}{3}\bar{s}$$

and yields the profits

$$\pi^{i/i} = \nu\frac{4}{9}p_H\bar{s} - (1-\nu)\,p_L, \tag{2}$$

$$\pi^{j/i} = \nu\frac{1}{9}p_H\bar{s}. \tag{3}$$

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 does not monitor its clientele in the period-1.

Proof. See Appendix A. ■

3.1.2. Competition with Monitoring

Consider now the case in which bank i monitors its clientele. As bank i has private information about the type of its own clients, it makes an offer only to the G-type projects. On the other hand, bank j's offering decision for i's clients always depends on the default record in the first period as is in the previous case. Lucky type G borrowers will have an offer from both banks and make the same decision on switching as they do in the above case. The difference from the previous case lies in the situation of unlucky type G borrowers and of lucky type B borrowers. Unlucky type G borrowers receive an offer from their own bank, and they accept it. lucky type B borrowers now receive only one offer from bank j, and they will accept it and change their bank. By an analysis similar to the previous case, we obtain:

Lemma 2. *For $\sigma^i = 1$, Period-2 competition on i's clientele results in the interest rate same as lemma 1 and yields the profits*

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

$$\bar{\pi}^{j/i} = \nu\frac{1}{9}\bar{s} - (1-\nu)\,p_L. \tag{5}$$

Proof. See Appendix B. ■

It is noteworthy that banks make positive profit in the second period. It is related to the presence of the switching cost.

3.2. First-period Equilibrium

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

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

We assume that banks do not discount future profits. Bank i's overall profits can be written as a function of first-period interest rate policies and the monitoring strategy of two banks:

$$\Pi^i = \mu^i \left[\begin{array}{l} \bar{p}R_1^i - 1 \\ +\sigma^i \left(-c + \bar{\pi}^{i/i} + \nu\Delta p R_1^i\right) + \left(1 - \sigma^i\right)\pi^{i/i} \end{array} \right] + \mu^j \tilde{\pi}^{i/j} \tag{6}$$

where $\tilde{\pi}^{i/j} \equiv \sigma^j \bar{\pi}^{i/j} + \left(1 - \sigma^j\right)\pi^{i/j}$ implies the second period profit of bank i on bank j's period-1 clientele. The linearity of formula allows to characterize bank i's optimal decision on monitoring. Given R_1^i, bank i monitors if $c < c_0\left(R_1^i\right)$ and does not monitor if $c > c_0\left(R_1^i\right)$ where

$$c_0\left(R_1^i\right) = \nu\Delta p R_1^i + \left(\bar{\pi}^{i/i} - \pi^{i/i}\right) \tag{7}$$

As this condition is applied to all banks, we can characterize two kinds of symmetric pure strategy equilibria. Firstly, given that no monitoring is the equilibrium strategy for all banks ($\sigma^A, \sigma^B = 0$), the overall profit of each bank can be written as

$$\Pi^i = \mu^i \left[\ \bar{p}R_1^i - 1 + \pi^{i/i} - \pi^{i/j} \ \right] + \pi^{i/j}. \tag{8}$$

As the first period competition is classic Bertrand price competition, the equilibrium rate (R_1^*) is such that

$$\bar{p}R_1^* - 1 + \pi^{i/i} - \pi^{i/j} = 0. \tag{9}$$

R_1^* is the no monitoring equilibrium rate if $c > c_0\left(R_1^*\right)$.

By the similar reasoning for monitoring equilibrium, we obtain the following proposition:

Proposition 1. *We can characterize a unique symmetric pure strategy equilibrium upon monitoring cost c:*

No monitoring equilibrium: No banks monitor if $c > c_0$ where

$$c_0 = \nu\frac{4}{9}\Delta p\bar{s} + \left(1 - \nu\right)p_L + \frac{\nu\Delta p}{\bar{p}}\left[1 - \nu\frac{1}{3}p_H\bar{s} + \left(1 - \nu\right)p_L\right] \tag{10}$$

and the equilibrium rate and the profit is described as

$$R_1^* = \frac{1 - \nu\frac{1}{3}p_H\bar{s} + (1-\nu)\,p_L}{\bar{p}}, \tag{11}$$

$$\Pi^* = \pi^{i/j} = \nu p_H \frac{1}{9}\bar{s}. \tag{12}$$

Monitoring equilibrium: All banks monitor if $c < \bar{c}_0$ where

$$\bar{c}_0 = \nu\frac{4}{9}\Delta p\bar{s} + (1-\nu)\,p_L + \frac{\nu\Delta p}{\bar{p}}\left[1 - \nu\frac{1}{3}\bar{s} + \nu\frac{4}{9}\Delta p\bar{s}\right] \tag{13}$$

and the equilibrium rate and the profit is described as

$$\bar{R}_1^* = \frac{1 - \nu\frac{1}{3}\bar{s} - (1-\nu)\,p_L + c}{\bar{p} + \nu\Delta p}, \tag{14}$$

$$\bar{\Pi}^* = \bar{\pi}^{i/j} = \nu\frac{1}{9}\bar{s} - (1-\nu)\,p_L. \tag{15}$$

Proof. See Appendix C. ■

3.3. Comparison between two equilibria

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

$$\nu\frac{1}{3}\bar{s} + (1-\nu)\,p_L > \nu\frac{1}{3}p_H\bar{s} - (1-\nu)\,p_L.$$

This is the result of a deterioration in the 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 type B. Only external banks offer a loan to lucky B type clientele, which worsens the adverse selection problem when banks try to poach rival's clients. Each bank would take all the lucky B type clientele. For this reason, banks are less affected by a 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. In contrast, when banks monitor, the winner's curse problem becomes important and poaching becomes less profitable. This makes the first-period

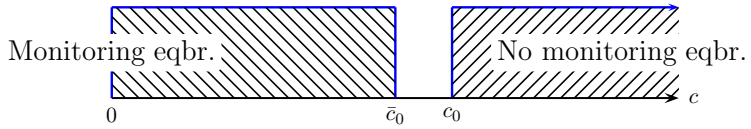

Figure 4: Equilibria without securitization

market share more important, and thus banks bid more aggressively in the first-period competition and waste more profit. As a result of this aggressive competition in the first period, banks can make even less profit than they would have by means of private information through monitoring.

$$\Pi^* - \bar{\Pi}^* = (1-\nu)\, p_L - \nu \frac{1}{9} \Delta p \bar{s} \tag{16}$$

The equation (16) represents the difference between the profit when banks do not monitor and the profit when banks monitor in the first period. The abovementioned mitigation of the winner's curse problem is captured in the first term of (16).

However, it is noteworthy that there exists another countervailing effect when banks do not monitor. Monitoring by banks increases the success probability of type G borrowers, which ameliorates the quality of the applicant pool in the second period since the poaching bank will offer loans only to borrowers that succeeded in period 1. The absence of monitoring prevents banks from benefitting from this positive effect. 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 (16).

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

Proposition 2. *Banks can collectively make more profit when they do not produce private information by monitoring and only depend 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 the winner's curse always dominates the pool worsening effect. In this case, banks can collectively make more profit when they have no private information.

On the other hand, proposition 1 characterize two different pure strategy equilibria upon monitoring cost c, which is presented in Figure 4. It is noteworthy that banks always make more profit in a no-monitoring equilibrium,

whereas it is not always attainable. In particular, no-monitoring equilibrium is never attainable for small monitoring costs, $c < \bar{c}_0$. Even though banks could make more profit if they were able to coordinate between themselves, it is not possible because the private gain received from deviating from monitoring is always higher when monitoring cost is small.

4. Choice on Monitoring with Securitization

In this section, we will analyze the effect of the introduction of securitization on the banks' decision on monitoring. We will show that banks can use loan securitization as a tool signaling the withdrawal of monitoring when a no-monitoring equilibrium is more profitable than a monitoring equilibrium.

4.1. Securitization

Now, banks are allowed to securitize their loan portfolio. At date $t = 0^+$, banks can sell a fraction $\tau \in [0, 1]$ of the loan portfolio to outside investors at a price $P(\tau, R_1^i, p^e)$ where p^e stands for the average quality (repayment probability) of securitized loan portfolio expected by investors. For simplicity, we assume in this section that banks issue pass-through securities on their whole loan portfolio and sell a fraction of τ to outside investors and retain $1 - \tau$ in their own balance sheet.[4] In other words, banks transfer a fraction τ of the revenue of each loan to buyers. On the other hand, we assume that loan sale market is perfectly competitive and investors are rational so that loans are sold at a price same as their final cash-flow value expected by investors.

4.2. Choice on Monitoring with Securitization

Overall expected profit of bank i is now described as:

$$\Pi^i = \mu^i \left[\begin{array}{l} P(\tau, R_1^i, p^e) + (1-\tau)\bar{p}R_1^i - 1 \\ +\sigma^i \left(-c + \bar{\pi}^{i/i} + (1-\tau)\nu\Delta p R_1^i\right) + (1-\sigma^i)\,\pi^{i/i} \end{array} \right] + \mu^j \tilde{\pi}^{i/j} \quad (17)$$

By the reasoning similar as the previous section, given τ, bank i does not monitor if $c > c_s(R_1^i)$ and monitor if $c < c_s(R_1^i)$ where

$$c_s\left(R_1^i\right) = (1-\tau)\,\nu\Delta p R_1^i + \left(\bar{\pi}^{i/i} - \pi^{i/i}\right) \quad (18)$$

In the way similar to the previous section, we can characterize two kinds of pure strategy equilibria. Consider no monitoring equilibrium. Given that no

[4]Alternatively, by this assumption, we can consider that the quality of sold loan portfolio and that of loans retained by bank is same. Or, banks sell their loans before monitoring if they intend to do. This assumption makes sense in that we consider interim monitoring.

monitoring by two banks is the equilibrium strategy $(\sigma^A, \sigma^B = 0)$, and that each bank sells a fraction τ of the revenues of its loan portfolio, in equilibrium it is sold at a fair price $P(\tau, R_1^i) = \bar{p}\tau R_1^i$. By the simple computation, we obtain that equilibrium rate and equilibrium profit remain unchanged comparing the equilibrium without securitization (R_1^*, Π^*). Plugging R_1^* into (18), we can obtain no monitoring equilibrium threshold. In applying similar analysis, we can obtain the following proposition;

Proposition 3. *When banks securitize a fraction τ of its loan portfolio:*
No monitoring is a unique equilibrium if $c > c_s$ where

$$c_s = \nu\frac{4}{9}\Delta p\bar{s} + (1-\nu)\,p_L + (1-\tau)\,\frac{\nu\Delta p}{\bar{p}}\left[1 - \nu\frac{1}{3}p_H\bar{s} + (1-\nu)\,p_L\right]; \quad (19)$$

Monitoring by both banks is a unique equilibrium if $c < \bar{c}_s$ where

$$\bar{c}_s = \nu\frac{4}{9}\Delta p\bar{s} + (1-\nu)\,p_L + (1-\tau)\,\frac{\nu\Delta p}{\bar{p}+\nu\Delta p}\left[1 - \nu\frac{1}{3}\bar{s} + \nu\frac{4}{9}\Delta p\bar{s}\right]. \quad (20)$$

The behind intuition of the above proposition is straightforward. Compare no monitoring equilibrium threshold between the case without securitization and the case with securitization of a fraction τ of loan portfolio. (equation (10) and (19) respectively). The first two terms in the right-hand side stands for the gain from monitoring in the second period, which remain unchanged after securitization. On the other hand, first period gain from monitoring, represented by the third term in RHS in (19), is lower than in (10). By securitization, banks have to transfer a part of this gain to loan buyers. Accordingly, by engaging in securitization, banks renounce publicly a part of this monitoring gain that they could obtain if they monitor. As such, securitization plays a role in signaling banks' intensity to no monitoring.

A certain level of securitization can shift the equilibrium from monitoring to no monitoring with monitoring cost c $(< c_0)$. This reduces informational asymmetry between first-period relationship bank and the external bank, which makes poaching in the second period more profitable. As a result, it can soften first-period competition for the initial market share. Given the condition that $\nu < \hat{\nu}$, banks collectively make more overall profits.

Proposition 4. *Given the monitoring cost c such that $c_s^0 < c < c_0$ (where $c_s^0 = \nu\frac{4}{9}\Delta p\bar{s} + (1-\nu)\,p_L$), securitization of the fraction τ of loan portfolio can lead to the emergence of the no-monitoring equilibrium as the pure strategy equilibrium and banks collectively more overall profits. The threshold of minimum level of τ such that $\tau \geq \hat{\tau}(c)$ is*

$$\hat{\tau}(c) = 1 - \frac{\bar{p}\left[c - \frac{4}{9}\nu\Delta p\bar{s} - (1-\nu)\,p_L\right]}{\nu\Delta p\left[1 - \frac{1}{3}\nu p_H\bar{s} + (1-\nu)\,p_L\right]} \quad (21)$$

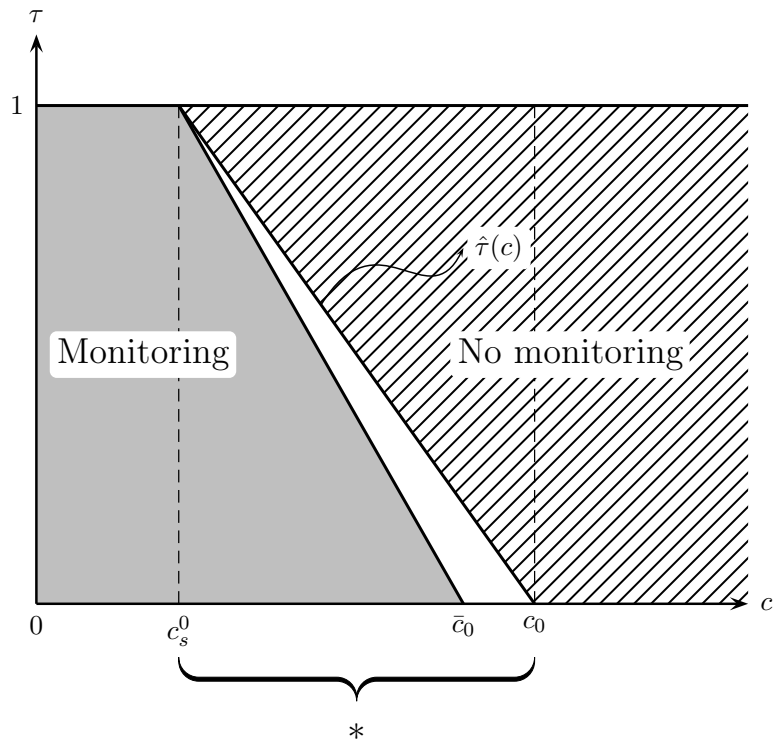

Figure 5: Equilibrium with securitization

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Proof. Straightforward from (19). ■

Figure 5 illustrates the above result. In the zone $*$, securitization can have an effect on the monitoring intensity of banking sector and on overall profits.

5. Securitization and Loan Market Efficiency

In this section, we will discuss about the relationship between securitization and efficiency. We measure loan market efficiency by the total surplus created thanks to bank loans including Bank's monitoring cost. The difference of surplus between monitoring equilibrium ($\bar{W}$) and no monitoring equilibrium (W) is:

$$\Delta W = \bar{W} - W = \nu \Delta p Y + \nu \left(1 - p_H\right)\left(Y - 1\right) - c \tag{22}$$

The first term is related to net monitoring gain from improving the performance of the G type project by controlling it in period 1. On the other hand, monitoring permits the financing of unlucky G type projects that might

otherwise be rejected in period 2. Monitoring leads to more efficient loan decision by banks in period 2, which is captured by the second term in (22). When $\Delta W > 0$, the shift to no monitoring equilibrium by securitization implies reduction in total surplus.

It is noteworthy that according to the proposition 4, securitization increases banks' overall profits. This increases in profits is related to softening competition in the first period by reducing the winner's curse effect in the second period. This comes to the detriment of loan market efficiency. Increases in profits is thus pure extraction of rent by banks from borrowers.

Our result is supported by several empirical studies. There are several empirical evidences that securitization or loan sales diminish the quality of loans. Keys et al. (2010), Mian and Sufi (2009), Purnanandam (2009) showed that the securitization led to inferior quality of loans by analyzing the US subprime mortgage loans. On the other hand, Berndt and Gupta (2009), Gaul and Stebunovs (2008) demonstrated that similar results on the link between loan sales and the loan performance in the corporate loan market.

In theoretical analysis, Parlour and Plantin (2008), Hakenes and Schnabel (2010) showed that securitization reduces banks' incentive to monitor their borrowers and is harmful in terms of social welfare.[5] However, the decrease in the monitoring incentive in their model is derived from informational asymmetry between loan selling banks and buyers. In our model, the reduction of the incentive to monitor is not derived from the problems associated with informational asymmetry in the secondary loan market but is motivated by an intention to soften competition. Thus, our analysis suggests an alternative explanation about the link between securitization and the deterioration of the quality of loans via loan market competition channel.

This channel has been received few attention in the current discussion about design of the new regulatory scheme. Our result suggests that enhancing transparency in the market for securitization such as more information disclosure would not be enough as far as loan market competition is concerned. Our analysis shows that even if investors expect perfectly the quality of sold loans, banks can have an incentive to reduce their intensity to monitoring. Among some proposals, obligation of retaining a certain fraction of loan such as taking first loss position can improve welfare by preventing banks from signaling on no monitoring. Our analysis provides an analytical guideline concerning the minimum retaining fraction of securitized loan portfolio. From equation (20), given c, the minimum fraction of retention level

[5]Morrison (2005) demonstrated similar result in the context of use of CDS.

is calculated as:

$$\tilde{\tau}(c) = 1 - \frac{(\bar{p} + \nu\Delta p)\left[c - \frac{4}{9}\nu\Delta p\bar{s} - (1-\nu)\,p_L\right]}{\nu\Delta p\left[1 - \nu\frac{1}{3}\bar{s} + \nu\frac{4}{9}\Delta p\bar{s}\right]}$$

6. Empirical implication

This article analyzed the motivation of loan securitization. We showed that banks can use the loan securitization as a strategic tool to soften loan market competition. We demonstrate that the use for this purpose can make banks collectively better off by increasing overall profits to the detriment of overall loan market efficiency. This result is valid as far as the proportion of high quality loan applicant is not too high (Proposition 2). Our analysis thus may shed light on the recent crisis triggered from sub-prime mortgage sector characterized typically by low proportion of high quality applicants.

Several analyses document particular increases in competition in this loan sector during a decade precedent to the crisis because other traditional mortgage market were saturated. One of the important segment in this sub-prime loan market is the sector for new applicants without credit records and new home owners who have no previous mortgage loan records (Hull, 2009). In spite of theirlow quality in average characterised by their low income and low wealth, this segment has been considered as profitable owing to high level of housing prices till the first half of 2000's. The official maturity of mortgage loans are very long whereas one of the main practices observed in this sub-prime loan sector is renegotiation of loan terms after short period of initial rate known as teaser rate. On the other hand, borrowers themselves consider that they will switch their mortgage lender after this teaser rate period if they find another lender who offers a more attractive loan contract. These observations (competition for borrowers without credit record, second round competition after short period, low proportion of high quality borrowers but ex ante profitable loan sector) are fit well to the environment that we have considered.

According to the prediction of our model, in this environment, securitization and associated lower level of monitoring can be a equilibrium play. It is more profitable for banks not to monitor their loan applicants than to do it. For monitoring worsens winner's curse effect in poaching rival's clients after teaser rate period, which will intensify competition for initial market share. Our analysis therefore offer an alternative explanation on seemingly related three empirical observations in this sub-prime loan market, in particular new loan applicant segment: Increasing competition, massive securitization, as well as low level of monitoring suggested by several empirical works (Dell'Ariccia et al., 2008, Keys et al., 2009).

Appendices

Appendix A. Proof of Lemma 1

We can write per-borrower expected profit on bank i 's clientele when bank i has only public information as

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

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

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

■

Appendix B. Proof of Lemma 2

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

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

■

Appendix C. Proof of Proposition 1

$\bar{c}_0$ can be calculated similar way to (7) - (9) in the no monitoring equilibrium. In what follows, we demonstrate that there is no profitable deviation for each equilibrium.

Note that the formulae (2), (3), (4), and (5) 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

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

Monitoring Equilibrium

First, we consider the Nash equilibrium with monitoring. Assume that one bank, say A, deviates to no monitoring. Let $\hat{R}_1^A$ denote 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

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

and overall profit for the deviating bank is written as

$$\begin{aligned}\hat{\Pi}^A &= \hat{\mu}_A\left(\bar{p}\hat{R}_1^A-1\right)+\left(\hat{\mu}_A\pi^{A/A}+\left(1-\hat{\mu}_A\right)\bar{\pi}^{A/B}\right) &\text{(C.2)}\\ &= \hat{\mu}_A\left(\bar{p}\hat{R}_1^A-1+\left(\pi^{A/A}-\bar{\pi}^{A/B}\right)\right)+\bar{\pi}^{A/B}. &\text{(C.3)}\end{aligned}$$

Now, given B's equilibrium offer in period one ($\bar{R}_1^*$), A's market share is given by[6]

$$\hat{\mu}^A = \begin{cases} 0 & \text{if } \hat{R}_1^A > \bar{R}_1^*,\\ \frac{1}{2} & \text{if } \hat{R}_1^A = \bar{R}_1^*,\\ 1 & \text{if } \hat{R}_1^A < \bar{R}_1^*.\end{cases} \tag{C.4}$$

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

From (C.3) and (C.4), one easily sees that $\hat{\Pi}^A > \bar{\Pi}^* = \bar{\pi}^{A/B}$ if and only if $\bar{p}\hat{R}_1^A - 1 + \left(\pi^{A/A} - \bar{\pi}^{A/B}\right) > 0$ and $\hat{R}_1^A \leq \bar{R}_1^*$. A necessary and sufficient condition for the absence of profitable deviation is thus

$$\bar{p}\bar{R}_1^* - 1 + \left(\pi^{A/A} - \bar{\pi}^{A/B}\right) < 0. \tag{C.5}$$

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 (C.5) can be rewritten as Proposition 1.

No monitoring Equilibrium

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 are given as

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

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

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

Using the equilibrium interest offer

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

we get the equivalent condition

$$\nu\Delta pR_1^* + \left(\bar{\pi}^{A/A} - \pi^{A/A}\right) - c < 0. \tag{C.6}$$

■

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