Securitization, Competition and Incentive to Monitor☆

Jung-Hyun Ahn[a,*], Régis Breton[b,c]

[a]*Rouen Business School, Dept. of Economics and Finance, 1, rue du Maréchal Juin - BP 215, 76825 Mont-Saint-Aignan Cedex, France.*
[b]*Banque de France, 35-2341 DGO-DSF-SMF,75049 PARIS Cedex 01, France*
[c]*CNRS-LEO, University of Orléans.*

Abstract

This article analyzes the interaction between loan securitization and competition in loan market. We consider a two-period loan market competition model in which period 2-competition is affected by the winner's curse. This increases *ex ante* competition for a greater initial market share. Given that securitization transfers a part of the 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 the exploitation of informational asymmetries in the secondary market for loans. Our result suggests that current securitization reform exclusively focusing on informational asymmetries in securitization market would not be enough.

Keywords: securitization, loan sales, banking competition, monitoring
JEL: G21, L12, L13

☆The authors are grateful to Vincent Bignon, Jean Cartelier, Xavier Freixas, Bertrand Gobillard, Vadim Khramov, Antoine Martin, Bruno Parigi, Guillaume Plantin, Jean-Charles Rochet, Jean-Paul Pollin and Laurence Scialom for helpful discussions. Part of this paper was written while Ahn was a visiting scholar at Pompeu Fabra University, where the hospitality of Xavier Freixas is gratefully acknowledged. Thanks also to the seminar participants at MFA (New Orleans), AMES(Seoul), FMA (NewYork), AFSE (Paris), EEA (Barcelona), SMYE (Istanbul), the International Financial Research Forum (Paris), Tor Vergata (Rome), MMF (London), Symposium on Money, Banking and Finance (Luxembourg) as well as at Pompeu Fabra University, the Univ. of Orléans, the Univ. of Paris 10 and Rouen Business School. 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.

*Corresponding author. Tel.: +33 2 32 82 46 75, Fax: +33 2 32 82 58 34.
Email addresses: `jung-hyun.ahn@rouenbs.fr` (Jung-Hyun Ahn), `regis.breton@banque-france.fr` (Régis Breton)

May 2012

1. Introduction

The recent financial crisis triggered by the US subprime mortgage sector in mid-2007 had an unprecedented negative impact on the real economy and on the banking sector. There is widespread concensus that the losses related to the securitized products such as MBS and CDOs are at the heart of the financial crisis. A number of discussions have followed among the community of practitioners, academics and regulators concerning the remedies related to the securitization of the financial markets. (See for example American Securitization Forum et al., 2008, ECB, 2008, Franke and Krahnen, 2008, .)

Several recent empirical studies have placed the emphasis on the link between securitization and reduction in loan quality. This literature argued that the main cause of the crisis was the originate-to-distribute model of securitization and the lack of skin in the game for lenders or securitizers. In other words, as lenders and securitizers retain few or no stakes by securitization, they tend to be less care about the quality of assets, which causes moral hazard such as lazy monitoring or screening as well as intentional sales of low quality assets Berndt and Gupta (2009), Dell'Ariccia et al. (2008), Mian and Sufi (2009), Keys et al. (2010), Purnanandam (2011).

The main remedies adopted in the US or European countries reflect this view: the main recommendations of the Dodd-Frank Wall Street Reform and Consumer Protection Act enacted on July 2010 in the US requires more skin in the game for securitzers by retaining 5 % of the securitized portfolio, better information disclosure on the securitized products. The European Union has also adopeted a similar proposal requiring originators to hold at least 5% of the securitized portfolio.[1]

As such, recent reforms on the securitization focus exclusively on the problems related to informational asymmetries between the sellers and buyers of securitization markets. However, this line of prescription may overlook the other side of securitized asset market: the market for underlying asset, in particular loan market. In this article, we analyze the interaction between loan market competition and the use of securitization by banks and its effect on bank's incentive to monitor. More specifically, we show that banks can strategically use loan securitization to soften the effect of loan market competition. Incidentally, we also show that, under certain condi-

[1]For more details, see IX.D. of the Dodd-Frank Act "Improvements to the Asset-Backed Securitization Process" and Article 122a, European European Parliament, 2009.

tions, securitization increases banks' profits but worsens overall loan quality and loan market efficiency, even without informational asymmetry in the securitization market. This result suggests that new regulation focusing only on securitization market may not be sufficient to cure inefficiency associated to securitization.

For this purpose, we consider a simple duopoly model of the loan market, where banks compete for borrowers over two periods, inspired by Gehrig and Stenbacka (2007) and 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 about 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 the more acute informational asymmetry that 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 are able to signal a reduction in 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 banks are reducing 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 that no longer renders monitoring with securitization is profitable. Thus the 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, but it may have a negative effect on overall loan market efficiency. This 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 have been rejected in the second period.

Our paper is related to several strands of the literature. 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 suggested in their models, but from the intention to soften competition in the future. Our analysis thus sheds light on the current discussion on regulations in the securitization market, and suggests a new dimension that policy makers must consider.

On the other hand, our study is also obviously related to the literature on the motivation of loan securitization. One commonly held idea concerning the rationale for securitization is banks' perspective on risk management, according to which banks use securitization to transfer or diversify credit risks (Allen and Carletti, 2006, Wagner and Marsh, 2006, etc.). Another well-known argument is that of the regulatory arbitrage associated with capital requirements (Acharya et al., 2010, 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 creates additional cost for banks. By taking this loan off their balance sheet, they can save their capital. A third argument is related to the more efficient recycling of bank funds (Gorton and Pennacchi, 1995, Parlour and Plantin, 2008). With a constraint on funds, retaining a loan until maturity involves an opportunity cost if banks have other more profitable lending opportunities. By using securitization, banks can recuperate their funds earlier, and redeploy them in 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 of why banks securitize their loans, 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 in order to survive in the face of interbank competition, because this allows banks to shield their rent better. However, we show that a relationship banking orientation can increase *ex ante* competition in order to

capture more new clientele so as to extract rent in the future, which in turn reduces 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 Sections 3 and 4. We analyze the use of securitization as a signaling tool, and discuss its effect on loan market efficiency in Section 5. To conclude, we discuss some empirical implications of our analysis in Section 6.

2. Environment

Consider a two-period duopoly model with two banks, A and B. They compete in two subsequent periods over loan rates (Bertrand price competition) by offering short-term loan contracts. The lending rate may 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 because they have no funds of their own. Such projects may 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.[2] We assume that controlling a project allows borrowers to derive a positive non-

[2]The assumption that a type L borrower's second project fails with probability 1 is made for analytical convenience. If we also use p_L for the second project, the result is unaffected whereas the maths becomes more tedious.

pecuniary private benefit that the lender cannot extract (Holmstrom and Tirole, 1997). As a result, under limited liability, type L borrowers will undertake the project in the second period, even though they know that they will certainly become bankrupt. The risk-free net interest rate is normalized to 0. Furthermore, it will be assumed that

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

$$\bar{p} Y > 1 > \frac{\nu (1 - p_H)}{1 - \bar{p}} Y, \tag{A3}$$

where ν denotes the prior probability of a type H and $\bar{p} = \nu p_H + (1 - \nu) p_L$, the prior probability that a project succeeds. (A2) implies that H (L, respectively) makes an *ex ante* positive (negative, respectively) net return. Making a loan in the first period is *ex ante* efficient (1st inequality in (A3)), whereas making a loan to a project that fails in period 1 is never profitable (2nd inequality in (A3)). (A1) – (A3) are the items of information known to the public.

2.2. Banks

Initially, banks have no specific information about the borrowers' type. The first period results are publicly observable (by a credit bureau or a credit registry, in which the default record of borrowers are registered, and are accessible to banks). Banks can use this information to evaluate the type of borrowers by Bayesian revision.

Banks can produce private information by monitoring. During the first period, the initial lender can learn its borrowers' type, at a cost $c > 0$. This is a relationship-specific information known only to 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).[3] We assume $p_H + \Delta p = 1$ for simplicity. Banks decide strategically whether to monitor or not. We note by $\sigma_A, \sigma_B \in \{0, 1\}$, the strategy on monitoring, $\sigma_i = 1$ denoting the case in which 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

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

borrowers, assuming that they incur an 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 other parties, including banks. As a consequence, banks cannot make a contract conditional on individual switching costs. This allows the banks to make a positive profit on the Bertrand price competition. The heterogeneity and private character of switching costs renders poaching a rival's borrowers 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.

This assumption about the switching cost is quite natural, to the extent that borrowers' satisfaction or dissatisfaction with a bank may differ depending on the individual preference for the bank's 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, and also the loss of the relationship benefit between the borrower and his former bank.[4]

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 to 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 regarding second-period projects to its own borrowers, R_2^i, and his rival's borrowers, Q_2^i. Q_2^i is the poaching rate by which 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 to continue their relationship with the first-period bank, or to change their bank. The rest is similar to the first period. The timing is summarized in Figure 1.

3. Baseline Model: Choice on Monitoring without Securitization

In this section, we analyze the outcome of competition when banks do not have the possibility of securitizing their loan portfolio. In this section, banks

[4]See Barone et al. (2011), Kim et al. (2003) and Stango (2002) for empirical evidence on switching costs in the banking and credit card sector.

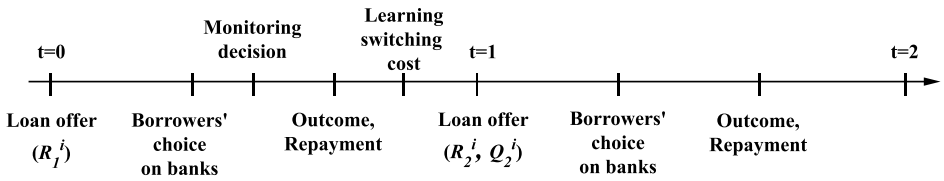

Figure 1: Timing

hold their loans on their balance sheet until maturity ("*Originate-to-Hold*"). We take this case as a benchmark, and we will introduce the possibility of securitization in the next section. We solve this game by backward induction. We focus our analysis on pure strategy equilibria.

3.1. Second-period Competition

We first 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_2^A (respectively Q_2^A) be the interest rate offered by bank A to borrowers among its clientele (respectively, within bank B's clientele). Analogously, denote bank B's strategy by $\left(R_2^B, Q_2^B\right)$.

3.1.1. Competition without monitoring

Consider first the case where bank i does not monitor ($\sigma^i = 0$). As no banks have private information about bank i's clientele, banks' decision on offering a loan depends exclusively on public information, *i.e.*, the period 1-default record. Given (A3), no banks offer a loan contract to unsuccessful borrowers in the first period (unlucky borrowers), independently of their type. Only those borrowers that succeeded in the first period (lucky borrowers) will receive 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 the switching cost. In other words, given limited liability, their expected payoff is always 0 irrespective of the loan rate, whereas they have to incur a switching cost when they change their bank. We can obtain a unique Nash equilibrium associated with the competition for bank i's clientele:

Lemma 1. *For $\sigma^i = 0$, when $\nu \geq \nu_0 = \frac{p_L}{\frac{4}{9}p_H\bar{s}+p_L}$, period-2 subgame on i's clientele has a unique pure strategy equilibrium with the interest rate*

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

and profits

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

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

where $\pi^{i/i}$ ($\pi^{j/i}$, respectively) is the profit of bank i (j, respectively) from the period-1 clientele of bank i when i does not monitor its clientele in period-1.

Proof. See Appendix. ■

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 for 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 in the previous case. Lucky type G borrowers will receive an offer from both banks, and will 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 $\sigma^i = 1$, when $\nu \geq \bar{\nu}_0 = \frac{p_L}{\frac{1}{9}\bar{s}+p_L}$, period-2 subgame on i's clientele has a unique pure strategy equilibrium. Competition in the second period results in the interest rate being the same as in lemma 1, and it yields the profits*

$$\bar{\pi}^{i/i} = \frac{4}{9}\nu\bar{s}, \tag{3}$$

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

Proof. See Appendix. ■

It is noteworthy that banks make a positive profit in the second period. This 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 compete only with the first-period loan rate. As a result, first period market shares obey

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

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 the two banks:

$$\Pi^i = \mu^i \left[\begin{array}{l} \bar{p}R_1^i - 1 \\ +\sigma^i \left(-c + \bar{\pi}^{i/i} + \nu \Delta p R_1^i\right) + \left(1 - \sigma^i\right) \pi^{i/i} \end{array} \right] + \mu^j \tilde{\pi}^{i/j} \tag{5}$$

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

$$c\left(R_1^i\right) = \nu \Delta p R_1^i + \left(\bar{\pi}^{i/i} - \pi^{i/i}\right) \tag{6}$$

As this condition applies to all banks, we can characterize two kinds of symmetric pure strategy equilibria.

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

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

$$c_0 = \frac{4}{9}\nu \Delta p \bar{s} + (1 - \nu) p_L + \frac{\nu \Delta p}{\bar{p}} \left[1 - \frac{1}{3}\nu p_H \bar{s} + (1 - \nu) p_L\right] \tag{7}$$

and the equilibrium rate and the profit is described as

$$R_1^* = \frac{1 - \frac{1}{3}\nu p_H \bar{s} + (1 - \nu) p_L}{\bar{p}}, \tag{8}$$

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

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

$$\bar{c}_0 = \frac{4}{9}\nu \Delta p \bar{s} + (1 - \nu) p_L + \frac{\nu \Delta p}{\bar{p}} \left[1 - \frac{1}{3}\nu \bar{s} + \frac{4}{9}\nu \Delta p \bar{s}\right] \tag{10}$$

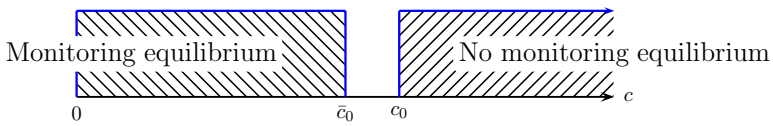

Figure 2: Equilibria without securitization

and the equilibrium rate and the profit is described as

$$\bar{R}_1^* = \frac{1 - \frac{1}{3}\nu\bar{s} - (1-\nu)\, p_L + c}{\bar{p} + \nu\Delta p}, \tag{11}$$

$$\bar{\Pi}^* = \bar{\pi}^{i/j} = \frac{1}{9}\nu\bar{s} - (1-\nu)\, p_L. \tag{12}$$

Proof. See Appendix. ■

Proposition 1 characterizes two different pure strategy equilibria upon monitoring cost c, which is presented in Figure 2.

4. Monitoring Incentive and Banks' profits

In this section, we discuss the difference in bank's profits between monitoring and no-monitoring equilirbrium. When all banks monitor, this worsens the winner's curse problem in period 2. Monitoring creates an informational asymmetry between the first period lending bank and the external bank. If period-1 banks had monitored and learned the type of borrowers, they would not offer a loan to type L. Only external banks offer a loan to lucky L type clientele, which worsens the adverse selection problem when banks try to poach their rival's clients. Each bank would take all the lucky L type clientele of its rival. Inversely, banks are less affected by a rival's L type clientele when they do not monitor. This effect renders poaching in period 2 more profitable and, in turn, renders period-1 market share less important when they have no private information. This 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 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 may make even less profit than they would have by means of private information through monitoring.

$$\Pi^* - \bar{\Pi}^* = (1-\nu)\, p_L - \frac{1}{9}\nu\Delta p\bar{s} \tag{13}$$

Equation (13) 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 (13).

However, it is noteworthy that there exists another countervailing effect when banks do not monitor. Monitoring by banks increases the success probability of type H borrowers, and this improves the quality of the applicant pool in the second period, since the poaching bank will offer loans only to those 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 succeed 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 H borrowers. This yields the following proposition.

Proposition 2. *Banks can collectively make more profit when they do not produce private information by monitoring, and depend only on public information, if* $max\{\nu_0, \bar{\nu}_0\} \leq \nu < \hat{\nu}$,

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

Proof. The first inequality is derived from the condition that pure strategy equilibrium exists. (Lemma 1 and 2) The second inequality is immediately derived from $\Pi^* - \bar{\Pi}^* > 0$. ■

If the average quality of borrowers, ν, is not too high, the effect of the mitigation of the winner's curse always dominates the pool worsening effect. In this case, the banks may collectively make more profit when they have no private information. However, in spite of banks' collective interest of this no-monitoring equilibrium, it is noteworthy that that it is not always attainable. In particular, a 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, this is not possible, because the private gain received from deviating from monitoring is always higher when the monitoring cost is low.

5. 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 to signal the withdrawal of monitoring when a no-monitoring equilibrium is more profitable than a monitoring equilibrium.

5.1. Securitization

Now banks are allowed to securitize their loan portfolio. At date $t = 0^+$, banks can sell a fraction $\tau \in [0, 1]$ of their 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 the 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.[5] In other words, banks transfer a fraction τ of the revenue of each loan to buyers. τ and R_1^i are observable. On the other hand, the loan sale market is perfectly competitive and investors are rational, so that they expect the quality of securitized loan portfolio (p) from τ.

5.2. Choice on Monitoring with Securitization

Overall expected profit of bank i is now described as

$$\Pi^i = \mu^i \left[\begin{array}{l} P(\tau, R_1^i, p^e) + (1-\tau)\bar{p}R_1^i - 1 \\ +\sigma^i \left(-c + \bar{\pi}^{i/i} + (1-\tau)\nu\Delta p R_1^i\right) + (1-\sigma^i)\,\pi^{i/i} \end{array} \right] + \mu^j \tilde{\pi}^{i/j} \quad (14)$$

By reasoning similar to that in 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

$$c_s\left(R_1^i\right) = (1-\tau)\,\nu\Delta p R_1^i + \left(\bar{\pi}^{i/i} - \pi^{i/i}\right) \quad (15)$$

In a way similar to the previous section, we can characterize two kinds of pure strategy equilibria. Consider no monitoring equilibrium. Given that no 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 comparied to the equilibrium without securitization (R_1^*, Π^*). Plugging R_1^* into (15), we can obtain no monitoring equilibrium threshold. In applying a similar analysis, we obtain the following proposition;

Proposition 3. *When banks securitize a fraction τ of its loan portfolio:*

1. No monitoring is a unique equilibrium, if $c > c_s$ where

$$c_s = \frac{4}{9}\nu\Delta p\bar{s} + (1-\nu)\,p_L + (1-\tau)\,\frac{\nu\Delta p}{\bar{p}}\left[1 - \frac{1}{3}\nu p_H\bar{s} + (1-\nu)\,p_L\right]; \quad (16)$$

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

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

$$\bar{c}_s = \frac{4}{9}\nu\Delta p\bar{s} + (1-\nu)\,p_L + (1-\tau)\,\frac{\nu\Delta p}{\bar{p}+\nu\Delta p}\left[1 - \frac{1}{3}\nu\bar{s} + \frac{4}{9}\nu\Delta p\bar{s}\right]. \quad (17)$$

The intuition behind the above proposition is straightforward. Compare no monitoring equilibrium threshold between the case without securitization and the case with the securitization of a fraction τ of the loan portfolio. (equations (7) and (16), respectively). The first two terms on the right-hand side stand for the gain from monitoring in the second period, which remains unchanged after securitization. On the other hand, the first period gain from monitoring, represented by the third term on RHS in (16), is lower than in (7). 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 monitored. 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 the first-period relationship bank and the external bank, and it makes poaching in the second period more profitable. As a result, it can soften the first-period competition for 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 $c_s^0 = \nu\frac{4}{9}\Delta p\bar{s} + (1-\nu)\,p_L$), the securitization of a fraction τ of the loan portfolio can lead to the emergence of the no-monitoring equilibrium as the pure strategy equilibrium, and the banks collectively make greater overall profits. The threshold of minimum level of τ such that $\tau \geq \hat{\tau}(c)$ is*

$$\hat{\tau}(c) = 1 - \frac{\bar{p}\left[c - \frac{4}{9}\nu\Delta p\bar{s} - (1-\nu)\,p_L\right]}{\nu\Delta p\left[1 - \frac{1}{3}\nu p_H\bar{s} + (1-\nu)\,p_L\right]} \quad (18)$$

.

Proof. Straightforward from (16). ■

Figure 3 illustrates the above result. In the zone $*$, securitization can have an effect on the monitoring intensity of the banking sector, and on overall profits.

6. Securitization and Loan Market Efficiency

In this section, we will discuss the relationship between securitization and efficiency. We measure loan market efficiency by the total surplus created

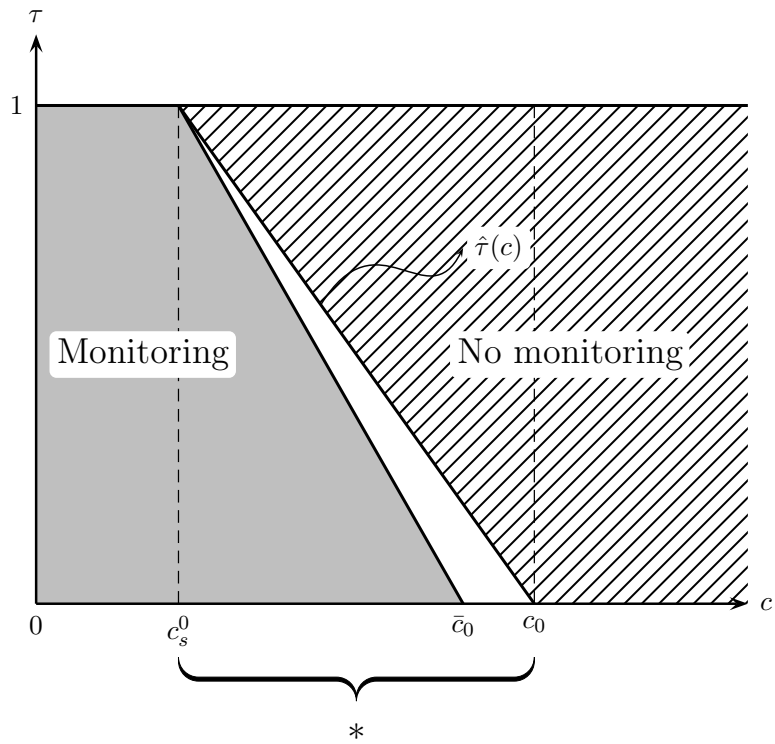

Figure 3: Equilibrium with securitization

thanks to bank loans, including the bank's monitoring cost. The difference of surplus between the monitoring equilibrium ($\bar{W}$) and the no monitoring equilibrium (W) is

$$\Delta W = \bar{W} - W = \nu \Delta p Y + \nu \left(1 - p_H\right)\left(Y - 1\right) - c \tag{19}$$

The first term is related to the net monitoring gain from improving the performance of the H type project, by controlling it in period 1. On the other hand, monitoring permits the financing of unlucky H type projects that might otherwise be rejected in period 2. Monitoring leads to more efficient loan decisions by banks in period 2, as captured by the second term in (19). When $\Delta W > 0$, the shift to a no-monitoring equilibrium by securitization implies reduction in total surplus.

It is noteworthy that, according to proposition 4, securitization increases banks' overall profits. This increase in profits is related to the reduction of 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 are thus a pure extraction of rent, by banks from borrowers.

There are several examples of empirical evidence that securitization and loan sales reduce the quality of loans. Keys et al. (2010), Mian and Sufi

(2009) and Purnanandam (2011) showed that securitization led to an inferior quality of loans, by analyzing US subprime mortgage loans. On the other hand, Berndt and Gupta (2009) and Gaul and Stebunovs (2009) demonstrated similar results on the link between loan sales and the loan performance in the corporate loan market.

In theoretical analysis, Parlour and Plantin (2008) and Hakenes and Schnabel (2010) showed that securitization reduces banks' incentive to monitor their borrowers, and is harmful in terms of social welfare.[6] However, the decrease in the monitoring incentive in their model is derived from the 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. Rather, it is motivated by the intention to soften competition. Thus, our analysis suggests an alternative explanation of the link between securitization and the deterioration of the quality of loans via the loan-market competition channel.

This channel has received little attention in the current discussion of the design of the new regulatory scheme. Our analysis suggests that, even if investors anticipate perfectly the quality of the loans sold, banks may have an incentive to reduce their intensity to monitoring. Our result thus suggests that enhancing transparency in the market for securitization, by such meauns as more information disclosure, would not be enough when loan market competition is taken into account. Among several regulatory remedies under consideration, the obligation to retain a certain fraction of loans, 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 retained fraction of the securitized loan portfolio. From equation (17), given c, the minimum compulsory fraction of retention level is calculated as:

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

7. Empirical implications

We showed that banks can use loan securitization as a strategic tool to soften loan market competition. We demonstrate that 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 long as the proportion of high-quality loan applicants is not too high (Proposition 2).

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

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 by banks to fiercer competition in loan markets. In the last two decades, the landscape of the banking sector has changed dramatically, 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.

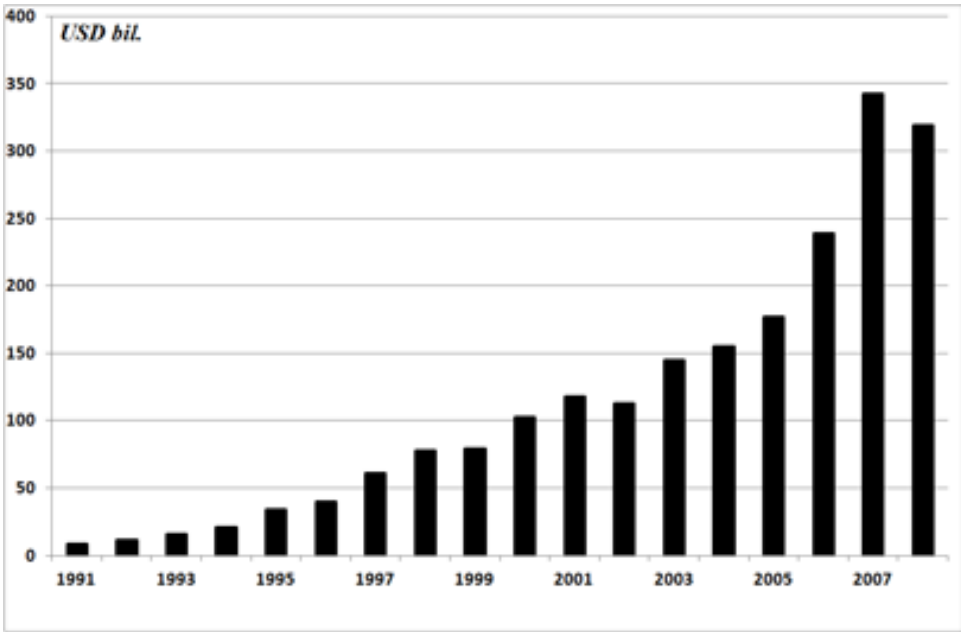

Figure 4: ABS market in the US (*Source: reproduced from the data in Gorton and Metrick (2011)*)

The Gramm-Leach-Bliley Act of 1999 terminated the separation between commercial banking and investment banking business. The EU area introduced the single banking license in 1993, thus enabling a bank that obtained a banking license in one member country to open branches in another member country without further permission. Interbank competition has thus dramatically increased, as several studies have noted. (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 (Figures 4 and 5. See also BIS (2003; 2008)). This phenomenon is even referred to as a 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 these increases in securitization with the increases in loan

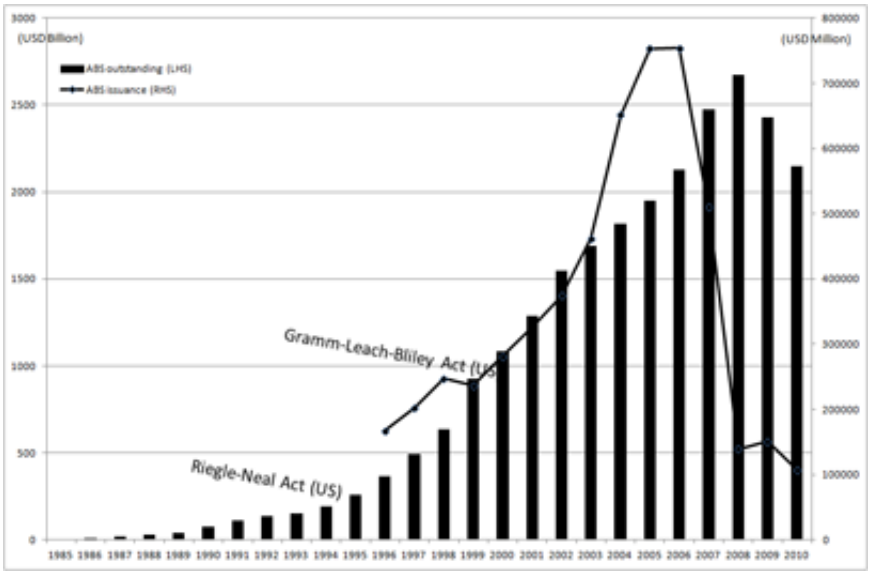

Figure 5: Single name loan sales in the US (*Source: Reuters LPC Traders Survey*)

market competition. More specifically, we show that banks can strategically use loan securitization to soften the effect of loan market competition, which suggests that securitization may be a consequence of increasing competition.

Our analysis may thus shed light on the recent crisis triggered from the sub-prime mortgage sector characterized typically by a low proportion of high quality applicants.

Several analyses document particular increases in competition in this loan sector during the decade prior to the crisis (Ashcraft and Schuermann, 2008, Bernanke, 2007) - in part, the saturation of other traditional mortgage markets and the result of excess capacity in the lending industry. One 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 their low quality on average, as characterized by their low income and low wealth, this segment has been considered profitable, owing to the high level of housing prices until the first half of the 2000s. The official maturities of mortgage loans are very long, whereas one of the main practices observed in the sub-prime loan sector is the renegotiation of loan terms after a short period of initial rate, known as the 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 that offers a more attractive loan contract. These observations (competition for borrowers without a credit record, second round competition after a short period, a low proportion of high quality borrowers but an *ex ante* profitable

loan sector) fit well with the environment that we have considered.

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

Appendix: Proofs

Proof of Lemma 1: We can write per-borrower expected profit on bank i 's clientele when bank i has only public information as

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

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

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

This is a unique equilibrium if $\pi^{i/i}$ and $\pi^{j/i}$ are not negative, in other words, $\frac{4}{9}\nu p_H \bar{s} - (1-\nu)\, p_L \geq 0$, which implies $\nu \geq \frac{p_L}{\frac{4}{9}p_H \bar{s} + p_L}$.■

Proof of Lemma 2: We can write per-borrower expected profit on bank i 's clientele when bank i monitors as

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

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

A similar calculation yields

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

This is a unique equilibrium if $\bar{\pi}^{i/i}$ and $\bar{\pi}^{j/i}$ are not negative, in other words, $\frac{1}{9}\nu \bar{s} - (1-\nu)\, p_L \geq 0$, which implies $\nu \geq \frac{p_L}{\frac{1}{9}\bar{s} + p_L}$.■

Proof of Proposition 1: First, 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

$$\Pi^i = \mu^i \left[\ \bar{p} R_1^i - 1 + \pi^{i/i} - \pi^{i/j}\ \right] + \pi^{i/j}. \tag{20}$$

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

$$\bar{p} R_1^* - 1 + \pi^{i/i} - \pi^{i/j} = 0. \tag{21}$$

By plugging above R_1^* to (6), we can obtain no monitoring equilibrium threshold c_0.

By similar reasoning for the monitoring equilibrium, we obtain monitoring equilibrium interest rate $\bar{R}_1^*$ and monitoring equilirbrium threshold $\bar{c}_0$. In what follows, we demonstrate that there is no profitable deviation for each equilibrium.

Note that the formulae (1), (2), (3), and (4) allow us 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

$$\hat{\Pi}_2^A = \hat{\mu}_A \pi^{A/A} + (1 - \hat{\mu}_A)\, \bar{\pi}^{A/B}, \tag{22}$$

and overall profit for the deviating bank is written as

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

$$= \hat{\mu}_A \left(\bar{p}\hat{R}_1^A - 1 + \left(\pi^{A/A} - \bar{\pi}^{A/B}\right)\right) + \bar{\pi}^{A/B}. \tag{24}$$

Now, given B's equilibrium offer in period one ($\bar{R}_1^*$), A's market share is given by[7]

$$\hat{\mu}^A = \begin{cases} 0 & \text{if } \hat{R}_1^A > \bar{R}_1^*, \\ 1/2 & \text{if } \hat{R}_1^A = \bar{R}_1^*, \\ 1 & \text{if } \hat{R}_1^A < \bar{R}_1^*. \end{cases} \tag{25}$$

From (24) and (25), 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

$$\bar{p}\bar{R}_1^* - 1 + \left(\pi^{A/A} - \bar{\pi}^{A/B}\right) < 0. \tag{26}$$

Now, using

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

condition (26) 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

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

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

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

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

Using the equilibrium interest offer

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

we get the condition equivalent to (26) in the case of monitoring equilibrium.

$$\nu \Delta p R_1^* + \left(\bar{\pi}^{A/A} - \pi^{A/A}\right) - c < 0. \tag{27}$$

■

References

References

Acharya, Viral, Philipp Schnabl and Gustavo Suarez (2010), Securitization without risk transfer. Working parper, NewYork University.

Allen, F. and E. Carletti (2006), 'Credit risk transfer and contagion', *Journal of Monetary Economics* **53**(1), 89–111.

American Securitization Forum, Securities Industry and Financial Markets Association, Australian Securitisation Forum and European Securitisation Forum (2008), Restoring confidence in the securitisation markets.

Ashcraft, Adam B. and Til Schuermann (2008), Understanding the securitization of subprime mortgage credit, Staff Reports 318, Federal Reserve Bank of New York.

Barone, Guglielmo, Roberto Felici and Marcello Pagnini (2011), 'Switching costs in local credit markets', *International Journal of Industrial Organization* **29**(6), 694 – 704.

Bernanke, Ben (2007), The subprime mortgage market, Speech at the Federal Reserve Bank of Chicago's 43rd Annual Conference on Bank Structure and Competition (Chicago, Illinois). Available at http://www.federalreserve.gov/newsevents/speech/bernanke20070517a.htm.

Berndt, Antje and Anurag Gupta (2009), 'Moral hazard and adverse selection in the originate-to-distribute model of bank credit', *Journal of Monetary Economics* **56**(5), 725–743.

BIS (2003), Credit risk transfer, Report, Basel Committee on the Global Financial System.

BIS (2008), Credit risk transfer: Developments from 2005 to 2007, Joint forum report, Basel Committee on Banking Supervision.

Boot, A. and A. Schmeits (2006), 'The competitive challenge in banking', *in L. Renneboog ed., Advances in Corporate Finance and Asset Pricing* pp. 133–160.

Boot, A. and A. Thakor (2000), 'Can relationship banking survive competition', *Journal of Finance* **55**(2), 679–713.

Bouckaert, J. and H. Degryse (2004), 'Softening competition by inducing switching in credit markets', *Journal of Industrial Economics* **52**(1), 27–52.

Buiter, W. (2007), 'Lessons from the 2007 financial crisis', *CEPR Policy Insight* (18).

Calomiris, C. and J. Mason (2004), 'Credit card securitization and regulatory arbitrage', *Journal of Financial Services Research* **26**, 5–28.

Carlstrom, C. and K. Samolyk (1995), 'Loan sales as a response to market-based capital constraints', *Journal of Banking and Finance* **19**(3-4), 627–646.

Dell'Ariccia, Giovanni, Deniz Igan and Luc Laeven (2008), Credit booms and lending standards: Evidence from the subprime mortgage market, Discussion Papers 6683, C.E.P.R.

Dewatripont, M. and E. Maskin (1995), 'Credit and efficiency in centralized and decentralized economies', *The Review of Economic Studies* **62**(4), 541–555.

Diamond, D. W. (1991), 'Monitoring and reputation: The choice between bank loans and directly placed debt', *Journal of Political Economy* **99**(4), 401–419.

Duffee, G. and C. Zhou (2001), 'Credit derivatives in banking: Useful tools for managing risk?', *Journal of Monetary Economics* **48**(1), 25–54.

ECB (2008), The incentive structure of the 'originate and distribute' model.

European Parliament (2009), Report on the proposal for a directive of the European Parliament and of the Council amending Directives 2006/48/ec. Session document A6-0139/2009.

Franke, G. and J. P. Krahnen (2008), The future of securitization, Working papers 2008/31, CFS.

Gaul, L. and V. Stebunovs (2009), Ownership and asymmetric information problems in the corporate loan market: Evidence from a heteroskedastic regression. OCC Economics Working Paper 2009-1, Office of the Comptroller of the Currency.

Gehrig, T. and R. Stenbacka (2007), 'Information sharing and lending market competition with switching costs and poaching', *European Economic Review* **51**, 77–99.

Gorton, G and A. Metrick (2011), Securitization. mimeo.

Gorton, G. and G. Pennacchi (1995), 'Banks and loan sales: Marketing nonmarketable assets', *Journal of Monetary Economics* **35**(3), 389–411.

Hakenes, H. and I. Schnabel (2010), 'Credit risk transfer and bank competition', *Journal of Financial Intermediation* **19**(3), 308–332.

Hauswald, R. and R. Marquez (2006), 'Competition and strategic information acquisition in credit markets', *Review of Financial Studies* **19**(3), 967–1000.

Hellwig, M. (2008), Systemic risk in the financial sector: An analysis of the subprime-mortgage financial crisis, Preprints 2008/43, the Max Planck Institute for Research on Collective Goods Bonn. available at http://www.coll.mpg.de/pdf_dat/2008_43online.pdf.

Holmstrom, B. and J. Tirole (1997), 'Financial intermediation, loanable funds, and the real sector', *The Quarterly Journal of Economics* **112**(3), 663–691.

Hull, John (2009), *Risk Management and Financial Institutions*, 2nd edn, Pearson.

Keys, B., T. Mukherjee, A. Seru and V. Vig (2009), 'Financial regulation and securitization: evidence from subprime loans', *Journal of Monetary Economics* **56**(5), 700–720.

Keys, B., T. Mukherjee, A. Seru and V. Vig (2010), 'Did securitization lead to lax screening? evidence from subprime loans', *Quarterly Journal of Economics* **125**(1), 307–362.

Kim, M., D. Kliger and B. Vale (2003), 'Estimating switching costs and oligopolistic behavior', *Journal of Financial Intermediation* **12**(1), 25–56.

Mian, Atif and Amir Sufi (2009), 'The consequences of mortgage credit expansion: Evidence from the 2007 mortgage default crisis', *Quarterly Journal of Economics* **124**(4), 1449–1496.

Morrison, A. (2005), 'Credit derivatives, disintermediation, and investment decisions', *The Journal of Business* **78**(2), 621–648.

Nicolo, A. and L. Pelizzon (2008), 'Credit derivatives, capital requirements and opaque OTC markets', *Journal of Financial Intermediation* **17**(4), 444–463.

Parlour, C. and G. Plantin (2008), 'Loan sales and relationship banking', *Journal of Finance* **63**(3), 1291–1314.

Parlour, Christine and Andrew Winton (2008), Laying off credit risk: Loan sales versus credit default swaps. mimeo.

Peterson, M. and R. Rajan (1995), 'The effect of credit market competition on lending relationships', *The Quarterly Journal of Economics* **110**(2), 407–443.

Purnanandam, A. K. (2011), 'Originate-to-distribute model and the subprime mortgage crisis', *Review of Financial Studies* **24**(6), 1881–1915.

Stango, V. (2002), 'Pricing with consumer switching costs: Evidence from the credit card market', *Journal of Industrial Economics* **50**(4), 475–492.

Wagner, G. and I. Marsh (2006), 'Credit risk transfer and financial sector stability', *Journal of Financial Stability* **2**(2), 173–193.