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Incentives to Issue Low-Quality Securitized Products in the OTD Business Model

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Abstract

We consider an economy in which a lender finances loans to borrowers by issuing a securitized product to investors and in which the credit quality of the product can depend on whether the lender screens borrowers. In the presence of asymmetric information between the lender and investors regarding the credit quality of potential borrowers, overvaluation from the lender's perspective can occur for low-quality securitized products, which inefficiently induces the lender not to screen borrowers and hence to issue the securitized products of low credit quality. This is likely to occur when the probability of being in a bad state (i.e., the presence of low-quality borrowers) is low, or when the seeds of recession begin emerging in a booming economy.

Keywords: Originate-to-distribute; Securitization; Asymmetric information; Screening; Verification
JEL classification: G14, G21, G24

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1 Introduction

The originate-to-distribute (OTD) business model is said to help match the diverse risk preferences of investors and the payoff characteristics of securitized products in financial markets. One would expect each specialized player in the securitization process, including originators and issuers, to be guided by price mechanisms, thereby creating securitized products best-matched to the risk-payoff preferences of investors and yielding efficient resource allocation. In short, the pricing of securitized products should lead to the greatest economic welfare.

Such views of the OTD business model have helped expand the market for securitized products in recent years. However, the advent of the subprime mortgage crisis has led the presumed efficacy of this business model to be called into question. With the benefit of hindsight, it is not now extraordinary to point to incentive problems in different steps along the securitization process. For example, moral hazard problem taking advantage of information superiority in transactions or elusive evaluations of securitized products have been cited as underlying causes of the factors that led to the crisis.

This paper focuses on the effect of securitized product pricing in financial markets on screening incentives for lenders by explicitly modeling the link between the market price of securitized products and loan activities in the OTD business, and examines the potential inefficiencies in the OTD business model from this perspective. The basic setup of the model is as follows: Having costly screening and verification technologies, a lender decides whether to screen borrowers' credit quality when making loans. There is asymmetric information between the lender and securities investors regarding the distribution of the ultimate borrowers' credit quality, which is determined by the on-site state of the loan market. In the good state, all potential borrowers are of high credit quality. In the bad state, certain borrowers are of low credit quality. The lender knows the true state of this loan market, but the investors cannot. Nor can the investors actually observe the lender's screening activities. The lender can verify the credit quality of the securitized product to be issued. The presence or absence of such screening affects the credit quality of the loan pool backing the securitized product. This factor, in conjunction with verification, affects the price that the investors are willing to pay for the securitized product. In turn, the price of the securitized product affects whether the lender undertakes such costly screening and verification. Given the cost of screening and verification, the lender screens borrowers and issues a securitized product of high credit quality only when the price of the securitized product backed by screened loan pool is high enough, relative to that of the securitized product backed by unscreened loan pool, to cover the screening and verification costs.

We demonstrate below that under certain conditions, there exists an equilibrium in which the pricing of the securitized product may distort the lender's incentive to screen borrowers. Indeed, we show that a securitized product of low credit quality can be overpriced from the lender's perspective in the bad state. When the low-quality product is sufficiently overpriced, the lender will choose not to screen borrowers and to issue a low-quality product, even in the case in which, without such overvaluation, he would screen borrowers and issue a high-quality product. This happens because the lender's gains from issuing a high-quality product at a higher price do not exceed the cost of screening and verification borne by the lender. We will derive conditions for the emergence of inefficient equilibrium pricing and discuss implications for policy measures required to enforce optimal levels of screening to achieve efficiency in the OTD business model.

This paper is organized as follows. Section 2 discusses related papers. Section 3 formulates the model. Section 4 derives the results of the model analysis and shows comparative statics based on the results. Section 5 discusses the results obtained, and Section 6 provides some concluding remarks.

2 Related Papers

The interest in this paper is closely related to the one in Gorton and Pennacchi (1995). They study incentive compatible loan sales contracts by a bank (a lender) and investigate circumstances wherein a bank originates loans after a costly screening of borrowers' credit quality, then sells a portion of the loans to outside investors. They then examine the optimal levels of screening efforts and loan sales by the originating bank.[1] Our model considers a similar (albeit more stylized) situation and analyzes optimal screening efforts for a bank.

[1] Gorton and Pennacchi (1995) point out that their model can also be interpreted as a costly monitoring model.

Our work is also closely related to Holmstrom and Tirole (1997). They analyze the effects of wealth distribution among all risk-neutral and capital-constrained firms, intermediaries, and investors on investment, interest rates, and the intensity of monitoring. In their model, monitoring by intermediaries improves the quality of projects undertaken by the firms, which increases the return on investment for the firms and hence increases the aggregate amount of capital that intermediaries and investors are willing to provide. Thus, in equilibrium, the investors' required rate of return should affect the intensity of monitoring by intermediaries and hence the quality of projects. In our paper, the price that investors are willing to pay for a securitized product affects the lender's incentive to screen borrowers and the credit quality of the loan pool. However, unlike Holmstrom and Tirole (1997), there is asymmetric information between the lender and the investors on the true state of the loan market, and the prices in equilibrium endogenously determine the intensity of the lender's screening efforts, the credit quality of the loan pool, and the credit quality of securitized products.

In the literature on security design, Allen and Gale (1988) are closely related to this paper. Allen and Gale (1988) analyze security innovations by producers who maximize profits from selling securities backed by their production to consumers. Our model can be regarded as an extension of Allen and Gale (1988) to the specific context of loan screening, wherein asymmetric information between lenders and investors yields a complex relationship between the state of the loan market, the market price of securitized products, and loan screening incentives.

This paper is also closely related to DeMarzo (2005) and DeMarzo and Duffie (1999) that analyze the optimal payoff design of securitized products, given asymmetric information between originators and investors. In these papers, the credit quality of securitized products is determined by tranching the underlying loan pool, or by creating a senior claim. In contrast, the securitized product in this paper is backed by the whole loan pool, and its credit quality is determined by screening the borrowers in the loan pool.

Our paper is also closely related to the strand of empirical studies of loan standard determinants. Jimenez and Saurina (2006) show in their study of Spanish banks that high-risk borrowers are more likely to be granted loans during boom times than during leaner years. Dell'Ariccia et al. (2008) investigate the factors underlying lending standards in

US mortgage loan markets, discussing their relationship to *ex post* delinquencies in the subprime mortgage market. They find that a decline in lending standards is associated with an increase in the number of loan applicants, suggesting that a credit boom affects lending standards. They also find that an increase in competition and securitization transactions lowers lending standards. Such a decline in lending standards has not been related to the economic fundamentals of the loan applicants. As a result, delinquency rates rose more sharply in areas that experienced larger increases in the number and volume of originated loans, competition, and securitization transactions.

Berger and Udell (2004) develops the so-called institutional memory hypothesis to explain the cyclical profile of loans and nonperforming loan losses, positing that as time passes since the most recent loan crisis, loan officers become less skilled in screening when to grant loans to high-risk borrowers. It therefore becomes difficult to find skilled loan officers inside a bank and to hire skilled loan officers on the labor market. During the next boom, with its surging pool of loan applicants, the shortfall in skilled loan officers reduces the quality of loan processing and risk assessments, leading to lower profitability for the bank. The empirical analysis of US banks in the paper supports this hypothesis. Focusing on how reward and punishment are implemented in a bank, Rajan (1994) suggests that incentive mechanisms for bank managers explain fluctuations in loan standards.

In general, these works point to low lending standards in boom times and high lending standards in recessions. The results presented in this paper are consistent with this finding, but point to a more subtle phenomenon: Lenders will refrain from screening borrowers and are more likely to issue low-quality securitized products, when the bad state in which certain borrowers are of low quality may occur with relatively low probability against the good state in which all borrowers are of high quality. This result seems realistic. When the state of the loan market is good and all borrowers are of high quality, little screening is needed, and an equilibrium without screening should emerge. When the state of the loan market begins to degrade or when the bad state can occur with low probability, as long as the investors cannot tell the true state, the price that the investors give for the securitized product is the same in both bad and good states and still high enough because products are likely to be of high credit quality. However, since the price is the same in both the good and bad states and high enough, the lender does not have the incentive to perform costly screening or verification in either loan market state, resulting in the issue of low-quality securitized products. On the other hand, when the state of the loan market is bad with high probability, efforts for screening and verification are more likely to reward the lender, since investors price high-quality securitized products much higher than low-quality securitized products, leading to an equilibrium with screening and verification.

Finally, the financial system perspective theory proposed in Shin (2008, 2009) gives insight on determinants of loan standards, as shown in a discussion of a potential mechanism underlying the expansion of the subprime mortgage problem. The theory states that the inflow of funds from outside the leveraged financial institution sector enables the sector to expand its total asset holdings against ultimate borrowers. As the loan capacity of the sector expands, the financial institutions begin filling this capacity by finding borrowers even by descending the ladders of credit quality. While the financial system perspective theory attributes declining loan standards to increasing loan capacity, this is not a factor in the model discussed herein. Rather, this paper provides a complementary explanation for determinants of loan standards in terms of the relationship between securities pricing and loan screening incentives.

3 The Model

There are two periods, period 0 and period 1. There are borrowers, a lender, and investors, all of whom live for two periods. The lender makes loans to the borrowers in period 0 and collects repayments in period 1. The lender finances the loans by selling a securitized product backed by these loans to the investors in period 0. There are two possible states of the loan market: the good state ω_g and the bad state ω_b. In the good state, all borrowers are of high credit quality. In the bad state, certain borrowers are of low credit quality. The good state occurs with probability $1-p$ $(0 < p < 1)$, while the bad state occurs with probability p. Although all borrowers, the lender, and the investors know the probability of a good or bad state, only the lender knows which state has actually occurred in period 0.

3.1 Borrowers and Loan Opportunities

A continuum of borrowers exists, with each borrower borrowing D (< 1) amount of loan in period 0 by promising to repay 1 amount in period 1. The borrowers are of either high or low quality. High-quality borrowers will repay their loans with probability 1 by paying 1 back to the lender when the loans come due. Low-quality borrowers may default with probability q by making only partial repayment z $(0 < z < 1)$ to the lender when the loans come due, while making full repayment by paying 1 with probability $1-q$. We assume that the defaults of the low-quality borrowers are perfectly correlated. To clarify our exposition of the essence of the main results, we also assume that the defaults on the part of low-quality borrowers are independent of the state of the loan market. Note that the expected repayment of a low-quality borrower is given by $(1-q)1 + qz$.

The composition of high and low-quality borrowers in the loan market is given exogenously and depends on the state of the loan market. In the good state, there are only high-quality borrowers. In the bad state, certain borrowers are of low quality, and the ratio of high-quality borrowers in all loan opportunities is $1-\alpha$ while that of low-quality borrowers is α. For the ease of analysis below, we assume that the mass of borrowers is greater than $\frac{1}{1-\alpha}$.[2]

Finally, we assume that each borrower obtains the same amount u_B of utility by borrowing D from the lender, regardless of whether the borrower is of high or low credit quality.

3.2 The Lender and Securitization

There is a lender who makes loans to borrowers in period 0 and collects repayments in period 1. The lender finances the loans by selling a securitized product backed by the loans to investors in period 0. Thus, the lender is the originator of the loans and the issuer of the securitized product.[3] The payoff of the securitized product is equal to the total amount

[2] This assumption guarantees that the number of good borrowers are large enough so that the lender can make loans only to the high credit quality borrowers by screening in the bad state ω_b.

[3] A non-bank MBS originator is the example for the lender in this paper. Ashcraft and Schuermann (2008) provide an overview of the subprime mortgage securitization process and problems arising from informational frictions between players in the process.

of repayment by the borrowers in period 1. We assume that the nominal amount of the securitized product issued by the lender is set to 1. That is, the lender has an exogenously given target for the issue amount of the securitized product. We also assume that the lender sells all portions of the securitized product in period 0 to generate cash.[4]

The lender can screen the quality of loan opportunities if he bears screening cost $\gamma_s > 0$. Thus, in the bad state ω_b where low-quality borrowers are possible, the lender's decision to pay this cost determines the credit quality of the loan pool. If the lender pays the screening cost, the lender can make loans only to high-quality borrowers and issue a securitized product backed solely by high-quality loans. If the lender chooses not to pay the screening cost, he can still issue the securitized product, but the product is now backed by a mixture of high- and low-quality loans. In other words, the lender makes loans randomly and issues a securitized product backed by this loan pool. The credit quality of the loan pool is reflected in the payoff of the securitized product issued by the lender.

Let y be the payoff of the securitized product in period 1. Note that y depends on the credit quality of the loans made by the lender. In the good state ω_g, in which all borrowers are of high credit quality, and in the bad state ω_b if the lender screens borrowers and makes only high-quality loans, $y = 1$; that is, the securitized product backed by high-quality loan pool is risk-free. In the bad state ω_b, if the lender does not screen borrowers and the loan pool includes low-quality borrowers, y is a random variable that takes the value 1 with probability $1-q$, and $(1-\alpha)+\alpha z$ with probability q; that is, the securitized product backed by low-quality loan pool is vulnerable to defaults. We define $x = (1-q)1 + q\{(1-\alpha)+\alpha z\}$.

A costly verification technology exists whereby the lender can verify the credit quality of the securitized product for the investors. The cost of verification borne by the lender is $\gamma_v > 0$.[5] We assume that this verification is so accurate that investors can be assured of the verified credit quality.

The lender can observe which state of the loan market, ω_g or ω_b, occurs at the start of period 0. However, the lender cannot credibly inform the investors of the true state for

[4] As in DeMarzo and Duffie (1999) and DeMarzo (2005), we may assume that it is costly for the lender to hold assets other than cash from period 0 to period 1. We then assume that the cost is so high that it is advantageous for the lender to sell all assets in period 0.

[5] This verification technology may be interpreted to be a benevolent and reliable rating agency. We do not investigate moral hazard problem or inability of such rating agency, although these are important issues.

free. Let $S(\gamma, \omega)$ be the price of the securitized product when the lender pays the costs γ of screening and/or verification in state ω. Note that $\gamma = 0$ implies that the lender performs neither screening nor credit-quality verification, $\gamma = \gamma_s$ only screening, $\gamma = \gamma_v$ only verification, and $\gamma = \gamma_s + \gamma_v$ both screening and verification.

After observing the true state of the loan market, the lender decides whether to perform screening and/or verification to maximize profits from the OTD business. That is, for each state $\omega = \omega_g, \omega_b$, the lender solves the following profit maximization problem:

$$\begin{aligned} & Max_{\gamma}[S(\gamma, \omega) - \gamma - D] \\ s.t.\ \gamma &= 0,\ \gamma_s,\ \gamma_v,\ or\ \gamma_s + \gamma_v. \end{aligned}$$

3.3 Investors

There are risk-neutral investors in financial markets. In period 0, these investors purchase the securitized product. In period 1, they consume the proceeds from their investment. For the sake of simplicity, we assume that the investors have no discount between period 0 and 1. We also assume that the investors behave competitively. Thus, the price of the securitized product purchased by the investors is determined by the investors' expected payoff for the securitized product.

We assume that, unlike the lender, the investors do not know the true state of the loan market, creating asymmetric information between the lender and the investors. The investors do not know whether the loan market is in the good state ω_g, in which all borrowers are of high quality or in the bad state ω_b, in which certain borrowers are of low quality. Moreover, the investors cannot assess the credit quality of the securitized product, either. The lender only can verify the credit quality of the securitized product by paying verification cost γ_v. The investors observe whether the lender performs this verification, infer the credit quality of the securitized product, and price the securitized product based on this inference.

4 Equilibrium and Incentives to Issue Low-Quality Securitized Products

Let S_h be the price given by investors to a high-quality securitized product whose expected payoff in period 0 is 1 with probability 1, when the investors know the securitized product is of high quality. Let S_l be the price given by investors to a low-quality securitized product whose expected payoff in period 0 is x, when the investors know the securitized product is of low quality. Note that $S_h = 1$ and $S_l = x$.

We assume that the following condition holds:

$$x < 1 - \gamma_s - \gamma_v, \tag{1}$$

or, equivalently, $S_l < S_h - \gamma_s - \gamma_v$. That is, in the bad state ω_b, it is socially more valuable to screen borrowers and issue high credit-quality securitized products by paying screening and verification costs than to omit screening and verification, and issue low credit-quality securitized products.

4.1 A Benchmark Case in Which Investors Know the True State of the Loan Market

In this subsection, as a benchmark, we consider a case in which the investors know the state of the loan market, i.e., good or bad, before purchasing the securitized product in period 0. However, we assume that the investors cannot observe whether the lender screens borrowers.[6]

Since the investors know the true state, in the good state ω_g in which all borrowers are of high credit quality, the securitized product is of high quality, and its price is $S_h = 1$. In the bad state ω_b in which certain borrowers are of low credit quality, the credit quality and price of the securitized product depend on whether the lender screens borrowers and verifies the credit quality of the product. In this case, since $S_l < S_h - \gamma_s - \gamma_v$, the lender screens the borrowers, makes loans only to high-quality borrowers, verifies the credit quality, and

[6] If the investors can also observe whether the lender screens borrowers, the investors and the lender have symmetric information. In this case, the lender does not need to verify the credit quality of the securitized product, and we obtain the same result as below, where the verification cost γ_v is set to zero.

sells the high-quality securitized product to investors at price S_h. Thus, in equilibrium, the lender issues only securitized product of high credit quality, without paying any technology cost in the good state and with paying the screening and verification costs in the bad state.

Note that since each borrower obtains the same amount u_B of utility from borrowing and the lender makes the same amount of loans to the borrowers, the welfare of the borrowers remains the same. Additionally, since the investors are risk-neutral, the net gain of their expected utility, or the expected payoff less the price of the securitized product, is always zero *ex ante* or before the true state is realized. Hence, the net *ex ante* gain of welfare in this economy can be measured by the expected value of the securitized product less the amount of loans and screening and verification costs, or the lender's profits, with respect to the state of the loan market.

Since the net *ex post* gain of welfare is $S_h - D$ in the good state and $S_h - D - \gamma_s - \gamma_v$ in the bad state, the net *ex ante* gain of welfare is $(1-p)(S_h - D) + p(S_h - D - \gamma_s - \gamma_v)$ in the benchmark case in which the investors know the true state of the loan market but cannot observe whether the lender screens borrowers.[7]

4.2 A Pooling Equilibrium with Low-Quality Securitized Products

Recall that there is asymmetric information between the lender and the investors so that unlike the lender, the investors do not observe the true state of the loan market. Such asymmetric information between the lender and the investors may result in a certain pricing of the securitized product, moderating the lender's incentive to screen the borrowers' credit quality. To describe such a situation, we are interested in a pooling equilibrium in which a high-quality securitized product is issued in the good state, a low-quality securitized product is issued in the bad state, and both are given the same price by investors.

Consider an equilibrium in which the lender does not verify the credit quality of the securitized product in either the good state ω_g or the bad state ω_b. Since investors can

[7] If the investors and the lender have symmetric information and the investors know the true state of the loan market and can observe whether the lender screens borrowers, there is no need for verification in the bad state. In such a case, the net gain of welfare becomes $S_h - D$ in the good state and $S_h - D - \gamma_s$ in the bad state. This is the first best of the economy.

observe only whether the lender performs the verification, they cannot tell whether they are in the good or bad state. Hence, the investors price the securitized product as the average of its values in the good state and the bad state. In the good state, all borrowers are of high credit quality, the securitized product is of high quality, and hence the value should be $S_h = 1$. In the bad state, certain borrowers are of low credit quality. Now, assume that the lender does not screen borrowers, makes loans randomly, and hence issues the low-quality securitized product. (We will soon state the conditions under which this holds true.) Then, the value of the product in the bad state should be $S_l = x \equiv (1-q)1+q\{(1-\alpha)1+\alpha z\}$. Thus, the price given by investors to the securitized product is $\bar{S} = (1-p)S_h + pS_l = (1-p)1+px$. By definition, $S_l < \bar{S} < S_h$.

In the good state ω_g, the lender decides whether to verify the credit quality of the securitized product. (Note that all borrowers are of high quality, removing any need for screening.) If the lender performs verification, the investors know that the credit quality of the securitized product is high, and give price S_h to the product. If the lender does not perform verification, the price is $\bar{S}$. Thus, in the equilibrium without verification considered here, the price of the securitized product is $\bar{S}$ rather than S_h. That is, the product is undervalued. Despite this underpricing, the lender will choose not to perform verification in the good state, if

$$S_h - \gamma_v \leq \bar{S}.$$

where we assume that when $S_h - \gamma_v = \bar{S}$, the lender chooses not to verify the credit quality.

In the bad state ω_b, the lender can issue a high-quality product at price S_h by screening borrowers and verifying the credit quality of the securitized product. However, he will choose not to do so if the choice is more profitable; that is, if the following condition holds:

$$S_h - \gamma_s - \gamma_v \leq \bar{S}.$$

Clearly, $S_h - \gamma_s - \gamma_v \leq S_h - \gamma_v$. Thus, if $S_h - \gamma_v \leq \bar{S}$, there exists a pooling equilibrium in which the lender neither screens the borrowers nor verifies the credit quality of the securitized product in either the good or bad states, but sells a high-quality securitized product in the good state and a low-quality securitized product in the bad state at the same price $\bar{S}$.

Recall that $S_h = 1$ and $S_l = x$. With a simple calculation (shown in the appendix), we have the following claim:

Proposition 1

> There exists a pooling equilibrium in which the lender neither screens borrowers nor verifies the credit quality of the securitized product in either the good or bad states of the loan market, but sells the securitized product of high (or low) quality in the good (or bad) state at price $\bar{S}$ if
>
> $$1 - x \leq \frac{\gamma_v}{p}. \tag{2}$$
>
> Moreover, *ex ante*, the pooling equilibrium is less efficient than the benchmark by the expected loss
>
> $$p(1 - x - \gamma_s - \gamma_v)$$
>
> of issuing low-quality securitized products in the bad state.

In the good state, the net *ex post* gain of the economy is the sum of the lender's gain $\bar{S} - D$ and the investors' $S_h - \bar{S}$, which is $S_h - D$. This is equal to the net *ex post* gain $S_h - D$ in the good state of the benchmark equilibrium. Thus, the inefficiency of the pooling equilibrium must be attributable to inefficient lending/screening in the bad state of the pooling equilibrium.

Such inefficient screening occurs for the following reason: In the bad state of the pooling equilibrium, a securitized product of low credit quality is issued, but its price at $\bar{S}(> S_l)$ is overvalued from the perspective of the lender, since investors cannot distinguish it from a high-quality product. Due to this overvaluation, the lender has less incentive to screen borrowers than when the low-quality product is priced correctly, at S_l. This is because the lender's net gain $(S_h - \gamma_s - \gamma_v) - \bar{S}$ from screening and verification to issue a high-quality product when the low-quality product is overpriced at $\bar{S}$ is less than his net gain $(S_h - \gamma_s - \gamma_v) - S_l$ from screening and verification to issue high-quality products when the low-quality product is correctly priced at S_l.

In other words, such overvaluation from the lender's perspective diminishes penalty on the lender for neglecting screening, reducing the lender's incentive to screen borrowers, and resulting in inefficient screening. Thus, the market price may not provide appropriate incentives to lenders to screen borrowers and issue securitized products efficiently.

Finally, it is worth pointing out that this overvaluation tends to occur when the probability of bad state p is relatively small and when the expected payoff x of the low-quality securitized product is relatively large. That is, the low-quality securitized products attributable to inefficient screening are likely to be issued when the bad state is deemed less likely, or when the seeds of recession accompanied by deteriorating credit quality of borrowers begin to emerge in a booming economy.

4.3 An Equilibrium with Only High-quality Securitized Products

Depending on the parameter values of the economy, there also exists an equilibrium in which the lender issues only securitized products of high credit quality in both the good and bad states. We consider the case in which

$$\bar{S} < S_h - \gamma_v,$$

or equivalently, $1 - x > \frac{\gamma_v}{p}$. Note that in this case, the lender in the good state has no incentive to issue a securitized product without verification. Hence, the investors give the price S_l to the securitized product without verification, and $S_l < \bar{S} < S_h - \gamma_v$. Therefore, in the good state, the lender verifies the securitized product. Also, in the bad state, the lender performs screening and verification, since without such verification, the price of the product will be S_l, which is less than $S_h - \gamma_s - \gamma_v$. Consequently, in both the good and bad states, only securitized products of high credit quality are issued and verified. We call this equilibrium a separating equilibrium because although the realized quality of the securitized product is the same, the choice of action by the lender differs for each state of the loan market; in the good state, the lender pays the cost of verification; in the bad state, he pays the cost of verification and screening.

The net *ex post* gain in the good state is $S_h - \gamma_v - D$, less than the benchmark net *ex post* gain $S_h - D$ by verification cost γ_v. On the other hand, the net *ex post* gain in the bad state is $S_h - \gamma_s - \gamma_v - D$, equal to that of the benchmark. Thus, the net *ex ante* gain is less than that of the benchmark by the amount of the expected verification cost $(1-p)\gamma_v$.

From the arguments above, we have the following claim:

Proposition 2

> There exists a separating equilibrium in which the lender issues only high-quality securitized products with screening and verification in the bad state and with verification in the good state if
>
> $$1 - x > \frac{\gamma_v}{p}. \tag{3}$$
>
> Moreover, *ex ante*, this equilibrium is less efficient than the benchmark by the expected cost
>
> $$(1-p)\gamma_v$$
>
> of verification in the good state.

It is worth noting that in our setting, verification cost γ_v is wasted in the good state for the lender to separate the high-quality product in the good state from the low-quality product in the bad state. This situation occurs when the probability of bad state p is relatively large and when the expected payoff x of the low-quality securitized product is relatively small. Thus, when investors know that the economy is highly likely to be in the bad state, the lender will tend to issue only high-quality securitized products by paying the cost for the separation in the good state.

4.4 Comparative Statics

Note that the inefficient screening levels described in the previous section occur due to pooling equilibrium-pricing of the securitized product and that such pricing occurs since investors cannot distinguish between high-quality and low-quality products. We have derived the conditions for such pricing and inefficient screening levels. In this section, we provide comparative statics regarding these conditions and investigate the relationship between the state of the loan market and the resulting equilibrium.

The condition for the pooling equilibrium (equation (2)) is rewritten as follows:

$$p \leq \gamma_v \left(\frac{1}{1-x} \right).$$

Figure 1 shows the areas separated by the above condition for the different types of equilibrium. Note that the conditions for pooling equilibrium (equation (2)) and for separating equilibrium (equation (3)) are mutually exclusive. The area marked A is the area in which the separating equilibrium holds and only high-quality securitized products are issued. The area marked B is the area in which the pooling equilibrium holds.

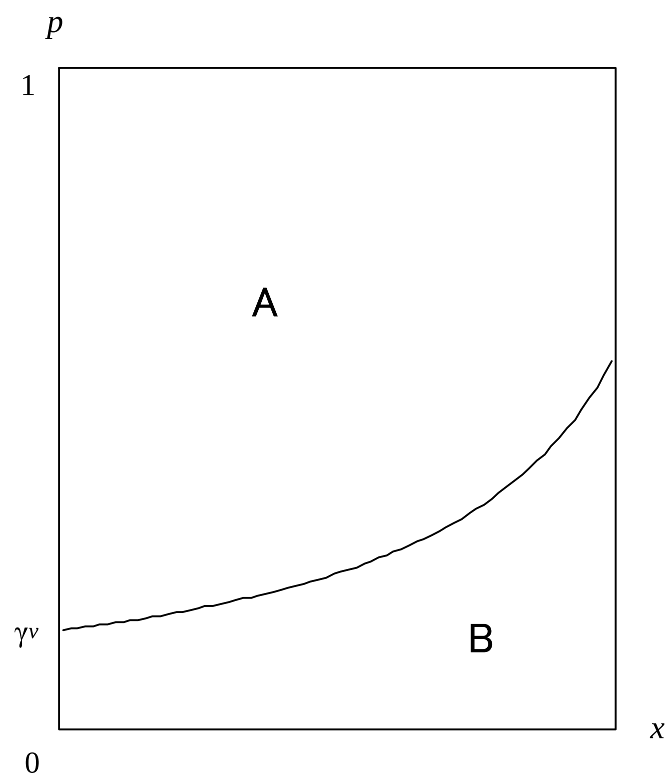

Figure 1. Areas of Different Equilibrium Types

The figure suggests an interesting observation. In the area above $p = \gamma_v$, the area with smaller x with a certain value of p tends to be the one for the separating equilibrium. This accords with intuition: The lower the average credit quality of the pool of borrowers, the more sense it makes to screen borrowers.

A decrease in r_v in the figure shifts down the curve of $p = \gamma_v\,(1/(1-x))$. The mechanism underlying the shift in the curve is that for a certain set of x and p just below the curve with a certain value of γ_v, it is rational for the lender to pay verification costs to avoid the pooling equilibrium-pricing of the securitized product by investors when verification costs become less expensive. The effects of the decline in γ_v on the welfare loss in different equilibria discussed in the last section are as follows: In the separating equilibrium, the welfare loss, $(1-p)\gamma_v$, decreases because the unavoidable cost of verification to achieve the equilibrium without pooling equilibrium-pricing of the securitized product is reduced. In the pooling equilibrium, the welfare loss, $p(1-x-\gamma_s-\gamma_v)$, increases. This result may be somewhat counterintuitive, since it is generally believed that any reductions in any costs related to financial transactions will improve efficiency. In fact, the net *ex ante* gain of welfare in the benchmark equilibrium, in which the investors know the true state of the economy, is $(1-p)(S_h-D)+p(S_h-D-\gamma_s-\gamma_v)$. This value increases as γ_v decreases. This is consistent with the general faith in the benefits of sophistication in financial transactions. The point here is that inefficiency in the pooling equilibrium is a relative notion. In the pooling equilibrium, the attainable welfare in the benchmark case is larger for a smaller γ_v, while the attained welfare in the equilibrium is invariant to verification cost because no verification is performed. Thus, the difference increases, which appears as an increase in welfare loss.

5 Implications and Discussion

The main result of this paper is that, in the OTD business model, overvaluation of low-quality securitized products from lenders' perspective induces them to perform insufficient screening and to issue low-quality securitized products inefficiently. This occurs when the probability of being in the bad state is relatively small. Thus, we can say that the credit quality of securitized products is likely to be deteriorated when boom times with an ample pool of good quality borrowers begin to fade and the pool of good borrowers is in a downward trend, but this trend is not yet widely perceived.

In the recent subprime mortgage problem, one factor suspected to underlie the scope of the problem is inadequate screening of low-quality borrowers. This aspect was aggravated as it became more difficult, during a period in which the economy had been healthy for an extended period, to find high-quality borrowers, since these borrowers successfully obtained mortgage loans and their pool dwindled over time. The main result of this paper sheds light on why this happened from the viewpoint of the relationship between the price of securitized products and incentives for screening.

The other important point made in this paper is that if the bad state is highly probable, lenders will tend to issue only high-quality securitized products. This happens, however, with the inefficient cost of verification in the good state. Since investors cannot distinguish between the good state and the bad state, the lender in the good state must separate his high-quality product from the low-quality product in the bad state to keep prices high by performing costly quality verifications. Thus, at least in our stylized setting with asymmetric information between a lender and investors regarding the state of the loan market, in which the lender must verify the credit quality of the securitized product, the OTD business model will not work efficiently.

Finally, it is interesting to note that in this paper, inefficiencies in the financial markets occur even with perfectly credible ratings. This is in contrast to arguments stressing the inefficacy or moral hazard of rating agencies in the securitization process. In our model, the ratings are perfectly credible once provided, but may still entail inefficiencies. The inefficiencies arise because the lender determines whether to perform costly verification, and because his incentive to screen borrowers and verify the quality of the securitized product is related to the price of securitized product. This is a fundamental issue worth investigating.

6 Concluding Remarks

We have shown that in the OTD business model in which the lender finances loans to borrowers by issuing a securitized product to investors, the price of the securitized product affects the lender's incentive to screen borrowers and consequently the credit quality of the securitized product. Moreover, inefficient screening level can emerge, depending on the state of the loan market and screening and verification costs. The mechanism underlying this result is that the lender compares the price of securitized products backed by screened loans (high-quality securitized products) to that of securitized products backed by unscreened loans (low-quality securitized products), and that the asymmetric information between the lender and the investors yields to relative overvaluation of low-quality securitized products from the lender's perspective.

In the context of loan sales by banks, Gorton and Pennacchi (1995) point out that measures to compel lenders to provide partial guarantees regarding the payoff of loans in loan sale markets create greater incentive to screen borrowers and increase the credit quality of loan assets. Although the setup of our paper differs from Gorton and Pennacchi (1995), the results in our paper suggest that the appropriateness of such requirement for lenders may depend on the state of the loan market.

What incentive schemes should be imposed on lenders? What is the optimal design? These are the questions to be pursued in future research.

Appendix

This appendix provides the proof for Proposition 1. Inserting the equation $\bar{S} = (1-p)S_l + pS_h$, $S_h = 1$ and $S_l = x$ into the condition for the pooling equilibrium $S_h - \gamma_v \leq \bar{S}$, we have the condition for the pooling equilibrium in the proposition. As for the welfare loss, note that the net *ex ante* gain of welfare in this pooling equilibrium is $(1-p)(\bar{S}-D)+p(\bar{S}-D)$. Recall that the net *ex ante* gain of welfare in the benchmark equilibrium, in which investors know the true state of the loan market, is $(1-p)(S_h - D) + p(S_h - D - \gamma_s - \gamma_v)$. Subtracting the *ex ante* gain in the pooling equilibrium from the one in the benchmark equilibrium, we have a difference of $p\left((S_h - S_l) - (\gamma_s + \gamma_v)\right)$. This is positive if and only if $\gamma_s + \gamma_v < S_h - S_l$. The condition is equivalent to the assumption made in this paper of $S_l < S_h - \gamma_s - \gamma_v$. Inserting $S_h = 1$ and $S_l = x$ into $p\left((S_h - S_l) - (\gamma_s + \gamma_v)\right)$, we obtain a value for welfare loss of $p\left(1 - x - \gamma_s - \gamma_v\right)$.

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