Loan Sales and Screening Incentives*

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Abstract: We analyze the effect of loan sales on the intensity of costly screening. Loan sales strengthen screening incentives when screening primarily improves the bank's ability to identify profitable loans and when banks retain most of those. However, loan sales dampen screening incentives when the benefit of screening primarily helps to weed out unprofitable projects. Moreover, alternative institutions of information production and the institutional market framework affect the relative benefits and costs of screening. Accordingly, the potential regulation of loan sales has to take into account the whole impact on societal information production, both in markets and non-market institutions.

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Loan sales has turned into a booming activity of banks since the late 1980's and since its vibrant starting days there has been a lively debate about dis-intermedation and the future of banking. If the primary role of banks consists of producing private information by screening borrowers, how will the practice of selling those loans to the market impact on screening and the ultimate justification of banks? Wouldn't the fact that opaque loans are sold to the market reduce the rewards for screening to the originators, and thus reduce screening activity in the first place?

In fact, the securitization of sub-prime loans in the build-up to the financial crisis of 2007/8 has been interpreted as evidence of disintermediation and increased laxity in screening (e.g. Bushman, Wittenberg-Moerman 2009, Berndt, Gupta 2009, Keys et al. 2010, Dell'Arriccia, Igan, Laeven, 2008, Mian, Sufi, 2008). Moreover, banks increasingly switched from the traditional originate-to-hold to an originate-to-distribute business model concentrating on their core competencies of screening loans.

On the other hand, one might argue, to the extent that banks can sell-off average or even subprime loans to the market and only keep the most profitable ones in their in-house portfolios, incentives to screening might actually be improved. This argument is particularly true if banks funding costs for average quality loans exceed the average market funding costs.[1] In that case, banks will concentrate their permanent holdings on the superior segment of the lending portfolio only.

We investigate the effects of loan sales on banks' screening incentives in a stylized model of imperfect screening. Hence we replace the monitoring stage of the Parlour and Plantin (2010) set-up by a screening stage. As in Broecker (1990), banks screen borrowers by means of an imperfect creditworthiness test. This test will misclassify applicants with positive probability,

[1] The regulation of bank capital may be one reason for extra funding cost of banks (Pennacchi, 1988). This may seem somewhat paradoxical since regulating bank capital is widely regarded as complementing prudential supervision to increase the safety and soundness of the financial system. On the other hand, the practice of massive loan sales essentially took off just before the implementation date of Basel I in 1988.

erroneously rejecting some truly good borrowers (type-I error) and erroneously accepting some projects that should have been rejected (type-II error). We allow banks to fine-tune the characteristics of their screening technology. By investing costly resources type-I and type-II errors can be reduced as in Gehrig (1998). In this framework we can analyze the effect of loan sales on the production of information by banks as well as the portfolio characteristics of the loans kept in the banks' books and those sold to the market. This allows us to assess the effect of loan sales on the stability of individual banks as well as the riskiness of securitized loans for the whole financial system. Moreover, we can study the implications of various policy proposals concerning securitization on societal information production.

Our main finding is that the effect of loan sales on screening critically depends on the nature of the screening technology and the characteristics of the underlying pool of borrowers. If screening benefits primarily serve the purpose to eliminate credit losses loan sales will not reward adequately the screening investment. Hence, under such conditions loan sales will indeed increase laxity in information production. If on the other hand, screening benefits primarily consist in identifying profitable projects, the ability to sell lower quality projects to the market will strengthen screening incentives when bank capital is costly. Since the bank plans to keep profitable projects in its own books, unless faced by a liquidity shock, it can improve the book quality by selling off the average and below average projects to the market. If faced by a liquidity shock, the bank values future returns associated with a loan lower than the market. Under such circumstances, the option to sell loans at a price higher than their value to the bank strengthens the bank’s incentives to identify profitable loans compared with the traditional originate-to-hold model.

Also policy recommendations are sensitive to economic conditions. In situations when loan sales stimulate screening a mandatory minimal retention requirement will reduce screening incentives, resulting both in a lower quality portfolio held by banks as well as a lower quality pool of loans sold to the market. In such cases minimal retention requirements are welfare reducing when the marginal costs of information provision are low or moderate. Of course, the same regulation may be welfare enhancing in situations when loan sales undermine screening incentives. In such cases minimal retention bounds screening incentives since the bank is concerned about the loans it is required to keep in its books. Overall, our simple model strongly suggests that the effects of minimal retention regulation should be sensitive to the economic environment.

Empirical evidence accords well with our theory. A recent stream of papers documents lenders' screening incentive in the market for securitized mortgage loans (Keys et al. 2009, Mian and Sufi, 2008, Dell' Arriccia et al., 2009). In line with our predictions Berndt and Gupta (2009) find for the US market for syndicated loans that "borrowers with an active secondary market for their loans underperform their peers by about 9% per year in terms of annual, risk-adjusted abnormal returns, over a three year period subsequent to the initial sale of their loans." They also show that secondary market trading is typically associated with value destruction over a longer period. This finding is reinforced by Bushmann and Wittenberg-Moerman (2009), who find that on average prices of traded loans decrease subsequent to their initial trading date. However, they also find that in the case of reputable lead arrangers the decline is less marked. Hence, there is evidence that screening incentives of lead arrangers are also strengthened by reputational concerns.

While we concentrate on information production by the bank, our argument requires that the market prices banks can acquire from a loan sale are opaque. This means that in case of a loan sale the bank is not (adequately) compensated for the information generated in the screening process. The situation could be different if alternative investors with inside information were available in the market. If for example, hedge funds with proper information were in the market for buying loans, secondary prices would adequately reflect borrower information. In such a case an actively screening bank could be compensated by a fair return on truly good projects sold to the market. In this case complementary market information stimulates screening. Such a case is discussed in Chemla and Hennessy (2012). We exclude this phenomenon by assuming that secondary market prices are sufficiently opaque, which they typically are in the case of complex securitized assets.

Our analysis is further related to Fender and Mitchell (2009) and Kiff and Kisser (2010), who analyze securitization of loans. However, both studies rely on a very specific screening technology and a very specific form of macro-economic risk such that loan sales always stimulate information production. Their focus is on the optimal securitization decision and on optimal retention. In particular, according to these studies, under suitable conditions retention of mezzanine tranches may generate higher screening incentives than retaining the equity piece.

The role of loan heterogeneity and the possibility of banks to pick the more profitable loans distinguishes our work from the early work by Pennacchi (1988) and Gorton, Pennacchi (1995), who focus on a representative loan and insist that a constant portion of the loans can be sold only. Moreover, our contribution is the first to analyse the effects of loan sales on ex ante screening incentives rather than (interim) monitoring. Moreover, by introducing aggregate risk Chiesa (2008) establishes that optimal lending no longer needs to be in form of a standard debt contract but may involve loan sales backed by bank guarantees.

The sequel is organized as follows: Section 1 provides the basic model. Optimal lending for the traditional originate-to-hold model is derived in section 2. The effect of loan sales on screening incentives is discussed in section 3. Section 4 presents extensions and section 5 includes a discussion. Concluding comments are offered in section 6. Formal proofs (and calculations) are delegated to an Appendix – the arguments though are explained in the main text.

1. The Model

Banks are viewed as delegated information producers. They test the creditworthiness of borrowers and fund projects classified as creditworthy. However, creditworthiness tests typically are imperfect. They may induce the erroneous rejection of truly good projects (type-I error) and they may misclassify truly bad projects as worthwhile projects (type-II error). The errors can only be controlled indirectly by means of the screening technology. Resource investments into the screening technology can reduce type-I or type-II errors, or even both. We assume that complete elimination of any errors will be too costly, thereby never economical.

Borrowers

Potential borrowers require financing for an initial investment of $I=1$. Applicants are heterogeneous in their abilities to produce (observable) cash flows. We consider two types. Good borrowers always produce a future cash flow of $x > 0$, while - for simplicity - bad borrowers always generate 0 future cash flows. The proportion of good borrowers in the initial applicant pool is given by $0 < \pi < 1$.

Borrowers do not know their types. Moreover, borrowers do not possess any initial wealth or assets that they could post as collateral. They are best viewed as small start-up firms endowed with potentially valuable project ideas but no cash or assets to finance the set-up costs.

Banks

Banks specialize in screening borrowers and in identifying the good types. They have access to competitive capital markets, where they issue bonds at the competitive rate normalized to zero. These funds are channeled to worthwhile borrowers in return for a future repayment $0 < R < x$. While truly good borrowers will repay in the future, bad borrowers are protected by limited liability. The borrower's expected payoff is thus $\pi(x - R)$.

Banks maximize profits. Hence they try to avoid lending to bad borrowers. They cannot offer screening contracts because borrowers are not informed about their types. Therefore, the only way to separate good from bad borrowers is by means of costly creditworthiness tests. The creditworthiness test will allow to classify projects into good *g* or bad *b* types. The corresponding probabilities depend on the resources *e* invested in the test.

Define the acceptance probability for truly good projects as $\alpha(e) = prob[g|G,e]$ and let $\beta(e) = prob[g|B,e]$ be the acceptance probability for truly bad projects for screening intensity $e \in [0,1]$. Accordingly, imperfect screening generate a type-I error with probability $1-\alpha(e)$ and a type-II error with probability $\beta(e)$.For most of the subsequent analysis we will assume that the screening intensity affects type-I and type-II errors in the same directions, i.e. $\alpha'(e) > 0$ and $\beta'(e) < 0$.[2] Moreover, to ensure internal solutions it is convenient to assume $\alpha''(e) \geq 0$ and $\beta''(e) \leq 0$. The cost of screening intensity *e* is determined by a continuous, strictly increasing and sufficiently convex cost function $C(e)$ with $C(0) = 0$, $C'(0) = 0$ and $C'(1) = \infty$. This implies that an intensity of 1 will never be optimal.

While we offer a particular example of a screening technology below, the chosen approach to screening is quite general. The acceptance probabilities should be interpreted as the reduced form representation capturing a rich class of economic environments. Typically, screening strategies and business expertise, accounting conventions, firms' disclosure strategies and the stochastic properties of the business environment will affect banks' learning, and hence their screening investments. We only exclude the potential (endogenous) information conveyed by market prices or trading volumes. Nevertheless, for the sake of concreteness it may be helpful to present a specific example of a creditworthiness test.

Example:

If the true project type is $i \in \{B, G\}$, the bank detects its type with probability e and with probability $1-e$ it observes an imperfect signal which is correct only with probability $\gamma_i \in \left]1/2, 1\right[$. Thus if $\gamma_i > \gamma_j$, the creditworthiness test is more efficient in detecting projects of type i than type j. When the bank tests a project of type G, it observes signal G and accepts the project with probability $\alpha(e) = e + (1-e)\gamma_G$. Similarly, the acceptance probability for a B-project is $\beta(e) = (1-e)(1-\gamma_B)$. In order to calculate explicit solutions it is convenient to use the cost function $C(e) = k\, e^2/2$ with $k > 0$.

After a loan has been granted, banks become privately informed about the borrower's type prior to the cash-flow realization of the project.

As in Parlour and Plantin (2010), banks face liquidity shocks with some probability $\lambda \in [0,1]$. In case of a liquidity shock, they incur a discount on the valuations of repayments by a factor $\delta \in (0,1)$. The shock can be viewed as the need to replenish costly bank capital in difficult

[2] In Section 5 (Extensions) we will discuss alternative screening rules with the property that the type-I and type-II errors are affected in different directions.

times. In such cases liquidity stressed banks may want to sell their loans to other long-term investors with access to capital at lower costs.

Loans can be traded in a large competitive secondary loan market at the price $\delta R \leq p \leq R$. This price for traded loans is determined by uninformed and risk neutral investors. Banks' liquidity needs and their loan assessments remain private information for the banks. Basically we have in mind opaque markets for secondary trading such as the markets for syndicated loans or for mortgage backed securities.[3] Furthermore, following the Parlour and Plantin (2010) approach, we assume that the bank learns the type of the funded project before interacting in the secondary market independently of its screening activities.[4] It should also be emphasized that we exclude considerations associated with possible incentives of liquidity-constrained banks to signal their loan types. For a detailed evaluation of issues related to transparency/opaqueness of secondary loan markets we refer to Pagano and Volpin (2012).

2. Intermediated Finance

Let us start by analyzing the screening incentives of traditional banks in the absence of loan sales. This case is indexed by a superscript NS to indicate the regime of "No Sales".

Bank revenues depend on the realization of the liquidity shock. Positive revenues are earned, when truly good projects are recognized as good projects by the screening technology. Losses are accumulated, when truly bad projects are erroneously funded.[5]

$$\Pi^{NS}(e) = \lambda(\pi\alpha(e)(\delta R - 1) - (1-\pi)\beta(e)) + (1-\lambda)(\pi\alpha(e)(R-1) - (1-\pi)\beta(e)) - C(e) \tag{2.1}$$

[3] Chemla, Hennessy (2012) consider situations with informed investors in the market for secondary trading.
[4] But, of course, the screening importantly guides the bank in identifying which projects to fund.

Due to the convexity and boundary conditions of the cost function the optimal screening intensity is found as an internal solution. The optimal screening intensity $e = e^{NS}$ satisfies the first-order condition:

$$(1-\lambda)\pi\alpha'(e^{NS})(R-1) + \lambda\,\pi\,\alpha'(e^{NS})(\delta R-1) \;-\; (1-\pi)\beta'(e^{NS}) - C'(e^{NS}) = 0\,. \qquad (2.2)$$

The marginal benefit of increased screening has two components:

i) more truly good projects will receive funding, which enhances revenues, and

ii) less truly bad projects will be funded, which cuts credit losses.

Optimal screening is attained when the marginal benefits are balanced by the corresponding marginal resource costs.

3. Loan Sales and Screening

How will loan sales affect screening incentives? In the sequel we will distinguish two cases, a complete loan sale, which we identify with the originate-to-distribute business model of banking and a partial loan sale, when banks retain a fraction of their loans in some states of nature.

Complete originate-to-distribute

Obviously, if banks originate the loans already with the intention to sell them anyways , and independently of the liquidity shock, there will be no gains from screening. Probably this is the

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[5] We assume $\Pi^{NS}(0) \geq 0$.

scenario that skeptical observers of the originate-to-distribute business model have in mind.[6] In this case the typical bank's objective function reads

$$\Pi^{OTD}(e) \;=\; p \;-1-\; C(e), \tag{3.1}$$

In fact, as long as the secondary market is active and provides a positive (expected) return on each loan, banks would never actively engage in screening and just fund any application. Optimal screening is less than under traditional banking, i.e. $e^{OTD} = 0 < e^{NS}$. Hence, with complete originate-to-distribute banking disintermediation will result. Of course, in this case there may not exist any equilibrium in the secondary loan market. *Optimal loan sale*

The condition for an active market of loan sales is $\delta R < p < R$. This requires that a certain fraction of loans is kept in the books in good times, while all loans are sold when a liquidity shock occurs. Hence, loan sales are not equivalent to a complete originate-to-distribute business model of banking, where all originated loans are sold to the market.

The typical bank's objective function now reads

$$\Pi^{LS}(e) \;=\; \{\lambda[\pi\alpha(e)+(1-\pi)\beta(e)]+(1-\lambda)(1-\pi)\beta(e)\}(p-1)+(1-\lambda)\pi\alpha(e)(R-1)-C(e) \tag{3.2}$$

because it always sells all bad loans, while good loans are only sold when the bank faces a liquidity shock.By selling loans in the distressed case the banks can increase the average returns on those loans. Moreover, they can sell bad loans in the market, which potentially undermines screening incentives.

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[6] Yerramilli, Winton (2012) demonstrate that originating banks may build up a reputation for after sales servicing even in the case of a complete asset sale.

The market will anticipate banks' behavior and demand compensation for potentially increased risk. Since the return on alternative investments is fixed to zero, investors will demand to at least break even on secondary market loans. This implies

$$p \leq \frac{\lambda\alpha\pi R}{\lambda\pi\alpha + (1-\pi)\beta}. \tag{3.3}$$

On the other hand, banks are willing to sell good loans for liquidity reasons only if $p \geq \delta R$.

With loan sales the bank's optimal screening $e = e^{LS}$ is determined by

$$(1-\lambda)\pi\alpha'(e^{LS})(R-1) + \{\lambda\pi\alpha'(e^{LS}) + (1-\pi)\beta'(e^{LS})\}(p-1) - C'(e^{LS}) = 0. \tag{3.4}$$

As long as the secondary market is active, banks are partially insured against type-II errors, since they can sell bad loans at a positive price. This implicit insurance adds to the benefit of trading loans in cases of a liquidity shock. However, it impairs screening incentives, since the need to control lending costs is reduced. The condition for an active secondary market in loans is characterized in Result 3.1.

Result 3.1 (active market for loan sales)

The secondary market for loans is active at a positive price p>0 when $\delta < \dfrac{\lambda\alpha\pi}{\lambda\alpha\pi + (1-\pi)\beta}$.

Proof: See Appendix.

In the sequel we will concentrate on the equilibrium with $\delta R < p$ such that loan sales are profitable and the secondary market is active. Our setting is rich enough to allow for alternative specifications of the secondary loan market. In a competitive market with risk neutral investors, the equilibrium price exactly corresponds to the fair evaluation of the uninformed outside investors, i.e. $p^c = \dfrac{\lambda\alpha\pi R}{\lambda\pi\alpha + (1-\pi)\beta}$. However, we also allow for less competitive secondary loan markets or limited risk bearing capacity. In this respect our analysis is sufficiently robust to capture a spectrum of market structures.

Furthermore, it should be noted that there is always also an equilibrium with p=0 and an inactive secondary market, which corresponds to the traditional business model with no loan sales. In the sequel we will concentrate on the equilibrium with an active secondary market.

The existence of an active market in secondary loans requires that a sufficiently large amount of truly profitable projects is actually traded when liquidity shocks are realized. Hence, to support a secondary loan market the probability of liquidity shocks must be large enough and the bank's precision in identifying truly good projects must be sufficiently high.

Comparison across different bank business models

How do loan sales affect screening incentives relative to traditional banking? By inspecting the first-order conditions (2.2) and (3,4) it becomes transparent that the major difference in screening incentives relates to the marginal benefit of avoiding type-II errors. This is most clearly seen in the limiting cases for the acceptance probabilities.

Consider first the limiting case where $\alpha' \to 0$. In this case the type-I errors are independent of the screening efforts, meaning that the marginal benefit of screening is largely related to a reduction of type-II errors. Since loan sales insure against type-II errors, screening incentives are lower when secondary trading is possible. This is verified by comparing the relevant first-order conditions, i.e. the screening incentives with loan sales compared with those in the traditional model. It is readily verified that $e^{LS} < e^{NS}$.

In contrast, when $\beta' \to 0$ the type-II errors are independent of the screening investments. Thus, the marginal benefit associated with screening accrues to the reduction of type-I errors. Since $p > \delta R$ screening incentives are stronger under loan sales relative to traditional banking, i.e. $e^{LS} > e^{NS}$. This captures the idea that with loan sales the bank has an increased incentive to identify those loans it keeps when it faces a liquidity shock.

By way of summarizing we have established the following (limiting) result:

Result 3.2 (screening intensities under alternative business models):

Provided the conditions for secondary market trading of Result 3.1 are satisfied, the following screening properties hold true:

i) *Loan sales soften screening relative to traditional banking when α' is sufficiently small. In this case $e^{OTD} = 0 \le e^{LS} < e^{NS}$.*

ii) *Loan sales intensify screening relative to traditional banking when β' is sufficiently small. In this case $e^{OTD} = 0 < e^{NS} < e^{LS}$.*

Proof: See Appendix

Results 3.2 (i) and (ii) characterize the effects of loan sales on screening incentives for the polar cases in which screening mainly helps to reduce either type-II or type-I errors. In case i) marginal increases in screening efforts mainly serve the purpose of avoiding bad loans (type-II errors). To the extent that loan sales are successful in transferring bad assets to the market screening incentives are reduced. In case ii) marginal screening efforts mainly serve the purpose of identifying successful projects, thus reducing type-I errors. Since the secondary market price always exceeds the continuation value after a liquidity shock, ceteris paribus returns on ex-ante screening are enhanced with loan sales. Accordingly, the returns from screening are two-fold: By selling off bad loans the bank can avoid credit losses. In addition, based on separating good from bad loans, the bank can expropriate the returns exceeding market rates for the good projects. Overall, the screening incentives are strengthened under loan sales as long as the disincentives from avoiding bad loans remain sufficiently small.

How is screening affected, when both type-I and type-II error are sensitive to screening effort? Result 3.3 provides an answer for the symmetric case with identical marginal contributions of screening effort on both types of errors.

Result 3.3 (symmetric creditworthiness tests):

Provided the conditions for secondary market trading of Result 3.1 are satisfied, and if the marginal sensitivities of type I and type II-errors are symmetric, i.e. if $\alpha' = -\beta'$, *loan sales intensify screening if and only if* $\lambda \pi (p - \delta R) > p(1 - \pi)$.

Proof: See Appendix:

Result 3.3 demonstrates that the beneficial effect of screening adds value as long as the liquidity shock is sufficiently likely and sufficiently costly at the same time. Increasing screening effort is profitable for banks if the ex-ante return on loan sales exceeds the lending hazard of the unscreened pool $\lambda \frac{p-\delta R}{p} > \frac{1-\pi}{\pi}$. This is particularly the case if δ is sufficiently small and $\lambda > (1-\pi)/\pi$, i.e. for a high likelihood of sufficiently costly liquidity shocks.

Example:

For our example more specific conditions can be determined directly for the relative screening incentives with and without loan sales. Since $\alpha'(e) = 1 - \gamma_G$, case i) of Result 3.2 applies if $\gamma_G \rightarrow 1$, which implies that the probability of rejecting a good project becomes negligible. Similarly, since $\beta'(e) = -(1-\gamma_B)$, case ii) becomes relevant if $\gamma_B \rightarrow 1$ so that the risk of accepting a bad project tends to zero. If $\gamma_G = \gamma_B$ in our example, the creditworthiness test is equally effective for both types of projects as stated in Result 3.3 for the general case.

It is instructive to compare our results with the theory of Fender and Mitchell (2009) and Kiff and Kisser (2010). These studies focus on optimal securitization and optimal retention. In particular, these studies studies characterize conditions such that retention of mezzanine tranches may generate higher screening incentives than retaining the equity piece. These studies focus on monitoring as a mechanism to improve the returns of funded projects. However, these studies do not investigate the effects of loan sales under circumstances where banks can invest in order to find out the creditworthiness of loan applications. In particular, these studies incorporate no classification errors, and do not separate the effects of type-I errors from those associated with type-II errors. Furthermore, in these studies banks have to commit to their securitization strategies prior to the realizations of potential liquidity shocks.

Properties of the loan portfolios

What are the implications of loan sales for loan portfolios?

Obviously the retained loan will be of higher quality in the traditional model if $\alpha' \to 0$ and under loan sales if $\beta' \to 0$. And in each case, because of adverse selection, the retained loan is of higher quality than the portfolio of loans traded in the secondary markets.

However, can anything more be said about the quality of the traded loans? Yes, indeed we can identify conditions under which screening incentives are sufficiently strengthened under loan sales so that even the traded loan portfolio is of higher quality than a portfolio held by the bank with intermediated finance. Especially, when screening is useful to identify successful firms in a strongly adversely selected pool of applicants, the possibility of loan sales may be quite important.

Corollary 3.4: (high quality of secondary market loans)

Whenever economic conditions are such that $e^{LS} > e^{NS}$*, there is a critical* $0 < \overline{\lambda} < 1$ *such that the pool of loans sold to the secondary market has higher quality than the loan portfolio in the absence of the secondary loan market when* $\lambda > \overline{\lambda}$.

Proof: See Appendix

From Corollary 3.4 we can conclude that loan sales are particularly good for screening incentives when liquidity shocks occur with sufficient frequency. Under such circumstances, in the absence of loan sales, banks will not be able to benefit sufficiently from their screening activities unless the liquidity cost is ameliorated by the possibility of loan sales. This case resembles the activity in the venture capital industry. Also there, one crucial requirement for successful investments is the option for venture capitalists to sell their investments to the market via IPOs. Hence an active market for IPOs resembles similar valuable screening incentives as an active market for secondary loans.

4. Extensions

While it is useful to conduct the analysis in an otherwise institution free framework in order to understand the main motivations for screening under different market structures, it may be important to consider the potential interfering role of relevant institutions, before policy conclusions are offered. In this section we will briefly discuss three particular institutions: covered bonds, information exchange between lenders and internal processes of loan evaluations.

Covered Bonds

Covered bonds have become very topical as an instrument to deal with liquidity shocks after the financial crisis of 2007/8. Covered bonds have the property that the repayment in the bad state is bounded from below and above zero in our model. Introducing positive repayments in the bad state will reduce the incentives for defensive screening. Accordingly, in the terminology of our model, the relative role of α' will be enhanced relative to β'. Generally, screening incentives will be reduced basically because risk is reduced. However, the relative screening result of Result 3.2 will continue to hold true in the limiting cases.

Information sharing

The theory developed in the previous sections, strictly speaking, applies to new projects only. In practice, however, it is not clear, whether loan applications arrive at a bank because the potential borrowers had been denied credit elsewhere or whether they are new entrants to the pool

(Broecker, 1990, Gehrig, Stenbacka, 2011). If only a percentage $0 < \mu < 1$ of the overall pool consists of new entrants, information sharing regarding existing customers will affect the returns from screening. Mandatory information sharing, which is wide spread in the real world (Japelli, Pagano, 2002), affects the statistical properties of the screening technologies. Especially, when black information is shared among banks the potential lender-specific benefit of reducing type-II errors by additional screening is reduced.

If banks share information about declined applications the need to screen in order to avoid bad loans will be significantly reduced. To see this, following Japelli and Pagano (2002) assume that the remaining $1-\mu$ applicants for exogenous reasons need to move from some other island, where their type had been observed before. If black information is shared only, this implies that the overall pool effectively consists of $\pi + (1-\pi)\mu$ projects the type of which remains unknown. As μ becomes small, only good projects remain to be funded. Accordingly, the marginal benefit of avoiding bad loans shrinks to zero, i.e. $\beta' \to 0$. Likewise, the benefit from recognizing good loans is gradually reduced. In light of the analysis in the previous section, the institution of information sharing may support a configuration where loan sales promote screening investments. Moreover, information sharing itself may adversely affect screening incentives and hence, paradoxically, information production.[7]

Alternative internal processes of credit tests

The microstructure of the lending process itself may also affect screening incentives. One way to see this is by modeling the screening process as a process with several (independent) experts

[7] See Gehrig, Stenbacka (2007) and Gehrig, Stenbacka (2011) for a more detailed analysis of information sharing and the role of pool effects in information production.

evaluating a loan. For example, a loan provisionally approved by a loan officer gets a second (independent) screen by his superior. If they agree, the loan is granted. If they disagree some aggregation rule is applied, or another expert is called in for another independent evaluation. This situation has been analyzed in pioneering work by Sah and Stiglitz (1986).

For the sake of concreteness let us concentrate on only two aggregation rules. Consider a set of *n*>1 experts with independent assessments and exogenously given (identical) individual acceptance probabilities α and β. The first aggregation rule requires unanimity (U) of expert opinions, while the second aggregation rule require a single sponsor (S) in order to be funded.

It is immediately verified that in case of the unanimity requirement $\alpha^U(e) = \alpha^n$ and $\beta^U(e) = \beta^n$, which imply $\alpha' < 0$ and $\beta' < 0$. Although this example does not directly satisfy our maintained assumptions on the screening technology, our analysis can easily be adopted. In this case traditional banking always generates stronger screening incentives than loan sales.

In case of single sponsorship we get $\alpha^S(e) = 1 - (1-\alpha)^n$ and $\beta^S(e) = 1 - (1-\beta)^n$ so that $\alpha' > 0$ and $\beta' > 0$. Now loan sales provide stronger screening incentives than traditional lending.Accordingly, the aggregation rule of in-house expertise decisively influences screening incentives and the (social) desirability of loan sales.[8]

5. Discussion

Overall our analysis reveals that the social desirability of loan sales or their regulation decisively depends on characteristics of the screening technology, on characteristics of the underlying applicant pool as well as on the particular societal institutions of information production. These institutions include for example, information sharing requirements and accounting conventions with the opaqueness or transparency associated with them. Many of the variables are difficult to observe for researchers, policy makers and regulators. Nevertheless empirical regularities might give us certain hints about important factors, possibly directing future research in trying to shed more light on variables, which are difficult to observe.

Empirical implications

Whether loan sales promotes information production by banks or not largely depends on the economic environment and especially on variables that are difficult to observe for industry outsiders. Such variables include the composition of the borrower pool or the pool of lending applications. Nevertheless, empirical observation suggests that despite massive loan sales prior to the 2007/8 financial crisis and despite massive securitization, screening incentives have not completely disappeared. Furthermore, banks still hold significant amounts of loans in their books. Even though it is difficult to argue that the retained loans are more profitable than loan portfolios associated with traditional banking, the empirical evidence WHAT EVIDENCE? at least accords well with the scenario of a low β', i.e. the scenario where marginal screening efforts predominantly serve the purpose of identifying successful projects. This is the case where our model predicts positive screening incentives of loan sales. And, in fact, additional institutional features might support that case. In many countries information sharing is mandatory, especially for black information. In those cases, additional screening will generate valuable information especially about good projects, some of which may be truly new projects and others good projects that had not been black-listed before. Black-listed projects on the other side are very likely to be discarded at this stage.

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[8] This statement also holds when aggregation rules are adjusted by threshold requirements, such that the total

Policy implications

The likelihood of loan sales is intimately linked to the condition $\delta R < p$ and hence to the potential costs of a liquidity shock δ and the profitability of good projects R. Obviously the latter is affected also by the intensity of competition in the lending industry. While we do not model banking competition explicitly, the repayment to the bank will typically reflect the degree of competition in the banking industry (e.g. Gehrig, 1998). Hence, an active market for loan sales is more likely when the costs of liquidity shocks increase and when the lending industry is more competitive. The banking markets were characterized by both these features in the late 1980's, which arguably is the period when the market for loan sales took off (Pennacchi, 1988). It is the period when capital regulation was internationally harmonized and the Basel-I regulation was implemented as well as a period of intense integration of the European banking market and the international capital market.[9]

To the extent that quantitative easing is directed at reducing banks' liquidity costs, its role can be interpreted as reducing the probability of the liquidity shock λ. An immediate consequence of such a policy is that it reduces the incentives to sell profitable projects to the secondary loan market. Hence, the viability of secondary loan markets is reduced in periods of massive liquidity injection by monetary policy. Moreover, liquidity injections also affect screening incentives positively, since banks behave more according to the traditional model of originate-to-keep and, hence, are more concerned about loans that they keep on the balance sheet.

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number of projects implemented is the same across rules (see Gehrig, Regibeau, Rockett, 2000).

9 Implicitly our argument assumes that bank capital is costly. A contrasting view of why bank capital may not be (so) costly is offered by Admati et al. (2010).

6. Conclusion

We have analyzed the impact of loan sales on the screening activity of banks. In our framework complete loan sales are never optimal, neither for individual banks nor from a social perspective. In this sense loan sales will always be partial in nature. In this respect, private incentives do not justify public concerns about a complete shift towards an originate-to-distribute business model for all loans. Most importantly, our analysis reveals that the effects of loan sales on screening incentives delicately depends on the microstructure of the screening technology and on societal institutions of information production such as information sharing agreements.

When the marginal benefit of identifying truly good projects exceeds the benefit from avoiding bad loans screening incentives are strengthened by allowing for loan sales. Of course, this argument only holds true as long as incentives of originators are maintained by allowing them to keep a stake in their loan portfolio. Forced holdings, however, as suggested by recent proposal for regulatory reform (e.g. Fender, Mitchell, 2009), are counter-productive for screening, since they tend to reduce the quality of the traded pool of loans if banks face liquidity needs.

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Appendix

Proof of Result 3.1

Investors participate in the market for secondary loans if they can break even; hence $\frac{\lambda\pi\alpha}{\lambda\pi\alpha+(1-\pi)\beta}R > p$.

Banks participate in the market for secondary loans if they can generate (immediate) cash-flow that exceed the discounted value of the returns on their (good) loans: $\delta R < p$.

Accordingly, the secondary market for loans is active at a market price $p > 0$ as long as $\delta < \frac{\lambda\pi\alpha}{\lambda\pi\alpha+(1-\pi)\beta}$.

q.e.d.

Proof of Result 3.2

Inspection of the first order conditions for the OTD model reveals that screening incentives are nil in the case of a complete asset sale, i.e. $e^{OTD} = 0$.

The first order condition in case of no loan sale (NS) is equivalent to:

$$(1-\lambda)\pi\alpha'(R-1) \quad + \quad \lambda\pi\alpha'(\delta R-1) \quad - \quad (1-\pi)\beta' \quad = \quad C'$$

The first order condition in case of a loan sale (LS) is equivalent to:

$$(1-\lambda)\pi\alpha'(R-1) \; + \; \{\lambda\pi\alpha' + (1-\pi)\beta'\}(p \; -1) = \; C'$$

Inspecting the marginal benefits of the respective market situations, one readily verifies that the marginal benefits under NS and LS are affected in opposite directions by β'. Hence, as $\alpha' \to 0$ screening incentives are stronger under NS, i.e. $e^{NS} > e^{LS} \geq e^{OTD} = 0$.

Moreover, when $\beta' \to 0$ marginal benefits depend on the relation of $\delta R - 1$ to *p-1*. Since loan sales are attractive for banks only if $\delta R < p$, also the marginal benefit of screening is larger under LS than NS, i.e. $e^{LS} > e^{NS} \geq e^{OTD} = 0$.

q.e.d.

Proof of Result 3.3

When $\alpha' = -\beta'$ the first-order condition associated with no loan sale (NS) can be rewritten according to $A\,\alpha'(e^{NS}) \; - \; C'(e^{NS}) \; = \; 0$,

where $A = \pi(1-\lambda)(R-1) + \lambda\,\pi(\delta R - 1) + (1-\pi)$. Total differentiation of this first-order condition yields

$$\frac{\partial e^{NS}}{\partial A} \; = \; \frac{\alpha'(e^{NS})}{C''(e^{NS}) - \alpha''(e^{NS})} \; > \; 0\,.$$

Following a similar procedure the first-order condition associated with loan sales (LS) can be rewritten according to

$$B\,\alpha'(e^{LS}) \; - \; C'(e^{LS}) \; = \; 0\;,$$

where $B = \pi(1-\lambda)(R-1) + (\lambda\pi - (1-\pi))(p-1)$. Total differentiation of this first-order condition yields

$$\frac{\partial e^{LS}}{\partial B} = \frac{\alpha'(e^{LS})}{C''(e^{LS}) - \alpha''(e^{LS})} > 0.$$

From these comparative statics properties we can conclude that $e^{LS} > e^{NS}$ if and only if $B > A$, which is equivalent to $\lambda\pi(p - \delta R) > p(1-\pi)$. In the limit $\delta \to 0$ this inequality simplifies to $\lambda\pi > (1-\pi)$. Therefore it is satisfied for δ small enough whenever $\lambda\pi > (1-\pi)$.

q.e.d.

Proof of Corollary 3.4

Quality of the pool sold under LS: $\frac{\lambda\pi\alpha\left(e^{LS}\right)}{\lambda\pi\alpha\left(e^{LS}\right) + (1-\pi)\beta\left(e^{LS}\right)} R$

Loan portfolio under NS: $\frac{\pi\alpha\left(e^{NS}\right)}{\pi\alpha\left(e^{NS}\right) + (1-\pi)\beta\left(e^{NS}\right)} R$

Under the maintained hypothesis $e^{LS} > e^{NS}$ and the properties of the screening functions we have $\alpha\left(e^{LS}\right) > \alpha\left(e^{NS}\right)$ and $\beta\left(e^{LS}\right) < \beta\left(e^{NS}\right)$.

Since the quality of the pool and the loan portfolio are both increasing in α / β this proves the statement for $\lambda \to 1$.

q.e.d.