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Banks and loan sales
Marketing nonmarketable assets

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Abstract

Theories of financial intermediation predict that bank loans should not be marketable because of moral hazard problems; banks will not conduct credit risk analysis or monitor borrowers if they are not at risk for failing to perform these services. Throughout most of history, bank loans have not, in fact, been marketable. Yet, by the end of the 1980's the amount of commercial and industrial loan sales outstanding had grown to over $250 billion from trivial amounts at the beginning of the decade. To explain the opening of this loan sales market, we present a model of incentive-compatible loan sales that allows for implicit contractual features between loan sellers and loan buyers. We then test for the presence of these features using a sample of over 800 recent loan sales.

Key words: Banking; Loan sales

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1. Introduction

Historically, financial intermediaries have created loans that were not later sold. A reason for the illiquidity of loans is illustrated by the example of Penn Square, the bank that failed in 1982. According to the former director and chairman of the FDIC Irvine Sprague (1986, pp. 11–12):

> Penn Square was plunging other banks' money into the risky oil and gas business. Its mode of operation was to make large, high-priced but chancy loans to drillers and then to sell the loans, in whole or in part, to other banks while pocketing a fee for the service. Such loans are called 'participations' and are a common practice in banking. Penn Square, however, transformed the practice into a species of wheeling and dealing ... The large participating banks were exposed, embarrassed, and threatened. Buying loan participations in enormous amounts were some of the country's leading and, supposedly, most sophisticated institutions ... Their transactions with Penn Square violated all tenets of sound banking ... They were content to rely on someone else's faulty and fragmentary loan documentation. Now they were exposed to massive and potentially fatal losses.

Subsequently, Seafirst of Seattle and Continental of Illinois, both major purchasers of Penn Square's loans, failed.

Recent theories of financial intermediation (e.g., Boyd and Prescott, 1986; Diamond, 1984) predict that purchasing loans would be treacherous. Banks provide borrowers with unique services in the form of (publicly unobserved) credit evaluation and monitoring activities. For a bank to have the incentive to provide an efficient level of these services, it is necessary that it hold (or retain the risk of) the loans that it creates. If loans were sold without recourse or guarantee to the buyer, then the bank would lack the incentive to produce an efficient level of credit information and monitoring since it would not receive the rewards from these activities. Ordinarily, loan buyers would recognize this lack of incentive and value the loan lower than otherwise. Therefore, the existence of financial intermediaries implies the creation of bank loans that banks should be unable to sell. The experience of Penn Square would seem to confirm the danger in buying loans and reinforce the presumption that bank loans are illiquid, which is the underlying rationale for much of bank regulation and Central Bank policy.[1]

[1]The nonmarketability of bank loans is often taken to imply that bank depositors have a difficult time valuing loans. It has been argued that such an information asymmetry between banks and outside investors is a precondition for banking panics. For example, Diamond and Dybvig (1983) assume that there is a cost to the bank of liquidating long-term investments. The cost is presumably motivated by the idea that such assets are nonmarketable. In Gorton (1985, 1986) banking panics are caused by depositor confusion over bank asset values.

The 'participations' involved in Penn Square were secondary loan participations, more generally known as 'commercial loan sales'. These are contracts under which a bank sells a proportional (equity) claim to all or part of the cash flow from an individual loan to a third party buyer. The contract transfers no rights or obligations between the bank and the borrower, so the third-party buyer has no legal relationship with the bank's borrower. Furthermore, loan sales involve no type of recourse, credit enhancement, insurance, or guarantee because only then can the originating bank remove the loan from its balance sheet (according to regulatory accounting rules). In other words, the loan buyer has no recourse to the selling bank should a loan default occur.[2]

Perhaps the problems inherent in selling loans, as exemplified by the Penn Square experience, explain why prior to the early 1980s loan sales never exceeded $20 billion annually and were confined to transactions within the bank correspondent network.[3] Important changes, however, occurred during the course of the 1980s when commercial and industrial loan sales grew tremendously, despite the practical experience and theoretical predictions that loan sales would be a 'lemons' market. The amount of commercial and industrial loan sales outstanding, according to quarterly FDIC Call Reports, increased from approximately $26.7 billion in the second quarter of 1983 to a peak of $290.9 billion in the third quarter of 1989.[4] This growth was accompanied by a market that expanded beyond the confines of historical correspondent banking networks.[5] Also, the market developed from one where loans were primarily those of investment-grade firms to one where a majority of loans sold were non-investment-grade.

[2]The lack of recourse, guarantee, or credit enhancement sharply distinguishes secondary participations from other kinds of participation (novations and assignments). See Gorton and Haubrich (1989) for a discussion. Secondary participations are also unlike asset-backed securities in this respect. Not only are asset-backed securities typically credit-enhanced, but they are claims on the cash flows from a pool of loans, whereas a loan sale or secondary participation is a claim on the cash flow from a single loan.

[3]According to American Bankers Association surveys, most loan sales in the correspondent network were due to overlines, i.e., instances where the originating bank exceeded its legal lending limit for an individual borrower.

[4]Loan sales declined during the subsequent recession as the volume of new loans originated, especially loans financing mergers and acquisitions, declined. See Demsetz (1993/4), Demsetz (1994), Haubrich and Thomson (1993), and Cantor and Demsetz (1993).

[5]Initially most loan purchasers were other banks (including a significant number of foreign banks), but nonbank firms accounted for about a quarter of loan purchases by the early 1990s (see Federal Reserve Board Senior Loan Officer Opinion surveys).

What explains the opening of the loan sales market?[6] A bank which needs to fund a new loan can: (1) fund the loan internally by issuing deposit liabilities having a cost defined as r_I, where r_I includes any regulatory or agency costs associated with this source of financing, or (2) fund the loan by obtaining funds from a buyer of the loan, where this source of financing has a cost defined as r_{ls}. The fact that loan sales have not been observed in significant quantities for most of banking history suggests that internal funding costs were generally low compared to funding costs resulting from loan selling, as predicted by theories of financial intermediation. These theories suggest that the return the bank would have to promise a loan buyer, r_{ls}, would be higher than the bank's internal funding cost because, having sold the loan, the bank would lack the incentive to undertake costly credit risk analysis or monitoring. Realizing this, and the resulting greater probability of the loan's default, loan buyers would demand a higher promised yield, r_{ls}, making loan sales relatively expensive.

Since we now observe significant quantities of loan sales, it appears that funding via loan selling is relatively inexpensive for some categories of loans originated by certain banks. This could be due to a rise in some banks' internal funding cost, r_I, and/or a decrease in the cost of funding loans via loan sales, r_{ls}. There seems to be little question that during the last fifteen years or so many banks' deposit funding costs have risen substantially. This period saw: (1) the lifting of interest rate ceilings on deposits (elimination of Regulation Q), (2) the development of interstate bank competition for deposits, and (3) increases in capital requirements that were binding constraints for many banks.[7] As shown in Pennacchi (1988) and Haubrich and Thomson (1993b), greater deposit market competition that leads to a rise in some banks' internal funding costs can result in an increase in aggregate loan sales, even if loan purchasers demand competitive rates of return on the loans that they purchase. This is because funds obtained from loan buyers, unlike deposit funds, avoid costs associated with required bank capital and required reserves. Banks facing competitive deposit

[6]While some of the previous work on loan sales is discussed below, Berger and Udell (1993) provide a more complete summary. Previous empirical work, including Berger and Udell (1994), Carstrom and Samolyk (1993), Pavel and Phillis (1987), and Haubrich and Thomson (1993a, b), uses *Call Report* data to address questions concerning which banks are buyers and which banks are sellers of loans and also the variation of aggregate loan sales volume over time. Bernanke and Lown (1991) discuss loan sales and the 'credit crunch'.

[7]It may also be the case that the internal funding costs are larger for particular categories of loans. Flannery (1989) argues that bank examination procedures create incentives for banks to hold only certain classes of loans, profitably selling the remainder. A significant fraction of loans sold during the 1980s were merger-related (see Federal Reserves Board Senior Loan Officer Opinion surveys). Loans to firms involved in highly levered transactions (HLT loans) faced particular regulatory pressure, suggesting that the costs of funding these loans internally was higher than for other categories of loans.

markets will find that some loans can be profitably sold to certain smaller domestic banks or foreign banks that, due to local market power and/or regulation, have a relatively lower cost of deposit funds.

Could the rise in internal funding costs have led to loan sales that are nothing more than an implicit underwriting activity in which the originating bank provides no special credit evaluation or monitoring services? In other words, is loan selling simply a substitute for explicit commercial paper underwriting, a financing avenue available to mostly well-known investment-grade firms? This seems unlikely. If banks provided no special credit services, an explicit investment bank underwriting contract, which gives the investor a direct claim on the borrowing firm, would dominate a loan sales contract. Should the firm fail, the direct claim allows the holders legal rights that the indirect loan sale claim precludes. Only if banks continue to provide specialized credit services would loan selling be preferred over underwriting. In fact, loan selling does not appear to be a simple underwriting function involving no bank credit services. Most loans that have been sold were those of non-investment-grade firms. Indeed, for the money center bank studied later in this paper, the majority of its loan sales were claims on borrowers that did not have a commercial paper rating. Thus, a potential moral hazard problem, arising from a bank's lack of incentive to provide credit services when loans are sold, needs to be considered when discussing the cost of funding via loan sales.

While many banks' internal funding costs have likely increased, a decline in the cost of loan sales funding, r_{ls}, also may have occurred. This could help explain an expansion of the loan sales market. In Section 2 we present a model of loan sales that assumes that banks continue to provide unique credit services that are unobservable to loan buyers. We consider two possible contract features that could reduce the agency cost of selling loans. The first feature is the possibility of a bank offering an implicit guarantee on the value of a loan sold to the loan buyer. Regulation prevents banks from inserting explicit loan guarantees in loan sales contracts. There are, however, reasons to believe that an implicit guarantee may operate. Loan buyers are concerned with the lack of a secondary market where they could sell the participation should they need cash, so selling banks informally offer to buy back loans. The question is whether this process constitutes a form of insurance.[8] If a loan buyer expects the originating bank to buy back problem loans, a means of providing de facto loan guarantees would exist. The issue of implicit insurance has also been raised by regulators. For example, FDIC director Sprague (1986, p. 112) reported that the

[8]These statements are based on conversations with bankers and loan buyers. We were, unfortunately, unable to obtain data on the fraction of loan sales that were repurchased by the selling bank in our sample. Loan buyers and sellers report that loans are occasionally repurchased, but opinions varied as to whether the repurchase price amounted to (partial) insurance.

chairman of Penn Square 'denied they had any hidden agreements to take back participated loans that went sour'. Gorton and Pennacchi (1989), using loan sales yields averaged across a sample of banks, find very weak evidence of implicit bank guarantees on loan sales.

The other contract feature we examine concerns a bank's choice of selling only part of a loan. By retaining a portion of the loan, the bank could reduce agency problems since it continues to face a partial incentive to maintain the loan's value. The greater the portion of the loan held by the bank, the greater will be its incentive to evaluate and monitor the borrower. Notably, no participation contract requires that the bank selling the loan maintain a fraction, so this contract feature would also appear to be implicit and would need to be enforced by market, rather than legal, means. Simons (1993) considers the relation between the fraction of loan syndications held by the lead bank and credit quality.[9] We discuss Simons' results in comparison to our own later.

The model illustrates how these two contract features affect the equilibrium loan sales yield, r_{ls}, on a loan of a given credit class. It shows that if the loan is not fully guaranteed by the bank (implicitly), then the bank does not undertake the level of credit evaluation or monitoring that it would were it to hold the entire loan. The loan buyer recognizes this moral hazard and reduces the price it is willing to pay.

In loan sales made through the old correspondent banking network, the mechanism for enforcing implicit contracts may have involved the threat of loan buyers terminating other business relationships that they maintain with the originating bank. In today's environment, if a loan selling bank reneges on its implicit agreement to repurchase a loan or its commitment to retain a fraction of the loan, then potential buyers may not purchase the bank's loans in the future. Thus, failure to honor implicit agreements could lead to a loss of reputation and future profitable loan sales by the loan selling bank.[10]

In Section 3 we turn to empirical tests of the model. These tests use a unique data set of 872 loan sales. Unlike previous studies of loan sales, the data include deal-specific loan sales prices and the interest rates on the underlying loans. We use these data to test for the presence of the implicit contract features modelled in Section 2. Section 4 concludes.

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[9]A loan syndication is not the same as a loan sale. In a loan sale the (legal) contractual relationship between the borrower and the bank is unaltered, but (part of) the cash flow promised by the borrower is sold to a third party with a new contract, the secondary participation. In a syndication a relationship between the borrower and the syndicate member is created from the beginning; in effect, there is no third party.

[10]See Boot, Greenbaum, and Thakor (1993) for a model where reputation causes implicit financial gurantees to be fulfilled whenever the (bank) guarantor has sufficient financial capital.

2. A model of the loan sales market

This section presents a model of the optimal contract between a bank and loan buyers. It considers a setting where the bank has an incentive to sell loans because of relatively high costs of internal funding.[11] Of course, banks may have other motives for loan sales, in particular, the desire to maintain a diversified loan portfolio. However, it seems hard to explain the dramatic 1980's rise in loan sales based solely on diversification, since this motive was likely to be present for most of banks' history. Various motivations for loan sales are discussed in Boyd and Smith (1989), James (1988), Pennacchi (1988), Benveniste and Berger (1987), Cumming (1987), Greenbaum and Thakor (1987), and Kareken (1987). See Berger and Udell (1993) for a review of the loan sales literature.

In the present model, a bank can improve the expected return on loans that it originates by evaluating (screening) loan applicants to identify better quality borrowers. However, as we explain below, the model can also be interpreted as one in which the bank provides alternative credit services by monitoring a borrower after originating a loan.[12] We adopt the standard assumption that the level of bank credit services is unobservable so that the bank and loan buyers cannot write contracts that are contingent on the level of these services.[13] Therefore, loan sales involve a moral hazard problem, namely, that the bank may not evaluate the credit of loan applicants at the most efficient level.

If a bank's diligence in screening loan applicants is unobservable, the consequent moral hazard problem can be mitigated by contractual features not directly concerned with the bank's effort. We consider the two features of the loan sale arrangement, discussed above, that could be contractually feasible: (i) an agreement by the bank to sell only a portion of the loan, retaining the remainder on its balance sheet, and (ii) a guarantee by the bank to repurchase the loan at a previously agreed upon price if the quality of the loan deteriorates. We interpret the second feature as equivalent to a (partial) guarantee against

[11] High internal funding costs may be linked to a number of sources. Pennacchi (1988) shows that regulations, such as capital and reserve requirements, can add to the cost of competitively priced bank deposits to produce relatively high internal funding costs. James (1988) illustrates how a Myers (1977) type 'underinvestment' problem can make deposit financing relatively costly when a bank has risky debt outstanding or is covered by fixed-premium deposit insurance.

[12] Campbell and Kracaw (1980) and Boyd and Prescott (1986) explain the existence of financial intermediaries as providing efficient credit evaluation services. A monitoring role for intermediaries is modeled in Diamond (1984), Gorton and Haubrich (1987), and Gorton and Kahn (1994).

[13] In recent years, the degree of asymmetric information between many borrowers and investors has likely declined, mitigating moral hazard problems in particular credit markets. However, complete elimination of asymmetric information between all potential borrowers and investors would leave banks with no role in credit intermediation. This seems extreme, so that we assume that a significant degree of asymmetric information continues to exist.

default on the loan sale. These two contract features can help mitigate the bank's moral hazard problem since the bank retains some of the risk of loan defaults and continues to face incentives to screen loan applicants.

2.1. Assumptions

The bank's problem is to maximize the expected profits from the sale of a particular loan.[14] The following assumptions are made about the loan's characteristics and possible contract features.

(A1) A bank loan requires one dollar of initial financing, and produces a stochastic return of x at the end of τ periods, where $x \in [0, L]$ and where L is the promised end-of-period repayment on the loan. The return, x, has a cumulative distribution function of $F(x, a)$, where a is the bank's level of credit evaluation. This distribution function satisfies

$$F(x, \lambda a + (1-\lambda)a') \leq \lambda F(x, a) + (1-\lambda)F(x, a') \quad \text{for all } a, a'; \quad \lambda \in (0,1).$$

(A2) The bank has a constant returns to scale technology for evaluating the credit of loan applicants. The cost function is given by $c(a) = c \cdot a$.

(A3) The bank can sell a portion, b, of the return on a loan, where $b \in [0,1]$, retaining the portion $(1-b)$. Risk-neutral loan buyers require an expected rate of return on loans purchased of r_f. The bank finances its portion by issuing deposit and/or equity liabilities having the internal funding cost of r_I.

(A4) The bank has a policy of granting an implicit (partial) guarantee against the default of each loan that it sells. Let γ refer to the proportion of each loan sale that the bank promises to guarantee, where $\gamma \in [0,1]$. The bank can fulfill this guarantee only if it is solvent at the time the loan matures. This future solvency of the bank is assumed to have probability p and to be uncorrelated with the return on the loan.

Assumptions (A1) and (A2) provide a rationale for a bank's services, improving the returns on loans by a costly credit evaluation of loan applicants.[15] We

[14]As shown in Pennacchi (1988), this problem is separable from the bank's choice of loan originations.

[15]These assumptions imply decreasing marginal profits from evaluating the credit of loan applicants.

can view the bank as expending an unobserved level of credit screening service, a, in choosing to make a single loan to a particular applicant from a heterogeneous loan applicant pool. It is assumed that potential loan buyers know the risk distribution of the loan applicant pool, but they cannot observe the risk of an individual loan applicant within this risk class.[16] The distribution function of the loan that the bank ends up making from this risk class, $F(x, a)$, will be a function of its level of credit screening effort.

Due to the nature of the loan sales data that we subsequently analyze, our model focuses on a bank's credit evaluation services prior to originating loans. However, the model could be re-interpreted as one where the bank produces a variety of credit services. For example, virtually the same assumptions can characterize a situation where the bank provides costly monitoring services, such as in Diamond (1984). The variable 'a' can be viewed as the level of any bank service that increases the expected return on a loan.

Assumption (A3) constrains the form of the explicit loan sale contract to that of a proportional equity split between the bank and the loan buyer. This assumption is due to regulatory constraints that prevent other contract forms in selling commercial and industrial loans.[17] Assumption (A4) allows the bank to offer an implicit guarantee on the loans it sells. This level of guarantee is assumed to be the same for all loans that are sold.[18] The assumption that the bank's solvency and the return on a particular loan are uncorrelated can be justified if the loan is considered to be a small portion of the overall portfolio of assets (including off-balance sheet liabilities) held by the bank.

While assumption (A3) states that the bank is a price-taker in the market for loan sales (it must offer the expected rate of return of r_f to loan buyers), we place no restriction on the bank's market power in originating loans. In other words, banks may extract surplus from borrowing firms. We believe this is an important and realistic consideration, especially for borrowing firms that lack access to public security markets.[19] Hence our model, as well as our subsequent

[16]For example, one particular risk class might be defined as all loan applicants that have no commercial paper rating. Within this (publicly observed) risk category, loan applicants could have varying degrees of (publicly unobserved) risk. Other risk classes might be those borrowers with A3, A2, A1, or A1+ commercial paper ratings.

[17]The constraints include restrictions on the form of a loan sale that enables a bank to remove the loan from its balance sheet, thereby avoiding reserve and capital requirements. Also, loan sales contracts must avoid the appearance of being 'securities' in order to avoid securities laws. These issues are discussed by Gorton and Haubrich (1989).

[18]The model can be extended to allow the bank to offer different implicit gurantees for each loan that it sells. This was done in an earlier version of this paper. Empirical results using this more complicated model are qualitatively similar.

[19]Rajan (1992) presents a model where a bank's acquisition of firm-specific credit information gives it market power in making loans. Market power in bank lending is also consistent with empirical evidence regarding the incidence of reserve requirements analyzed in Fama (1985) and James (1987).

empirical work, does not assume that the yield on the loan paid by the borrowing firm reflects purely a risk premium or purely a monopoly rent.

2.2. The bank's problem

The optimal loan sales contract involves the bank's choice of credit screening effort, a, and the fraction of the loan to be sold, b, that maximizes its expected profits:

$$\max_{a,b} \int_0^L [(1-b)x - b\gamma p(L-x)]\,\mathrm{d}F(x,a) - c(a) - \mathrm{e}^{r_I\tau}I, \tag{1}$$

where

$$I = 1 - \mathrm{e}^{-r_f\tau}\int_0^L [bx + b\gamma p(L-x)]\,\mathrm{d}F(x,a),$$

subject to

(i) $$\int_0^L (1 - b + b\gamma p)\,x\,\mathrm{d}F_a(x,a) = c'(a),$$

(ii) $b \leq 1$.

In problem (1), the first term in the bank's objective function is the expected return on the portion of the loan return held by the bank, minus the expected value of the implicit guarantee that the bank gives to the loan buyer. p is the probability that the bank is solvent (and can therefore honor its guarantee) when the loan matures in τ periods. I is the amount of internal (bank deposit and equity) funding that the bank must provide, at cost r_I, when a fraction b of the loan is sold. Constraint (i) is the incentive compatibility constraint. Hart and Holmstrom (1987) show that it can be written in this form when the distribution function, $F(x, a)$, satisfies the convexity-of-distribution-function condition given in (A1). Using the functional form $c(a) = c \cdot a$, and defining the expected return on the loan as

$$\bar{x}(a) = \int_0^L x\,\mathrm{d}F(x,a),$$

the incentive compatibility constraint can be rewritten as

$$\bar{x}_a = \frac{c}{1 - b(1-\gamma p)}, \tag{2}$$

where the subscript denotes partial differentiation. This constraint implies that when a bank sells a portion of the loan ($b > 0$), and there is some probability of the bank failing ($p < 1$) or the bank not fully guaranteeing the loan ($\gamma < 1$), then the level of credit screening, a, is less than would be the case if the bank retained the entire loan ($b = 0$) or credit screening was observable. In this latter case, credit screening could be set to its most efficient level, namely, that which satisfies[20]

$$\bar{x}_a = c. \tag{3}$$

The less-than-efficient level of credit screening that occurs when it is unobservable to loan buyers is the essence of the moral hazard problem that the bank attempts to minimize by other contractual arrangements. We now consider how the proportion of the loan that the bank sells, b, is optimally chosen to alleviate this problem.

2.3. Incentive compatible loan sales

Problem (1) can be solved to jointly determine the equilibrium level of credit screening and the fraction of the loan to be sold. Define $\theta \equiv \exp[(r_I - r_f)\tau] - 1$ to be the excess cost of internal bank finance relative to financing at the risk-free rate.[21] Then the first-order conditions with respect to the bank's choices of b and a are

$$\{\theta\bar{x}(a) + \gamma p\theta[L - \bar{x}(a)] - \lambda(1 - \gamma p)\bar{x}_a - \mu\}\, b = 0, \tag{4}$$

$$\{[1 + b(1 - \gamma p)\theta]\bar{x}_a - c'(a) + \lambda[(1 - b(1 - \gamma p))\bar{x}_{aa} - c''(a)]\}\, a = 0, \tag{5}$$

where λ and μ are the Lagrange multipliers associated with constraints (i) and (ii), respectively. Assuming the interior solution ($a > 0$) and the functional form $c(a) = c \cdot a$, Eq. (2) can be substituted into Eq. (5) to eliminate c. The resulting expression can then be used to eliminate λ in Eq. (4). This produces the following equilibrium condition:

$$b = \frac{\theta[\bar{x}(a) + \gamma p(L - \bar{x}(a))] - \mu}{(1 - \gamma p)[-\bar{x}_a^2/L\bar{x}_{aa})(1 - \gamma p)(1 + \theta) + \theta[\bar{x}(a) + \gamma p(L - \bar{x}(a))] - \mu]}. \tag{6}$$

This condition will be the basis of our empirical ests. However, as currently written, Eq. (6) is difficult to interpret since it depends on the unobserved level and derivatives of the expected return on the loan, $\bar{x}(a)$. It can be simplified by replacing these unobserved expressions by observable variables or estimable parameters. First, we can substitute for $\bar{x}(a)$ by noting that it is directly related to the promised yield on the loan sold and the fraction of the loan guaranteed.

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[20]Since the expected return on the loan is a concave function of the level of screening, a, comparing (2) and (3) implies a loss of efficiency when loans are sold.

[21]Note that θ is positive whenever $r_I > r_f$.

When a portion, b, of the loan is sold, the continuously compounded promised yield on the loan sale, r_{ls}, is defined by

$$r_{ls} = \frac{1}{\tau} \ln\left(\frac{Lb}{1 - I}\right), \tag{7}$$

where $1 - I$ is the amount a loan buyer pays in return for the promised payment Lb. Substituting for I from problem (1) into Eq. (7) and rearranging, we obtain

$$\bar{x}(a) = \frac{L(\mathrm{e}^{-(r_{ls} - r_f)\tau} - \gamma p)}{1 - \gamma p}. \tag{8}$$

Second, in order to evaluate the ratio $\bar{x}_a^2/\bar{x}_{aa}$, we need to make an explicit assumption regarding the effect of credit screening on a given loan's expected return. We choose a simple parametric form that is consistent with our earlier assumption about the bank's credit screening technology, assumption (A1), and also possesses sensible implications:

$$\bar{x}(a) = L(1 - \alpha \mathrm{e}^{-\beta a}). \tag{9}$$

This functional form implies that if no credit evaluation is done ($a = 0$), the expected return on the loan is $L(1 - \alpha)$. As credit services increase, the expected return on the loan asymptotes at the rate β to the promised payment, L.[22] Given Eq. (9), we have

$$-\bar{x}_a^2/\bar{x}_{aa} = L\alpha\,\mathrm{e}^{-\beta a} = L - \bar{x}(a). \tag{10}$$

This expression, as well as Eq. (8), can then be used to simplify Eq (6) as follows:

$$\begin{aligned} b &= \frac{\theta\,\mathrm{e}^{-(r_{ls} - r_f)\tau} - \mu/L}{(1 - \gamma p)[1 + \theta - \mathrm{e}^{-(r_{ls} - r_f)\tau} - \mu/L]} \\ &= \frac{r_I - r_f - \mu/(\tau L)}{(1 - \gamma p)[r_I - r_f + r_{ls} - r_f - \mu/(\tau L)]}. \end{aligned} \tag{11}$$

By simple differentiation of Eq. (11), it is straightforward to prove:[23]

Proposition. In equilibrium, a bank sells a greater proportion of loans: (i) the greater is the bank's internal cost of funding, $r_I - r_f$; (ii) the lower is the equilibrium loan sale premium, $r_{ls} - r_f$; and (iii) the greater is the bank's probability of solvency, p.

[22]The parameters α and β are assumed to be positive and loan specific. The parameter α is also assumed to be less than unity. The parameter β is a measure of the marginal increase in expected return on the loan from additional credit services.

[23]For an interior equilibrium, $0 < b < 1$, the Lagrange multiplier, μ, equals zero.

2.4. Discussion of the model

The implications of the model, as summarized by the previous proposition, are intuitive. Banks will sell larger proportions of loans if they face a greater excess internal funding cost, since this is the direct cost of funding the part of the loan that they retain. They will also sell a greater proportion of less risky loans, those for which the provision of bank credit services is less vital, and for which loan buyers demand, in equilibrium, a smaller default premium. In addition, since an implicit guarantee to buy back a problem loan substitutes for loan retention as a way for banks to commit to efficient credit services, the greater the quality of this guarantee (the higher the bank's solvency probability), the less the proportion of the loan that the bank needs to retain.

Our result that banks will optimally sell a smaller fraction of more risky loans is consistent with empirical findings on loan syndications by Simons (1993). While loan syndications differ from loan sales in that the original loan contract is between the borrower and each syndicate member, one could argue that the lead bank (agent) managing the syndication plays a dominant role in credit evaluation. Also, the lead bank typically recruits syndicate members after making the initial contact with the borrower. Simons (1993) analyzed 1991 Shared National Credit Program data that reported bank regulators' classifications of syndicated loans and found that lead banks held a larger proportion of syndicated loans that were subsequently criticized by bank regulators.[24]

The model also suggests that banks choose less-than-efficient levels of credit screening when portions of loans are sold and not fully guaranteed. To the extent that bank loans differ from bonds by the provision of bank credit screening (or monitoring), this means that bank loans are 'less special' when they are sold. Another interpretation is that 'bank relationships' are less important when loans are sold. Of the 872 loan sales that we study in Section 3, 538 were sales in which the borrowing firm had no commercial paper rating, suggesting that if there is a decline in the significance of bank relationships, it is not only affecting large firms. However, recent research on very small firms suggests that bank relationships continue to be important (see Petersen and Rajan, 1993, 1994; Berger and Udell, 1994).

3. Tests of the model

This section considers the empirical validity of the model given in the previous section. The data are introduced first and the statistical tests follow.

[24]On average, lead banks held a 17.4% stake in loans that were subsequently classified as 'pass', while for criticized loans, lead banks held average loan proportions of 18.0%, 29.4%, 30.5%, and 47.3% for the classifications 'specially mentioned', 'substandard', and 'loss', respectively.

3.1. An overview of the data

The data analyzed in this paper are a sample of 872 individual loan sales done by a major money center bank during the period January 20, 1987 to September 1, 1988. The bank, which has requested anonymity, is one of the largest loan sellers. For each loan sale, we were given the yield, maturity, and dollar size of the original loan made to the borrowing firm, the borrowing firm's commercial paper rating (if any), the yield and maturity of the loan sale, the fraction of the loan sold, and LIBOR corresponding to the date and maturity of the loan sale.[25] In order that the yield on the original loan and the yield on the loan sold be comparable and not unduly reflect changes in market interest rates over the time interval between loan origination and loan sale, we restricted the sample to those loan sales that occurred within three days of the loan origination. This totaled 872 loan sale observations, or 90.1% of the original observations.[26] Table 1 gives summary statistics for this sample. Note that the average difference between the yield on the loan and the yield on the loan sale is approximately 12 basis points.[27] This is quite close to the average spread of 13 basis points that was found for money center banks during the Federal Reserve Board's June 1987 Senior Loan Officer Survey of Bank Lending Practices.

Table 2 stratifies loan sales by maturity and commercial paper rating. For each commercial paper rating and maturity category, the table provides the average size of the loan sale, the number of observations, the fraction of total observations falling into that cell, and the fraction of the all observations with the same maturity falling into that cell. Notably, the largest categories of sales (by number, but also by dollar volume) are those with maturities of 6–15 days and 'No Rating', and 16–30 days and 'No Rating'. These two categories account for almost 47% of all loan sales. The next largest category is 31–60 days and 'No Rating', which accounts for 10% of the total. Thus, these three categories account for over half the total sales. This is consistent with the earlier observation that loan sales may not simply be a substitute for commercial paper.[28]

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[25]The identity of the borrowing firm was not given to us.

[26]Of this subsample of 872 loan sales, 74.8% were sales made on the date of origination, 15.4% were sales made one day after origination, 4.1% were sales made two days after origination, and 5.7% were sales made three days after origination.

[27]Buyers of commercial and industrial loans do not pay or receive any additional fees when purchasing loans. They simply receive the promised yield on the participation.

[28]Notably, this bank made no loan sales with maturities greater than one year, and its average maturity was about 28 days. This is shorter than the mean maturity of approximately one year reported by all banks during this time period. See Gorton and Haubrich (1989). The likely explanation for the shorter average maturity is that none of the loan sales in our sample involved merger-related financings, which tend to have maturities in the range of five years. Other banks sold significant amounts of merger-related loans during this time period. These loans were almost always priced at 250 basis points over LIBOR, and there were no loans of this type in our sample.

Table 1
Description of loan sales data; January 20, 1987 to September 1, 1988; 872 observations

Variable	Mean	Std. dev.	Minimum	Maximum
Loan maturity (days)	28.04	22.45	1	277
Loan sale maturity (days)	27.63	22.44	1	277
Fraction of loan sold	0.76	0.30	0.09	1.00
Loan rate (%)	7.53	0.61	6.25	9.18
Loan sale rate (%)	7.41	0.59	6.28	9.12
LIBOR rate (%)	7.29	0.57	6.19	8.75

Source: Money Center Bank.

Table 3 summarizes data that relates the spread of the yield on the loan negotiated with the borrower over LIBOR and the spread of the yield on the loan sale over LIBOR to the maturity of the loan and the rating of the borrower. Also given is the average fraction of each type of loan that the originating bank sells. Casual observation of Table 3 suggests that spreads generally increase as the borrower's rating declines and, perhaps, as the loan maturity lengthens. Also, the fraction of the loan sold by the bank appears to decline with maturity, holding the rating constant. However, there does not appear to be much relationship between the fraction sold and the rating of the borrower, holding maturity constant.

3.2. *Testing the specific functional form*

Our first empirical test focuses on the equilibrium condition given by Eq. (11). As a means of empirically implementing the model, we assume that the natural logarithm of the proportion of a loan sold equals the natural logarithm of the right-hand side of Eq. (11) plus a normally distributed error term. Our hope is that this error term can capture the influence of missing factors, assumed to be uncorrelated with the right-hand side of Eq. (11), that determine the proportion of each loan sold. Because the natural log of the fraction of the loan sold, b, has a range between minus infinity and zero, Eq. (11) with an appended error describes a Tobit model. Defining b_i^* as a latent variable for loan sale i, and b_i as the observed variable (fraction sold) for loan sale i, we have

$$\begin{aligned}\ln(b_i^*) &= -\ln(1-\gamma p) + \ln\left[\frac{\theta\,\mathrm{e}^{-(r_{ls}-r_f)\tau}}{1+\theta-\mathrm{e}^{-(r_{ls}-r_f)\tau}}\right] + \eta_i \\ &\equiv z_i(\gamma p, \theta, (r_{ls}-r_f)\tau) + \eta_i,\end{aligned} \tag{12a}$$

$$b_i = b_i^* \quad \text{if} \quad 0 \le b_i^* \le 1, \tag{12b}$$

$$b_i = 1 \quad \text{if} \quad 1 \le b_i^*, \tag{12c}$$

where $\eta_i \sim \mathrm{N}(m, \sigma^2)$. Since the fraction of the loan sold, b_i, can at most be one, so that $\ln(b_i)$ can at most be zero, the Tobit model is *censored* at $b_i = 1$. Therefore,

Table 2
Summary of the data: Loan sales size, rating, and maturity

Rating	Maturity (days)					
	0–5	6–15	16–30	31–60	61–90	90 +
A1 +						
Average size of loan sale ($millions)	5.0	5.0	25.0	28.3	41.2	0
Number of observations	1	1	1	9	3	0
% of all observations	0.1	0.1	0.1	1.0	0.3	0
% of observations of same maturity	4.8	0.3	0.3	4.9	8.1	0
A1						
Average size of loan sale ($millions)	28.8	25.8	29.1	35.6	0	8.2
Number of observations	8	34	27	20	0	3
% of all observations	0.9	3.9	3.1	2.3	0	0.3
% of observations of same maturity	38.1	11.6	8.6	10.8	0	13.6
A2						
Average size of loan sale ($millions)	15.8	13.6	12.9	20.4	21.6	19.2
Number of observations	3	41	73	64	18	9
% of all observations	0.3	4.7	8.4	7.4	2.1	1.0
% of observations of same maturity	14.3	14.0	23.2	34.6	48.6	40.9
A3						
Average size of loan sale ($millions)	0	11.7	15.9	18.8	20.0	0
Number of observations	0	3	8	4	1	0
% of all observations	0	0.3	0.9	0.5	0.1	0
% of observations of same maturity	0	1.0	2.5	2.2	2.7	0
No rating						
Average size of loan sale ($millions)	16.1	11.0	13.4	18.9	15.8	14.9
Number of observations	9	210	206	88	15	10
% of all observations	1.0	24.1	23.6	10.1	1.7	1.1
% of observations of same maturity	42.9	71.9	65.4	47.6	40.5	45.5

the likelihood function is given by

$$\prod_{b_i<1} \frac{1}{\sigma} \phi\left(\frac{\ln(b_i) - m - z_i}{\sigma}\right) \prod_{b_i=1} N\left(\frac{m + z_i}{\sigma}\right), \tag{13}$$

where ϕ is the standard normal probability density function.[29]

[29]For example, see Maddala (1983, Ch. 6).

Table 3
Summary of the data: Yield spreads (in basis points) and fraction of loan sold

Rating	Maturity (days)					
	0–5	6–15	16–30	31–60	61–90	90 +
A1 +						
Loan yield – LIBOR spread	– 6.5	0.0	– 5.0	18.6	60.8	—
Loan sale yield – LIBOR spread	– 0.5	– 2.0	– 7.0	0.4	– 3.3	—
Average fraction sold	1	1	1	0.843	0.556	0
Number of observations	1	1	1	9	3	0
A1						
Loan yield – LIBOR spread	12.4	2.9	8.9	1.8	—	30.4
Loan sale yield – LIBOR spread	3.9	– 1.4	– 3.5	1.9	—	6.0
Average fraction sold	0.917	0.867	0.746	0.455	—	1
Number of observations	8	34	27	20	0	3
A2						
Loan yield – LIBOR spread	5.1	6.2	9.1	18.4	23.1	22.9
Loan sale yield – LIBOR spread	4.8	4.7	3.1	5.8	10.5	12.7
Average fraction sold	0.733	0.826	0.810	0.746	0.600	0.608
Number of observations	3	41	73	64	18	9
A3						
Loan yield – LIBOR spread	—	22.8	15.7	14.6	25.0	—
Loan sale yield – LIBOR spread	—	17.5	12.7	12.0	17.5	—
Average fraction sold	—	0.778	0.771	0.625	1	—
Number of observations	0	3	8	4	1	0
No rating						
Loan yield – LIBOR spread	35.2	31.4	31.1	26.7	30.3	51.0
Loan sale yield – LIBOR spread	8.3	18.0	15.8	16.1	17.1	17.7
Average fraction sold	0.889	0.784	0.738	0.703	0.707	0.750
Number of observations	9	210	206	88	15	10

Recall that $\theta = \exp[(r_I - r_f)\tau] - 1$, so that the right-hand side of (12a) is a function of r_I, the bank's cost of internal financing. If we assume that the bank faces binding capital and reserve requirements, then the value of r_I can be written as[30]

$$r_I = \frac{r_e/(1-t) + \zeta r_d}{1 + \zeta(1-\rho)}, \tag{14}$$

where r_e is the cost (yield equivalent) of equity finance, r_d is the cost of deposit finance t is the corporate tax rate, ζ is the bank's maximum debt–equity capital ratio, and ρ is the required reserve ratio on deposits. Our empirical work

[30] See Pennacchi (1988) for the simple derivation.

assumes a corporate tax rate, t, of 34%. Also, since most money center banks were near their minimum capital–asset ratio of 6% when these loan sales were made, we assume $0.06 = 1/(1 + \zeta)$.

The bank's marginal cost of deposit funds is assumed to equal the LIBOR yield having the same maturity as the loan sale, a measure that was provided to us along with the loan sales data. Since LIBOR is a nearly risk-free market rate, we assume it is equivalent to the quantity r_f in our model. The bank's reserve requirement on deposits, ρ, is assumed to be 3%. This was the amount of reserves required on nonpersonal time deposits, such as large Certificates of Deposit, during the sample period. The bank's cost of equity funds, r_e, is probably the most difficult rate to recover. In our empirical work, we make alternative assumptions that it equals the risk-free rate, r_f, or a constant spread over the risk-free rate, where this spread or 'bank equity premium' is assumed to be 0.07, approximately the average difference between the rate of return on S&P 500 stocks and Treasury bills.

Estimating Eq. (12) also requires that we specify the probability of the bank failing by the maturity date of the loan sale. We assume that this probability is zero. This seems like a reasonable assumption due to the short maturity of the loan sales and the 'too big to fail' doctrine followed by bank regulators.[31] Given our previous assumption that the bank's partial guarantee, γ, is the same for each loan, then the term $-\ln(1 - \gamma p) = -\ln(1 - \gamma)$ is a constant. While this implies that $-\ln(1 - \gamma)$ is indistinguishable from m, the mean of the error term η_i, a quite literal interpretation of the model that assumes $m = 0$ would imply that γ could be estimated.

Employing the above assumptions, the Tobit model in Eq. (12) was estimated in the following form:

$$\ln(b_i^*) = a_0 + a_1 \ln\left[\frac{\theta \mathrm{e}^{-(r_{ls} - r_f)\tau}}{1 + \theta - \mathrm{e}^{-(r_{ls} - r_f)\tau}}\right] + \eta_i, \tag{15}$$

with the model restrictions being $a_0 = -\ln(1 - \gamma)$ and $a_1 = 1$. The results of estimating Eq. (15) are given in Table 4.

As shown in columns 1 and 3 of Table 4, the model was first estimated assuming a bank equity premium of either 0 or 0.07. In either case, the estimates of a_0 and a_1 were consistent with the theoretical model. The a_1 estimates were positive and significantly different from zero at the 5% confidence level, but not significantly different from their theoretical value of 1.0. Since the equity premiums of 0 and 0.07 led to estimates of a_1 that straddled its theoretical value of 1.0, we then estimated the model assuming an intermediate equity premium of

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[31] The alternative of estimating the failure probability from data on the bank's stock price was taken in an earlier version of this paper. Using these estimated failure probabilities, which averaged less than 0.0005 and had a maximum value of 0.017, produced qualitatively similar results.

Table 4
Test of the model's specific functional form; 872 observations; dependent variable: log of fraction of loan sold

$$\ln(b_i^*) = a_0 + a_1 \ln\left[\frac{\theta e^{-(r_{ls}-r_f)\tau}}{1+\theta - e^{-(r_{ls}-r_f)\tau}}\right] + \eta_i$$

Parameters	Tobit model parameter estimates assuming equity premium (E.P.) of 0, 0.04, 0.07 (standard errors in parentheses)		
	(1) E.P. = 0	(2) E.P. = 0.04	(3) E.P. = 0.07
a_0	0.8338	0.8349	0.8340
	(0.1061)	(0.1070)	(0.1073)
a_1	0.5989	1.0094	1.3035
	(0.2479)	(0.4320)	(0.5680)
Value of γ implied from $a_0 = -\ln(1-\gamma)$	0.5656	0.5661	0.5657
	(0.0462)	(0.0465)	(0.0465)
Standard error, σ	1.6850	1.6868	1.6875
	(0.1096)	(0.1097)	(0.1097)

Note: The assumed equity premium is used in computing the cost of bank internal finance, r_I, which is a component of θ.

0.04 and produced a statistically significant estimate of $a_1 = 1.0094$, almost identical to its theoretical value. See column 2. Hence, the model appears to be consistent with the data for a reasonable range of equity premia.

Given the assumption that $a_0 = -\ln(1 - \gamma p)$ and $p = 1$, our estimates for a_0 in Table 4 imply a statistically significant value for the bank's partial guarantee of $\gamma = 0.57$. However, we would emphasize that while this estimate for γ does not seem unreasonable, our test of the hypothesis that the bank provides a partial guarantee is very weak. The estimate of γ is likely to be highly dependent on the functional form specified for the bank's credit screening technology, as well as the assumption that the disturbance term mean, m, is equal to zero. Hence, we must conclude that while the data is not inconsistent with the bank's giving a partial guarantee, there is certainly no strong evidence for this practice.

3.3. *Testing the general predictions of the model*

While the data appear consistent with the model as given by Eq. (15), its specific functional form does not allow us to distinguish how the loan sale risk premium, $(r_{ls} - r_f)\tau$, and the excess cost of internal bank financing, $(r_I - r_f)\tau$, independently influence the proportion of the loan sold, b. In this section we consider the general predictions of the model as summarized by the proposition of Section 2. The proposition suggests a test of the following relation:

$$b_i^* = \alpha_0 + \alpha_1 (r_{ls} - r_f)\tau + \alpha_2 (r_I - r_f)\tau + \varepsilon_i, \tag{16}$$

where α_1 should be negative and α_2 should be positive. Since the fraction of the loan sold, b, is constrained to lie between $0 < b \leq 1$, a linear Tobit estimation technique was used. We first estimated Eq. (16) with the bank's cost of internal financing, r_I, calculated as before, assuming either an equity premium of 0 or 0.07. The results are given in columns 1 and 2 of Table 5.

Table 5 indicates that the coefficient on the loan sale risk premium, $(r_{ls} - r_f)\tau$, is correctly signed and statistically significant, verifying the model's prediction that the bank retains a greater proportion of the loan (sells less of the loan) for a larger equilibrium loan sale premium. In contrast, the coefficient of the

Table 5
Test of the model's general implications; 872 observations; dependent variable: fraction of loan sold

$b_i^* = \alpha_0 + \alpha_1 (r_{ls} - r_f)\tau + \alpha_2 (r_I - r_f)\tau + \varepsilon_1$

	Tobit model parameter estimates (standard errors in parentheses)			
Explanatory variables	(1)	(2)	(3)	(4)
Constant	0.4555 (0.0103)	0.4564 (0.0095)	0.4546 (0.0097)	(0.3839) (0.0515
$(r_{ls} - r_f)\tau$	– 131.47 (52.72)	– 124.78 (50.87)	– 155.87 (61.40)	– 133.70 (51.81)
$(r_I - r_f)\tau$ with E.P. = 0	3.959 (19.11)			
$(r_I - r_f)\tau$ with E.P. = 0.07		– 0.1571 (1.1799)		
$(r_I - r_f)\tau$ proxied by $-(r_I - r_f)\tau$			– 26.40 (30.48)	
$(r_I - r_f)\tau$ proxied by commercial paper ratings:				
Dummy = 1 if A1				0.06435 (0.05328)
Dummy = 1 if A2				0.06356 (0.5568)
Dummy = 1 if A3				0.00996 (0.07355)
Dummy = 1 if no rating				0.08048 (0.05195)
Standard error, σ	0.1388 (0.0055)	0.1388 (0.0055)	0.1390 (0.0003)	0.1377 (0.0054)

Note: The assumed equity premium (E.P.) is used in computing the cost of bank internal finance, r_I.

internal funding cost variable, $(r_I - r_f)\tau$, is statistically insignificant, whether an equity premium of 0 or 0.07 is assumed. This insignificance may be due to the insensitivity of loan sales contracts to short-term movements in this variable.[32]

As an alternative to measuring a bank's excess cost of internal financing based on regulatory costs, we considered additional proxies for this cost based on the theory developed in James (1988). Briefly, this theory considers a situation in which banks have risky debt outstanding or are covered by fixed-premium deposit insurance. A Myers (1977) 'underinvestment' problem can arise if the bank internally finances a new low risk loan because the new loan will lower the overall asset risk of the bank leading to a transfer of value from bank shareholders to bank debtholders or the FDIC. From the shareholders' perspective, this loss of value can be interpreted as a cost associated with internally financing low risk loans which can be avoided by loan sales. In contrast to low risk loans, the theory predicts that internally financing higher risk loans will be less costly since little, if any, value will be transferred from shareholders to debtholders or the FDIC. Thus, a measure of the safety or credit quality of a loan would be a proxy for the cost of internally funding the loan.

We then re-estimated Eq. (16) by trying two different proxies for $(r_I - r_f)\tau$: minus the premium on the loan made to the borrower, $-(r_L - r_f)\tau$, and a set of dummy variables indicating the borrower's commercial paper rating, if any. Columns 3 and 4 of Table 5 display the results. While in both cases the coefficient on the loan sale risk premium, $(r_{ls} - r_f)\tau$, continues to be correctly signed and statistically significant, the proxies for $(r_I - r_f)\tau$ are insignificant. Thus, none of our measures for the bank's cost of internal financing appear to be strongly supported by the data.

4. Concluding remarks

To better understand the opening of the loan sales market, we analyzed a model of bank and loan buyer behavior in which implicit contract features made loan sales incentive compatible. If the selling bank retained a fraction of the loan or it gave loan buyers an implicit guarantee against default, this could explain why market participants would buy loans (assuming these implicit contracts could be enforced). The money center bank loan sales data that we analyzed were generally consistent with the model. In particular, the model's prediction that a bank will retain a greater proportion of more risky loans, that

[32] Differences in the excess cost of internal financing appear to better explain contemporaneous loan sales activity for a cross-section of different banks rather than loan sales activity across short time periods at the same bank. Using Call Report data for a cross-section of banks, Haubrich and Thomson (1993) find a statistically significant relation between a bank's loan sales and its cost of internal financing.

is, those with a higher equilibrium loan sale yield, was strongly supported by our empirical tests. While the data did not rule out the possibility of the bank giving implicit guarantees against default, the low power of our tests implies that the presence of this contractual feature continues to be an open question. However, considering the empirical evidence as a whole suggests that certain types of loans may not be perfectly liquid. A loan selling bank must continue to convince loan buyers of its commitment to evaluate the credit of borrowers by maintaining a portion of the loan's risk.

The existence of well-functioning markets for bank assets, like those which appear to be developing, does not mean that intermediation per se is ending. All the explanations for loan sales considered above imply that banks still offer services for certain classes of borrowers that cannot be obtained in capital markets via the underwriting of public securities. The loan sales contracts mean, however, that it is no longer necessary for banks to hold all loans until maturity, risking their capital during the life of the asset created.

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