H or V | THE HECKMAN BINDERY, INC.
North Manchester, Indiana

KRL

BINDING COPY

JUST	FONT	SLOT	TITLE
H	CC	1W	22 BEBR
			21 FACULTY
			20 WORKING
			19 PAPER
H	CC	1W	8 1990
			7 NO.1705-1718
H	CC	1W	330
			B385<"CV">
			no.1705-1718
			cop.2
			<IMPRINT>
H	CC	7W	U. of ILL.
			LIBRARY
			URBANA

PERIODICAL ☐ CUSTOM ☐ STANDARD ☐ ECONOMY ☐ THESIS | NO VOLS THIS TITLE | LEAD ATTACH

BOOK ☐ CUSTOM ☐ MUSIC ☐ ECONOMY | AUTH. 1ST ☐

ACCOUNT: 66672 | LIBRARY: 001 | NEW | RUB OR SAMPLE | TITLE I.D.: 6632 | COLOR: FOIL: WHI | MATERIAL: 488

ACCOUNT NAME: UNIV OF ILLINOIS

ACCOUNT INTERNAL I.D.: B01912400 | ISSN

I.D #2: STX3 | NOTES | BINDING FREQUENCY | WHEEL: 1 | SYS. I.D: 3 | 39256

COLLATING: 35

ADDITIONAL INSTRUCTIONS

Dept=STX3 Lot=#20 Item=151 HNM=|BY#
1CR2ST3CR MARK BY # B4 91|

1 SET

SEP SHEETS | PTS. BD. PAPER | TAPE STUBS | CLOTH EXT | FILLER: GUM | STUB

POCKETS: PAPER | BUCK | CLOTH | SPECIAL PREP | LEAF ATTACH

INSERT MAT | ACCOUNT LOT NO: #20 | JOB NO.: HV363

PRODUCT TYPE: 11 | ACCOUNT PIECE NO.: 151 | PIECE NO: 81

HEIGHT: 11.2 | GROUP CARD: 1 | VOL THIS TITLE: 26

V | COVER SIZE: X 9

001247527

BEBR
FACULTY WORKING
PAPER NO. 90-1711

Banks and Loan Sales: Marketing Non-Marketable Assets

Gary Gorton
George Pennacchi

College of Commerce and Business Administration
Bureau of Economic and Business Research
University of Illinois Urbana-Champaign

BEBR

FACULTY WORKING PAPER NO. 90-1711

College of Commerce and Business Administration

University of Illinois at Urbana-Champaign

December 1990

Banks and Loan Sales: Marketing Non-Marketable Assets*

Gary Gorton
The Wharton School
University of Pennsylvania
Philadelphia, PA 19104
and
National Bureau of Economic Research

and

George Pennacchi
Department of Finance
University of Illinois
Urbana, IL 61801

*The data used in this paper were provided by a large bank which wishes to remain anonymous. We would like to thank the bank for the data and, particularly, the loan sales desk employees for their assistance in this study. Also, we are grateful to Mark Flannery for providing helpful comments on an earlier draft, and to the Geewax-Terker Research Program in Financial Instruments for research support for this project.

ABSTRACT

A defining characteristic of bank loans is that they are not resold once created. Yet, in 1989 about \$240 billion of commercial and industrial loans were sold, compared to trivial amounts five years earlier. Selling loans without explicit guarantee or recourse is inconsistent with theories of the existence of financial intermediation. What has changed to make bank loans marketable? In this paper we test for the presence of implicit contractual features of bank loan sales contract that could explain this inconsistency. In addition, the effect of technological progress on the reduction of information asymmetries between loan buyers and loan sellers is considered. The paper tests for the present of these features and effects using a sample of over 800 recent loan sales.

I. Introduction

In the last decade a market for selling commercial and industrial bank loans has opened. Since bank loans were previously nonmarketable, this innovation in banking is of critical importance to both academic economists and public policy makers. The existence of this new market challenges recent theories of financial intermediation which would predict that loan selling would be a 'lemons' market. Loan sales also contradict the presumption that bank loans are illiquid, which is the underlying rationale for much of bank regulation and Central Bank policy. Yet, little is known about this new market for loans, in part due to a lack of data. In this essay we use a sample of over 800 individual loan sales to investigate the nature of loan sales contracts.

Commercial and industrial loan sales grew tremendously during the 1980s. As Table 1 indicates, the outstanding amount of commercial and industrial loan sales 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. This growth has been accompanied by signs of a developing market. In the early stages of the market, the loans sold were very short maturity claims on the cash flows of loans to well-known firms. However, as the loan sales market has grown, the loans sold have increasingly represented claims on riskier firms. Now less than half the loans sold are the obligations of investment-grade firms. There is also evidence that the maturities of loan sales contracts have increased. In 1985, 80 percent of the loan sales had maturities of 90 days or less, while by mid-1987, over half had maturities exceeding one year.[1]

A commercial loan sale or secondary loan participation is a contract under which a

---

[1]See Gorton and Haubrich (1989) for a complete description of the development and regulation of the loan sales market.

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. Since many loans sales involve obligations of nonpublicly traded firms, third party buyers, most of whom are other banks, must rely upon the credit assessment of the originating bank. In addition, bank regulations require that the originating bank not give any type of loan guarantee to the loan buyer, if the originating bank wishes to remove the loan from its balance sheet. In other words, the loan buyer has no recourse to the selling bank should a loan default occur.

Loan sales appear paradoxical because commercial bank lending is thought to involve the financing of nonmarketable assets. The theory of financial intermediation explains that the (publicly unobserved) credit evaluation and monitoring services provided by banks require, for incentive compatibility, that the bank hold the loans it creates. Holding loans until maturity insures that the bank has incentive to effectively evaluate and monitor borrowers. If loans were sold, 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 this activity. 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 which banks should be unable to sell.[2]

The previous inability of banks to sell loans has historically been at the root of deposit insurance and bank regulation. The non-marketability of bank loans is often

---

[2] The explanations for the existence of financial intermediaries offered by Boyd and Prescott (1986), Campbell and Kracaw (1980), and Diamond (1984) all have the implication that the assets created by these firms cannot be resold.

taken to imply that bank depositors have a difficult time valuing loans. It has been argued that such an information asymmetry between banks and depositors is a precondition for banking panics.[3] If a large number of depositors seek to withdraw cash from their banks, then banks will be insolvent if there is no market to sell their assets. Thus, the illiquidity inherent in bank assets is one justification for government deposit insurance (and the Federal Reserve discount window). If a well-developed market for bank loans existed, then the rationale for bank regulation would not exist.

Loan sales are not merely underwriting which involves no special information production or monitoring services by banks. In fact, most loans that are currently sold are those of firms which have no commercial paper rating. (See Gorton and Haubrich (1989).) In addition, absent any services provided by banks, from an investor's point of view a direct claim on the firm would dominate the indirect claim of a loan sale. Should the firm fail, the direct claim allows the holders rights which the indirect claim precludes.

The advent of the loan sales market led to a number of papers which address banks' motivation for selling loans. Pennacchi (1988) shows that loan sales can provide a lower cost method of financing loans for those banks which face a competitive deposit market. By raising funds via loan sales, costs associated with required reserves and required bank capital can be avoided. James (1988) points out that loan sales can mitigate an "under-investment" problem for banks with previously issued risky debt. Flannery (1989) demonstrates that bank examination procedures create incentives for banks to hold only certain classes of loans, profitably selling the remainder. Boyd and Smith (1989) explain

---

[3] 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.

loan sales in terms of efficient allocation of resources across banks specializing in different types of lending.[4]

In this paper, we attempt focus on the nature of the contract between a bank and a loan buyer. In particular, we ask what contract features could, if enforceable, explain how the loan sales market is incentive-compatible. Without recourse, credit enhancement, contractual guarantees, or insurance, it is not obvious why loan sales are incentive-compatible. Moreover, the contract itself has not changed for at least fifty years; it is a standard secondary participation contract. But, this does not mean that no innovation has occurred. Since the regulatory authorities restrict the explicit contracts that banks may write, contract innovation may be implicit. Our first goal is attempt to empirically detect the presence of these (unobservable) contractual arrangements between banks and loan buyers which, if enforceable, could explain how the loan sales market is incentive-compatible. Our second goal is to test hypotheses about how implicit contractual features could be enforced.

We consider two possible implicit contract features which could explain the existence of loan sales. The first feature is the possibility of a bank offering an implicit guarantee on the value of the loan sold to the loan buyer. Restrictions prevent banks from inserting explicit loan guarantees in loan sales contracts. However, at times banks do repurchase loans from loan buyers. If a loan buyer expects the originating bank to buy back those loans which have deteriorated in value, a means of providing de facto loan guarantees would exist. Gorton and Pennacchi (1989), using loan sales yields averaged across a sample of banks, find very weak evidence of implicit bank guarantees on loan

[4] Other related papers include Benveniste and Berger (1987), Cumming (1987), Greenbaum and Thakor (1987), and Kareken (1987).

sales. In this study, not only are the data not averaged, but much more detailed deal-specific data are available.

The second feature is a bank's choice of selling only part of a loan, retaining the rest, so that the bank retains some 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 have to be enforced by market, rather than legal, means.

How could implicit contractual features be enforced? Loan sales would be incentive-compatible if the fundamental assumption that there is an information asymmetry between banks and outsiders, either depositors or loan buyers, has been reduced or eliminated by technological change. That is, loan sales are incentive-compatible if the loan buyer can verify whether the originating bank has effectively evaluated and monitored the borrower. This would enable the loan buyer to observe the bank's behavior, so that the potential moral hazard problem linked to loan selling can be averted. The originating bank can be induced to monitor borrowers in an efficient manner. The fact that most loan buyers are other banks, mostly foreign banks and smaller domestic banks, makes this feature plausible if one believes that banks might have a comparative advantage in monitoring the behavior of other banks. Recent improvements in technology that have lowered banks' cost of gathering and transmitting information would suggest that this feature could now be feasible. Our final test examines the hypothesis that asymmetric information has been reduced or eliminated.

In order to relate observable data to the presence of unobservable contract features, we develop a model of the loan sales market. The model is one in which banks can improve the distribution of loan returns by monitoring, but the level of monitoring by the bank may not be observed by loan buyers. The bank's problem is to choose the optimal fraction of the loan to be sold, its level of monitoring, and the fraction of the loan to be implicitly guaranteed. A key assumption is that implicit guarantees are costly because of regulatory constraints. The model provides a relationship between observable variables which we then test using a large sample of loan sales done by a money center bank.

The paper proceeds as follows. In Section II the data are introduced and some preliminary empirical analysis is performed. Section III introduces the model of loan sales and derives the equations to be estimated. In Section IV, a series of tests are carried out under the assumption that loan buyers cannot verify the monitoring services of the loan selling bank. In Section V, we provide more empirical analysis that attempts to test the proposition that loan buyers can verify the activities of the loan selling bank. Section VI concludes.

II. <u>An Overview of the Data</u>

Since little is known about the loan sales market, it is worthwhile examining the data which will be used subsequently. 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 is one of the largest loan sellers.

Table 2 presents some descriptive statistics about the data sample. Included are the mean values of the maturity of the underlying loans, the maturity of the loan sales, the fraction of the loan sold, and the interest rates on the loan, loan sale, and LIBOR. Note that the average difference between the yield on the loan and the yield on the loan sale is approximately 12 basis points. This is very close to the average spread of 13 basis points that was found for money center banks during a June 1987 Senior Loan Officer Survey of Bank Lending Practices performed by the Federal Reserve Board of Governors. We also constructed a variable to measure the probability of the bank's failure, which will be useful in our empirical analysis. The level and volatility of the bank's stock market value was used to infer this failure probability. A description of the method used to construct this variable is given in the Appendix. The data also include the borrower's commercial paper rating, if any, but not the identity of the borrower (which was not provided to us).

Table 3 presents another summary of the data. It 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 all observations falling into that cell, and the fraction of the total dollar volume of sales with the particular maturity having that rating. 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 percent of all loan sales. The next largest category is 31-60 days and 'No Rating' which accounts for ten percent 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.[5]

Table 4 summarizes data that relates the spread of the yield on the loan sold over

---

[5]Notably, during this period this bank made no loan sales with maturities greater than one year. In this respect, the bank is not representative, since the mean maturity of loan sales during the period was approximately one year. See Gorton and Haubrich (1989). The likely explanation for the shorter average maturities in our sample is that none of the bank's loan sales involved merger related financing, since these types of loans tend to have maturities in the range of five years.

LIBOR and the spread of the yield on the loan negotiated with the borrower 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 4 implies that spreads generally increase as the borrower's rating declines and also, 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.[6]

Gorton and Pennacchi (1989) hypothesized that the spread of the loan sale over LIBOR should be positively related to the risk of the borrowing firm's loan, but negatively related to a possible (implicit) loan sale guarantee by the loan selling bank. This simple relationship can be tested if we make the following two assumptions. First, that the spread of the loan over LIBOR is a measure of the risk of the borrower's loan and second, that the (implicit) loan sale guarantee by the bank becomes less valuable the higher is the probability of the bank's failure. The idea behind the second assumption is that if the bank which originates the loan becomes insolvent, it will not be able to fulfill its implicit guarantee to the loan buyer. Hence, ceteris paribus, we would expect that the spread of the loan sale over LIBOR should be positively related to the probability of the

---

[6] The following OLS regression supports these observations. Letting fr = the fraction of the loan sale retained by the bank, maturity = the maturity (in days) of the loan, and rate = {4 if no rating, 3 if A3, 2 if A2, 1 if A1, and 0 if A1+}, we have:

$$\underset{}{fr} = \underset{(.02965)}{.17890} + \underset{(.00046)}{.00151}\ \text{maturity} + \underset{(.00762)}{.00742}\ \text{rate}$$

No. of Obs. = 872, R^2 = .012. (Standard errors in parentheses.)

Thus, point estimates suggest the fraction retained increases with maturity and the risk of the rating, but only the maturity variable is significant.

bank's failure. The following OLS regression tests this hypothesis. (Standard errors are in parentheses.)

$$r_{ls} - r_f = \underset{(.00004)}{.00061} + \underset{(.01196)}{.23551}\,(r_b - r_f) + \underset{(.05122)}{.00684}\,\text{pfail}$$

No. of Observations = 872. R^2 = .311.

where r_{ls}-r_f is the spread on the loan sale over LIBOR, r_b-r_f is the spread on the loan to the borrower over LIBOR, and pfail is the probability of the bank failing by the maturity of the loan.

The loan sale spread is significantly positively related to the spread paid by the borrowing firm. However, while the coefficient on pfail is of the expected positive sign, it is insignificantly different from zero. This simple test seems to indicate little evidence of implicit loan sale guarantees. However, banks might choose to give guarantees on some loans and not on others. Without a model of the bank's choice of loan guarantees, this issue may not be resolved. In addition, the regression ignores the possible effects on the risk of the loan sale of the bank retaining a fraction of the loan.

To see how the fraction of the loan sold by the bank might relate to the spread on the loan sale, we repeat the above regression adding the fraction sold, denoted by b, to the right hand side of the regression equation.

$$r_{ls} - r_f = \underset{(.00009)}{.00098} + \underset{(.01182)}{.23877}\,(r_b - r_f) + \underset{(.05057)}{.00787}\,\text{pfail} - \underset{(.00010)}{.00051}\,b$$

No of Observations = 872. R^2 = .329.

A higher fraction of the loan sold is significantly related to a lower spread on the loan sale. This might seem counter-intuitive, since one could reason that the greater the fraction of the loan sold, the more likely is the bank to monitor the borrower inefficiently, and hence the greater should be the spread on the loan sold. But this logic ignores possible reverse casualty. Profit maximizing banks may choose to sell larger fractions of less risky loans, those loans that require less monitoring, because by doing so the yield paid by loan buyers will not rise significantly. The reported negative relation between the fraction of the loan sold and the spread paid by loan buyers could be picking up this effect.

Clearly, in order to sort out this issue as well as the issue of which loans banks may choose to guarantee, we need to develop a model of bank optimizing behavior. This is the goal of the next section. It will prepare the way for further empirical tests.

III. A Model of the Loan Sales Market

This section presents a model of the optimal contract between banks and loan buyers. We allow the contract to possibly involve a number of implicit features. The goal is to determine the optimal combination of contract features consistent with incentive compatibility and bank profit maximization. This model will then provide the framework for more detailed empirical work.

The model extends the analysis in Pennacchi (1988) to allow the possibility of banks granting implicit guarantees to loan buyers. It considers a setting where banks have an incentive to sell loans in order to avoid the costs of required reserves and required capital associated with issuing bank deposits and equity.[7] Banks can improve the

---

[7]More generally, the model of loan sales applies to any situation where the bank's internal financing is costly. For example, agency costs, rather than reserve and equity restrictions might motivate loan sales.

expected return on loans by monitoring borrowers. We first adopt the standard assumption that bank monitoring is unobservable so that banks and loan buyers cannot write contracts that are contingent on the level of monitoring. Therefore, loan sales involve a moral hazard problem, namely, that the bank may not monitor at the most efficient level after having sold its loans. However, we will later directly test this assumption of asymmetric information to consider the possibility that loan buyers might have the ability to verify the monitoring activities of the originating bank.

If bank monitoring is unobservable, the consequent moral hazard problem can be mitigated by contractual features not directly concerned with the level of monitoring. Because of regulation, these contract features would have to be implicit. We consider two features of the loan sale arrangement which could be contractually feasible. One feature is an agreement by the bank to sell only a portion of the loan, retaining the remainder on its balance sheet. The second feature is an implicit guarantee by the bank to repurchase the loan at a previously agreed upon price if the quality of the loan deteriorates. We interpret this second feature as equivalent to a (partial) guarantee against default on the loan sale. These two contract features can make loan sales incentive compatible because banks retain some of the risk of loan defaults. Therefore, they would still face incentives to monitor, even though some or all of the loan has been sold.

The bank's problem is to maximize the expected profits from the sale of a particular loan.[8] The following assumptions are made about the loan characteristics and possible contract features.

---

[8]This problem is separable from the bank's choice of loan origination. See Pennacchi (1988) for analysis of the initial loan portfolio choice.

(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 level of monitoring by the bank. This distribution function satisfies

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

(A2) The bank has a constant returns to scale technology for monitoring loans. The cost function is given by $c(a) = c \cdot a$.

(A3) The bank can sell a fraction, b, of the return on a loan where $b \in [0,1]$, retaining the portion (1-b). Risk neutral loan buyers require an expected return on loans purchased of r_f. The bank finances its portion with a weighted average cost of deposit and equity financing given by r_I.

(A4) The bank can offer an implicit (partial) guarantee against the default of a loan that it sells. Let γ refer to the proportion of a loan sale that the bank promises to guarantee, where $\gamma \in [0,1]$. Such implicit guarantees carry a potential regulatory cost, with the expected cost to the bank given by $k(\gamma)$, where $k' > 0$ and $k'' \geq 0$. The bank can fulfill this guarantee only if it is solvent at the time the loan matures. The probability the bank is solvent, p, is assumed to be uncorrelated with the return on the loan.

Assumptions (A1) and (A2) provide a real role for banks, namely, as improving the expected returns on loans by costly monitoring.[9] 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 which prevent other contract forms in selling commercial and industrial loans.[10] The cost of implicit guarantees, specified in (A4) derives from regulatory pressure. Banks are not allowed to offer explicit guarantees, i.e., they must sell loans without recourse in order to remove them from the balance sheet.

The optimal loan sales contract involves the bank choosing a level of monitoring, a, the fraction of the loan to be sold, b, and the fraction of the loan to be implicitly guaranteed, γ.

$$\max_{a,b,\gamma} \int_0^L [(1-b)x - b\gamma p(L-x)]\, dF(x,a) - c(a) - k(\gamma) - e^{r_f \tau} I \tag{1}$$

where

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

subject to

[9]That the existence of financial intermediaries can be explained by their role as monitors was first explained by Diamond (1984). Also, see Gorton and Haubrich (1987).

[10]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).

(i) $$\int_0^L (1 - b + b\gamma p)x \, dF_a(x,a) = c'(a)$$

(ii) $$b \leq 1$$

(iii) $$\gamma \leq 1$$

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 guarantee the bank gives to the loan buyer. I is the amount of internal (bank deposit and equity) funding which the bank provides when fraction b of the loan is sold. Constraint (i) is the incentive compatibility constraint. Hart and Holmstrom (1986) 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).

Define $\theta \equiv \exp[(r_I - r_f)\tau] - 1$ to be the excess cost of internal bank finance relative to financing at the riskfree rate. Then the first order conditions with respect to the bank's choices of b, a, and γ are

$$\{\theta\bar{x}(a) + \gamma p\theta[L-\bar{x}(a)] - \lambda(1-\gamma p)\bar{x}_a - \mu\}b = 0 \tag{2}$$

$$\{[1 + b(1-\gamma p)\theta]\bar{x}_a - c'(a) + \lambda[(1-b(1-\gamma p))\bar{x}_{aa} - c''(a)]\}a = 0 \tag{3}$$

$$\{bp\theta[L-\bar{x}(a)] - k'(\gamma) + \lambda bp\bar{x}_a - \epsilon\}\gamma = 0 \tag{4}$$

where λ, μ, and ϵ are the Lagrange multipliers associated with constraints (i), (ii), and (iii), respectively and where

$$\bar{x}(a) = \int_0^L x dF(x,a)$$

with subscripts referring to partial differentiation with respect to a.

If b and γ are positive in equilibrium, i.e., at least some of the loan is sold and a partial guarantee is given, then equations (2) and (4) can be combined to yield the following relation between the optimal choice of b and γ.

$$b = \frac{(k'(\gamma)+\epsilon)(1-\gamma p)}{p(\theta L-\mu)} \tag{5}$$

In addition, using the functional form c(a) = ca assumed in (A2), we can substitute the incentive compatibility constraint, (i), into equation (3) to eliminate c. The resulting expression can be used to eliminate λ in equation (2). This allows us to obtain the relationship between the bank's optimal share of the loan to sell and its optimal level of monitoring, given a partial guarantee of γ.

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

The equilibrium relations in (5) and (6) will provide the basis of our first set of empirical tests. However, as currently written, equation (6) depends on the unobserved level and derivatives of the expected return on the loan, $\bar{x}(a)$. These expressions can be replaced by observable variables or estimable parameters. First, we can substitute for

$\overline{x}(a)$ by noting that it is directly related to the yield on the loan sold and the fraction of the loan guaranteed. Since the continuously compounded yield on the loan sale, r_{ls}, is given 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 to purchase a share, b, of the loan such that the buyer's expected return equals r_f. Substituting for I from problem (1) into equation (7) and rearranging, we obtain

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

Second, in order to evaluate the ratio $\overline{x}_a^2/\overline{x}_{aa}$, we need to make an explicit assumption regarding the effect of monitoring on a given loan's expected return. We assume the parametric form[11]

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

An implication of this function form is

[11]The parameters α and β are assumed to be positive and loan specific. The parameter α is also assumed to be less than unity. Note that if no monitoring is done, the expected return is $L(1-\alpha)$. The parameter β is a measure of the marginal increase in expected return on the loan from additional monitoring. The assumed function implies that as the level of monitoring rises to infinity, the expected return on the loan asymptotes to the promised payment, L, with the speed determined by the parameter β.

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

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

$$b = \frac{\theta e^{-(r_{ls}-r_f)\tau} - \mu/L}{(1 - \gamma p)[1 + \theta - e^{-(r_{ls}-r_f)\tau} - \mu/L]} \tag{11}$$

$$\approx \frac{r_I - r_f - \mu/(\tau L)}{(1 - \gamma p)[r_I - r_f + r_{ls} - r_f - \mu/(\tau L)]}$$

Hence we see that when b is less than one, so that $\mu = 0$, the fraction of the loan sold is approximately proportional to the ratio of the excess cost of internal financing (over the risk free rate) to the excess cost of internal financing plus the excess cost of funds received from the loan sale. Thus for a given loan sale guarantee, if the equilibrium yield on the loan sale greatly exceeds the risk free rate, the bank will be selling a smaller fraction of the loan it originates.

Equations (11) and (5) are two conditions that define relationships between the bank's optimal choice of b and γ. Given a parametric assumption regarding the guarantee cost function, k(γ), in equation (5), the equilibrium values of b and γ can be determined. However, if one assumes that the bank is constrained to give the same partial guarantee, γ, for all the loans it sells, then equation (11) is sufficient to determine the bank's optimal share of each loan sold given this guarantee. We illustrate this point in the first part of the next section.

IV. A Test of Implicit Guarantees on Loan Sales

The first of our empirical tests will make the assumption that the loan selling bank has a policy of making an identical implicit (partial) guarantee, γ, for each loan that it sells. Later, we will change this assumption to allow the bank to optimize over the value of γ so that it will make different implicit guarantees on each loan sold.

A) Equal Guarantees on All Loan Sales

If the loan selling bank's partial guarantee, γ, is the same for each loan, then it can be treated as a parameter and estimated using a relationship similar to equation (11). As a means of empirically implementing our model, we assume that the natural logarithm of the proportion of a loan sold equals the natural logarithm of the right hand side of equation (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 (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, equation (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

$$\ln(b_i*) = \ln[\frac{\theta e^{-(r_b-r_f)\tau}}{1+\theta-e^{-(r_b-r_f)\tau}}] - \ln(1-\gamma p) + \eta_i \equiv z_i(\gamma) + \eta_i \tag{12a}$$

$$b_i = b_i* \qquad if\ 0 \leq b_i* \leq 1 \tag{12b}$$

$$b_i = 1 \qquad if\ 1 \leq b_i* \tag{12c}$$

where $\eta_i \sim N(m,\sigma^2)$. 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 <u>censored</u> at $b_i = 1$. Therefore, the likelihood function is given by[12]

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

where ϕ is the standard normal probability density function.

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 weighted average cost of deposit and equity finance, which is assumed to be the marginal cost of the bank's internal financing. If the bank's equity capital constraint is binding, r_I takes the form[13]

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

---

[12] For example, see Maddala (1983) chapter 6.

[13] See Pennacchi (1988) for the simple derivation

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 ratio, and ρ is the required reserve ratio on deposits. Our empirical work assumes a corporate tax rate, t, of 34%. Also, since most money center banks were near their maximum capital-asset ratio of six percent when these loan sales were made, we assume $.06 = 1/(1 - \zeta)$.

The bank's marginal cost of deposit funds is assumed to equal the LIBOR yield having the same maturity as the loan, 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 effective reserve requirement on deposits, ρ, is assumed to be three percent, the amount of reserves required on non-personal time deposits such as large Certificates of Deposit. 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 .07, approximately the average difference between the rate of return on S&P 500 stocks and Treasury bills.

The method of computing the bank's solvency probability, p, is outlined in the Appendix. It is computed in a manner similar to the analysis of Gorton and Pennacchi (1989) who show how the risk of the bank can be inferred from bank stock prices.

The estimation of the Tobit model in equation (12) was carried out by nesting it in the following more general model:

$$\ln(b_i*) = a_0 + a_1\ln[\frac{\theta e^{-(r_L-r_f)\tau}}{1+\theta-e^{-(r_L-r_f)\tau}}] + a_2\ln(1-\gamma p) + \eta_i \tag{15}$$

Equation (12) restricts $a_0=0$, $a_1=1$, and $a_2=-1$. The results of estimating equation (15) is given in Table 5.

Table 5 presents parameter estimates under the hypothesis that the bank makes the same level of guarantee, γ, on all loans sold. Columns (1) through (3) give estimates of the Tobit model specified in equation (12) assuming that the cost of bank equity, r_e, equals the risk free rate, r_f. In columns (1) and (5) we restrict the constant term to have a zero mean, while in column (3) γ (and a_2) was restricted to equal zero, as would be the case if no implicit guarantee was given by the bank to loan buyers. In each of the first three columns, the estimated value of a_1 was approximately 0.6. Its standard error implies that it is significantly different from zero at the 10% level, and one can not reject the hypothesis that it equals its theoretical value of one. However, in each of the cases in which estimates were obtained for γ and a_2, their standard errors were very large, implying that they were not significantly different from zero. In the fourth and fifth columns of Table 5, the model was re-estimated assuming that the bank equity premium was 7 per cent. Whether the error term in the model was assumed to equal zero (column 4) or not (column 5) did not appear to make much of a qualitative difference. In each case the parameter estimate of a_1 was approximately 1.3 and significantly different from zero at the 10% level, but not significantly different from its theoretical value of one. However, as in the case when the equity premium was assumed to be zero, the estimated values of γ and a_2 have such large standard errors, that one cannot reject the hypothesis that they equal zero.

In summary, the results of this section's tests provide some evidence that the bank retains a fraction of the loans it originates in the same manner that would be predicted from our optimizing model. However, under the assumption that the bank offers the same level of an implicit guarantee on each loan that it sells, we find no significant evidence that any guarantee is being given. We now consider the case in which the bank is assumed to possibly give a different level of implicit guarantee on each loan it sells.

B) Different Guarantees on Loan Sales

When the bank is assumed to be able to commit to different levels of implicit guarantees on the different loans that it sells, it will optimize using equation (5) in addition to equation (11). Using equation (5) to substitute for (1-γp) in equation (11), and rearranging, one obtains:

$$k'(\gamma) + \epsilon = \frac{b^2p(\theta L-\mu)[1+\theta-e^{-(r_b-r_f)\tau}-\mu/L]}{\theta e^{-(r_b-r_f)\tau}-\mu/L} \tag{16}$$

To solve for the optimal level of the loan guarantee as a function of the loan sold, we need to specify the form of the marginal guarantee cost, k'(γ), on the left hand side of (16). Since a necessary condition for an interior solution is that the cost function be convex, we assume a simple quadratic form, $k(\gamma) = k_0 + k_1\gamma + \frac{1}{2}k_2\gamma^2$. Solving for γ in equation (16) then gives:

$$\gamma = [\, \frac{b^2p(\theta L-\mu)(1+\theta-e^{-(r_b-r_f)\tau})}{\theta e^{-(r_b-r_f)\tau}-\mu/L} - k_1 - \epsilon \,]/k_2 \tag{17}$$

Under the assumption that the optimal level of the loan guarantee is strictly less than 1, so that ϵ can be assumed to equal zero for all loans, we can transform equation (11) along with equation (17) into a Tobit model. The transformation is again that of equation (12) above, except that γ on the right hand side of (12a) can be replaced with its optimal level given by equation (17). However, since γ is a function of b^2, b will appear on the right hand side of equation (12a) as well as on the left hand side. In principle, this equation could be solved for b in terms of the other variables and parameters, but this involves solving a cubic equation in b. This would make estimation of the parameters k_1 and k_2 rather difficult, since the roots of this equation would be a mixture of real and complex numbers depending on the parameter values. However, Tobit model estimates of the cost function parameters can still be obtained without uniquely solving for b. This can be done by using only those observations for which b is strictly less than 1. (Note μ will equal zero.) In this case the latent variable is always observed, i.e., $b_i=b_i^*$. Therefore, this model can be estimated as a standard Tobit model that is truncated (both z_i and b_i are unobserved) at $\ln(b_i)=0$. The results of carrying out this estimation is given in Table 6.

Of the 872 loan sales observations in our sample, 360 of these were sales in which the originating bank retained a positive share of the loan, i.e., $0<b<1$. This subset of observations was used to produce the estimates in Table 6, where column (1) provides estimates assuming a zero bank equity premium, and column (2) provides estimates assuming a 7 percent bank equity premium. The size of the assumed equity premium does not appear to affect the qualitative results. Basically, all of the relevant parameter estimates have large standard errors, so that none are significantly different from zero. Hence, these results provide no evidence of any implicit bank guarantees.

If we use the point estimates for k_1 and k_2 given in Table 6, we can calculate the implied value of the bank's implicit guarantee for each observation using equation (17). Summary statistics of these calculations are given at the bottom of Table 6. What we find is that the implied levels of implicit guarantees are all negative. When a zero equity premium is assumed, the average value of γ is -5.341. For a 7 percent equity premium, γ averages -.348. Of course, since the point estimates for k_1 and k_2 have such large standard errors, these implied values of γ provide little or no information about bank behavior. Hence the results of this section's empirical tests provide no indications of the implicit mechanisms used to market loans.

V. Technological Progress and Tests of Observability

The previous tests provide little evidence that loan buyers expect to receive implicit guarantees by the loan selling bank. However, there is some weak evidence that the proportion of the loan retained by the originating bank contributes, at least partially, to incentive compatibility. Still, it appears that there is sufficient scope for an alternative (perhaps complementary) explanation for the emergence of this market.

A critical assumption of the model presented above is that loan buyers could make the loan selling bank commit to some level of guarantee or force the bank to retain a portion of the loan. But, as mentioned earlier, there is nothing in the participation contract which explicitly states that the loan selling bank is committing to give a guarantee or that the bank is restricted from selling the entire loan. Hence, it is not apparent how either of these implicit mechanisms could be enforced. Since these implicit contractual features would require market forces to insure the loan selling bank's commitment, the possibility of a change in contracting technology that now makes this possible must be considered.

Various sources of indirect evidence suggest that significant changes affecting the underlying contracting technology have occurred. While it is difficult to measure precisely, the tremendous advances in computer technology and telecommunications during the past two decades have undoubtedly led to a drastic reduction in the cost of gathering, analyzing, and transmitting information. This is not to say that this lower cost of collecting and disseminating information has reduced information asymmetries between all borrowers and investors in the economy by equal amounts. One would expect that institutional investors who acquired the necessary computer and telecommunications technologies would have benefitted more than most individual investors. Intermediaries such as commercial banks, thrifts, mutual funds, insurance companies, and pension funds were likely to be most affected by this technological progress, in part because they were positioned to benefit by economies of scope from investing in computers and telecommunications. Computer and telecommunications systems are vital to lowering the cost of banks' and thrifts' transactions services, the cost of mutual funds' servicing of shareholder's accounts, the cost of insurance companies' accounting and analysis of customers' risks, and the cost of pension funds' servicing their participants' accounts.

A) Informal Evidence of Technological Change

If institutional investors have benefitted most from technologies that have reduced information costs, one would expect that they should hold a large proportion of those assets where information acquisition would be critical to valuation. High yield bonds or "junk" bonds are assets that would appear to fit into this category. The junk bond market grew dramatically during the 1980s. Prior to 1981, annual new issues were less than $1.5 billion, but peaked to over $30 billion new issues in 1986, and settling in the range of \$25 to \$30 billion through the end of the decade.[14] Importantly, as of year end 1988, three quarters of the stock of junk bonds were held by insurance companies, money managers, mutual funds, or pension funds. Individual investors owned only 5 percent of the stock of junk bonds.[15]

Given that financial institutions have invested relatively greater amounts in information technology and have therefore experienced relatively greater reductions in information costs, what effect would this have on bank lending? First, if other financial institutions can directly acquire information about borrowers at low cost, there should be less need for banks to provide information production and monitoring services for many borrowers. Banks' comparative advantage in eliminating duplication of information services or free-riding problems by multiple investors is likely to be reduced when these multiple investors have low costs of information acquisition. Therefore, if regulations such as reserve and capital requirements increase the costs of funds of banks who already must pay competitive rates for deposit and equity financing, these banks would become uncompetitive as a source of financing for many borrowers. The previously mentioned growth in the junk bond market might reflect this phenomenon. There is also evidence that banks' comparative advantage has been reduced even more at the other end of the debt risk spectrum. The ratio of nonbank commercial paper to banks' commercial and industrial loans rose from less than 10 percent in 1959 to over 75 percent in 1989, indicating a migration of large and medium sized corporations from bank financing to

---

[14]See Becketti (1990) for more description of recent developments in the junk bond market.

[15]These figures are from U.S. Securities and Exchange Commission (1990). For purposes of comparison, statistics from the Federal Reserve Bulletin show that individual investors held more that 10% of all outstanding Treasury securities as of year-end 1988.

publicly issued securities.[16]

Second, even if many financial institutions could not directly acquire information about certain classes of borrowers at low cost, they may be able to inexpensively verify the information collected by another bank regarding these borrowers. Hence we might expect that individual financial institutions could verify the accurate production of credit information and monitoring by a bank wishing to sell a single loan that it has originated. This would explain the ability of banks to sell single commercial and industrial loans to other institutions. To take this idea a step further, if we make the logical assumption that banking institutions, being in the same line of business as a loan selling bank, are able to verify the credit analysis and monitoring of the loan selling bank at lower cost than nonbank financial institutions, this would explain why over three-fourths of loan buyers are other banks.

B) An Empirical Test of Observability in the Loan Sales Market

A final test is performed that provides some evidence of the ability of loan buyers to verify the monitoring performance of a loan selling bank. Recalling the model described in the previous section, note that the incentive compatibility constraint, equation 1(i), makes the assumption that the bank's level of monitoring is not directly observable by the loan buyer. If monitoring were observable, the bank and loan buyer could contract to set the level of monitoring at its most efficient level, namely the level which would satisfy equation 1(i) where $b=0$, i.e., the level of monitoring the bank would choose if it had not sold the loan. Therefore, the possibility of the loan buyers having

[16]See Gorton and Pennacchi (1990A,B) for the theoretical rationale and empirical evidence of a shift from bank financing to direct financing.

the ability to verify the loan selling bank's performance produces the following effect.

$$\bar{x}_a = \frac{c}{1-b(1-\gamma p)}, \textit{ if monitoring unobserved.} \tag{18a}$$

$$\bar{x}_a = c, \textit{ if monitoring observed.} \tag{18b}$$

This suggests that a direct empirical test of the incentive compatibility constraint might be able to shed light on the question of whether or not bank monitoring of borrowers is observable by loan buyers. If we again assume the functional form given by equation (8), we find that

$$\bar{x}_a = \beta L \frac{1-e^{-(r_{ls}-r_f)\tau}}{1-\gamma p} \tag{19}$$

Substituting equation (19) into equation (18a) and rearranging, we arrive at

$$\beta = \frac{c}{L(1-e^{-(r_{ls}-r_f)\tau})} \frac{1-\gamma p}{1-b(1-\gamma p)} \tag{20}$$

The left hand side of equation (20) equals the loan specific parameter β which is a measure of a given loan's benefit from greater monitoring. On the right hand side are two multiplicative ratios. The first, which is independent of the fraction of the loan sold, b, and the fraction of the loan guaranteed, γ, is the relationship between the loan sale yield, r_{ls}, and β that would hold if monitoring were observable. The second term on the right hand side denotes the effect of unobservability. We propose to test the relationship given in equation (20) using the borrower's commercial paper rating as an instrument for β_i. The empirical relationship that we test is in the following log form:

$$\ln(\beta_i) = a_1 \ln[\frac{c}{L(1-e^{-(r_u-r_p)\tau})}] + a_2 \ln[\frac{1-\gamma p}{1-b(1-\gamma p)}] + \nu_i \tag{21}$$

where a_1 is a parameter that should equal 1 if the model is correctly specified, a_2 is a parameter that should equal 1 if monitoring is unobservable and should equal 0 if monitoring is observable, and ν_i is assumed to be a normally distributed, independent error term.

Equation (21) was estimated as a probit model using 334 of the 872 loan sale observations for which the borrower reported a commercial paper rating. The borrower's commercial paper rating was assumed to be a discrete measure of the its benefit from bank monitoring. It was assumed that the fraction of the loan guaranteed (if any) was the same for all loan sales, so that γ was treated as a parameter.

The results of this estimation are given in Table 7. Column (1) gives estimates of the parameters in equation (21) while column (2) does the same but restricts a_2 and γ to equal zero. In either case, the estimate of a_1 is of the correct sign and significantly different from zero. However, it is also significantly different from its theoretical value of 1, suggesting some degree of model misspecification. In column (1), the estimated value of γ seems reasonable, but the estimate of a_2 is of the wrong sign. Both estimates have huge standard errors, so that they are not significantly different from zero. Hence, the results present no evidence of unobservability in monitoring. Perhaps the significant sign of the coefficient a_1 might suggest that the monitoring of the loan selling bank is partially observable to loan buyers.

VI. Concluding Remarks

To investigate the possibility of implicit features combined in commercial and industrial loan sale contracts, we specified and estimated an optimizing model of bank and loan buyer behavior. Our empirical tests required making assumptions on the specific form of the bank's monitoring technology and the form of the bank's expected cost of giving implicit guarantees. Whether or not these functional forms are reasonable approximations of reality is difficult to verify. However, if these assumptions can be trusted, our results indicate that there is little reason to believe that the bank selling the loans in our sample is giving implicit guarantees to loan buyers. This conclusion is invariant to the alternative initial assumption that the bank makes equal guarantees or different guarantees on the loans it sells.

The equilibrium behavior of the fraction of the loan sold by the bank is somewhat consistent with our model. Assuming the bank gives no guarantees on loans sold, our results are in general agreement with the model's implication that the share of the loan sold is a decreasing function of the spread between the loan sale yield and LIBOR. This is evidence that certain types of loans may not be perfectly liquid, but that the bank must continue to convince loan buyers of its commitment to monitoring borrowers by taking a share of the loan's risk.

Technological change appears to have played an important role in the opening of the loan sales market. Our tests suggest that the monitoring of borrowers by the loan selling bank may now be observable by loan buyers. While this development is not yet well-understood, it would seem to have an important impact on the way banking is conducted.

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 issuance of open market securities.[17] The loan sales contracts mean, however, that it is no longer necessary for banks to hold loans until maturity, risking their equity during the life of the asset created.

If bank loans can be sold in fairly liquid markets, then the rationale for bank regulation is called into question since it is fundamentally based on the illiquidity of bank assets. Deposit insurance was, at least originally, aimed at providing the public with a circulating medium which did not expose people to losses either due to better informed traders or because of banking panics. If markets for bank assets open, the market incompleteness necessitating government intervention would seem to be gone. While the loan sales market is sizeable, it is by no means clear that the requisite volume of bank assets are marketable.

---

[17]There is, however, abundant evidence that the demand for bank provision of these services has fallen. The rise of the commercial paper market and the medium term note market suggest that the same technological forces which make loan sales feasible have allowed directly marketable instruments to compete more effectively with bank loans.

Appendix

This appendix outlines the method used to calculate the bank's solvency probability, p. Similar to Marcus and Shaked (1984), we assumed that the equilibrium value of bank equity can be modeled as a Black-Scholes call option:

$$e_t = a_t N(d_1) - N(d_2) \tag{A.1}$$

where e_t is the market value of bank equity per dollar of bank liabilities, a_t is the market value of bank assets per dollar or bank liabilities, and d_1 and d_2 equal:

$$d_1 = \frac{\ln(a_t) + \frac{1}{2}\sigma^2\tau_e}{\sigma\sqrt{\tau_e}}, \quad d_2 = d_1 - \sigma\sqrt{\tau_e} \tag{A.2}$$

where σ^2 is the variance of the rate of return on bank assets and τ_e is the time until the next bank examination. Given the value of bank equity in (A.1), Ito's lemma implies that the instantaneous standard deviation of the rate of return on bank equity, σ_{et}, is given by:

$$\sigma_{et} = \frac{\sigma a_t N(d_1)}{a_t N(d_1) - N(d_2)} \tag{A.3}$$

We used a time series of daily values of e_t as well as an estimate of the standard deviation of the rate of return on equity, σ_e, computed over the period January 1987 through September 1988, to infer daily values of a_t and σ. This was done by numerically solving the nonlinear system of equations (A.1) and (A.3).

Given that we now had an estimate of the bank's market value of assets to liability ratio for any date between January 1987 and September 1988, we could compute the probability at the time that a loan was sold that the bank would remain solvent until the loan's maturity date. This was done by making the (risk-neutral) assumption that the expected rate of return on bank assets and liabilities were both equal to the risk free rate. Taking the (theoretically constant) value of σ to be the average of our estimates, then the probability of the bank's solvency at date $t+\tau$ given that its asset to liability ratio equals a_t at date t is:

$$p = N\left(\frac{\ln(a_t) - \frac{1}{2}\sigma^2\tau}{\sigma\sqrt{\tau}}\right) \tag{A.4}$$

References

Amemiya, Takeshi (1985), Advanced Econometrics, Harvard University Press, Cambridge, Mass.

Becketti, Sean (1990), "The Truth about Junk Bonds," Federal Reserve Bank of Kansas City Economic Review 75(4), 45-54.

Benveniste, Lawrence, and Allen Berger (1987), "Securitization With Recourse: An Investment that Offers Uninsured Bank Depositors Sequential Claims," Journal of Banking and Finance 11, 403-24.

Boyd, John, and Edward Prescott (1986), "Financial Intermediary-Coalitions," Journal of Economic Theory 38, 211-32.

Boyd, John, and Bruce Smith (1989), "Securitization and the Efficient Allocation of Investment Capital," Federal Reserve Bank of Minneapolis, Working Paper 408.

Campbell, Tim, and William Kracaw (1980), "Information Production, Market Signalling and the Theory of Financial Intermediation," Journal of Finance XXV(4) (September), 863-81.

Cumming, Christine (1987), "The Economics of Securitization," Federal Reserve Bank of New York Quarterly Review (Autumn), 11-23.

Diamond, Douglas (1984), "Financial Intermediation and Delegated Monitoring," Review of Economic Studies LI.

Diamond, Douglas, and Philip Dybvig (1983), "Bank Runs, Deposit Insurance and Liquidity," Journal of Political Economy 9(13).

Flannery, Mark (1989), "Capital Regulation and Insured Banks' Choice of Individual Loan Default Rates," Journal of Monetary Economics 24, 235-58.

Gorton, Gary (1989), "Self-Regulating Bank Coalitions," The Wharton School, University of Pennsylvania, Working Paper.

___________ (1985), "Bank Suspension of Convertibility," Journal of Monetary Economics 15(2).

Gorton, Gary and Joseph Haubrich (1989), "The Loan Sales Market," Research in Financial Services, edited by George Kaufman, forthcoming.

___________ (1987), "Bank Deregulation, Credit Markets and the Control of Capital," Carnegie-Rochester Conference Series on Public Policy 26 (Spring).

Gorton, Gary and George Pennacchi (1989), Are Loan Sales Really Off-Balance Sheet?," Journal of Accounting, Auditing, and Finance 4(2), 125-145.

____________ (1990A), "Financial Intermediation and Liquidity Creation," Journal of Finance 45(1), 49-72

____________ (1990B), "Financial Innovation and the Provision of Liquidity Services," Reform of Deposit Insurance and the Regulation of Depository Institutions in the 1990s, ed. by James Barth and Dan Brumbaugh, forthcoming.

Greenbaum, Stuart, and Anjan Thakor (1987), "Bank Funding Modes: Securitization versus Deposits," Journal of Banking and Finance 11, 379-402.

Hart, Oliver, and Bengt Holmstrom (1986), "The Theory of Contracts," Massachusetts Institute of Technology, Working Paper No. 418.

James, Christopher (1988), "The Use of Loan Sales and Standby Letters of Credit by Commercial Banks," Journal of Monetary Economics 22, 395-422.

Kareken, John (1987), "The Emergence and Regulation of Contingent Commitment Banking," Journal of Banking and Finance 11, 359-77.

Maddala, G.S. (1983), Limited-Dependent and Qualitative Variables in Econometrics, Cambridge University Press, Cambridge, U.K.

Marcus, Alan, and Israel Shaked (1984), "The Valuation of FDIC Deposit Insurance Using Option-Pricing Estimates," Journal of Money, Credit, and Banking 16, 446-60.

Pennacchi, George (1988), "Loan Sales and the Cost of Bank Capital," Journal of Finance 43, 375-95.

U.S. Securities and Exchange Commission (1990), "Recent Developments in the High Yield Market," Staff Report, March.

Table 1

Quarterly Outstanding Loan Sales of Commercial Banks*
($ billions)

Date	Loan Sales	Loan Purchases
1983Q2	26.7	–
Q3	26.8	–
Q4	29.1	–
1984Q1	32.8	–
Q2	33.3	–
Q3	35.5	–
Q4	50.2	–
1985Q1	54.6	–
Q2	59.9	–
Q3	77.5	–
Q4	75.7	–
1986Q1	65.4	–
Q2	81.2	–
Q3	91.3	–
Q4	111.8	–
1987Q1	162.9	–
Q2	195.2	–
Q3	188.9	–
Q4	198.0	–
1988Q1	236.3	16.64
Q2	248.4	16.22
Q3	263.0	17.65
Q4	286.8	19.29
1989Q1	272.7	16.16
Q2	276.5	18.20
Q3	290.9	17.82
Q4	258.7	19.89
1990Q1	228.3	16.07
Q2	190.2	15.94

*Sales reported are gross and exclude sales of consumer loans and mortgage loans. Also excluded are loans subject to repurchase agreements or with recourse to the seller.

Source: FDIC *Call Reports*, Schedule L.

Table 2

Description of Data

Variable	Mean	Standard Deviation	Minimum	Maximum
1) Maturity of the Loan (days)	28.04	22.45	1.00	277.0
2) Maturity of the Loan Sale (days)	27.63	22.44	1.00	277.0
3) Fraction of Loan Sold	0.76	0.30	0.09	1.00
4) LIBOR Rate	7.29	0.57	6.19	8.75
5) Loan Sale Rate	7.41	0.59	6.28	9.12
6) Loan Rate	7.53	0.61	6.25	9.18
7) Probability of Bank Failure	0.000047	0.000625	0.00	0.0171

Sample Period: January 20, 1987 - September 1, 1988.

Number of Observations: 872.

Source: Money Center Bank.

Table 3

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+						
Avg. Size of Loan Sale ($millions)	5.0	5.0	25.0	28.3	41.2	0
Number of Observations	1	1	1	9	3	0
% of All Observations	.1	.1	.1	1.0	.3	0
% of Observations of Same Maturity	4.8	.3	7.9	4.9	8.1	0
A1						
Avg. Size of Loan Sale ($millions)	28.8	25.8	29.1	35.6	0	8.2
Number of Observations	8	34	27	20	0	3
% of All Observations	.9	3.9	3.1	2.3	0	.3
% of Observations of Same Maturity	38.1	11.6	8.6	10.8	0	13.6
A2						
Avg. Size of Loan Sale ($millions)	15.8	13.6	12.9	20.4	21.6	19.2
Number of Observations	3	41	73	64	18	9
% of All Observations	.3	4.7	8.4	7.4	2.1	1.0
% of Observations of Same Maturity	14.3	14.0	23.2	34.6	48.6	40.9
A3						
Avg. Size of Loan Sale ($millions)	0	11.7	15.9	18.8	20.0	0
Number of Observations	0	3	8	4	1	0
% of All Observations	0	.3	.9	.5	.1	0
% of Observations of Same Maturity	0	1.0	2.5	2.2	2.7	0
NR						
Avg. 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

Table 4

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+						
$R_{LS} - R_{LIBOR}$ basis pts.	– .5	– 2.0	– 7.0	.4	– 3.3	–
$R_B - R_{LIBOR}$ basis pts.	– 6.5	0.0	– 5.0	18.6	60.8	–
Average Fraction Sold	1	1	1	.843	.556	0
Number of Observations	1	1	1	9	3	0
A1						
$R_{LS} - R_{LIBOR}$ basis pts.	3.9	– 1.4	– 3.5	1.9	–	6.0
$R_B - R_{LIBOR}$ basis pts.	12.4	2.9	8.9	1.8	–	30.4
Average Fraction Sold	.917	.867	.746	.455	–	1
Number of Observations	8	34	27	20	0	3
A2						
$R_{LS} - R_{LIBOR}$ basis pts.	4.8	4.7	3.1	5.8	10.5	12.7
$R_B - R_{LIBOR}$ basis pts.	5.1	6.2	9.1	18.4	23.1	22.9
Average Fraction Sold	.733	.826	.810	.746	.600	.608
Number of Observations	3	41	73	64	18	9
A3						
$R_{LS} - R_{LIBOR}$ basis pts.	–	17.5	12.7	12.0	17.5	–
$R_B - R_{LIBOR}$ basis pts.	–	22.8	15.7	14.6	25.0	–
Average Fraction Sold	–	.778	.771	.625	1	–
Number of Observations	0	3	8	4	1	0
NR						
$R_{LS} - R_{LIBOR}$ basis pts.	8.3	18.0	15.8	16.1	17.1	17.7
$R_B - R_{LIBOR}$ basis pts.	35.2	31.4	31.1	26.7	30.3	51.0
Average Fraction Sold	.889	.784	.738	.703	.707	.750
Number of Observations	9	210	206	88	15	10

Table 5

Parameter Estimates Assuming Bank Gives
Equal Guarantees on All Loan Sales

Dependent Variable: Log of Fraction of Loan Sold

Number of Observations: 872

$$\ln(b_i*) = a_0 + a_1 \ln\left[\frac{\theta e^{-(r_{L}-r_{f})\tau}}{1+\theta-e^{-(r_{L}-r_{f})\tau}}\right] + a_2 \ln(1-\gamma p) + \eta_i$$

Tobit Model Parameter Estimates
(Standard Errors in Parentheses)

Parameters	(1) ep=0	(2) ep=0	(3) ep = 0	(4) ep=.07	(5) ep=.07
a_0	0	10.1886 (2113.44)	.83380 (.10794)	0	10.57055 (2324.74)
a_1	.59463 (.34609)	.60254 (.34447)	.59890 (.34416)	1.30229 (.78109)	1.31195 (.78073)
a_2	1.18385 (271.6884)	-5.59434 (2517.72)	0	.50472 (25.881)	-6.06104 (2949.55)
γ	.506687 (127.37)	.81218 (322.90)	0	.80840 (72.815)	.79941 (340.51)
Standard Error	1.69070 (.19195)	1.68455 (.19058)	1.68499 (.19043)	1.68745 (.19106)	1.68707 (.19113)
- Log Likelihood	838.93	838.88	838.93	839.16	839.11

Note: ep refers to the assumed equity premium used in computing the excess cost of bank internal finance, θ.

Table 6

Parameter Estimates Assuming Bank May Give Different Guarantees on Loan Sales

Dependent Variable: Log of Fraction of Loan Sold

Number of Observations: 360

$$\ln(b_i*) = a_0 + a_1\ln[\frac{\theta e^{-(r_L-r_f)\tau}}{1+\theta-e^{-(r_L-r_f)\tau}}] + a_2\ln(1-\gamma*p) + \eta_i$$

$$where\ \gamma* = [\frac{b^2 p\theta L(1+\theta-e^{-(r_L-r_f)\tau})}{\theta e^{-(r_L-r_f)\tau}} - k_1]/k_2$$

Tobit Model Parameter Estimates
(Standard Errors in Parentheses)

Parameters	(1) ep=0	(2) ep=.07
a_0	-.53355 (3.87253)	-.70868 (5.35174)
a_1	.00326 (.02547)	-.00702 (.05358)
a_2	.26724 (1.36110)	1.08310 (7.47424)
Regulatory Cost Parameter k_1	.01028 (.06360)	.00685 (.09711)
Regulatory Cost Parameter k_2	.00191 (.00130)	.01914 (.16057)
Standard Error	.16955 (.00134)	.16883 (.00137)
- Log Likelihood	-7631.58	-7627.73

Note: ep refers to the assumed equity premium used in computing the excess cost of bank internal finance, θ.

Values of Loan Sale Guarantees Implied by k_1 and k_2 Estimates

Mean of Sample	-5.341	-.348
Standard Deviation	.053	.011
Minimum	-5.385	-.358
Maximum	-4.938	-.270

Table 7

Parameter Estimates of Incentive Compatibility Constraint

Dependent Variable: Log of Commercial Paper Rating

Number of Observations: 334

$$\ln(\beta_i) = a_1 \ln\left[\frac{c}{L(1-e^{-(r_b-r_f)\tau})}\right] + a_2 \ln\left[\frac{1-\gamma p}{1-b(1-\gamma p)}\right] + \nu_i$$

Probit Model Parameter Estimates
(Standard Errors in Parentheses)

Parameters	(1)	(2)
a_1	.36692 (.05835)	.33910 (.05503)
a_2	-.65856 (10.11244)	0
γ	.55820 (4.67695)	0
- Log Likelihood	283.03	285.03

Note: The borrower's commercial paper rating was assumed to be a discrete measure of its of its benefit from monitoring as measured by β. Commercial paper ratings were translated as A1+=0, A1=1, A2=2, A3=3.