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ON THE RELATIONSHIP BETWEEN STANDBY LETTERS OF CREDIT AND BANK CAPITAL

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FEDERAL RESERVE BANK OF CHICAGO

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On the Relationship Between
Standby Letters of Credit and Bank Capital

Abstract

A relatively recent trend in commercial banking has been the rapid growth in the issuance of off balance sheet guarantees. This paper theoretically models and empirically estimates the relationship between bank standby letter of credit activity, a type of guarantee, and primary capital. To accurately estimate this relationship, a simultaneous equation model is developed to capture the feedback effects of standby letter of credit issuance on the decision to manage intermediary risk though changes in bank capital. Currently, federal bank regulators are concerned that banks are bolstering profits by shifting out of liquid assets and secondary reserves and increasing their issuance of off balance sheet guarantees to generate fee income and conserve capital. This paper addresses the appropriateness of risk-based capital rules, recently proposed as a means of altering the perceived relationship between standby letter of credit issuance and bank capital.

I. Introduction

A relatively recent trend in commercial banking has been the rapid growth in guarantor activities that are carried off the balance sheet. Some of the largest of these off balance sheet activities, in terms of dollar amounts, are instruments such as standby letters of credit, loan commitments, and commercial letters of credit. From 1973 to 1985, the combined industry-wide issuance of standby letters of credit in constant 1982 dollars grew at an annual rate of 24% while total loans grew at a 3% rate (Benveniste and Berger [1]). Off balance sheet items are contingent claims that usually generate fee income for the bank at the time they are initiated but also create credit, interest rate, and liquidity risks.[1] When a bank issues a standby letter of credit, three parties are involved: the issuing bank, its customer, and the beneficiary entitled to draw down the credit. The bank makes an irrevocable commitment to pay the beneficiary the credit amount when the beneficiary presents evidence that the bank's customer failed to fulfill the obligations of an underlying agreement. A standby letter of credit makes the beneficiary similar to an uninsured depositor because a claim is owned on the bank's assets, contingent upon default by the bank's customer.

The contribution of this paper is to theoretically model and empirically estimate the relationship between bank standby letter of credit activity and primary capital. This relationship is important because public policy concerning bank risk management and the use of off balance sheet items should be based on a logical understanding of how bank balance sheet and off balance sheet decisions are related. Recently, the Federal Reserve has proposed a risk-based capital standard in which banks must hold a minimum level of capital against their outstanding standby letters of credit.[2] The assumption underlying this proposal is: because the current minimum capital standards

exclude off balance sheet items, bank capital decisions do not offer a prudent buffer for an organization's off balance sheet risk exposure. Federal banking agencies are concerned that banks are bolstering profits and taking risks by shifting out of liquid assets and secondary reserves and increasing their off balance sheet activity.

Currently, the ability to earn non-interest income while avoiding capital requirements makes standby letters of credit an attractive alternative to booking balance sheet assets. Goldberg and Lloyd-Davies [4] found an inconsistent relationship between capital and letter of credit activity; a positive relationship existed only for small banks. In contrast, Koppenhaver [7] examined why a bank may be in the guarantee market. He concludes that the relationship between capital and letter of credit activity is negative but again, only for small banks. Finally, Benveniste and Berger [1] estimate that banks with low capital ratios are more likely to issue standby letters of credit but, given that they do issue these instruments, capital ratios and standby letter of credit volume are positively related.

Another viewpoint suggests that a uni-directional relationship may not fully capture the interaction between standby letters of credit and bank capital. On the one hand, the risks of standby letter of credit issuance may be fully recognized by those banks that issue these guarantees and they increase their capital position simultaneously. The bank might raise their capital position because of an internal assessment of increased credit, interest rate, or liquidity risk or because of market discipline imposed by demanders of guarantees. Since a standby letter of credit is a guarantee of funds availability issued by the bank for a transaction between the bank's customer and the letter of credit beneficiary, the bank must be sufficiently sound to make the guarantee credible.[3] A bank with greater equity is

perceived as being more sound by the guarantee market, and hence, it can issue more standby letters of credit. In this view, capital and standby letters of credit are then complementary decisions. On the other hand, the ability to issue standby letters of credit may depend on other aspects of the bank's overall safety and soundness besides equity capital, such as asset quality, liability mix, and absolute size. A bank will not need to hold as much capital if it is viewed as sufficiently sound to issue standby letters of credit. Thus, the relationship between outstanding standby letters of credit and capital could be negative. If this is the true relationship, it runs contrary to the proposal by the Federal Reserve that banks should hold additional capital against their standby letters of credit.

This study examines whether or not banks explicitly increase their capital to reflect the potential risk exposure from standby letter of credit activity. To accurately estimate the relationship, a simultaneous equation model is needed to capture the joint decision process for standby letter of credit issuance and bank capital. This paper models the standby letter of credit and capital decisions in sections II and III, presents the estimation results in section IV, and addresses the appropriateness of the recently proposed risk-based capital rule in the conclusion.

II. Theoretical Model

The model of bank balance sheet and off balance sheet activities developed here retains the traditional depiction of bank decision-making as a process of reconciling the goals of profitability, liquidity, and solvency.[4] The model incorporates the latter two goals by assuming i) the bank has access to a competitive funds market where funds can be purchased or sold in any desired quantity at a given rate, and ii) bank management makes decisions given a

soundness function based on the expected value of the bank in the event of forced liquidation. Management can affect the degree of bank soundness explicitly through both balance sheet and off balance sheet decisions. Uncertainty in bank decision-making is introduced through the interest rate at which funds can be purchased or sold and through the takedowns on outstanding standby letters of credit. The model is closely related to Luckett [8] although risk aversion is introduced, as well as the off balance sheet decision to issue standby letters of credit.[5]

Assume the bank has a one period planning horizon. At the beginning of the period, bank management must decide on the quantity of equity, K, to hold, and the quantity of standby letters of credit, S, to issue. At this time, the rate on and quantity of earning assets, R_L and L, the rate on and quantity of insured retail deposit liabilities, R_D and D, and the opportunity cost of equity, R_K, are all known. Unknown to bank management is the cost of purchased funds, $\tilde{R}_B$, and the takedown per dollar of standby letters of credit issued, $\tilde{\theta}$. These unknown values are revealed at the end of the period when the bank either borrows or lends ($B \gtrless 0$) in the competitive, uninsured funds market. The ex post balance sheet constraint can be written as:

$$L + \theta S = B + (1-r)D + K, \qquad (1)$$

with r equal to the exogenously imposed reserve requirement on retail deposits.

The ex ante decisions (K and S) and the ex post decision (B) are arguments in a function that reflects the bank's desire to maintain an economically sound institution (see Mingo and Wolkowitz [12]). The soundness function measures the bank's financial strength by weighting the various items in the bank's balance sheet and calculating the excess of weighted assets over

weighted liabilities. Asset weights are based on credit risk and marketability; liability weights are based on interest rate sensitivity and insurance status. Let the ex ante expected soundness measure be given by:

$$E\tilde{\tau} = \gamma(L + E\tilde{\theta}S) + \alpha K - \beta E\tilde{B} - \delta(1-r)D, \qquad (2)$$

with E equal to the expectations operator and $\alpha>\beta,\gamma,\delta>0$ equal to the weights known by all members of the financial community. Therefore, $E\tilde{\tau}$ increases if either an increase in earning assets is funded by an increase in equity or an increase in equity replaces deposit liabilities; $\tilde{E}\tau$ decreases if the bank increases its leverage at the expense of equity. The relative magnitudes of β,γ, and δ are left unspecified because financial and banking theories are not clear on the effects their respective balance sheet items have an expected soundness. To illustrate, recast Equation (2) by substituting for B from Equation (1).

$$E\tilde{\tau} = (\gamma-\beta)[L+E\tilde{\theta}S] + (\alpha+\beta)K + (\beta-\delta)(1-r)D \qquad (2')$$

Changes in expected soundness due to a change in the bank's balance sheet are now relative to an offsetting change in purchased funds.

The earning asset weight, $(\gamma-\beta)$, may be negative because an increase in leverage to expand earning assets means that more uninsured depositors have a claim on bank assets. However, this ignores the quality of the bank's uses of funds. If the quality of bank assets are high, then expected soundness may increase in spite of the increased leverage. It could also be argued that exposing a bank to the increased market discipline associated with purchased funds increases expected soundness because it offsets the risk-taking incentives provided by flat-rate deposit insurance. Similarly, $\beta-\delta$ may be positive or negative depending on the strength of the market discipline argument ($\beta<\delta$) versus the argument that a greater reliance an insured retail

deposits makes a run on the bank less probable and hence more sound ($\beta>\delta$).

Bank profits, Π, at the beginning of the planning horizon are:

$$\tilde{\Pi} = R_L(L+\tilde{\theta}S) - (\tilde{R}_B+\rho)B - (R_D+\rho)D - R_K K + f(E\tilde{\tau})S, \qquad (3)$$

with ρ equal to the flat-rate deposit insurance premium on all balance sheet liabilities, and f equal to the initial fee income earned upon standby letter of credit issuance.[6] Note that f is a function of the expected soundness of the bank at the end of the period. Assume $f'(E\tilde{\tau})>0$ ($f''(E\tilde{\tau})\leq 0$), since the more sound the bank, the greater the likelihood that it can provide funds to the standby letter of credit beneficiary should the need arise. All other things equal, the more sound the bank, the greater the guarantee market's demand for its standby letters of credit and the greater the fee income earned. Therefore, by altering its mix of assets, liabilities, and equity, the bank can influence the fees earned in the market for standby letters of credit.

The choice problem facing the bank can be simplified by i) substituting Equation (1) into Equation (3), and ii) substituting Equation (2') into Equation (3). B is determined after $\tilde{\theta}$ is revealed to equate assets with liabilities plus equity. Profits at the start of the period are then a function of the K and S decisions alone.

$$\tilde{\Pi}(K,S) = (R_L-R_B-\rho)(L+\tilde{\theta}S)$$
$$+ [(\tilde{R}_B+\rho)(1-r)-R_D-\rho]D + (\tilde{R}_B+\rho-R_K)K + f(E\tilde{\tau})S. \qquad (3')$$

To close the model, let the unconstrained decisions K and S in Equation (4) be based on the bank's subjective expectation about future events, described by the joint cumulative density $F(\tilde{R}_B,\tilde{\theta})$. It is assumed that this joint distribution does not change over the planning period. The decision problem is then to select K and S to maximize the expected utility of profits given $F(\tilde{R}_B,\tilde{\theta})$.

$$\underset{K,S\geq 0}{\text{Maximize}} \quad EU[\tilde{\Pi} \mid F(\tilde{R}_B,\tilde{\theta})] \qquad (4)$$

where U is a risk averse utility function such that $U'(\tilde{\Pi})>0$ and $U''(\tilde{\Pi})<0$, and Π and $E\tilde{\tau}$ are defined in Equations (3') and (2'). Note that $E\tilde{\tau}$ is endogenous to the decision problem with weights given by either bank customers, industry-wide agreement, or federal banking regulators.

By assuming constant absolute risk aversion and a jointly normal distribution for the random variables, the objective function in expression (4) can be rewritten in a mean-variance expected utility framework. The optimal solutions for the ex ante decisions can be shown to be:

$$K^* = [L-(1-r)D] + \{(E\tilde{R}_B+\rho-R_K) + S^*[(\alpha-\beta)f' - \lambda[(R_L-\rho)Cov[\tilde{R}_B,\tilde{\theta}] -Cov[\tilde{R}_B,\tilde{R}_B\tilde{\theta}]]]\}/\lambda Var[\tilde{R}_B], \text{ and} \tag{5}$$

$$S^* = \{(R_L-E\tilde{R}_B-\rho)E\tilde{\theta} - Cov[\tilde{R}_B,\tilde{\theta}] + f - \lambda[-L+(1-r)D+K^*][(R_L-\rho) Cov[\tilde{R}_B,\tilde{\theta}] - Cov[\tilde{R}_B,\tilde{R}_B\tilde{\theta}]]\}/\{\lambda Var[(R_L-\tilde{R}_B-\rho)\tilde{\theta}] -(\gamma-\beta)E\tilde{\theta}f'\}, \tag{6}$$

where λ is the index of risk aversion, Var represents variance, and Cov represents covariance. Note that Equations (5) and (6) form a system of simultaneous equations for the solutions K* and S*; once this system is solved, B* is determined by the realization of $\tilde{\theta}$.

Holding S* constant, Equation (5) implies that bank equity increases with an increase in the expected rate on purchased funds or required reserves; equity decreases with an increase in the cost of equity or a decrease in the marginal effect of capital on standby fee income. The impact of a change in S* on equity is unknown because the magnitude and sign of the covariance terms in the second term on the right hand side of Equation (5) are subject to empirical investigation. Holding K* constant in Equation (6), standby letter of credit issuance increases with an increase in the per dollar fee income earned and with a decrease in the expected rate on purchased funds, provided

$\beta>\gamma$. The effect on standby letter of credit issuance due to changes in K* is ambiguous, again due to the lack of apriori expectations about the covariance terms.

To gain further insight into the optimal joint decisions facing the bank, assume $\tilde{R}_B$ and $\tilde{\theta}$ are joint normally distributed.[7] If so, then $Cov[\tilde{R}_B,\tilde{R}_B\tilde{\theta}] = E[\tilde{R}_B]Cov[\tilde{R}_B,\tilde{\theta}] + E[\tilde{\theta}]Var[\tilde{R}_B]$. Without loss of generality, also assume that $f''=0$. These assumptions can then be used in Equations (5) and (6) to show that

$$\partial K^*/\partial S = \{(\alpha+\beta)f' - \lambda[(R_L-E\tilde{R}_B-\rho)Cov[\tilde{R}_B,\tilde{\theta}]-E\tilde{\theta}Var[\tilde{R}_B]]\}/\lambda Var[\tilde{R}_B] \tag{7}$$

$$\partial S^*/\partial K = \{(\alpha+\beta)f' - \lambda[(R_L-E\tilde{R}_B-\rho)Cov[\tilde{R}_B,\tilde{\theta}]-E\tilde{\theta}Var[\tilde{R}_B]]\}/ \{\lambda Var[(R_L-\tilde{R}_B-\rho)\tilde{\theta}] - 2(\gamma-\beta)E\tilde{\theta}f'\}. \tag{8}$$

It seems likely that higher market interest rates are associated with more bank customer defaults and hence, greater letter of credit takedowns by beneficiaries. If so, $Cov[\tilde{R}_B,\tilde{\theta}]$ will be positive. However, if there is no relationship between market rates and takedowns ($Cov[\tilde{R}_B,\tilde{\theta}] = 0$), then each decision is still not independent of the other; the decisions are related through the marginal effects on standby fee income.

Regardless of the sign of the covariance terms in Equations (7) and (8), the partials will have the same sign as long as $\beta>\gamma$. Assuming $Cov[\tilde{R}_B,\tilde{\theta}]$ is positive and expectations are such that $E\tilde{R}_B > \tilde{R}_L - \rho$, then takedowns of letters of credit result in a loss of expected utility, provided the takedowns are funded by purchased liabilities. To guard against this risk, more capital is desired as S increased ($\partial K^*/\partial S > 0$) to decrease the bank's potential dependence on purchased funds. But as bank equity is increased and the potential dependence on purchased funds declines the takedown risk is less and the bank issues more standby letters of credit ($\partial S^*/\partial K > 0$). On the other hand, if expectations are such that the numerators of Equations (7) and (8) are negative ($E\tilde{R}_B < R_L - \rho$), then takedowns increase expected utility; less

capital is needed as a cushion for letter of credit issuance ($\partial S^*/\partial K < 0$) and standby letters of credit can be substituted for capital in maximizing expected utility ($\partial S^*/\partial K < 0$).

The partials in Equations (7) and (8) will have the opposite signs if $(\gamma-\beta)>\lambda Var[(R_L-\tilde{R}_B-\rho)\tilde{\theta}]/2E\tilde{\theta}f'>0$. That is, if i) high quality loans made as a result of standby takedowns enhance expected bank soundness enough to offset funding the takedowns with purchased liabilities or ii) increased exposure to market discipline enhances expected bank soundness by a large enough magnitude, then less capital might be desired when more standby letters of credit are issued ($\partial K^*/\partial S < 0$). An increase in capital still facilitates the credibility of the guarantee and the bank will desired to issue more standbys ($\partial S^*/\partial K > 0$). The critical level that $(\gamma-\beta)$ must exceed increases with bank risk aversion and the variability of takedowns returns; it decreases with greater expected takedowns.

Equations (5) and (6) demonstrate that bank equity and standby letter of credit decisions are interrelated in a model of bank behavior under risk aversion. The most important point is that ex ante balance sheet and off balance decisions are linked by the correlation of their respective returns and the determination of the standby fee schedule. The relationship between decisions, however, depends on the weights assigned to balance sheet items in the function measuring bank quality. The model also suggests that factors such as interest rate risk exposure, required reserves, and measures of overall bank quality influence both of these decisions. The next section of the paper introduces a linear simultaneous equation system to investigate the empirical relationship between standby letter of credit issuance and bank capital.

III. Empirical Model

Based on the previous section, the model is presented as the following set of equations.

Standby Letters of Credit:

$$\underset{(N\times 1)}{S} = \underset{(N\times 1)}{\alpha_1 K} + \underset{(N\times K_1)(K_1\times 1)}{\Gamma_1 X_1} + \underset{(N\times 1)}{e_1} \quad (9)$$

Capital:

$$\underset{(N\times 1)}{K} = \underset{(N\times 1)}{\delta_1 S} + \underset{(N\times K_2)(K_2\times 1)}{\Gamma_2 X_2} + \underset{(N\times 1)}{e_2} \quad (10)$$

where the predetermined variables are represented by X_i. The parameters - α_1, δ_1, Γ_1, and Γ_2 - are estimated in the model using the sample of banks active in the standby letter of credit market. The purpose of this simultaneous model is to represent the endogenous variables in terms of their mutual interaction as well as selected exogenous variables. The sample includes all banks with assets in excess of $500 million which reported standby letter of credit activity in the June 1985 Report of Condition and Income. The final sample with complete information is 459 banks.[8] While standby letters of credit are issued by a large number of U.S. banks of all asset sizes (over 50% of all banks), approximately 96% of the outstanding dollar value was issued by banks with assets greater than $500 million at this report date. Almost all variables are normalized by total bank assets. (See Table 1 for variable definitions.)

Primary capital is defined as equity (including perpetual preferred stock) and allowance for loan and lease losses less goodwill. While Marcus [9] employed a market value measure of capital, this information is not easily available for all banks in the sample. Primary book capital has been used in previous research and is employed by the Federal Reserve System. The standby letter of credit variable includes letters originated by the bank less those which have been conveyed to others through participations.

Table 1

Summary Statistics and Definitions of Variables
For Banks with Assets Greater Than $500 million
(N=459)

Variable	Mean	Standard Deviation	Equation No.	Definitions
CAPITAL	0.0714	0.0179	9, 10	Primary capital/Total assets
STANDBY	0.0285	0.0303	9, 10	Net standbys outstanding/ Total assets
SIZE	7.418	1.0273	9, 10	Logarithm of total assets/1,000,000
INDEX	0.3033	0.0854	9, 10	Sum of squared shares of ten loan categories
GAP	-0.0149	0.0944	9, 10	One year maturity gap/Total assets
BHC	0.9412	0.2356	9, 10	= 1 if affiliated, = 0 otherwise
FUNDS	0.2435	0.1377	9	Short-term borrowings, foreign deposits, and large CDs/Total assets
RESERVES	0.0404	0.0078	9, 10	Required reserves/Total assets
LLOSS	0.0079	0.0030	9, 10	Loan loss reserves/Total assets
BINDING	0.0588	0.2356	9	= 1 if CAPITAL < 5.5%, = 0 otherwise
FDIC	0.4802	0.2084	10	Insured deposits/Total assets
CR3	0.7437	0.1894	9, 10	Three-firm share of total deposits in county
CNSTRL	0.0395	0.0421	9	Construction loans/Total assets
MUNI	0.0830	0.0437	9	Municipal loans and securities/ Total assets
CASH	0.1232	0.0682	10	Cash and due/Total assets
USTRSY	0.0786	0.0669	10	U.S. Treasury securities/Total assets
ROA	0.0041	0.0037	10	Net income/Total assets

Source: Report of Condition and Income, June 1985.

Exogenous variables in the letter of credit equation (Equation (9)) enter through the fee schedule that banks face in issuing these instruments. The logarithm of asset size is expected to relate to letter of credit activity in two ways: i) larger banks have the specialized management skills needed to be an active participant in this market, ii) larger banks can more easily diversify their asset portfolios which may include contingent guarantees (Koppenhaver [7] and Marcus [9]). The direct effect of loan portfolio diversification is also measured for ten different loan categories.[9] Additional variables reflecting the quality of the bank include the asset-liability maturity gap at one year forward (GAP), whether or not the bank is affiliated with a holding company (BHC), and reliance on purchased funds (FUNDS). For interest rate risk (i.e., the maturity gap), the issue is whether or not those banks with mismatched balance sheets would also be willing to incur the additional risk of standby takedowns.

Regulatory variables also affect the willingness of banks to engage in letter of credit activity. Those specifically included in Equation (9) are the level of required reserves (RESERVES), the bank's loan and lease loss reserves (LLOSS), and a binding capital constraint (BINDING). Koppenhaver [7] suggests that the cost of funding assets with reservable deposits and examiner pressure to allocate balance sheet assets into loan and lease losses may more than offset the additional risks of issuing standby letters of credit.

Additional variables that are likely to be important in the standby letter of credit decision include: i) a measure of market concentration (CR3); ii) the level of construction loans outstanding (CNSTRL), and iii) the level of municipal loans and securities outstanding (MUNI). It is hypothesized that the greater the concentration of a banking market the less likely the bank is to accommodate customer needs for loan guarantees.[10] The construction loan

variable is likely to be associated with standby letters of credit because they are often utilized to back up an obligation to complete a construction project. Uses of standbys also include credit enhancement facilities to municipal borrowers and liquidity backstops that require the bank to buy bonds put to them.

For Equation (10), the capital ratio equation, the selected exogenous variables are assumed to affect the capital ratio through the cost of equity and the marginal effect of capital on the schedule of standby fees (R_k and f', respectively, in Equation (5), above). The logarithm of asset size appears because the larger, more diversified banks need less capital for deposit losses. It is included as a means of monitoring a size effect on the capital ratio. Return on assets (ROA), loan loss reserves, and loan portfolio diversification are also assumed to affect the judgment of both examiners and, for large banks, the financial markets regarding the necessary level of capital. Because more liquid banks require less capital (Heggestad and Mingo [5]), a liquidity measure is included in this study and defined as the ratio of cash and due from banks to total assets (CASH). The riskiness of the investment portfolio and the level of secondary reserves is quantified in Equation (10) by the ratio of U.S. Treasury securities to total assets (USTRSY).[11] The twelve month cumulative gap is included as a measure of overall interest rate risk assumed by the bank. Other variables assumed to affect capital are whether or not the bank is affiliated with a holding company, required reserves, insured deposit funding, and banking market concentration.[12]

IV. Empirical Results

The simultaneity of the relationship between letter of credit activity and the level of primary capital in commercial banks, as depicted in Section II, has not been examined in previous research. When performance measures such as those used in this study are employed, explicit consideration must be made for the correlation between the error terms. The use of ordinary least squares when such correlation is present can lead to inefficient and possibly biased estimators. This study utilizes the three stage least squares procedure to correct this problem. Table 2 reports the results of the 3SLS estimation.

The results for the exogenous variables are generally as expected. The very large banks in the sample are most active in this market as indicated in the letter of credit equation. Kim and Stover [6] found similar results in the industrial development bond market. The significant holding company variable suggests that it has a separate positive effect on the credibility of standby guarantees.

From the model in Section II, the level of standby letter of credit activity increases with a decrease in the expected rate on purchased funds. The empirical estimation confirms this as evidenced by the positive coefficient for GAP, which is likely to reflect interest rate expectations. The assertion that banks substitute letter of credit commitments for the booking of balance sheet assets is refuted by our results. Neither CONSTRL or MUNI is significant. Finally, the bank concentration ratio, CR3, indicates that banks faced with greater competition engage in more letter of credit activity.

The capital equation indicates that these banks do not tradeoff traditional banking risks and capital. Banks with greater asset size and greater competition exhibited lower capital ratios. However, no significant

Table 2
Three-Stage Least Squares Estimates of
Equations (9) and (10) for
Bank Participants with Assets Greater Than $500 Million
(N=459)

RHS Variable	Dependent Variable (1) STANDBY Coefficient	(1) STANDBY Std. error	(2) CAPITAL Coefficient	(2) CAPITAL Std. error
CAPITAL	0.6445*	0.1911	--	--
STANDBY	--	--	0.7923*	0.1860
SIZE	0.0179*	0.0013	-0.0167*	0.0025
INDEX	0.0197	0.0152	-0.0076	0.0131
GAP	0.0433*	0.0139	-0.0140	0.0150
BHC	0.0130*	0.0047	-0.0130*	0.0038
FUNDS	0.0057	0.0092	--	--
RESERVES	-0.3680*	0.1805	0.1419	0.1433
LLOSS	-0.1309	0.4726	1.2791*	0.3262
BINDING	0.0043	0.0077	--	--
BINDING·FIDC	-0.0161	0.0182	--	--
FDIC	--	--	0.0005	0.0089
CR3	-0.0428*	0.0063	0.0333*	0.0070
CNSTRL	-0.0329	0.0249	--	--
MUNI	-0.0139	0.0238	--	--
CASH	--	--	-0.0082	0.0152
USTRSY	--	--	0.0253**	0.0130
ROA	--	--	0.8912*	0.2535
CONSTANT	-0.1192*	0.0245	0.1419*	0.0120
System R^2	0.445			

*Significantly different from zero at the 5% level.
**Significantly different from zero at the 10% level.

relationship exists between interest rate risk (GAP) and capital. Also, the coefficient for the level of insured FDIC deposits is insignificant. The positive coefficient for USTRSY confirms the results of Marcus [9].

Most importantly, the coefficients of the endogenous variables indicate that bank capital is recognized in the letter of credit market, while the level of participation in this market affects the management of the issuing banks' capital. This evidence confirms the feedback system suggested by the model in Section II. The positive coefficient for CAPITAL in the first column indicates that the level of standby letter of credit activity is related to the soundness of the bank as measured by its capital ratio. A one standard deviation increase in the mean capital ratio increases the ratio of letter of credit volume to assets by 0.012. Despite the importance of the capital ratio, the capital adequacy guidelines of 5.5% (BINDING) has no significant effect.

The significant coefficient for the letter of credit volume in the capital equation implies that these banks do allocate more capital in response to greater standby letter of credit issuance. A one standard deviation increase in the mean ratio of standby letter of credit volume to assets increases the capital ratio by 0.02.[13] This responsiveness may reflect the role of credit agencies such as Standard and Poors [15] which factors outstanding letter of credit volume into its analysis of capital adequacy for bank rating.[14]

V. Conclusion and Implications

Given that a bank may not issue standby letters of credit unless the guarantee can be made credible to the beneficiary, bank decisions will have an effect on its participation in this guarantee market. An identification problem exists with respect to the impact of a bank's capital policy. Ceteris

paribus, the bank with the higher capital ratio is assumed to be more sound. However, a well-managed portfolio of bank assets and liabilities reduces the need for capital as a buffer against losses. If bank management decisions reflect a sound banking organization, regardless of the effect of equity capital, this should have a direct effect on the level of standby letters of credit issued. The contribution of this study is to examine the relationship between capital and letter of credit activity as joint decisions made by management.

The empirical results substantiate the theoretical argument that a feedback system exists between the letter of credit activity and capital. The major result of the simultaneous estimation of these decisions is that a bank's capital ratio appears to add credibility to the guarantee embodied in the standby letter of credit. The capital ratio effected greater letter of credit volume. Further, the level of capital reflects this volume of loan guarantees.

The results have implications for the public policy debate surrounding bank off balance sheet activities and the risks they embody. Under proposed Federal Reserve capital guidelines, outstanding letter of credit volume would be treated exactly the same as a balance sheet loan. However, the empirical results of this study suggest that the large issuing banks are maintaining sufficient capital, from the regulator's viewpoint, to offset this off balance sheet activity. Adoption of the proposed risk-based capital guidelines would impose a redundant and meaningless constraint on existing large bank capital policies.

Footnotes

[1]A contingent claim involves an obligation to lend or provide funds should the contingency be realized; it does not create a change in the balance sheet until that time. Wolkowitz et al. [16] provides an overview of these off balance activities along with descriptive statistics on bank usage up to 1980.

[2]On January 20, 1986, the Board of Governors of the Federal Reserve System proposed rules for implementing risk-based capital guidelines. In guidelines, revised March 6, 1987, supplemental capital ratios are to be calculated that explicitly include standby and commercial letters of credit, and loan commitments. Standby letters of credit are either given a weighting of 50% or 100% depending on their reason for issuance. The weights determine the quantity of each item that are included in risk assets and then compared to primary capital.

[3]In an extreme situation, the standby letter of credit will not be made if the beneficiary is not satisfied. This assumes that the terms of the underlying contract between the bank customer and the beneficiary are fixed. If not, the contract terms may change in light of the quality of the guarantee and then the bank's customer would have an additional interest in obtaining the highest quality guarantor possible.

[4]In another theoretical paper on the standby letter of credit decision, Benveniste and Berger [2] investigate the non-regulatory incentives for standby issuance in a state-dependent model with risk neutral banks. After an analysis of arbitrage conditions, standby letters of credit are found to be more profitable than warehousing balance sheet assets if their are states of nature in which the bank fails while some of its loans are not in default.

[5]See also Mingo and Wolkowitz [12]. For justification of expected utility maximization by banks, see the empirical studies by Edwards [3] and Ratti [14].

[6]Equation (3) assumes that the return to standby takedowns is the same as a balance sheet loan. However, since takedowns are caused by bank customer default, one might argue that the credit risk of a loan resulting from a takedown is higher than a warehoused loan. Based on a survey of 28 banks in 1978, Lloyd-Davies [Federal Reserve Bulletin, September 1979, pp. 716-719] finds the loss experience on standby takedowns to be less than on warehoused loans, in part due to bank customer collateral requirements.

[7]This assumption is technically inconsistent with previous assumptions but is made to gain insight into the joint bank decisions. Rates and quantities in the model cannot be joint normally distributed if profits and rates are joint normally distributed as implied by the closed-form solution in Equations (5) and (6).

[8]This sample represents approximately 92% of all U.S. commercial banks in this size category filing Reports of Condition and Income in June, 1985.

[9]These loan categories are: loans secured by real estate, loans to depository institutions, agricultural loans, commercial and industrial loans, acceptances of other banks, loans to individuals, loans to foreign governments, municipal loans, other loans, and lease financing receiveables. Given these categories, the variable INDEX in Table 1 was calculated.

[10]With the exercise of monopoly power, balance sheet risks can be passed on to customers through high and variable loan rates and low deposit rates. CR3 proxies the competitiveness of the bank's market, assuming the relevant market is a county. Admittedly, this is a questionable assumption for money center and regional banks, but a more accurate measure of competition is not readily available.

[11]Marcus [9] found that the coefficient of this ratio was positive and significant, suggesting that interest rate fluctuations made governments more risky than loans.

[12]Exogenous variables were selected with consideration given to previous research on bank equity decisions. See [5], [9], [10], [11], and [12].

[13]Two other capital ratios were used as dependent variables in the system estimation; the ratio of primary capital to total assets plus outstanding standbys, and the ratio of primary capital less non-interest income to total assets. These ratios were used to keep the immediate effect of booking fee income from confusing the capital/standby relationship. The results using these alternative measures were not significantly different from Table 2.

[14]It should be noted that in a dispute arising from the collapse of the Penn Square Bank, Oklahoma City, in 1982, a federal appeals court in Denver ruled in December 1984 that a standby letter of credit was like an insured deposit. Although the Supreme Court recently overturned this ruling (Ruling 6-3, May 27, 1986), uncertainty abut the eventual insurance status of standby letters of credit at the time the data for this study was collected could influence the estimation results. Given it is often argued that flat-rate deposit insurance subsidizes bank risk-taking, the positive relationship between standby letters of credit and bank capital found here is even more noteworthy.

References

1. Benveniste, J. and A. Berger. "An Empirical Analysis of Standby Letters of Credit." Proceedings of a Conference on Bank Structure and Competition, Federal Reserve Bank of Chicago, 1986, pp. 387-412.

2. Benveniste, L. and A. Berger. "Substituting Loan Insurance for Intermediation: The Private and Social Benefits of Standby Letters of Credit." Research Papers in Banking and Financial Economics #92, Board of Governors of the Federal Reserve System, October 1986.

3. Edwards, F. "Managerial Objectives in Regulated Industries: Expense Preference Behavior in Banking." Journal of Political Economy, 85 (February 1977): 147-162.

4. Goldberg, M. and P. Lloyd-Davies. "Standby Letters of Credit: Are Banks Overextending Themselves?" Journal of Bank Research, 16 (Spring 1985): 28-39.

5. Heggestad, A. and J. Mingo. "Capital Management by Holding Company Banks." Journal of Business, 48 (October 1975): 500-505.

6. Kim, J. and R. Stover. "The Role of Bank Letters of Credit in Corporate Tax Exempt Financing." Financial Management, 16 (Spring 1987): 31-37.

7. Koppenhaver, G. "The Effects of Regulation on Bank Participation in the Guarantee Market." Paper presented at a Conference on Asset Securitization and Off Balance Sheet Risks of Depository Institutions, Northwestern University, February 1987.

8. Luckett, D. "Credit Standards and Tight Money." Journal of Money, Credit and Banking, 2 (November 1970): 420-434.

9. Marcus, A. "The Bank Capital Decision: A Time Series-Cross Section Analysis." Journal of Finance, 38 (September 1983): 1217-1232.

10. Mingo, J. "Capital Management and Profitability of Prospective Holding Company Banks." Journal of Financial and Quantitative Analysis, 10 (June 1975): 191-203.

11. Mingo, J. "Managerial Motives, Market Structure and Performance of Holding Company Banks." Economic Inquiry, 14 (September 1976): 414-424.

12. Mingo, J. and B. Wolkowitz. "The Effects of Regulation on Bank Balance Sheet Decisions." Journal of Finance, 32 (December 1977): 1605-1616.

13. Morgan, G. "On the Adequacy of Bank Capital Regulation." Journal of Financial and Quantitative Analysis, 19 (June 1984): 141-162.

14. Ratti, R. "Bank Attitude Toward Risk, Implicit Rates of Interest, and the Behavior of an Index of Risk Aversion for Commercial Banks." Quarterly Journal of Economics, 95 (September 1980): 309-331.

15. Standard and Poors and Credit Overview, "Structural Financings-Letters of Credit," 1983.

16. Wolkowitz, B., P. Lloyd-Davies, B. Gendreau, G. Hanweck, and M. Goldberg. "Below the Bottom Line: The Use of Contingencies and Commitments by Commercial Banks." Staff Studies #113, Board of Governors of the Federal Reserve System, January 1982.