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Abstract

A potential reform of risk-adjusted deposit insurance pricing with forward contracts is presented. We demonstrate that bank spread management itself may provide the Federal Deposit Insurance Corporation's (FDIC's) protection from credit and interest rate risks even though the bank's spread decisions are made prior to the realization of those two risks. But if the bank's spread decisions are made subsequent to the realization of the credit and/or interest rate risks, the forward contracts may serve the FDIC for microhedging and/or macrohedging purposes. Further, a decrease in the capital-to-deposits ratio decreases the FDIC's going-concern insurance premium market value. This paper suggests that capital regulation and bank spread management can also be important in influencing the FDIC's hedging decisions.

Keywords: *Federal Deposit Insurance Corporation, Forward Contract, Credit Risk, Interest Rate Risk*

JEL Classification: *G21, G22*

I. Introduction

It has been recognized that bank and thrift failures and deposit insurance payouts have reached record highs in the last few years. These plagues are the Federal Savings and Loan Insurance Corporation (FSLIC) has liabilities far in excess of its assets, and even the Federal Deposit Insurance Corporation (FDIC) faces threats to its solvency. Following those failures and payouts, a number of reforms have been implemented under the Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991. Much literature concerning bank regulatory policies intends to manage moral hazard problems associated with deposit insurance and optimal regulatory design.[1] The bank authority has emphasized capital adequacy rules, most in the form of risk-based capital requirements. The insurer, e.g. the FDIC, has focused on the pricing and the feasibility of risk-adjusted insurance premiums. The question is why have thrift and bank failures recently seem to be going from bad to worse. A possible explanation demonstrated by Kling (1986) is that these failures reflect an increasingly risky economy, which in turn has increased the risk of bank portfolios.

While the FDIC takes deliberate steps to curb problems with moral hazard, there are virtually no changes in the FDIC's speculator position of "hedging" transactions in an increasingly risky economy. Under these circumstances, the hedger (an insuree) is much more unwilling to bear risk, whereas the speculator (an insurer) is much less. The hedger is buying bank deposit insurance; the speculator is selling it. As a hedger, hedging demand can immunize its balance sheet against unexpected changes; as a speculator, hedging supply cannot. Thus, from a viewpoint of deregulation, it remains an open question whether limits on the FDIC's speculator position could encourage greater "market discipline," and keep the FDIC from facing threats to its

[1] As pointed out by Kupiec and O'Brien (1998), analyses have focused on uniform bank capital requirements, risk-based capital requirements, risk-adjusted priced insurance premium rates, and incentive-compatible designs. Cecchetti (1999) demonstrated the moral hazard arising from government guarantees is one of the crucial justifications to address why we regulate financial intermediaries.

solvency.

The option-theoretic analysis of deposit insurance pricing has assumed that when a bank is found to be insolvent, the FDIC can realize the full value of the bank's assets (see Merton, 1977). The value, the so-called "going-concern" value in Mullins and Pyle's (1994) sense, realized by the FDIC at that time is assumed to be the value that would prevail if the bank had been found solvent and continued in operation. However, we believe that realization of the going-concern value by the FDIC will not be possible for all bank assets. Part of the overall program of risk management will accompany the transfer of assets from the insured bank to the FDIC in an increasingly risky economy. If the FDIC is permitted to protect itself from losing through a counterbalancing transaction (e.g. permitting private insurers to provide full or supplemental coverage), facing threats to solvency may be expected to lessen. This deregulated adoption of hedging may be treated as an important step in the direction of deposit-insurance potential reform to overcome the FSLIC and FDIC plagues mentioned above. The purpose of this paper is to study the microhedging and macrohedging behavior of the FDIC, who faces a bank's going-concern value, based on a simple firm-theoretic model under multiple sources of uncertainty in an option-theoretic analysis.[2]

The Black-Scholes (1973) approach is a powerful tool known as risk-neutral valuation. The principal advantage of this approach is the explicit treatment of volatility, which has long played a prominent role in discussions of intermediary

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[2] Transactions designed to hedge individual components of the balance sheet are referred to as microhedges, whereas those designed to protect the overall balance sheet are called macrohedges (Sinkey, Jr., 1992, p.482). In this paper, microhedges occur when the asset and liability sides of bank

behavior. This approach, however, omits a key aspect of a bank's spread management, accordingly, the FDIC's going-concern value in this paper.[3] It is assumed that asset and deposit markets are perfectly competitive so that quantity setting is the relevant behavioral mode in both markets. This assumption is not applicable to some loan markets since such markets are virtually always highly concentrated where banks, e.g. money-center banks mentioned in Zarruk and Madura (1992), set loan rates and face random loan levels. As the spread is so important to bank profitability, the issue of how it is optimally determined in the Black-Scholes valuation faced by the FDIC deserves closer scrutiny.

As Finn and Frederick (1992) have noted, spread management in practice is done through a "cost of goods sold" approach in which deposits are the "material" and loans are the "work in process". Zarruk (1989), and Zarruk and Madura also provided firm-theoretic models to explain bank spread management. Both papers looked at situations with only a single source of uncertainty: interest rate or funding risk as in Zarruk and credit risk as in Zarruk and Madura. Applying a richer risk structure as in Wong (1997), this model features a bank facing both credit risk and interest rate risk, demonstrated by random loan levels and random deposit rates, respectively. Loans are subject to non-performance because the bank does not know ex ante what proportion of its loans will perform. A mismatching of asset rate sensitivities and liabilities occurs because the bank funds part of its fixed rate loans via variable rate deposits. With reasonable assumptions about the bank's underlying performance faced by the FDIC, the effects of spread management on microhedging

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operations are dichotomous (see Slovin and Sushka, 1983), whereas macrohedges occur when those of bank operations are simultaneous (see Krasa and Villamil, 1992, a , b).

[3] According to Mercer (1992), earnings from the margin, or spread, between interest rates on assets

and macroheding are explored.

The results of this paper show how regulation, credit risk and interest risk conditions jointly determine the FDIC's optimal hedging decisions. We find that a bank's spread management on its loan rate and deposit settings under the Black-Scholes valuation may provide the FDIC's protection from credit risk when the FDIC prices risk-adjusted deposit insurance. This spread management protection of credit risk obviates the need for forward market protection. Furthermore, we demonstrate that a bank's spread management may not provide the FDIC's protection from interest risk. Under these circumstances, the FDIC's need for forward market protection of interest rate risk is suggested.

In this paper, we further argue that the absence of consistent evidence about the theory of normal backwardation is due to a model of loan-rate-setting behavior, which cannot be generalized to a model of quantity-setting behavior. That the loan-rate-setting behavior in the FDIC's going-concern valuation per se, and not merely a bank's strategic competition, may lead to normal backwardation is the main concern of this paper. The intuition behind this result is that the loan-rate-setting behavior of a bank may provide partial protection from credit and interest rate risks, but that this protection need not be symmetric with respect to those two risks. The analysis in this paper can be viewed as a complement to the theory of normal backwardation and suggests that a bank's strategic behavioral mode of loan-rate setting can also be important in influencing the FDIC's hedging decisions.[4]

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and interest rates on liabilities typically account for eighty percent or more of bank profits.

[4] In this paper, the normal backwardation in loan quantity occurs when the forward loan quantity is less than the expected future spot quantity and the normal backwardation in deposit rate occurs when

The paper is organized as follows. Pricing risk-adjusted deposit insurance under the Black-Scholes valuation of the FDIC is presented in Section II. In Section III, the dichotomous and simultaneous behavioral modes of a loan-rate-setting and deposit-rate-taking bank faced by the FDIC address the issue: FDIC's pricing and its hedging decisions. In Section IV, the FDIC's going-concern value and capital regulation to the bank is examined. Section V contains the conclusions.

II. The Model

The model in this paper illustrates the relationship between the FDIC's going-concern spread value and its potential hedging. To focus on the effect of the bank's lending-borrowing money on the FDIC's hedging, we consider a simple option-theoretic and firm-theoretic model under credit and interest rate risks. We assume that a bank makes decisions in a single-period horizon. At the beginning of the period, the bank raises D in deposits, K in equity and pays out P in an insurance premium. Thus, the bank faces the following balance sheet:

$$L + B = D + K - P \tag{1}$$

where L is the amount of loans and B is the quantity of open market securities. The bank acts as a price taker in the open market so that the interest rate on the open

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the forward deposit rate is less than the expected future spot rate.

market securities, R, is given. The equity of the bank, K, is assumed to be fixed during the single period horizon, although it must satisfy the capital adequacy requirement by regulation, $K \geq qD$, where q is the required minimum capital-to-deposits ratio. The required minimum capital-to-deposits ratio, q, can be made as in Zarruk and Madura (1992) since risk concerning the amount of loan loss arises from random loan defaults. Accordingly, q is assumed to be an increasing function of L, $\partial q/\partial L > 0$.

Loans granted by the bank belong to a single homogeneous class of fixed-rate claims with one-period maturity. The loan market is imperfect in the sense that the bank is a loan-rate setter and faces a downward-sloping loan demand function. Stigler (1964) originally points out banks that have market power in the asset market. Behavioral mode of loan-rate setting by banks is well documented by Hancock (1986). This assumption is utilized to analyze the issue of contingent claim in this paper. Uncertainty is introduced into the model of loan-rate-setting behavior as well. Applying Sealey (1980), we model that the random loan demand faced by the bank can be specified through the following demand function:

$$L = L(R_L, ¯), \qquad \partial L/\partial R_L < 0 \;, \qquad \partial L/\partial ¯ > 0 \tag{2}$$

where ¯ is a random element, which is not known ex ante but has a known subjective probability distribution. The random variable ¯ is assumed to vary over the range $\sim \leq ¯ < \infty$. The lower limit of ~ for the random variable ¯ must be such at $L \geq 0$. Following Targgart and Greenbaum (1978), we assume that the bank's lending doest not affect the distribution of ¯ so that the degree of uncertainty per dollar of loans is constant.

Kling explains that bank and thrift failures simply reflect an increasingly risky economy; accordingly, interest rates have become more volatile, increasing the risk default of bank portfolios. As pointed out by Neal (1996), one of the risks of making a bank loan is credit risk, the risk of borrower default. Credit risk is generally influenced by both business cycles and firm-specific events. We model this credit risky using ¯ to denote the possible non-performing loans. At any time during a single period horizon, the value of the bank’s risky asset is:

$$V(R_L, ¯) ¯ \begin{cases} = (1+R_L)L(R_L, ¯) & \text{if credit risk} = 0 \\ < (1+R_L)L(R_L, ¯) & \text{if credit risk} > 0 \end{cases} \quad (3)$$

The promised security repayments to the bank at the end of the period are certain because of its risk-default characteristics. The value of the earning-asset portfolio is:

$$A(R_L, ¯) = V(R_L, ¯) + (1+R)[(1+q)D - P - L(R_L, ¯)] \quad (4)$$

The deposit market is perfect in the sense that the bank is a deposit-rate taker where the supply of deposits is perfectly elastic. However, deposits issued by the bank are assumed to have a maturity shorter than one period so that they must be operated at the unknown deposit rate, $R_D(¯)$, and $\partial R_D / \partial ¯ > 0$. As the bank operates imperfectly competitive fixed-rate loans via perfectly competitive variable-rate deposits, it inevitably exposes itself to interest rate risk. This is the reason why we model the random deposit rate specified through $R_D(¯)$.

The cost structure of a bank is generally divided into two parts: financial costs (e.g. the interest cost of deposits) and operative costs (e.g. variable cost of wages and fixed cost of capital equipment). The bank's random end-of-period interest costs for deposits is $(1+R_D(\bar{\ }))D$. The total costs at the end of period are then given using:

$$Z=(1+R_D(\bar{\ }))D+P+C_L(L(R_L,\bar{\ }))+C_D(D) \tag{5}$$

where C_L and C_D denote the variable costs of servicing loans and deposits, respectively.[5] It is assumed that $\partial C_L/\partial L>0$, $\partial^2 C_L/\partial L^2>0$, $\partial C_D/\partial D>0$, and $\partial^2 C_D/\partial D^2>0$.

Let us derive the value of the bank's equity at the end of the period as a function of the residual value of the bank after meeting all of its obligations. The term $\max\{A-Z,0\}$ indicates the bank's equity value. However, if the bank is not able to meet all of its obligations, the FDIC pays out *Z-A*; hence, $\max\{Z-A,0\}$. Following Mullins and Pyle, define $S=\max\{A-Z,0\}$ to be the Black and Scholes' value of the call option effectively purchased by the equity holders of the bank. Similarly, define $P=\max\{Z-A,0\}$ to be the Black and Scholes' value of the put option, written on the bank's earning-asset portfolio and with an exercise price equal to the promised payments to the depositors, which the FDIC has effectively written to

[5] The fixed cost of the bank is omitted for simplicity because the inclusion of this cost complicates the model without changing the results of the model. Furthermore, we assumed that the variable costs of servicing loans and deposits are separable. This assumption is frequently utilized in the literature. See, for example, Sealey (1980).

the equity-holders of the bank. We impose two conditions on the model:

$$\underset{R_L, D}{Max}\, S = V(R_L, \beta)N(d_1) - \{Z-(1+R)[(1+q)D-P-L(R_{L,}\beta)]\}e^{-\delta}N(d_2) \tag{6-1}$$

$$P = \{Z-(1+R)[(1+q)D-P-L(R_{L,}\beta)]\}e^{-\delta}N(-d_2) - V(R_L, \beta)N(-d_1) \tag{6-2}$$

where,

$$d_1 = \frac{1}{\hat{\sigma}}\{[\ \ln \frac{V}{Z-(1+R)[(1+q)D-P-L]}] + \delta + \frac{1}{2}\hat{\sigma}^2\}$$

$$d_2 = d_1 - \hat{\sigma}$$

$$\hat{\sigma}^2 = \hat{\sigma}_v^2 + \hat{\sigma}_1^2 - 2\rho_{v,1}\sigma_v\sigma_1$$

$$\delta = R - R_D$$

$N(\cdot)$ is the cumulative density of a standard normal random variable. $\hat{\sigma}$ is the standard deviation of the rates of return on the bank's earning-asset portfolios. σ_v and σ_1 are the standard deviation of the returns on the risky and default-free assets, respectively. $\rho_{v,1}$ is the instantaneous correlation coefficient between the two assets in the bank's portfolio. δ is the deposit spread, which is defined as the spread between the risk-free rate and the promised rate on deposits. Suppose that the bank maximizes the expected equity values. Then the bank selects R_L and D to maximize the expectation of the equity value. Initially, the deposit insurance premium is actuarially fair with the conditions of $\partial S/\partial R_L = 0$ and $\partial S/\partial D = 0$. Given the optimal loan rate and deposit amount, the FDIC then pays out the optimal going concern value of (*Z-A*) if the bank is not able to meet all of its obligations.

III. FDIC's Pricing and Forward Contacts

It may first be noted that, at the time of entering into the insurance contract, the FDIC is concerned with the future stochastic behavior of the bank's assets because once the insurance is contracted, the FDIC insures out-of-pocket expenses if the terminal value of the bank's assets after insurance is less than its liabilities. Second, the deposit insurance premium does not depend directly on the risk-free spread rate. Hence, the spread management can indirectly affect the cost of deposit insurance via its effects on two of the premium's direct determinates: the bank's loan rate setting and the deposit market rate. As the FDIC is aware of those two uncertain determinates, it faces both credit and interest rate risks due to not realizing the full value of the bank's assets and liabilities. A forward market may have a viable role in hedging the credit and interest rate risks when one of the components of the bank's spread management is asymmetric, provided the FDIC is permitted to hedge the asset/ liability imbalance at the time it enters into the insurance contract. Applying O'Hara (1985), we consider when the FDIC, who faces the going-concern value of a bank's spread management would prefer to "lock in" loan quantity and/or deposit rate by entering a forward contract, or to wait and accept these uncertain quantity and/or rate that will prevail in the spot market. Furthermore, applying Hicks (1946), we define the FDIC's purchasing loan at an optimal rate determined by the bank via a forward contract to be short hedging and selling deposit at a rate determined by the market via a forward contract to be long hedging.

In the following section, the FDIC's credit risk microhedging is conducted when the deposit is fixed and interest rate risk microhedging is done when the loan rate is pre-determined. These two dichotomous results are obtained for two reasons. First, bank spread management itself frequently encounters situations where loan-rate decisions must be made in the presence of fixed deposit rates and where deposit decisions must be made in the presence of fixed loan rates. Sealey, and Slovin and Sushka (1983) have modeled those dichotomous modes of financial behavior. However, Krasa and Villamil (1992, a, b) argue that the bank's problem clearly embodies optimization by all agents (borrower-intermediary-lender in their models) in the economy. Accordingly, those results are used in a later section when the simultaneous effects of credit and interest rate risks are analyzed.

The optimal deposit insurance premium is equation (6-2) with the first-order conditions calculated from equation (6-1). The following proposition characterizes the properties of equation (6-2).

Proposition 1: Let $S(L, R_D)$ be the bank's current market value during the period horizon with $\partial S/\partial R_L = 0$ and $\partial S/\partial D = 0$, then

(i) $P(L, R_D)$ is strictly concave in L if the bank's equity maximization is made both prior and subsequent to the realization of $L(\bar{\ })$.

(ii) $P(L, R_D)$ is strictly convex in R_D if the bank's equity maximization is made prior to the realization of $R_D(\bar{\ })$.

(iii) $P(L, R_D)$ is convex in R_D if the bank's equity maximization is made subsequent to the realization of $R_D(\bar{\ })$ with $D(\partial D/\partial R_D)+Z-(1+R)B>0$.

Proof: Given the timing of part (i), R_L is a number since the bank's equity maximization is made prior to the realization of $L(\bar{\ })$. Thus, $\partial P/\partial L<0$ and $\partial P^2/\partial L^2>0$. But if the bank's equity maximization is made subsequent to the realization of $L(\bar{\ })$, R_L is a function of L. $\partial P/\partial L<0$ and $\partial P^2/\partial L^2>0$ are obtained as well. Accordingly, strict concavity is verified. Part (ii) follows symmetrically from part (i). D is a number if the bank's equity maximization is made prior to the realization of $R_D(\bar{\ })$. Thus, $\partial P/\partial R_D>0$ and $\partial P^2/\partial R_D^2>0$. Strictly convexity is verified. In the case of being subsequent to the realization of $R_D(\bar{\ })$, D is a function of R_D. $\partial P/\partial R_D>0$ if $D(\partial D/\partial R_D)+Z-(1+R)B>0$, $\partial P^2/\partial R_D^2$ indeterminate. Thus, part (iii) is stated.

Proposition 1 illustrates the relationships between a bank's spread management of credit and interest rate risks and the FDIC's going concern deposit insurance premium market value. If the bank cannot know the realization of $L(\bar{\ })$ before its operation, the part (i) indicates that the FDIC's current market value of insurance premium, written on the bank's assets and with an exercise price equal to the promised payments to the depositors, is nonlinearly affected by loan quantity changes. This occurs even though a constant optimal loan rate remains and the premium value can only vary with loan-quantity levels.

The shape of the premium value function of the put option has important implications for the FDIC's forward market decisions. As part (i) indicates, the premium value function is strictly concave in the loan quantity; however, this is no longer the forward market equilibrium. This concavity means that the FDIC actually prefers loan quantity variability. To induce the FDIC to purchase loan forward, the forward loan quantity would have to be less than the expected future spot loan quantity. Therefore, the FDIC is, at worst, indifferent to the loan quantity risk and it has no reason to lock in a loan quantity whether or not the bank can know the realization of $L(\bar{\ })$.

Similarly, if the bank cannot know the realization of $R_D(\bar{\ })$ before its deposits are absorbed, then part (ii) indicates that the premium value is nonlinearly affected by deposit rates changes even though a constant remains, optimal deposits are fixed. The shape of the premium value function of the put option is strictly convex in $R_D(\bar{\ })$, which indicates that there is no longer the forward market equilibrium. This is because the FDIC prefers deposit rate variability. To induce the FDIC to sell deposit forward, the forward deposit rate would have to exceed the expected future spot deposit rate. Accordingly, the FDIC is, at worst, indifferent to the deposit rate risk and it has no reason to lock the deposit rate. To summarize, we have the following corollary.

Corollary 1: If a bank's spread management is made prior to the realization of $L(\bar{\ })$ or $R_D(\bar{\ })$, the forward market equilibrium of the FDIC premium value cannot occur.

If the bank can know the realization of $L(\bar{\ })$ before its operation, the optimal loan rate to set for each loan quantity realization can be selected. The FDIC's premium value will vary accordingly because of loan-rate changes. Loan-rate shifts indicate that different loan quantity levels have different, nonlinear effects on the going-concern premium value. The interpretation of this result follows a similar argument as in the case of not knowing the credit risk.

But if the bank can know $R_D(\bar{\ })$, part (iii) states that the premium value function is nonlinearly affected by the deposit rate changes under the limitation of $D(\partial D/\partial R_D) + Z - (1+R)B > 0$. If the optimal deposit quantity to determine for each deposit rate realization can be selected, the premium value will vary because of the deposit quantity changes. Given the above mathematical limitations, we can argue that there is no longer the forward market equilibrium in the case of the realization of $R_D(\bar{\ })$ and the following corollary is established.

Corollary 2: If a bank's spread management is made subsequent to the realization of $L(\bar{\ })$, a similar argument as corollary 1 occurs; if made subsequent to the realization of $R_D(\bar{\ })$, a forward market equilibrium cannot occur under $D(\partial D/\partial R_D) + Z - (1+R)B > 0$.

Spread management allows a money-center bank, which is assumed to be a loan-rate-setting and deposit-rate-taking bank in this model, to have a much freer hand about the completion of lending business than about its acquisition of borrowing business. A related question to consider is the impact of a bank's spread management on the FDIC's imbalance in long and short hedging. To resolve this problem, an idea due to Hicks (1946, p.137) is utilized to develop an anticipatory microhedging strategy specific to bank credit and interest rate risks for the FDIC.

This idea is that if forward markets consist entirely of hedgers, there will always be a tendency for a planned weakness on the supply side and accordingly, a smaller proportion of planned sales than planned purchases will be involved by forward contacts. An implication of these conditions is that the spread management may be sufficient to an imbalance in long and short microhedging

Spread management, however, may not be necessary to generate this microhedging imbalance. The bank's mode of loan-rate-setting behavior may be sufficient to induce differential microhedging. This can be demonstrated by incorporating some additional properties of the going concern spread management and credit value and interest rate into the model. According to the analyses of corollary 1 and 2, the FDIC is, at worst, indifferent to credit and interest rate risks and it has no reason to lock in those risks. A forward market equilibrium characterized by a normal backwardation cannot occur. The institution behind this anticipatory result is that bank spread management faced by the FDIC may have already provided partial protection from credit and interest rate risks, but this protection may not be symmetric with respect to loan non-performance and deposit rate volatilities. Consequently, we establish the following corollary.

Corollary 3: If a bank's spread management faced by the FDIC is made prior to the realization of $L(\bar{\ })$ and subsequent to the realization of $R_D(\bar{\ })$, a forward market equilibrium characterized by normal backwardation cannot occur if $D(\partial D/\partial R_D) + Z - (1+R)B > 0$.

Based on the dichotomous results of the previous analyses, it is now possible to determine the FDIC's simultaneous influence of macrohedging on loan and deposit rate decisions. One implication of the simultaneous determination is that timing differences of the financial intermediation faced by the FDIC may not be sufficient to generate an imbalance in long and short macrohedging.

If loans are known in advance of the financial intermediation faced by the FDIC than are deposit rates, then the current market value of the premium will be strictly concave in L but unknown in R_D. This means that the FDIC will not be willing to hedge loans and may or may not be willing to hedge deposit rates. But if deposit rates are known in advance of the financial intermediation than loans, then the premium value function will be strictly convex in R_D but concave in L. This implies that the FDIC will not be willing to hedge deposit rates as well as loans. Under these circumstances, if hedgers are present in forward markets, the two imbalances would not induce normal backwardadation.

Corollary 4: If the FDIC's current deposit insurance premium market value is priced prior to the realization of $L(\overline{\ })$ and $R_D(\overline{\ })$ simultaneously, the forward market equilibrium cannot occur.

The interpretation of the following two corollaries follows a similar argument as in the case of the dichotomous determination. Thus, the simultaneous results are consistent with the dichotomous results. Our fining provides a complement to the more extensive analyses of Krasa and Villamil, and Slovin and Sushka on the existence of simulteaneous/dichotomous determination.[6]

Corollary 5: If the FDIC's current market value of deposit insurance premium is priced subsequently to the realization of $L(\bar{\ })$ and $R_D(\bar{\ })$ simultaneously, a forward market equilibrium characterized by the normal backwardation is possible.

Corollary 6: If the FDIC's current insurance deposit market value is priced prior to the realization of $L(\bar{\ })$ and subsequent to the realization of $R_D(\bar{\ })$, a similar argument as Corollary 5 is present.

IV. FDIC's Pricing and Capital Regulation

As pointed out by Zarruk and Madura, asset quality problems have plagued banks in recent years. Money-center banks have experienced financial problems due to their exposure to less-developed-country debt. Concerns about bank asset quality and failures have prompted regulatory authorities to adopt a risk-based system of capital standards, which forces a bank capital position to reflect its asset portfolio risk. This section examines the relationship between capital regulation and the FDIC's premium value. Our result is allowed to address a crucial issue: what is the most likely effect of the risk-based capital guidelines on the FDIC's premium value?

[6] As mentioned, Krasa and Villamil (1992, a, b) argued that the problem clearly embodies optimization by all agents (borrower-intermediary-lender in their models) in the economy. Slovin and Sushka (1983, p. 1586) argue that "Over all, the asset and liability sides of bank operations are dichotomized." and " When the constraint binds, … , and the dichotomy between the asset and liability sides of bank operations is broken."

Consider the impact on the FDIC's premium value from changes in the capital-to-deposits ratio, q. Implicit differentiation of equation (6-2) with respect to q yields

$$\partial P / \partial q = (1+R)D/2 + R > 0 \tag{7}$$

Proposition 2: When deposits are insured, an increase (a decrease) in the capital-to-deposits ratio increases (decreases) the FDIC's current market value of deposit insurance premium.

The interpretation of this proposition is straightforward. As the bank is forced to its capital relative to its deposit level, it must now provide a return to a larger equity base. As the value of the bank's assets is less than the promised payments to the depositors, the FDIC pays out the difference. A larger equity implies a lower insurance payment; accordingly, a higher current market value for the FDIC's premium.

Furthermore, as shown in Keeley (1991), the rise in bank and thrift failures may reflect the secular decline in capital-to-assets ratio in recent years.[7] There are two possible reasons: lower capital, holding earning-asset risk constant, leads to less protections against failure; lower capital ratios increase the incentives for banks to increased asset risk. Those two reasons may explain why banks and thrifts allow the bankruptcy risk to increase, which in turn causes the FDIC to decrease its current insurance premium market value. As Keeley has shown, increased competition may

[7] A similar result can be explained by capital-to-deposits ratio (see Zarruk and Madura, 1992).

have reduced bank's incentives to act prudently with regard to risk taking. Under this circumstance, banks would have a greater incentive to increase earning-asset portfolio risk due to the decline in capital ratios. An implication of Proposition 2 is that the above argument in turn results in decreasing the FDIC's current insurance premium market value. Thus, this Proposition provides an extensive explanation for Keeley's observation.

V. Conclusions

From the viewpoint of potential deregulation, this paper has presented the FDIC's forward market decisions on its going-concern pricing risk-adjusted deposit insurance value. The distinguishing characteristic of the model presented in this paper is that loan-rate-setting behavior (and thus spread management), credit (loan quantity) risk, and interest (deposit rate) risk under the Black-Scholes valuation are simultaneously incorporated into the model. Based on a reasonable view of microhedging and marcohedging decisions making and current deposit insurance pricing arrangements, it seems unlikely that the omission of any of the above aspects of the FDIC's hedging behavior can be justified. More importantly, these considerations play a crucial role in determining the FDIC's going-concern value for a bank's loan rate (and thus its optimal earning-asset portfolio) and deposit decisions under the Black-Scholes valuation. Earlier models of hedging on the risk-adjusted deposit insurance pricing that ignore these considerations are incomplete and many of their implications cannot be extended to models based on more general assumptions.

Our model shows that a bank's spread management on its loan rate and deposit settings may provide the FDIC protection from credit and interest rate risks when the FDIC prices its risk-adjusted deposit insurance. This spread management protection obviates the need for forward market protection even if the bank cannot know the realization of those two risks either dichotomously or simultaneously. If the bank can know only the realization of the credit risk, the spread management protection obviates the need for forward market protection as well. But if the bank can know only the interest rate risk, the FDIC's forward market microhedging and marcohedging decision on interest rate risk may be necessary. The asymmetric microhedging and macrohedging on credit and interest rate risks stem from a bank's loan-rate-setting and deposit-rate-taking behavioral modes faced by the FDIC. It has been shown, for example, that a crucial Sealey, Jr.'s conclusion (1980, p.1152): "that many of the results concerning the theory of financial intermediation derives from models of quantity-setting behavior cannot be generalized to models of rate-setting behavior" is supported by our arguments in this paper. Furthermore, we have demonstrated that the theory of normal backwardation on the FDIC's microhedging and marcohedging forward loan and deposit rate may or may not be supported, depending on the bank's interest rate risk realization. Nevertheless, by focusing strictly on a bank's loan-rate-setting behavioral mode, this paper demonstrates the crucial link between rate setting and hedging behavioral modes on pricing risk-adjusted deposit insurance.

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