A contingent claim analysis of a rate-setting financial intermediary

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Abstract

Realizing that a financial intermediary’s lending, treated as an investment opportunity, is like a financial call option clarifies the role of uncertainty. We argue that the portfolio-theoretic approach and the firm-theoretic approach have important linkages that can be used to demonstrate the contingent claim analysis of a rate-setting financial intermediary. Borrower-intermediary-lender relationships between the portfolio-theoretic combined volatilities and the firm-theoretic rate-setting modes under the Black-Scholes valuation are investigated, and the conclusions depend upon the portfolio composition redistribution effect. The effect of changes in the open market security rates on the loan rate and deposit rate settings depend on the borrower-intermediary-lender relationship, portfolio risk, and management of rate-setting strategy. Moreover, movements in open market security rates are not necessarily transmitted to the loan lender and deposit absorber. © 2000 Elsevier Science Inc. All rights reserved.

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1. Introduction

Dealing with the analysis of the determinants of the prices of contingent claim assets whose value is a non-proportional function of the value of another asset, the Black-Scholes option-pricing model basically utilizes the concept of the portfolio-theoretic approach. As pointed out by Smith (1976), many modifications of this option-pricing model have shown that the analysis is quite robust with respect to relaxation of the basic assumptions under which this model is derived. Recently, many extensions,
rather than modifications, of the Black-Scholes valuation model (e.g., Johnson & Shanno, 1987; Johnson & Stulz, 1987; Hull & White, 1995; Jarrow & Turnbull, 1995; Klein, 1996) have been presented.

Smith also suggests that the Black-Scholes option-pricing model can be used to value the equity and debt of a firm. A financial intermediary itself is a highly leveraged firm. Merton (1989) and Crouhy and Galai (1991) evaluated financial intermediaries using a continuous time contingent claim framework. Mullins and Pyle (1994) analyzed risk-based capital rules in a single period model that relied on the Black-Scholes option valuation. The principal advantage of this valuation technique is the explicit treatment of uncertainty, which has played an important role in discussions of financial intermediary behavior.1

Sealey (1980) demonstrated that two divergent approaches, portfolio-theoretic and firm-theoretic, have been employed in the literature to model the financial intermediary. With the advantage of explicitly treating the uncertainty of the underlying entity, the portfolio-theoretic approach assumes that both loan and deposit markets are perfectly competitive. Slovin and Sushka (1983) argue that many studies assume that the loan market is competitive but sometimes the loan rate does not clear the market, the lending operation is constrained by the supply function, and financial intermediaries engage in nonprice rationing of loan-borrowers. Slovin and Sushka (1983), Hancock (1986), and Zarruk and Madura (1992) recognized the context of a model of financial intermediary behavior, which assumes that the loan market is imperfectly competitive.

A financial intermediary generally absorbs deposits from a limited geographical area, named a local deposit market, where the area contains only a limited number of financial intermediaries. Sealey indicates that the deposit rate-setting behavioral mode is the most interesting issue for a financial intermediary. Following Sealey (1980) and VanHoose (1988), the model assumes that the intermediary is a rate-setter, rather than a rate-taker, in a local deposit market to capture the nature of imperfect competition. The rate-setting behavior incorporated in loan and deposit decisions is the so-called firm-theoretic approach to financial intermediaries.

By applying Dixit and Pindyck (1995), recognizing that lending treated as an investment opportunity is like a financial call option, clarifies the role of uncertainty. The purpose of this paper is to integrate portfolio-theoretic volatilities with the firm-theoretic rate-setting modes in the analysis of the contingent claim of an imperfectly competitive financial intermediary.2 In general, an intermediary is willing to take on more risk to trade a higher rate of return. One of our main findings is that the relationship between the portfolio-theoretic combined volatilities and the firm-theoretic rate-setting modes under the Black-Scholes valuation is indeterminate. Furthermore, the effect of changes in the open market security rates (returns of default-free asset) on the loan rate and deposit rate settings depend on three critical factors: the borrower-intermediary-lender relationship, portfolio risk, and management of rate-setting strategy. In other words, the redistribution of portfolio compositions and the strategy for absorbing deposits cannot be optimally determined without examining the firm-theoretic characteristics of the intermediary in the contingent claim analysis. A possible examination of these indeterminate results may originate from the assump-
tion of the behavioral modes of imperfectly competitive loan and deposit markets. Therefore, by bridging important linkages between the portfolio-theoretic approach and the firm-theoretic approach, the contingent claim analysis of a rate-setting intermediary may be further investigated in this article.

The rest of this article is organized as follows. Section 2 presents a simple model. Section 3 is devoted to the analysis of equilibrium and comparative statics, including volatilities and open market security rates. Section 4 contains the concluding remarks.

2. The model

Consider a single-period model of a financial intermediary that holds two types of earning assets: open market securities, $B$, and loans, $L$. The intermediary is assumed to act as a rate taker in the open market so that the interest rate on open market securities, $R$, is given. The intermediary is also assumed to face a downward-sloping demand curve for its loans and chooses the loan rate $R_L$ to maximize profits. Accordingly, the assumptions of a perfectly competitive security market structure and an imperfectly competitive loan market structure by Slovin and Sushka (1983) are used to discuss the issue of contingent claims in this paper. To capture the redistribution effect of a portfolio composed of those two earning assets, the demand for loans is assumed to be a positive function of open market rates as well, as shown in Eq. (1):

$$L = L(R_L, R), \frac{\partial L}{\partial R_L} < 0, \frac{\partial L}{\partial R} > 0$$ (1)

The assumption of an imperfectly competitive fund-demand market demonstrated by Sealey in the previous section is used to discuss the issue of contingent claims in the model. The intermediary can then be assumed to face an upward-sloping deposit supply curve. In addition, the supply of deposits is also assumed to be a negative function of the open market rate since alternative instruments, deposits and open market securities, chosen by the public are emphasized in the model. This deposit supply function is then a function of the deposit rate, $R_D$, and open market rate under the consideration of rate variation setting shown in Eq. (2):

$$D = D(R_D, R), \frac{\partial D}{\partial R_D} > 0, \frac{\partial D}{\partial R} < 0$$ (2)

It is assumed that the intermediary holds no excess or borrowed reverses during the horizon and faces the balance sheet constraint at the start of the period shown in Eq. (3):

$$L + B = D + E$$ (3)

where $E$ is the value of the intermediary’s equity. The initial loanable funds are invested in default-free securities maturing at the end of the period and in risky lending assets with an unspecified maturity greater than one period. At any time $t$ ($0 \leq t \leq 1$), the value of the intermediary’s risky assets is given by Eq. (4):
Since the open market securities are treated as risk-default assets in the model, the total promised security repayments to the intermediary at the end of the period are certain. Thus, the value of the intermediary’s earning-asset portfolio is given in Eq. (5):

\[ A = V(R_L, R) + (1 + R)[E + D(R_D, R) - L(R_L, R)] \] (5)

The depositors are offered a rate \( R_D \) on their deposits. The total promised payment to the depositors at the end of the period is \((1 + R_D)D(R_D, R)\). As mentioned, the intermediary itself is a highly leveraged firm. The limited liability effect of debt (deposits) financing creates a possible part of the residual claimants for debtholders. Depositors in the model, nevertheless, will receive the promised payment only if that possibility does not take place at the end of the period. However, if that possibility occurs, all of the intermediary’s assets belong to the original depositors. The values of deposits at the end of the period are given in Eq. (6):

\[ P = \begin{cases} (1 + R_D)D(R_D, R) & \text{if solvent } (A > P) \\ A & \text{if insolvent } (A \leq P) \end{cases} \] (6)

The value of the intermediary equity at the end of the period horizon is defined as the residual value of the intermediary after meeting all of its debt obligations and is expressed as

\[ S = \begin{cases} A - P & \text{if solvent } (A > P) \\ 0 & \text{if insolvent } (A \leq P) \end{cases} \] (7)

By applying Crouhy and Galai (1991) and Mullins and Pyle (1994) the value of the intermediary’s equity as described by Eq. (7) has the features of a contingent claim, which is written on the value of the intermediary’s earning assets. In other words, this market value of equity can be treated as the Black-Scholes value of the call option effectively purchased by the shareholders of the intermediary. Since we adopt no restrictions on the detailed characteristics of this portfolio, including risky as well as default-free assets, the call option is written on the intermediary’s portfolio composition changes stochastically because of the risk differences between the two assets.

Thus, following Rubinstein (1983) and Crouhy and Galai (1991), the call option in this paper is written in two parts shown as follows. The first part is the risk adjusted present value of the intermediary’s assets (loan) with uncertainty expressed by the combined standard deviation of the return of the portfolio in the model. The second part is the risk adjusted present value of the net obligations of the intermediary to its initial depositors above and beyond its default-free securities. This exercise is then described as a spread rate that equals the difference between the open market rate and the promised deposit rate. Thus, the Black-Scholes value of the call option can be appropriately imposed on our model.

Under these assumptions, the intermediary’s objective can be expressed as:
Max \( S = V(R_L, R)N(d_1) - [(1 + R_D)D(R_D, R) - (1 + R)[E + D(R_D, R) - L(R_L, R)]]e^{-\mu}N(d_2) \) 

where,

\[
d_1 = \frac{1}{\hat{\sigma}} \left[ \ln \left( \frac{V}{(1 + R_D)D - (1 + R)(E + D - L)} \right) + \mu + \frac{1}{2} \hat{\sigma}^2 \right];
\]

\[
d_2 = d_1 - \hat{\sigma};
\]

\[
\hat{\sigma}^2 = \sigma_1^2 + \sigma_r^2 - 2p_{\sigma_1,\sigma_r} \sigma_1 \sigma_r;
\]

and

\[
\mu = R - R_D.
\]

In the objective function above, the cumulative standard normal distributions of \( N(d_1) \) and \( N(d_2) \) are the risk adjustment factors of the present value of the intermediary’s risky assets (loans) as well as net obligations (difference between deposit payment and securities repayment), respectively; \( \hat{\sigma}^2 \) is the variance with \( \sigma_1 \) and \( \sigma_r \) being the instantaneous standard deviation of the rates of return on the risky and default-free assets, respectively; \( p_{\sigma_1,\sigma_r} \) is the instantaneous correlation coefficient between the two assets in the portfolio. \( \mu \) is the net deposit rate spread, which is defined as the spread between the default-free security rate and the promised interest rate to the initial depositors. The time left to maturity of the initial deposits is equal to 1 because the model is manipulated under the assumption of a single-period horizon.

3. Equilibrium and comparative statics

Partially differentiating Eq. (8) with respect to \( R_L \) and \( R_D \), the first-order conditions are given using

\[
\frac{\partial S}{\partial R_L} = \frac{\partial V}{\partial R_L}N(d_1) - (1 + R)\frac{\partial L}{\partial R_L}e^{-(R - R_D)}N(d_2) = 0 \quad (9a)
\]

\[
\frac{\partial S}{\partial R_D} = (1 + R_D)D - (1 + R)(E + D - L) + D - (R - R_D)\frac{\partial D}{\partial R_D} = 0 \quad (9b)
\]

The first-order conditions in Eqs. (9a) and (9b) determine the optimal loan rate, hence the earning-asset portfolio and the optimal deposit rate of the intermediary. To analyze the comparative statics derived from Eqs. (9a) and (9b), we require that the second-order conditions be satisfied:

\[
\frac{\partial^2 S}{\partial R_L^2} = \frac{\partial^2 V}{\partial R_L^2}N(d_1) - (1 + R)\frac{\partial^2 L}{\partial R_L^2}e^{\mu}N(d_2)
\]

\[
+ \left\{ \frac{\partial V}{\partial R_L}n(d_1) - (1 + R)\frac{\partial^2 L}{\partial R_L^2}e^{-\mu}n(d_2) \right\} \frac{\partial d_1}{\partial R_L} \quad (10a)
\]
where \( n(d_1) \) and \( n(d_2) \) are the probability distribution functions of \( N(d_1) \) and \( N(d_2) \), respectively. To ensure that a unique market equilibrium is obtained, we further assume:

\[
\Delta = \frac{\partial^2 S}{\partial R_L \partial R_D} - \frac{\partial^2 S}{\partial R_D \partial R_L} > 0
\]

Because optimal loan and deposit rates are simultaneously determined, Eqs. (10b) and (10c) demonstrate the intermediary's interactive operation between loan rate and deposit rate settings. Eq. (10b) of \( \partial S/\partial R_L \partial R_D \) represents the change of the expected marginal equity value to loan rate setting of the intermediary influenced by the change of its deposit rate setting. By applying Bulow et al. (1985), the intermediary believes that its loan rate and deposit rate settings have the nature of a strategic substitute if \( \partial^2 S/\partial R_L \partial R_D < 0 \) or a strategic complement if \( \partial^2 S/\partial R_D \partial R_L > 0 \). In the case of a strategic substitute, the intermediary's adjustment to increasing (decreasing) its loan rate setting is the best response when it decides to decrease (increase) its deposit rate setting. On the contrary, the best response of the intermediary is expected to increase (decrease) its deposit rate setting if a strategic complement occurs. Eq. (10c) of \( \partial^2 S/\partial R_D \partial R_L \) can be explained symmetrically.

Both Eqs. (10b) and (10c) demonstrate that the intermediary's "two-sided problem" of loan rate and deposit rate settings pointed out by Krasa and Villamil (1992a, 1992b), is recognized as an interactive operation in its optimization. Moreover, the qualitative solution of Eq. (10b) is indeterminate, whereas that of Eq. (10c) is positive. Either a strategic substitute or a strategic complement occurs if the intermediary's adjustment to changing its set loan rate is treated as the best response when it decides to change its set deposit rate. However, a strategic complement only takes place if the intermediary's adjustment to changing its set deposit rate is identified as the best response when it decides to change its set loan rate. Thus, the intermediary's asymmetrical "two-sided problem" of set loan and deposit rates has been observed in this paper.

Loan repayment volatilities are of considerable importance to a financial intermediary. Expectations of loan repayment volatilities influence portfolio distribution as well as the set rate return from risky lending. In this paper, the effect of a change in the portfolio-theoretic combined volatilities on the firm-theoretic rate-setting modes is explored in the following:

\[
\frac{\partial^2 S}{\partial R_L \partial R_D} = \left[ \frac{\partial V}{\partial R_L} n(d_1) - (1 + R) \frac{\partial L}{\partial R_D} e^{-\mu n(d_2)} \right] \frac{\partial d_1}{\partial R_D} - (1 + R) \frac{\partial L}{\partial R_L} e^{-\mu} N(d_2) \quad (10b)
\]

\[
\frac{\partial^2 S}{\partial R_D \partial R_L} = -(1 + R) \frac{\partial L}{\partial R_L} e^{-\mu} N(d_2) > 0 \quad (10c)
\]

\[
\frac{\partial^2 S}{\partial R_D^2} = \left[ (R - R_D) \left( \frac{\partial D}{\partial R_D} + \frac{\partial^2 D}{\partial R_D^2} \right) - \left( D + \frac{\partial D}{\partial R_D} \right) \right] e^{-\mu} N(d_2) \quad (10d)
\]
\[
\frac{dR_I}{d\sigma^2} = \frac{I \frac{\partial^2 S}{\partial R_L \partial \sigma^2}}{\Delta \frac{\partial R_L}{\partial \sigma^2}} \tag{11a}
\]

where

\[
I = \left( \frac{\partial V}{\partial R_L} n(d_1) \frac{\partial d_1}{\partial \sigma^2} - (1 + R) \frac{\partial L}{\partial R_L} e^{-\nu n(d_2)} \frac{\partial d_2}{\partial \sigma^2} \right)
\]

The above qualitative result of the comparative statics derived from Eqs. (9a) and (9b) depends on the term \(I\). \(I\) can be treated as the portfolio composition redistribution effect caused by changes on the combined volatilities in this model. The degree of risky component of the earning-asset portfolio caused by changes in the combined volatilities is much more significant than that in the default-free component if the term \(I\) is negative. Generally speaking, an intermediary is willing to take on more risk to trade at a higher rate of return. This is a fundamental argument of financial management: the notion of a risk-return trade-off is supported only if the portfolio composition redistribution effect is negative.\(^3\) We may argue that bankers are legally restricted in the extent to which they can reach out for higher return. More importantly, the ambiguous result of Eq. (11a) is observed under the Black-Scholes valuation associated with the behavioral mode of loan-rate setting and with the combined volatilities \(\sigma^2\) of the paper. Accordingly, we argue that it may be significant to go a step further to evaluate the risk-return trade-off from the viewpoint of the portfolio-theoretic as well as firm-theoretic approach under the Black-Scholes valuation.

Krasa and Villamil (1992a, 1992b) constructed a model to analyze intermediated investment, where lenders and borrowers write contracts with an intermediary. Their model demonstrates the two-sided constraint that pertains to the borrower-intermediary as well as the intermediary-lender relationship. They regard that the intermediary’s problem clearly embodies optimization by all agents (borrower-intermediary-lender in their model) in the economy. The following analysis of changes in the portfolio-theoretic combined volatilities on the firm-theoretic deposit rate setting is originated from their consideration of the borrower-intermediary-lender relationship.

Consider next the impact on the intermediary’s deposit rate setting from changes in the combined volatilities. The result of the comparative statics derived from Eqs. (9a) and (9b) is presented in the following:

\[
\frac{dR_D}{d\sigma^2} = \frac{I \frac{\partial^2 S}{\partial R_D \partial \sigma^2}}{\Delta \frac{\partial R_D}{\partial \sigma^2}} \tag{11b}
\]

The result of the comparative statics of Eq. (11b) depends on the portfolio composition redistribution effect as well. As mentioned, the intermediary is willing to take on more risk to trade at a higher rate of return under the negative redistribution effect in the model. If this negative redistribution effect is still valid, the deposit rate setting from changes in the combined volatilities is expected to be positive since a strategic complement \((\partial^2 S/\partial R_D \partial R_L > 0)\) is performed by the intermediary. An explanation of the above positive argument is possible in terms of the borrower-intermediary-
lender relationship that makes the intermediary set a higher deposit rate to attract more deposit funds to meet a higher rate of return in its lending investment.

Finance theory says that movements in financial asset prices should reflect new information about fundamental asset values. Fleming and Remolona’s empirical finding (1997) that the largest price shocks and the greatest surges in trading activities in the open market security (bond) market stemmed from the arrival of reassuring public information during the period from August 1993 to August 1994. Accordingly, we may anticipate that the security market’s reactions signalled by changes in trading activities (changes in rates as well as volumes) depend on unexpected announcements and on conditions of uncertainty. Then, we can conjecture that the impact on a bank’s loan rate setting from changes in the open market security rate due to unexpected announcements and uncertainty using the following comparative static analysis:

\[
\frac{dR_L}{dR} = \frac{1}{\Delta} \left( H \frac{\partial^2 S}{\partial R_p^2} - G \frac{\partial^2 S}{\partial R_i \partial R_p} \right)
\]  

(12a)

where

\[
H = - \left[ \frac{\partial^2 V}{\partial R_c \partial R} N(d_1) + \frac{\partial V}{\partial R_c} n(d_c) - (1 + R) \frac{\partial L}{\partial R_L} e^{-\nu N(d_2)} \right] \frac{\partial d_1}{\partial R} \\
+ \left[ (1 + R) \frac{\partial L}{\partial R_L} - \frac{\partial L}{\partial R} - (1 + R) \frac{\partial^2 L}{\partial R_L \partial R} e^{-\nu N(d_2)} \right]
\]

\[
G = \left[ (1 + R) \frac{\partial L}{\partial R} - (E + D - L) + \frac{\partial D}{\partial R} - \frac{\partial D}{\partial R_D} \right]
\]

\[- (R - R_D) \left( \frac{\partial^2 D}{\partial R_D \partial R} + \frac{\partial D}{\partial R} \right) e^{-\nu N(d_2)}
\]

The loan rate is set as an ambiguous function of open market security rates since the result of the comparative statics of Eq. (12a) is indeterminate. The effect of changes in the open market security rates on the set loan rates depends on (i) changes in the intermediary’s portfolio allocation caused by changes in the loan rate setting behavioral modes (borrower-intermediary relationship), (ii) an increase or decrease in deposit liabilities caused by changes in the open market security rates (intermediary-lender relationship), (iii) the risk adjustment factor of the present value of the intermediary’s risky assets and net obligations (portfolio risk), and (iv) the intermediary’s best response between loan rate and deposit rate settings (strategic substitute and complement). The plausible arguments that can be used to explain the indeterminate effect in Eq. (12a) includes the borrower-intermediary-lender relationship, the portfolio risk, and the internal management of rate-setting strategy. Accordingly, the intermediary’s two-sided optimization problem can be stated as associated with portfolio risk as well as rate-setting strategy.

From the earning-asset-side viewpoint of the intermediary’s balance sheet constraint, the expression \(H(\partial^2 S/\partial R_p^2)\) in Eq. (12a) may be treated as a direct effect (or own effect) of the interaction of the intermediary’s asset portfolio diversification. This
is because the $H$ term demonstrates the effect of changes in the open market security rates on the value of the intermediary’s risky assets given a constant optimal deposit rate. The expression $G(\partial^2 S/\partial R_D \partial R_D)$ may be treated as an indirect effect (or cross effect) of that interaction. This is because the $G$ term shows the effect of changes in the open market security rates on the intermediary’s deposit liabilities given a constant optimal loan rate.

Crouhy and Galai (1991, p. 80) argue that “When the two securities [risky asset and default-free asset] are positively correlated, as would be expected. . . .” Slovin and Sushka (1983, p. 1595) state that “movements in open market interest rates are fully and quickly transmitted to commercial loan customers.” Both Crouhy and Galai’s and Slovin and Sushka’s arguments are supported by this paper if the direct effect of the interaction of the intermediary’s asset portfolio diversification Eq. (12a) is not fully offset by its indirect effect. Many bankers contend that for asset returns that are less than perfectly correlated, portfolio or asset diversification does reduce risk. By bridging an important linkage between those two rates, the issue of asset diversification associated with reducing risk can be further investigated in this paper.

In general, the switching of saving allocation (deposits and open market securities in this paper) by depositors (lenders) is an important consideration for a financial intermediary. This switching indicates the substitutability between deposits and securities by depositors. To capture the optimal operation in the deposit market, the deposit rate setting financial intermediary must optimally adjust its deposit rate with variant security rates.

The comparative static result of a change in the open market security rate on the deposit-rate-setting is

$$\frac{dR_D}{dR} = \frac{1}{\Delta} \left( G(\partial^2 S/\partial R_D \partial R_D) - H(\partial^2 S/\partial R_L \partial R_D) \right)$$

(12b)

Besides the borrower-intermediary-lender relationship, the effect of changes in the open market security rates on the set deposit rate depends on the combined volatilities of the asset portfolio, the intermediary anticipates, and the strategic complement the intermediary conducts. From the balance sheet constraint’s liability-side perspective, the expression $G(\partial^2 S/\partial R_D \partial R_D)$ in the above equation may be treated as a direct effect (or own effect) of changes in the open market security rates on the intermediary’s deposit liability. The expression $H(\partial^2 S/\partial R_D \partial R_L)$ may be treated as an indirect effect (or cross effect). The comparative static result of Eq. (12b) is expected to be positive if the direct effect is not completely offset by the indirect effect. Under the assumption above, the rate-setting intermediary will increase its deposit rate for holding the objective of expected profit maximization if the open market security rate increases. This is because the depositors are attracted by the increasing security rate, and they will withdraw their deposits from the intermediary if the deposit rate remains unadjusted.

This positive comparative-static result demonstrates that movements in open market security rates may be transmitted to depositors. As pointed out by Kane (1979), minimizing deposit interest costs is one of the three faces of liability management.
The ability to minimize deposit interest costs depends on the responsiveness of the depositors to changes in the deposit rates. The more interest sensitive pools of customer funds are, the more difficult it is to minimize deposit interest expenses. Thus, the comparative-static result of Eq. (12b) that we have been investigating supports Kane’s (1979) argument under the assumption of the direct effect over weighting the indirect effect.

4. Conclusion

A model of a rate-setting financial intermediary with uncertainty expressed in the form of loan losses has been presented. The distinguishing characteristic of the model is that loan rate-setting, deposit rate-setting, and security rate-taking behavioral modes are simultaneously incorporated into the model. Based on a microeconomic view of intermediary decision making and a macroeconomic view of the irresistible global trend toward financial liberalization, it seems unlikely that the omission of the above aspects of intermediary behavior can be justified. More importantly, these considerations play an important role in determining optimal asset portfolio (portfolio-theoretic approach) and loan-rate–deposit-rate (firm-theoretic approach) decisions under the Black-Scholes formula. By bridging an important linkage between these two approaches, the Black-Scholes valuation can be further utilized to discuss the option-pricing issue, which is focused on equity valuation (risky lendings) in relation to the values of other alternatives (net obligations of deposit payments) in this article.

Emphasizing the asset-transformation activity associated with uncertainty under loan rate and deposit rate conducting behavioral modes, there are several crucial conclusions. First, the concept of the positive risk-return trade-off is in general realized. In this article, we find an ambiguous relationship between the portfolio-theoretic combined volatilities and the firm-theoretic rate-setting modes under the Black-Scholes valuation. This ambiguous relationship is probably demonstrated by the intermediary’s limited ability to insure fully against risk under restrictive regulations. Second, the combined volatilities of the portfolio, as expected, have an influence on the deposit rate-setting behavioral mode since the asset and liability sides of the intermediary’s operations are inevitably related. Third, in this article, the effect of changes in the open market security rates (returns on default-free assets) on the set loan rates (returns on risky assets) depends on three critical factors: borrower-intermediary-lender relationship, portfolio risk, and the internal management of rate-setting strategy. Fourth, the effect of changes in the open market security rates on the deposit rate setting depends upon the above three factors as well. More specifically, the internal management of deposit rate-setting strategy is limited to the strategic complement under the setting of the article.

The Black-Scholes option-pricing valuation has long been important to an intermediary’s manager. In recent years, the structure-conduct-performance paradigm has had increasing importance in analyzing an intermediary’s competitiveness in both loan and deposit markets. Therefore, we argue that the appropriate operation of an intermediary cannot be determined without referring to those two approaches together.
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Notes

1. The Black-Scholes model is a function of the following variables: the exercise or option price, the exercise or expiration date, the risk of the underlying asset, and the risk-free rate of interest. Three of these variables are directly observed; only the variance rate (the risk of the underlying asset) must be estimated.

2. As pointed out by Smith (1976), option pricing models fall into two broad categories: ad hoc models and equilibrium models. From the viewpoint of the equilibrium model, the model we present in this article can be treated as a subgame-perfect equilibrium. In the first stage of the subgame-perfect setting, the financial intermediary determines the optimal loan and deposit rates. In the second stage, the financial intermediary determines the market values of its equity and deposits, given the known optimal loan and deposit rates. It is logical to limit this article to the first-stage analysis since the Black-Scholes valuation can be treated as a completion of the first-stage analysis by assuming that loan and deposit rates are given.


4. Note that both loan and deposit markets are assumed to be perfectly competitive in Crouhy and Galai (1991). Both markets are assumed to be imperfectly competitive in Slovin and Sushka (1983). Concerning the assumption of loan and deposit market structures, this article follows Slovin and Sushka. Furthermore, Crouhy and Galai present the value of a bank’s equity under the Black-Scholes setting. Slovin and Sushka demonstrate a bank’s operating profit under the profit-maximization setting. Concerning the assumption of equity or profit valuation, this article follows Crouhy and Galai.

5. Kane (1979) explains the phenomenon of liability management, emphasizing three aspects: minimizing bank interest expenses, the importance of customer relationships, and the circumvention of regulatory restrictions. For more on this subject, see Sinkey (1992, p. 428–433).

References


