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資本管制下主併銀行的利率設定行為：或有請求權分析

Acquisition and Capital Regulation of a Rate-Setting Acquirer Bank: A Contingent Claim Analysis

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資本管制下主併銀行的利率設定行為：或有請求權分析

中文摘要

本文利用 Black & Scholes 或有請求權分析來探討，來探討主併銀行運用其利率制定的策略，以追求併購淨利極大化的目標；換言之，利用併購策略追求利潤極大化。本文模型主要考慮的要素有三：放款產品互補/替代的特性、放款利率策略性互補/替代的策略和資本管制政策。結合這三種主要因素，探討主併銀行的最適放款利率。主要發現：當主併銀行占合併銀行的股份比例相對少時，最適利率將會相對高；當政府加強資本管制時，主併銀行最適利率將會降低。這兩個主要結論繫乎於放款產品的互補性及放款利率的策略性互補之假設。因此，本文銀行合併行為中的放款產品及其競爭策略的另一種詮釋。

Acquisition and Capital Regulation of a Rate-Setting Acquirer Bank: A Contingent Claim Analysis

Abstract

This paper explores the determinants of the acquirer bank's optimal loan-rate settings based on a firm-theoretical option-pricing model under the maximum net gain from acquisition. The model demonstrates how the nature of the loan (substitutes/complements), loan-rate-setting strategies (strategic substitutes/strategic complements) and regulation conditions jointly determine the acquirer bank's optimal loan-rate settings. We find that the acquirer bank's loan-rate-settings are negatively related to the proportion of the combined banks owned by the acquirer bank's shareholders and also negatively related to the capital regulation under the nature of the loan complements and the loan-rate-setting complement strategy. Our findings provide an alternative explanation for the acquirer bank's strategies for operating and competing in the market concerning bank acquisition behavior.

Keywords: Black-Scholes Valuation, Loan Rate Setting, Acquisition, Capital Regulation.

JEL Classification: G13, G14

1. Introduction

Expected increases in market share for loans, deposits and other services and geographic diversification to reduce risk by serving markets with different economic profiles and income flows caused by the liberalization of the banking and finance systems have contributed to a surge in mergers and acquisitions in the last two decades. Further adding momentum to this movement, the regulatory authorities have been plagued in many Asian countries who often use mergers and acquisitions since the financial crisis in mind-1997. Merging two banks to create a stronger one is seen as a panacea, thus resulting in more mergers and acquisitions.

The number of large acquisitions in recent years has allowed for the study of their effects on public shareholders and stock market reactions to the mergers (Neely, 1987). This merger-event approach focuses on stock prices around the time of the merger announcement.[1] Generally, we hypothesize that the only situation in which a weak bank can be successfully rescued in a merger is when the acquirer bank is much larger and stronger than the bank being acquired. Mergers and acquisitions become interesting when competition is imperfect. As a consequence, Neely's argument about increasing large acquisitions further allows the study of their effects on equity holders on the basis of the structure-conduct-performance characteristics of the firm-theoretic approach.

There are at least two different but equally important areas where a thorough understanding of the importance of large acquisitions is essential. First, finance theory suggests that acquisitions, like other investment decisions, should occur because they are positive net-present-value projects that increase the market value of the acquirer firm's shareholders. The acquisition investment decisions rely largely on understanding the return-risk characteristics of the portfolio-theoretic approach. Second, firm theory claims that the operating synergies in a strategic acquisition, like

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[1] Malatesta (1983), Neely (1987), and Cornett & De (1991) utilized merger events to analyze the wealth effect of merger activity.

other profit-maximizing decisions, occur because the acquirer firm can raise product prices after buying up the competition, therefore, gaining monopoly power through mergers. The profit-maximizing acquisition decisions thus depend on an understanding of the structure-conduct-performance characteristics of a firm-theoretic approach.

The principal advantage of the portfolio-theoretic approach is the explicit treatment of uncertainty, which has played a prominent role in acquisition discussions. More specifically, as mentioned by Neely, the target banking firms included in his sample were larger compared to most typical target banks because they were publicly traded. The uncertainty treated as stock return volatility is of considerable importance to investors since return volatility expectations influence the acquirer bank's portfolio choice and are critical factors in pricing options. Thus, an understanding of the volatility expectations and their relationship to the expected returns in banking acquisitions is critical. One of the objectives of this paper includes using the Black-Scholes (1973) formula, often employed to compute an implied variance from call option market prices,[2] to provide such an understanding.

Although uncertainty is well captured in the portfolio-theoretic approach, this approach omits a key behavior in bank acquisitions. It is assumed that asset and deposit markets are perfectly competitive so that rate taking (or quantity-setting) is the relevant behavioral mode in both markets. However, bank acquisitions, especially large bank acquisitions are made only when competition is imperfect. In addition, the premiums paid in bank acquisitions are critical to a cost-benefit framework for

[2] Merton (1989) and Crouhy & Galai (1991) evaluated financial intermediaries using a continuous time contingent claim framework. Mullins & Pyle (1994) analyzed risk-based capital rues in a single period model which relied on the Black-Scholes option valuation.

analyzing bank acquisitions as noted by Sinkey (1992, pp. 846-847). According to Rhoades (1987), the premiums paid in bank acquisitions can be treated as an indicator of the firm or market characteristics that are attractive to the managers of the acquirer firms. Furthermore, the liberalization of banking and finance systems also deregulates banking markets and activities, including the lending and absorption of funds. This paper also utilizes the firm-theoretic approach in order to capture the deregulation effect on acquisitions.

Bank acquisitions have significantly changed their asset and capital positions. Asset quality problems arising form the increase in acquisition activity has plagued banks in recent years. To force bank capital positions to reflect asset portfolio risks, the regulatory authority can utilize a risk-based system of capital standards. Changes in the regulatory parameters are expected to affect bank acquisitions as well as bank profits and risks.

In light of previous work, the purpose of this paper is to develop a model of a strategic bank acquisition that integrates the risk consideration of the portfolio-theoretic approach with the market conditions and capital regulations of the firm-theoretic approach. More specifically, the Black-Scholes formula is extended to integrate the portfolio-theoretic volatilities with the firm-theoretic rate-setting modes in an analysis of the acquirer bank’s strategy for maximizing the net gain from the acquisition. The comparative-static results of the model are examined to determine the influence of give-and-take premiums in the acquisition and capital regulation of an acquirer bank’s loan rate-setting decisions. We find that the acquirer bank’s loan-rate setting is negatively related to the premiums paid in the bank acquisition and the capital-to-deposit ratio, considering some specific firm and market characteristics as well as uncertainty. Our findings provide an alternative explanation for the acquirer bank's strategies for operating and competing in the loan market concerning bank acquisition.

This paper is organized as follows. Section II sets up a cost-benefit framework for analyzing bank acquisition. Section III develops the basic structure of the model. Section IV provides a derivation solution of the model and the comparative static analysis while the final section contains concluding remarks.

2. Cost-Benefit Framework

A cost-benefit framework for analyzing a strategic bank acquisition under uncertainty is constructed. The benefit of a bank acquisition can be stated as the difference between the synergistic present value of the combined banks, $S_{1\&2}$, and the sum of both the acquirer and acquired banks' present values, S and S^*, respectively, if they operate separately. $S_{1\&2} - S - S^* > 0$ makes this acquisition potentially worthwhile. Moreover, the cost of the acquisition can be expressed as the difference between the amount paid for the acquired bank, P^*, and its value as a separate bank. Accordingly, the premium paid for the acquired bank is $P^* - S^*$. The premium is believed to be the maximum by the acquired bank whereas this cost is expected to be the minimum by the acquirer bank. Thus, the premium is determined using a give-and-take negotiation process between the acquirer bank and the acquired bank. Combining the benefit and the cost of the bank acquisition, a potentially beneficial acquisition investment decision is beneficial if the benefit is expected to exceed the cost, that is,[3]

$$(S_{1\&2} - S - S^*) - (P^* - S^*) \begin{cases} > 0 & \text{if strategic acquisition comes into operation} \\ \leq 0 & \text{if strategic acquisition does not} \end{cases}$$

The difference in the above equation is treated as the net gain from the strategic acquisition activity to the acquirer bank. The focal point of the cost-benefit analysis emphasizes determining the values and premiums of the bank acquisition since the net gain can also be expressed as $S_{1\&2} - S - P^* > 0$ by rearranging terms in the equation above. Therefore, the net gain from the acquisition will be positive if the present value of the combined banks is greater than the present value of the acquirer bank plus the price paid for the acquired bank. Note that price of the acquired bank is defined as its present value plus the purchase premium.

Determining the amount paid for the acquired bank, P^*, is a critical issue in acquisition analysis. As noted by Sinkey, the payment formula used when the acquisition is financed using common stock can be expressed as ¢ multiplied by the value of the combined banks, $P^* = ¢S_{1\&2}$, where ¢ is the proportion of the

[3] The total market value of the combined banks may not increase after the merger. The merger will increase the wealth of the acquirer bank's shareholders if the merger price is sufficiently low (it may even have to be negative, pointed out by Delhaise (1998, p.44)), even if the total market value of the combined banks decreases after the merger. Conversely, the merger will decrease the wealth of the acquirer bank's shareholders if the merger price is sufficiently high, even if the total market value of the combined banks increases after the merger. In the Asian financial turmoil of 1997, Delhaise's (1998,p.44) contention is that "…some banks for sale are not exactly offering the kind of return on equity foreign buyers would expect. This problem can be reflected in the acquisition price, …many banks would have to carry a negative sale price to attract a buyer." In addition, from the viewpoint of the acquirer bank's acquisition investment decision, its manager is most likely motivated to increase the wealth of his shareholders. Thus, this paper makes a possible assumption in specifying a positive net-gain formula for acquisition pricing.

combined banks owned by the acquired bank's shareholders, $0 < ¢ < 1$.[4] Thus, the net gain to the acquirer bank can be simplified and given by the difference between the present value of the combined banks owned by the acquirer bank's shareholders and the present value of the acquirer bank operating individually, $¯S_{1\&2} - S > 0$, where $¯ = 1 - ¢$.

To manipulate the cost-benefit framework in this paper, several factors must be determined: $¢$, $¯$, the value of the combined banks, and the value of the bank making the acquisition. These determinations are critical to the model shown in the following section.

3. The Model

Consider a single-period model of a bank acquisition under loan repayment uncertainty. An acquirer bank with no legal reserve requirement holds two types of earnings assets: open market securities, B, and loans, L. The acquirer bank, in general, is generally a rate-taker in the open market so that the interest rate on open market securities, R, is given. As mentioned earlier, mergers and acquisitions take priority when competition is imperfect. As such, the acquirer bank is assumed to be a rate-setter that faces a downward-sloping demand curve for its loans and chooses the loan rate, R_L, to maximize profits. This assumption implies the acquirer bank

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[4] Estimating the premium paid for the bank to be acquired depends on how the merger is financed (e.g., cash, common stock, or some combination of the two). In a cash transaction, the premium payment to the acquiree bank's shareholders is independent of whether or not the merger activity conduct is a synergistic one since their return does not rely on the operation of the combined banks. Calculating the premium payment for the stock financing approach is a completely different matter and can be computed using two different methods. Rhoades (1987) determined three independent variables in his model: acquired firm characteristics, market characteristics, and acquiring firm characteristics. Darrell (1973) proposed three techniques to estimate premiums: the book-value approach, the market-to-book premiums, and the income-to income premiums. Thus use of these techniques alters both $¢$ and premium values computed.

exercises some monopoly power in its lending activities.[5] Correspondingly, the acquired bank holds two types of earning assets: market securities, B^*, and loans, L^*, and chooses the loan rate, R_L^*, to maximize profits.

To capture the rate-setting conjectural variations, if both the acquirer bank and the acquired bank operate separately, the demands for loans faced by both banks are respectively

$$L = L(R_L, R_L^*)\,, \quad \frac{\partial L}{\partial R_L} < 0 \tag{1-1}$$

$$L^* = L^*(R_L, R_L^*)\,, \quad \frac{\partial L^*}{\partial R_L^*} < 0 \tag{1-2}$$

where, L and L^* are substitutes when $\partial L / \partial R_L^* > 0 \quad (\partial L^* / \partial R_L > 0)$ and complements when $\partial L / \partial R_L^* < 0 \quad (\partial L^* / \partial R_L < 0)$.

Rhoades analyzed the premiums paid in bank acquisitions using the assumption that the premiums paid signaled market characteristics. Furthermore, regulatory capital requirements are an important factor in the firm characteristics of Rhoades' investigation. Given such factors, a risk-based system of capital standards is utilized since an acquisition involves capital expandability. This system is designed to force a banks' capital positions to reflect it's asset portfolio risks; the essence of the portfolio-theoretic approach.

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[5] For the characteristics of imperfect loan markets in which financial intermediaries exist, see Pringle (1973). Empirical studies by Slovin & Sushka (1983), and Hancock (1986) support the use of rate-setting behavior in loan markets. This assumption of imperfect loan markets is also employed by Zarruk & Madura (1992) to theoretically examine the relationships among capital regulation, deposit insurance, and optional bank interest margin.

At the start of a single-period model, the acquirer bank raises D in deposits and E in equity capital. E is restricted through regulations to a fixed proportion of the acquirer bank's deposits, $E \geq qD$.[6] Following Zarruk & Madura (1992), the required capital-to-deposit ratio, q, is assumed to be an increasing function of the loans held by the acquirer bank at the beginning point of the period, $dq/dL > 0$. We assume that the acquired bank faces the same required capital-to-deposit ratio regulation as the acquirer bank. Thus, $E^* \geq qD^*$ and $dq/dL^* > 0$.

When the capital constraint is binding, both the acquirer and the acquired banks' liquidity constraints are, respectively,

$$L + B = E + D = E(1 + \frac{1}{q}) \tag{2-1}$$

$$L^* + B^* = E^* + D^* = E^*(1 + \frac{1}{q}) \tag{2-2}$$

The initial loanable funds are invested in a two-asset portfolio composed of default-free securities maturing at the end of the period and risky lending assets with an unspecified maturity greater than one period. During the period, the value of the acquirer bank's risky lending assets is

$$V(R_L, R_L^*) \begin{cases} = (1 + R_L)L(R_L, R_L^*) & \text{without loan losses} \\ < (1 + R_L)L(R_L, R_L^*) & \text{with loan losses} \end{cases} \tag{3}$$

6 For an analysis of the effects of capital requirements in terms of capital-to-deposit ratio, see Mullins & Pyle (1994).

The total promised security repayments to the acquirer bank at the end of the period are certain because the open market securities are treated as risk-default assets in the model. The value of the acquirer bank's earning-asset portfolio, if operating separately, is then

$$A = V(R_L, R_L^*) + (1+R)[E(1+\frac{1}{q}) - L(R_L, R_L^*)] \tag{4}$$

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 $(1+R_D)E/q$. The limited liability effect of debt (deposits) financing creates a possible part of the residual claimants for debtholders (deposits). Depositors will receive all of the promised payment only if that possibility does not occur at the end of the period. However, all of the acquirer bank's earning assets (even if insufficient to cover all debts) are owned by the depositors under bankruptcy. The value of the deposits at the end of the period are given using:

$$J = \begin{cases} (1+R_D)\dfrac{E}{q} & \text{if solvency } (A > J) \\ A & \text{if insolvency } (A \le J) \end{cases} \tag{5}$$

The value of the acquirer bank's equity at the end of the period is defined as the residual value of the acquirer bank after meeting all of its debts, represented by

$$S = \begin{cases} A - J & \text{if solvency } (A > J) \\ 0 & \text{if insolvency } (A \le J) \end{cases} \tag{6}$$

By applying Crouhy & Galai (1991) and Mullins & Pyle (1994), it may be assumed that the dollar amount invested by the shareholders is equal to the call option they effectively purchase from the bondholders. We then analyze the acquisition decision using a single period model, which relies on Black & Scholes' option valuation. The stochastic variable, S, is the market value of the acquirer bank's assets at the time of an audit. For the sake of parsimony, the cost of an audit is not considered in this model. The market value of the equity S in equation (6) can be treated as the Black-Scholes value of the call option written bellow. The first part is the risk-adjusted present value of the acquirer bank's assets (loans) with repayment uncertainty expressed using the standard deviation of the return. The second part is referred to the risk adjusted present value of the acquirer bank's net obligations to its initial depositors above and beyond its default-free securities. This exercise is then expressed as a spread rate defined as the difference between the open market rate and the promised deposit rate, $\delta = R - R_D$. Under these assumptions, the acquirer bank's equity market value for equation (6) can be described as:

$$\begin{aligned} S &= V(R_L, R_L^*)N(d_1) \\ &\quad - \{(1+R_D)\frac{E}{q} - (1+R)[E(1+\frac{1}{q}) - L(R_L, R_L^*)]\}e^{-\delta}N(d_2) \end{aligned} \tag{7}$$

where,

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

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

$$\hat{\sigma}^2 = \sigma_v^2 + \sigma_l^2 - 2\rho_{v,l}\sigma_v\sigma_l$$

In equation (7), $N(d_1)$ and $N(d_2)$ are the cumulative standard normal distributions. $N(d_1)$ is the risk adjustment factor of the acquirer bank's risky assets (loans) while $N(d_2)$ is the risk adjustment factor of the acquirer bank's net obligations (the difference between deposit liability payment and open market securities repayment). σ^2 is the variance with σ_v and σ_l which are the instantaneous standard deviations for the rates of return on the risky and default-free assets, respectively. $\rho_{v,l}$ is the instantaneous correlation coefficient.

The presence of economies of scope and/or cost reduction may create an incentive for specialty banks to merge and become multiple-plant-multiple-product banks. To determine the value of the combined banks in the cost-benefit acquisition framework, we assume that the combined banks are an imperfectly competitive financial intermediary that "produces" two distinct yet interrelated loans (L and L^*) in two separate "plants" (the acquirer bank and the acquired bank) and "sells" them in a market. The combined banks' two distinct yet interrelated loans have a complementary nature if, for example, a bank has an advantage in retail financial services specialization and the other has an advantage in wholesale financial services. They have the nature of substitutes if, for example, both banks have similar advantages in financial services specialization and are primarily based on the belief that possible gains can be acquired through management of these advantages. Under the circumstances, the combined banks are treated as an imperfectly competitive multiple-plant-multiple-product financial intermediary with a multiple-loan demand function.

$$M = M(L(R_L, R_L^*), L^*(R_L, R_L^*)) , \quad \frac{\partial M}{\partial L} > 0 , \quad \frac{\partial M}{\partial L^*} > 0 \tag{8}$$

The combined banks have $D + D^*$ in deposits and $E + E^*$ in equity capital. Performing the acquisition activity under the capital requirement regulation, $E + E^*$ is assumed to be tied by the same fixed proportion q of $D + D^*$ as that of D or D^* if operated separately. Thus, when the capital constraint is binding, the combined banks' liquidity constraint is

$$M + (B + B^*) = (E + E^*) + (D + D^*) = (E + E^*)(1 + \frac{1}{q}) \tag{9}$$

The combined loanable funds are also 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, the value of the combined banks' risky assets is

$$W(L(R_L, R_L^*), L^*(R_L, R_L^*)) \begin{cases} = (1 + R_L)L(R_L, R_L^*) \\ \quad + (1 + R_L^*)L^*(R_L, R_L^*) & \text{without loan losses} \\ \\ < (1 + R_L)L(R_L, R_L^*) \\ \quad + (1 + R_L^*)L^*(R_L, R_L^*) & \text{with loan losses} \end{cases} \tag{10}$$

The value of the combined banks' earning-asset portfolios composed of the loan repayments and promised security repayments at the end of the period is

$$H = W(L(R_L, R_L^*), L^*(R_L, R_L^*))$$
$$+ (1+R)[(E+E^*)(1+\frac{1}{q}) - M(L(R_L, R_L^*), L^*(R_L, R_L^*))] \tag{11}$$

The value of the deposit liabilities at the end of the period is given using

$$K = \begin{cases} \dfrac{(1+R_D)(E+E^*)}{q} & \text{If solvency} \quad (H > K) \\ H & \text{If insolvency} \quad (H \le K) \end{cases} \tag{12}$$

The value of the combined banks' equity at the end of the period is

$$S_{1\&2} = \begin{cases} H - K & \text{If solvency} \quad (H > K) \\ 0 & \text{If insolvency} \quad (H \le K) \end{cases} \tag{13}$$

Computing the acquisition analysis, the combined banks' Black-Scholes call option value can be expressed as

$$S_{1\&2} = W(L(R_L, R_L^*), L^*(R_L, R_L^*))N(a_1)$$

$$- \{\frac{(1+R_D)(E+E^*)}{q} - (1+R)[(E+E^*)(1+\frac{1}{q})$$

$$- M(L(R_L, R_L^*), L^*(R_L, R_L^*))]\}e^{-«}N(a_2) \qquad (14)$$

where,

$$a_1 = \frac{1}{\pm_M^{\wedge}}\{[\ln \frac{W}{\frac{(1+R_D)(E+E^*)}{q} - (1+R)[(E+E^*)(1+\frac{1}{q}) - M]}] + « + \frac{1}{2}\pm_M^{\wedge 2}\}$$

$$a_2 = a_1 - \pm_M^{\wedge}$$

$$\pm_M^{\wedge 2} = \pm_{\nu M}^2 + \pm_{1M}^2 - 2\,°_{\nu M,1M}\pm_{\nu M}\pm_{1M}$$

In equation (14), $N(a_1)$ and $N(a_2)$, the cumulative standard normal distributions, are the risk adjustment factors of the present value of the combined banks' assets and net obligations, respectively. $\pm_M^{\wedge 2}$ is the variance with $\pm_{\nu M}$ and $\pm_{1M}$, i.e. the instantaneous standard deviation of the rates of return on the risky and default-free assets, respectively. $°_{\nu M,1M}$ is the instantaneous correlation coefficient.

The net gain from the strategic acquisition investment to the acquirer bank can be calculated with equations (7) and (14) by utilizing the cost-benefit framework discussed in the previous section. The acquirer bank should merge with the acquired bank if the benefit exceeds the cost, that is,

$$I = \bar{S}_{1\&2} - S > 0 \qquad (15)$$

Thus, the acquirer bank's net gain from the acquisition under the stock transaction is positive if the present value of the combined banks owned by the acquirer bank's shareholders is greater than the present value of the acquirer bank operating individually. This limitation provides an alternative insight for the acquirer bank's acquisition decision.[7]

4. Equilibrium and Comparative Statics

The acquirer bank's objective in the strategic acquisition is to set R_L as well as R_L^* in order to maximize the net gain.[8] Partially differentiating equation (15) with respect to R_L and R_L^*, the first-order conditions are given by

$$\begin{aligned}\frac{\partial I}{\partial R_L} = {} & -[(\frac{\partial W}{\partial L}\frac{\partial L}{\partial R_L}+\frac{\partial W}{\partial L^*}\frac{\partial L^*}{\partial R_L})N(a_1) \\ & -(1+R)(\frac{\partial M}{\partial L}\frac{\partial L}{\partial R_L}+\frac{\partial M}{\partial L^*}\frac{\partial L^*}{\partial R_L})e^{-\text{«}}N(a_2)] \\ & -[(\frac{\partial V}{\partial R_L}+\frac{\partial V}{\partial R_L^*}\frac{\partial R_L^*}{\partial R_L})N(d_1)-(1+R)(\frac{\partial L}{\partial R_L}+\frac{\partial L}{\partial R_L^*}\frac{\partial R_L^*}{\partial R_L})e^{-\text{«}}N(d_2)]=0 \end{aligned} \qquad (16\text{-}1)$$

$$\begin{aligned}\frac{\partial I}{\partial R_L^*} = {} & -[(\frac{\partial W}{\partial L}\frac{\partial L}{\partial R_L^*}+\frac{\partial W}{\partial L^*}\frac{\partial L^*}{\partial R_L^*})N(a_1) \\ & -(1+R)(\frac{\partial M}{\partial L}\frac{\partial L}{\partial R_L^*}+\frac{\partial M}{\partial L^*}\frac{\partial L^*}{\partial R_L})e^{-\text{«}}N(a_2)] \\ & -[(\frac{\partial V}{\partial R_L^*}+\frac{\partial V}{\partial R_L}\frac{\partial R_L}{\partial R_L^*})N(d_1)-(1+R)(\frac{\partial L}{\partial R_L^*}+\frac{\partial L}{\partial R_L}\frac{\partial R_L}{\partial R_L^*})e^{-\text{«}}N(d_2)]=0 \end{aligned} \qquad (16\text{-}2)$$

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[7] According to Rose's (1987) empirical study, the acquired bank is significantly more profitable compared to the acquirer bank in returns earned for stockholders. Rose's findings may discourage the acquirer bank from conducing the acquisition. Thus, it is not surprising if the acquirer bank cannot resist the temptation to look into the performance consideration. The target function of equation (15) in this model provides a useful tool for the acquirer bank's acquisition decision.

[8] Acquisition is an investment issue and loan-rate setting is a competition issue of the banking industry. In managing value, a bank needs a strategy for competing in the market and a strategy for corporate control. The objective of this paper is managing value using the loan-rate-setting acquirer bank to maximize the net gain from acquisition. Rather than emphasizing the management of loan-rate-setting, for the purpose of simplicity, we assumed that variances in the risky loans are unaffected by changes in the loan rate.

Note that the conjectural variations if operating together do not exist because the combined banks produce their own loans in different "plants" even though the combined banks are imperfectly competitive. The first-order conditions in equations (16-1) and (16-2) determine the optimal loan rates; accordingly, the earning-asset portfolios. Equation (16-1) implies that the acquirer bank sets its optimal loan rate, R_L, at the point where the proportion of the combined banks owned by the acquirer bank's shareholders, ¯, multiplied by the marginal equity value of R_L of the combined banks equals the "own" marginal equity value of R_L of the acquirer bank if operating individually. Equation (16-2) implies that the acquirer bank set its optimal loan rate, R_L^*, at the point where the proportion ¯ multiplied by the marginal equity value of R_L^* of the combined banks equals the "cross" marginal equity value of R_L^* of the acquirer bank if operating individually. Based on rather general assumptions, it is reasonable to believe that the marginal equity value of R_L is greater than the cross marginal equity value of R_L^* at least in the short run. Accordingly, the marginal equity value of R_L of the combined banks is expected to exceed that of R_L^* of the combined banks. This result is intuitive because the combined banks may have comparative advantages to conduct R_L rather than R_L^* since the combined banks are in general managed by the acquirer rather than the acquired bank.

To analyze the comparative statics derived from equation (16-1) and (16-2), we require that the second-order and the stability conditions be satisfied. They are

$$a \equiv \frac{\partial^2 I}{\partial R_L^2}\frac{\partial^2 I}{\partial R_L^{*2}} - \frac{\partial^2 I}{\partial R_L \partial R_L^*}\frac{\partial^2 I}{\partial R_L^* \partial R_L} > 0$$

$$\frac{\partial^2 I}{\partial R_L^2} < 0, \quad \frac{\partial^2 I}{\partial R_L^{*2}} < 0$$

The assumption $\partial^2 I / \partial R_L^2 < 0$ ($\partial^2 I / \partial R_L^{*2}$) shows that the acquirer bank's marginal net gain value of R_L (R_L^*) from the acquisition must fall when R_L (R_L^*) is set increasingly. Because both optimal loan rates are simultaneously determined by the acquirer bank to maximize the net gain from the acquisition, terms $\partial^2 I / \partial R_L \partial R_L^*$ and $\partial^2 I / \partial R_L^* \partial R_L$ demonstrate the acquirer bank's interactive operation between its two heterogeneous loan-rate settings. $\partial^2 I / \partial R_L \partial R_L^*$ can be represented in the following way: the change in the expected marginal equity value to the loan-rate (R_L) setting of the combined banks as influenced by the change in the other loan-rate (R_L^*) setting. By applying Bulow, Geanakoplos & Klemperper (1985), the acquirer bank believes that its own loan-rate settings of R_L and R_L^* have the nature of a strategic substitute if $\partial^2 I / \partial R_L \partial R_L^* < 0$; and a strategic complement if $\partial^2 I / \partial R_L \partial R_L^* > 0$. We further assume that $a > 0$. These assumptions insure that a unique symmetrical equilibrium exists in the acquirer bank conducting strategic substitutes or strategic complements.

A strategic substitute between two heterogeneous loans suggests that the acquirer bank increasing (decreasing) its loan rate setting (R_L) is the best response when it decides to decrease (increase) its other loan rate (R_L^*). The best response when the acquirer decides to increase (decrease) its other loan rate (R_L^*) as it increases (decrease) its loan rate setting (R_L) is a strategic complement. Rather than emphasizing a bank and its rival's competitive strategy in Bulow, Geanakoplos & Klemperper's sense, this paper expresses a loan's interactive strategy conducted by the acquirer bank to maximize the net gain from the acquisition. A bank acquisition can be viewed as a corporate-control transaction. A bank needs strategies for operating and competing in the market for corporate control. It is assumed that both loan markets faced by the acquirer bank are imperfectly competitive so that rate setting is the relevant behavioral mode not only in both markets but also in management itself. A strategic substitute/complement in this paper suggests a strategy that integrates a corporate-control transaction with the market conditions and rate-setting behavioral modes of the acquirer bank. $\partial^2 I / \partial R_L^* \partial R_L$ can be correspondingly explained as $\partial^2 I / \partial R_L \partial R_L^*$.

In this model with the net gain maximization of the strategic acquisition, the effect of changes in the proportion of the combined banks owned by the acquirer bank's shareholders $\overline{\ }$ on the acquirer bank's loan-rate setting is explored in the following:

$$\frac{dR_L}{d\overline{\ }} = -\frac{1}{a}\Big[\Big(\frac{\partial M}{\partial L}\frac{\partial L}{\partial R_L} + \frac{\partial M}{\partial L^*}\frac{\partial L^*}{\partial R_L}\Big)\frac{\partial^2 I}{\partial R_L^{*2}} - \Big(\frac{\partial M}{\partial L}\frac{\partial L}{\partial R_L^*} + \frac{\partial M}{\partial L^*}\frac{\partial L^*}{\partial R_L^*}\Big)\frac{\partial^2 I}{\partial R_L \partial R_L^*}\Big](N(a_1) - (1+R)e^{-\text{«}} N(a_2)) \quad (17)$$

An explanation of equation (17) is possible in term of: (i) product effect (substitutes or complements of the two loans), (ii) interactive operation effect (strategic substitutes or strategic complements), and (iii) risk effect (the risk adjustment factors of the combined banks' assets and net obligations). The product effect is related to the nature of the combined banks' two distinct yet interrelated loans. The interactive operation effect is related to the best responses of the combined banks' loan-rate settings in their multiple-plant-multiple-product operations. Equation (17) indicates that an increase in ¯ decreases the loan rate setting R_L only if the product effect is negative (complements), the interactive operation effect is positive (strategic complements), and the risk effect is positive (the risk adjustment factor of the assets are sufficient to cover that of the net obligations). It is reasonable to believe that the nature of the product effect determines the interactive operation effect. However, this paper illustrates that ¯ is negatively related to R_L under a possible constraint by the three effects mentioned as above. It is also possible to have the products as substitutes and yet have strategic complements if the risk effect alters.

The give-and-take of the negotiation process determines both the acquisition cost and amount paid to the acquired bank's shareholders. In the negotiation, the acquired bank tries to maximize the benefit from the acquisition (maximizing ¢ in the model) whereas the acquirer bank tries to minimize the cost (maximizing ¯). As mentioned earlier, Rose (1987) showed that the acquirer bank is significantly less profitable than the acquired bank in returns earned for shareholders. ¯ is expected to be relatively low. Under these circumstances, the acquirer bank is allowed to utilize the loan-rate-setting strategy to maximize its benefit from the acquisition.

As pointed out by Vennet (1996), an acquirer bank can raise its product prices after acquiring competitors by gaining monopoly power through horizontal mergers. Rose (1993) found that an acquirer bank that did achieve higher post-merger returns was frequently aided by increases in market concentration that resulted from its acquisition. A bank with improving post-merger returns also displayed stronger control over loan losses. Accordingly, an acquirer bank is expected to increase its product prices after acquiring competitors. A loan-rate-setting acquirer bank facing a low $\bar{\ }$ may attempt to increase its loan rate when there is a negative product effect, a positive interaction effect, and a positive risk effect. The above finding is consistent with the theory that the driving force behind acquisition is to gain market power. The synergistic benefits from combining two banks into one with reducing costs and increasing efficiency are generated not through substitution but by complementing each bank's product's strengths.[9] We argue that the portfolio-theoretic analysis of risk effect and the firm-theoretic analysis of product and interactive operation effects have an important relationship that can be used to analyze the cost-benefit analysis of an acquirer bank's acquisition decisions under uncertainty.

Consider next the impact on the acquirer bank's loan rate from a change in the capital-to-deposit ratio. The total change in R_L from a change q is given by

[9] In general, there are three types of mergers: horizontal, vertical and conglomerate mergers. Complementarity in this model may be treated as conglomerate mergers which can create or reinforce market power since both the acquirer and the acquired banks facilities tacit collusion as well as diversification.

$$\frac{dR_L}{dq} = -\frac{1}{a}\{[\bar{\ }(\frac{\partial M}{\partial L}\frac{\partial L}{\partial R_L} + \frac{\partial M}{\partial L^*}\frac{\partial L^*}{\partial R_L})G_a$$

$$-(\frac{\partial L}{\partial R_L} + \frac{\partial L}{\partial R_L^*}\frac{\partial R_L^*}{\partial R_L})G_d]\frac{\partial^2 I}{\partial R_L^{*2}}$$

$$-[\bar{\ }(\frac{\partial M}{\partial L}\frac{\partial L}{\partial R_L^*} + \frac{\partial M}{\partial L^*}\frac{\partial L^*}{\partial R_L^*})G_a$$

$$-(\frac{\partial L}{\partial R_L^*} + \frac{\partial L}{\partial R_L}\frac{\partial R_L}{\partial R_L^*})G_d]\frac{\partial^2 I}{\partial R_L \partial R_L^*}\} \tag{18}$$

where,

$$G_a = (\frac{\partial N}{\partial a_1} - (1+R)e^{-«}\frac{\partial N}{\partial a_2})\frac{\partial a_1}{\partial q}$$

$$G_d = (\frac{\partial N}{\partial d_1} - (1+R)e^{-«}\frac{\partial N}{\partial d_2})\frac{\partial d_1}{\partial q}$$

The interpretation of the result follows a similar argument as in the case of a change in $\bar{\ }$. The acquirer bank's decision for external growth through an acquisition strategy generally requires raising new capital to purchase a controlling equity interest in the acquired bank. This decision is complicated by the existing capital structures of both the acquirer and the acquired banks and by the regulatory capital requirements. Capital regulation in bank mergers and acquisitions is inevitably a regulatory intervention, the process through which the banking authorities attempt to correct a perceived unsafe or unsound banking practice. Given the concern about the intervention of capital regulation in bank mergers and acquisitions, an optimal adjustment on the acquirer bank's loan-rate setting is required to maintain the net gain maximization from its strategic acquisition investment.

G_a can be viewed as a marginal risk effect of capital regulation of the multiple loans and G_d can be that of the acquirer bank's loan. We assume that G_a and

G_d are positive since the bank authority attempts to correct a perceived unsafe banking practice by increasing the capital-to-deposit ratio. The result of equation (18) is stated as follows. An increase in the capital-to-deposit ratio decreases the acquirer bank's loan-rate setting (R_L) under $\partial R_L / \partial R_L^* = 0$ (Cournot-type "adjusted variation"), the negative product effect (complements) and the positive interactive operation effect (strategic complements).[10] As the acquirer bank is regulated by an increase in the capital relative to deposit level, it must provide a return to a larger equity base in its acquisition activity. One way the acquirer bank may attempt to augment its total returns from the acquisition is by shifting its investments to its loan portfolio and away from the open market securities. If loan demand is relatively rate-elastic, a larger loan portfolio is possible at a reduced loan rate.

The interpretation of equation (18) follows Zarruk &Madura's model in the case of decreasing or constant absolute risk aversion.[11] We argue that the negative relationship between loan-rate setting and capital regulation in this paper can be explained not only by the risk effect but also the product effect and the interactive operation effect. Therefore, this paper sheds light upon risk effect (portfolio-theoretic analysis) and product and interactive operation effects (firm-theoretic analysis) in capital regulation and acquisition.

[10] Cournot-type conjectural variation as it is commonly called is usually described as a competitive behavior between firms. Rather than using the term "conjectural variation", we use "adjusted variation" since a multiple loan function, $M(L(R_L, R_L^*), L^*(R_L, R_L^*))$, of adjusting operation between loans by the acquirer bank is modeled in this paper.

[11] Zarruk & Madura (1992) examined the relationship between capital regulation and the optimal bank interest margin. This paper investigated the relationship between capital regulation and the optimal acquirer bank's loan-rate setting.

5. Conclusions

Bank acquisitions are observable forms of behavior that reflect this decision. As such, bank acquisitions offer an opportunity for observing banking motivations and behavior in detail. A microeconomic model of a loan-rate-setting bank's acquisition decision under uncertainty was proposed in this paper that focused on a contingent claim analysis. The distinguishing characteristic of this model is that loan-rate-settings, the give-and-take of the negotiation on premiums paid in acquisition and capital regulation are simultaneously incorporated into the model. Based on a realistic view of an acquirer bank's acquisition decision, it seems that the conditions listed above are important and necessary. More importantly, these considerations play an important role in determining loan-rate decisions (the firm-theoretic approach) and hence optimal loan portfolio (the portfolio-theoretic approach) in bank acquisitions using a framework based on the Black-Scholes formula.

Emphasizing the acquisition decision associated with uncertainty under loan-rate conducting behavioral modes, there are two conclusions suggested by the model in this paper. First, the acquirer bank's give-and-take negotiation result expressed by the proportion of the combined banks owned by the acquirer bank's shareholders has a direct impact on its loan rate setting with the net gain maximization in the acquisition decision. In particular, we show that a decrease in this proportion increases the acquirer bank's loan rate setting under the negative product effect, the positive interactive operation effect, as well as the positive risk effect. The above finding is consistent with the theory that the driving force behind acquisition is gaining market power. Second, we show that the capital regulation has a negative effect on the acquirer bank's loan rate setting behavioral modes under the Cournot-type adjusted variation, the nature of loan complements and the operation of loan strategic complements. A strategic option, the contemporary model presented in this paper, provides an alternative explanation for the acquirer's bank strategies for operating and competing in the market under capital regulation that goes beyond those attained through traditional bank acquisition strategies.

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