

## **Municipal bond insurance, capital regulation and optimal bank interest margin: an option-based optimization**

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### **Abstract**

Nanda and Singh (2004) explained why municipal bonds are often issued with prepackaged insurance. We further propose an option-based model that examines the relationships among municipal bonds issued with prepackaged insurance, capital insurance, and optimal bank interest margins. Under the negative(positive) elasticity effect, both the optimal loan and deposit rates are positively related to the cost of the municipal bond insurance (the capital regulation). We argue that municipal bond insurance and capital regulation can add/deduct the optimal bank interest margins (and thus bank profits). Our findings provide alternative explanations for the theoretical evidence concerning bond insurance behavior.

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*Keywords* : *Municipal bond insurance, capital-to-deposits ratio, bank interest margins.*

### **I. Introduction**

Nanda and Singh (2004) presented several statistics that illustrate some of the changes in the municipal bond market. A major development is the much more significant growth in insurance for municipal bonds, in which a third-party insurer promises to step in and make timely payments to the bondholder in the event of a default, even though defaults

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among municipal bonds have been less frequent than among corporate bonds. Nanda and Singh pointed out that municipal bond issuers sold a total of \$285 billion (per value) of tax-exempt debt in the year of 2001. This is very close to the all-time figure of \$286 billion in 1998. Of the debt sold in 2001, 46% by dollar value, was insured, 40%, 46%, and 51% in 2000, 1999, and 1998, respectively, were brought to the market in the form of insured bonds. Furthermore, municipal bonds prepackaged with insurance have increased significantly from about 3% in 1980 and 26% in 1990 to close to current levels.

Banks, if playing a role in issuing municipal bonds, are in the business of lending and borrowing money. Mercer (1992) indicated that earnings from the margin, or spread, between interest rates on assets and interest rates on liabilities typically account for more than 80% of bank profits<sup>1</sup>. As the spread is so important to bank profitability, the issue of how it is optimally determined and how it adjusts to changes in the banking environment, such as municipal bond insurance and capital-to-deposits ratio, deserve closer scrutiny.

The literature on the special insurance features of bonds, for example, municipal bond insurance, is scarce. To date, there have been relatively few defaults on insured bonds. However, default in the municipal bond market is not uncommon. Fons (1987) and Cohen (1989) provided models of bond default rate studies. Cirillo and Jessop (1993) showed that during the eighties, about 2% of the bonds were defaulted. Rather than emphasize the bond default rates, Angel (1994) proposed the potential benefits on bond insurance, such as improving diversification and liquidity. Quigly and Rubinfeld (1991), and Nathans (1992) focused on determining the magnitude of the issuer's savings from bond insurance. Nanda and Singh (2004) explained why it is attractive for municipalities to issue bonds bundled with third-party insurance.

Unlike previous formulations, the model developed here assumes a setting in which the bank is subject to prevailing bond insurance and capital regulation. Our focus stems from Collin-Dufresne and Goldstein's (2001) argument in which a firm can issue new debt, thereby increasing the risk of default. Accordingly, the demand for bond insurance potentially takes place.

Regulation designs capital-to-deposits ratios that are positively relative to the amount of risky assets held by the banks. The third-party

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<sup>1</sup>Hereafter, the terms "margin" or "spread" refer to "bank interest margin".

insurers provide insurance coverage on bonds issued by the bank, and charge risk-insensitive premiums. Comparative static results show that under the negative elasticity effect, both the optimal loan and deposit rates are increasing functions of the cost of bond insurance. In addition, under the positive elasticity effect, both the optimal loan and deposit rates are increasing functions of the capital-to-deposits ratio.

As pointed out by Nanda and Singh (2004), there are two interesting features regarding to the types of bonds issued in the bond insurance market. First, insurer-provided information suggests that relatively few of the riskiest bonds are insured. Secondly, longer maturity bonds are more likely to be insured than similar bonds of shorter maturity. We further argue that the bond insurance adds the bank's optimal interest margin since the scale of the bank is reduced as a result of higher loan rate under the negative elasticity effect. Thus, our findings provide alternative explanations for the evidence concerning bond insurance behavior.

The remaining parts of this paper are organized as follows. Section II lays out the basic model of a banking firm under the option-based valuation. Section III derives the solution of the model. In Section IV and V, the nonsimultaneous effects of bond insurance and capital regulation on optimal loan and deposit rates, respectively, are investigated. The final section concludes the paper.

## II. The basic model

We made a few sampling assumptions in order to get closed-form, tractable solutions in our model. We consider a single-period model for a banking firm. Our model is myopic in the sense that all economic decisions are made and values are determined with a one-period horizon only. The model implies that the bank's capital structure is changed at the beginning of each period based on the past performance of its asset portfolio and its future prospects. Deposits are renewed and bonds are issued on the status of the bank at that time. Although the focus of this paper is on one period valuation, our model is, however, multiperiodic and dynamic in nature.

In our model, it is assumed that the bank acquires one kind of homogeneous loans ( $L$ ) as the only form of earning asset. The bank holds three types of claims: deposits ( $D$ ), tax-exempt municipal bonds ( $B$ ), and equity capital ( $K$ ). The balance sheet constraint can be written as:

$$L = D + B + K. \quad (1)$$

The model abstracts from legal reserve requirements and equity capital is assumed fixed throughout the decision period<sup>2</sup>. Following Wong (1997), we assume that the bank is a loan rate setter and loan demand faced by the bank is a downward-sloping function of loan rate,  $R_L$ . That is  $L = L(R_L)$ ,  $\partial L/\partial R_L < 0$ . The above assumption implies that the bank can exercise some monopoly power in the loan market. Empirical evidence by Hancock (1986) supports the presence of rate-setting behavioral modes in the loan markets. We argue that rate-setting behavior is appealing to banks whose loan portfolios are concentrated in particular industries and geographic areas. Our model based on this argument is directly valid for financial institutions, such as large money-center banks, with mainly agricultural, real estate, and oil-related loans.

The bank is also assumed to be a rate setter in the deposit market. Deposit supply is known upward-sloping function of the rate on deposits,  $R_D$ . The assumption of an upward-sloping deposit supply has been used in a number of models of the banking firm<sup>3</sup>. Empirical evidence that supports deposit rate-setting behavior by banks has been provided by Slovin and Sushka (1983). In addition to deposit supplies, bonds issued by the bank are also assumed to enter the model. Following Nanda and Singh (2004), the bank is assumed to operate in a perfectly competitive bond market so that the interest rate on bonds  $R$  is given. The supply of deposits is assumed to be a negative function of bond market rate. Thus, the deposit supply function can be stated for the bank as  $D = D(R_D, R)$ ,  $\partial D/\partial R_D > 0$  and  $\partial D/\partial R < 0$ .

At the start of the period, the bank issues  $B$  dollars of risky municipal bond, which is packaged with the third-party insurance with an insurance premium of  $P$  per dollar of bonds<sup>4</sup>. We assume that there is no private information that the bank is better than investors (bondholders) at monitoring or valuing the bonds to be insured. The bank provides bondholders with a rate of return equal to the market risk-free rate  $R$ . Equity capital held by the bank is tied by regulation to be a fixed proportion ( $q$ ) of the bank's deposits  $K \geq qD$ . The required regulatory ratio  $q$  is assumed to be an increasing function of the number of loans contracted by the bank at

<sup>2</sup>The inclusion of legal reserve requirements complicates the structure of our model without significantly changing the results of our model.

<sup>3</sup>For example, see Sealey (1980), Slovin and Sushka (1983), and Zarruk (1989).

<sup>4</sup>As pointed out by Nanda and Singh (2004, p. 2255), the bulk of municipal bond insurance is provided by four AAA-rate insurers. They are Ambac Assurance Corp., MBIA Insurance Corp., Financial Guaranty Insurance Co. and Financial Security Assurance.

the beginning of the period,  $\partial q/\partial L > 0$ .

The initial loanable funds are invested in risky loans with an unspecified maturity greater than one period. At any time during the period horizon, the value of the bank's risky assets is:

$$V(R_L) \begin{cases} = (1 + R_L)L(R_L) = V^0 & \text{if no loan losses,} \\ < V^0 & \text{if loan losses.} \end{cases} \quad (2)$$

The bank exposes itself to risk since it funds fixed-rate investments via variable-rate deposits. The bank is also insured by the *Federal Deposit Insurance Corporation* (FDIC), and for purpose of simplicity, it pays a zero insurance premium per dollar of deposit. It should be apparent in which follows that this abstraction does not affect the basic conclusions of our model. The bank's total costs ( $Z$ ) in our model are the deposit repayment, bond repayment, and bond insurance costs. That is:

$$Z = (1 + R_D)D(R_D, R) + (1 + R + P)B.$$

At the end of the period, an audit takes place to determine the bank's total lendings and costs, and assesses its current market value. The bank first pays its bondholders if its total assets are sufficient; otherwise, the third-party insurers pay out the rest. In addition, if the value of the bank's total assets after paying its municipal bonds is less than its total deposit payments, the FDIC pays out  $(Z - (1 + R)B - V)$ . Otherwise, the equity holders who retain any residual pay the deposits. Thus, the residual value of the bank after meeting all of its debts is the value of the bank's equity capital at the end of the period. That is  $S = \max\{0, V - Z\}$ . We assume that the administrative costs and the fixed cost are omitted for simplicity. This assumption is frequently used in the literature<sup>5</sup>.

The bank's objective is to set its loan and deposit rates to maximize the market value of the Black-Scholes' (1973) function defined in terms of its profit or equity capital. Santomero (1984) noted that the choice of an appropriate goal in modeling the bank's optimization problem remains a controversial issue. In our model, we analyze the lending and borrowing decisions by setting loan and deposit rates for the bank. To highlight the role of bank investment and liquidity management with packing bond insurance, we assume that those decisions are based on the bank's utility-free and market-value equity maximization.

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<sup>5</sup>See, for example, Slovin and Sushka (1983).

The selection of our model's objective function follows Merton (1974). It is derived in the spirit of Merton's approach to evaluate the bank using a contingent claim analysis. The equity capital of the bank is viewed as a call option on the bank's risky assets net of risky municipal bonds,  $V_A$ . The reason is that equity holders are residual claimants on the bank's assets net of bonds after all other obligations have been met. The strike price of the call option is the bank value of the bank's deposit payments and bond insurance costs,  $X$ . When the value of the bank's assets net of bonds is less than the strike price, the value of equity is zero. Thus, the market value of equity capital will be given by the Black-Scholes' (1973) formula for call options:

$$\text{Max}_{R_L, R_D} S = V_A N(d_1) - X e^{-\delta} N(d_1) \quad (3)$$

where

$$\begin{aligned} V_A &= V(R_L) - (1 - R)[L(R_L) - (1 + q)D(R_D, R)], \\ X &= (1 + R_D)D((R_D, R) + P[L(R_L) - (1 - q)D(R_D, R)]), \\ d_1 &= \frac{1}{\hat{\sigma}} \left[ \ln \frac{V_A}{X} + \delta + \frac{1}{2} \hat{\sigma}^2 \right], \\ d_2 &= d_1 - \hat{\sigma}, \\ \delta &= R - R_D. \end{aligned}$$

In this objective function, the cumulative standard normal distribution of  $N(d_1)$  and  $N(d_2)$  represent the risk-adjusted factors of  $V_A$  and  $X$ , respectively. When the total lendings are only the risky loans, our model becomes similar in structure to Rubinstein's (1983), and then the volatility  $\hat{\sigma}^2$  is simply the variance of the risky loans only.  $\delta$  is the spread, the difference between the bond market rate and the promised deposit rate to the initial depositors.

### III. Solution to the model

The first-order conditions for the maximization of equity market value are:

$$\begin{aligned} & \left[ \frac{\partial V}{\partial R_L} - (1 + R) \left( 1 - D \frac{\partial q}{\partial L} \right) \frac{\partial L}{\partial R_L} \right] \\ & \times N(d_1) - P \left( 1 - D \frac{\partial q}{\partial L} \right) \frac{\partial L}{\partial R_L} e^{-\delta} N(d_2) = 0, \end{aligned} \quad (4)$$

$$(1 + R)(1 + q) \frac{\partial D}{\partial R_D} N(d_1) - \left\{ [(1 + R_D) - P(1 + q)] \frac{\partial D}{\partial R_D} - [R_D D + P(L - (1 + q)D)] \right\} e^{-\delta} N(d_2) = 0. \quad (5)$$

Equations (4) and (5) determine the optimal loan and deposit rates. In Eq. (4), the first term associated with  $N(d_1)$  represents the bank's risk-adjusted present value between the marginal loan repayments and the marginal bond payments from a change in the bank's loan rate. The second term with  $N(d_2)$  demonstrates the bank's risk-adjusted present value for marginal bond insurance payment from a change in the bank's loan rate.  $\partial V / \partial R_L$  is treated as the interest rate elasticity of loan demand evaluated at the optimal loan rate. The bank thus will operate on the elastic portion of its loan demand, just as a monopolistic firm does. A decrease in the loan rate is expected to increase the bank's derived demand for bond amount since  $\partial V / \partial R_L < 0$  and then  $\partial B / \partial R_L = [1 - (\partial q / \partial L)D](\partial L / \partial R_L) < 0$ . Thus, the first term in Eq. (4) is negative. It is reasonable to believe that the direct effect on the marginal loan repayments from a change in the bank's loan rate is sufficient to offset the indirect effect on the marginal bond payments. Intuitively, the equilibrium condition in Eq. (4) shows that the marginal risk-adjusted present value for lending revenues is equal to the marginal risk-adjusted present value for costs of issuing bonds bundled with third-party insurance.

In Eq. (5), the first term associated with  $N(d_1)$  represents the bank's risk-adjusted present for marginal bond payments from a change in its deposit rate. This marginal value is positive since the bank faces an upward-sloping deposit supply curve. The second term associated with  $N(d_2)$  demonstrates the bank's present value for marginal strike price is composed of the marginal deposit payments and the marginal bond insurance cost of deposit rate. As expected, the marginal strike price is positive. Thus, the equilibrium condition shows that the bank's risk-adjusted present value for marginal bond payments equals that for marginal deposit payments net of marginal bond insurance cost from a change in its deposit rate-setting. The condition presented above can be given an alternative interpretation. That is, the risk-adjusted marginal bond payments bundled with marginal bond insurance cost equals the risk-adjusted marginal deposit payments.

#### IV. Comparative static effects on loan rate

Having examined the solution to the bank's optimization problems, in this section we consider the effect on the bank's optimal loan rate decisions from a change in the bond insurance premium and the capital regulatory ratio when the deposit rate is fixed. These nonsimultaneous results are obtained for the following reason. Banks frequently encounter situations where loan rates must be determined in the presence of fixed deposit rate. This behavioral mode has been modeled by Zarruk and Madura (1992), and Wong (1997) among others. To determine the effect of bond insurance premium on the bank's optimal loan rate, implicitly differentiating only Eq. (4) with respect to  $P$  yields the following comparative static result:

$$\begin{aligned} \frac{\partial L}{\partial P} = & \left\{ \left( 1 - D \frac{\partial q}{\partial L} \right) \frac{\partial L}{\partial R_L} e^{-\delta} N(d_2) \right. \\ & - \left[ \frac{\partial V}{\partial R_L} - (1 + R) \left( 1 - D \frac{\partial q}{\partial R_L} \right) \frac{\partial L}{\partial R_L} \right] \\ & \left. \times \left( \frac{\partial N}{\partial d_1} - \frac{N(d_2)}{N(d_1)} \frac{\partial N}{\partial d_2} \right) \frac{\partial d_1}{\partial P} \right\} / \frac{\partial^2 S}{\partial R_L^2}. \end{aligned} \quad (6)$$

Overall, the loan and deposit rates of bank operations are dichotomized. We can assume that the second-order condition in Eq. (6),  $\partial^2 S / \partial R_L^2 < 0$ , is satisfied. Before proceeding with the analysis of the comparative static result of Eq. (6), we treat the term  $\partial N / \partial d_1 - [N(d_1) / N(d_2)] (\partial N / \partial d_2)$  as the elasticity effect. We note that the sign for the elasticity will be the same as the sign for the difference between  $(\partial N / \partial d_1) / [N(d_1) / d_1]$  and  $(\partial N / \partial d_2) / [N(d_2) / d_2]$ . The first term is the marginal ratio to the average cumulative standard normal distribution of  $d_1$ , which represents as  $V_A$  the elasticity of the risk-adjusted factor  $d_1$ . The second term  $d_2$  follows a similar argument as  $d_1$  and represents as the  $X$  elasticity of the risk-adjusted factor  $d_2$ . Both the elasticities risk-adjusted factors are positive. If the  $V_A$  elasticity is greater (less) than the  $X$  elasticity, the elasticity effect is positive (negative).

The effect on the bank's optimal loan rate decisions from a change in the bond insurance premium depend on the risk-adjusted present value for marginal bond payment from a change in the bond insurance premium,  $V_A$ , and the elasticity effect,  $\partial d_1 / \partial P$ . If the elasticity effect is negative, the loan rate is set as a positive function of the bond insurance premium, which affects loan demand but is invariant to developments in deposit markets. Intuitively, an increase in the cost of bond insurance

discourages the bank's investments. In an imperfect loan market, the bank must increase its loan rate in order to decrease the amount of loans (and thus the total loan repayments). If loan demand is relatively rate-elastic, less loan repayments are possible at an increased loan rate. To summarize, we have the following proposition.

**Proposition 1.** *If the elasticity effect is negative, then an increase in the bond insurance premium will increase the bank's optimal loan rate.*

Proposition 1 reveals that the bank passes the burden of rising insurance express to borrowers by widening the bank interest margin. This result is consistent with the findings of Wong (1997) that bank interest margins are positively related to operating (insurance) cost. Accordingly, we can argue that the bond insurance for the emergence of third-party companies adds the bank's optimal interest margin since the scale of the bank is reduced as a resulting from a higher loan rate.

A related question is to consider the impact of an increase in the required capital regulatory ratio (capital-to-deposits ratio) on the bank's optimal loan rate decisions. Implicit differentiation of Eq. (4) with respect to  $q$  yields:

$$\frac{\partial R_L}{\partial q} = - \left\{ \left[ \frac{\partial V}{\partial R_L} - (1 + R) \left( 1 - D \frac{\partial q}{\partial L} \right) \frac{\partial L}{\partial R_L} \right] \times \left( \frac{\partial N}{\partial d_1} - \frac{N(d_2)}{N(d_1)} \frac{\partial N}{\partial d_2} \right) \frac{\partial d_1}{\partial q} \right\} / \frac{\partial^2 S}{\partial R_L^2}. \quad (7)$$

The effect on the bank's optimal loan rate decisions from a change in the capital-to-deposits ratio depend on the elasticity effect since  $V_A > 0$  and  $\partial d_1 / \partial q > 0$ . If the elasticity effect is positive (negative), the loan rate is set as a positive (negative) function of the capital-to-deposits ratio. Intuitively, as the bank is forced to increase its capital relative to its deposit level, it must now provide a return to a larger equity base or a less return to an equity base. When the  $V_A$  elasticity is greater than the  $X$  elasticity (the positive elasticity effect), the bank will decrease its loan repayments at an increased loan rate. When the  $V_A$  elasticity is less than the  $X$  elasticity (the negative elasticity effect), the bank will increase its loan repayments at a reduced loan rate. Thus, we established the following proposition.

**Proposition 2.** *If the elasticity effect is positive (negative), then an increase in the capital-to-deposits ratio will increase (decrease) the bank's optimal loan rate.*

Proposition 2 implies that changes in the bank's regulatory parameter, such as capital-to-deposits ratio, have a direct effect on the bank's optimal loan rate. Zarruk and Madura (1992) argued that bank's optimal loan rate is negatively related to capital-to-deposits ratio under the decreasing absolute risk aversion while we argue that under the negative elasticity effect in our model.

## V. Comparative static effects on deposit rate

In this section, the effects of bond insurance premium and capital-to-deposits ratio on optimal deposit rates are investigated when loan rates are fixed. Although this behavioral mode is less likely to be observed than that considered in the previous section, there may be instances where banks have fixed loan rates (and thus fixed loans) and must set deposit rates. Sealey (1980), for example, considered this behavioral mode for local-oriented savings and loan associations. However, the results from this section are also needed for the dichotomized analysis mentioned in the previous section.

The implicit differentiation of Eq. (5) with respect to bond insurance premium yields:

$$\frac{\partial R_D}{\partial P} = - \left\{ \left[ (1+q) \frac{\partial D}{\partial R_D} + [L - (1+q)D] e^{-\delta} N(d_2) + (1+R) \right. \right. \\ \left. \left. \times (1+q) \frac{\partial D}{\partial R_D} \left( \frac{\partial N}{\partial d_1} - \frac{N(d_2)}{N(d_1)} \frac{\partial N}{\partial d_2} \right) \frac{\partial d_1}{\partial P} \right] \right\} / \frac{\partial^2 S}{\partial R_D^2}. \quad (8)$$

We can assume that the second-order condition in the above equation,  $\partial^2 S / \partial R_D^2 < 0$ , is satisfied since bank dichotomized operations are recognized. The effects on the bank's optimal deposit rate decisions from a change in the bond insurance premium depend on the marginal strike price from a change in the bond insurance premium (positive), the marginal bond payments from a change in its deposit rate (positive), the elasticity effect, and  $\partial d_1 / \partial P < 0$ . If the elasticity effect is positive (negative), the deposit rate is set as a negative (positive) function of the bond insurance premium, which affects deposit supply but is invariant to development in loan markets. Basically, increases in the cost of bond insurance encourage the bank to shift findings to its deposits from bonds under the negative elasticity effect. In an imperfect deposit market, the bank must increase the deposit rate in order to increase the amount of deposits. Thus, we establish the following proposition.

**Proposition 3.** *If elasticity effect is negative (positive), then an increase in the bond insurance premium will increase (decrease) the bank's optimal loan rate.*

We demonstrate that in Proposition 1, the bank passes the cost burden of rising bond insurance premiums to its borrowers by increasing its loan rate (and thus widening its interest margin) under the negative elasticity effect. Although, in Proposition 3, when the cost burden of rising bond insurance premiums takes place, the bank will reallocate its cost portfolio by decreasing the deposit rate (and thus widening the interest margin) under the positive elasticity effect. Thus, we can argue that the municipal bonds issued with prepackaged insurance encourage the bank to shift its cost portfolio from its deposits to municipal bonds at a reduced deposit rate in order to increase the interest margin.

Implicit differentiation of Eq. (5) with respect to the capital-to-deposits ratio yields:

$$\frac{\partial R_D}{\partial q} = \left\{ (1+R) \frac{\partial D}{\partial R_D} N(d_1) + PD \left( \frac{\eta}{R_D} - 1 \right) e^{-\delta} N(d_2) + (1+R) \right. \\ \left. \times (1+q) \frac{\partial D}{\partial R_D} \left( \frac{\partial N}{\partial d_1} - \frac{N(d_2)}{N(d_1)} \frac{\partial N}{\partial d_2} \right) \frac{\partial d_1}{\partial q} \right\} / \frac{\partial^2 S}{\partial R_D^2} \quad (9)$$

where  $\eta$  is the interest rate elasticity of deposit supply evaluated at the optimal deposit rate. If  $\eta > R_D$ , the term associated with  $N(d_2)$  in Eq. (9) is positive. Based on rather a general assumption, it is reasonable to believe that  $\eta$  is elastic at least in the short run. That is, the bank will operate on the elastic deposit supply curve, just as a monopsonistic firm would do.

An increase in the capital-to-deposits ratio increases the bank's deposit rate under the positive elasticity effect. The explanation of this result follows a similar argument as in the case of a change in  $q$  in Proposition 2. Basically, as the bank is forced to increase its capital relative to its deposit level, it must now a return to a larger equity base. One way the bank may attempt to maintain its constant returns is to decrease its deposit amount at an increased deposit rate, and thus decreased the bank's interest margin. We establish the following proposition.

**Proposition 4.** *An increase in the capital-to deposits ratio increases the bank's optimal deposit rate under the positive elasticity effect.*

## VI. Conclusion

In this paper, we developed a simple firm-theoretic model to study the optimal bank interest margin (i.e., the spread between the optimal loan rate and the optimal deposit rate) of a bank under the option-based valuation. We utilize the model to show how cost, regulation and risk conditions jointly determine the optimal spread decisions. The results imply that changes in the bond insurance premium and the capital-to-deposits ratio have a direct effect on the bank's optimal spread decisions.

Specifically, we find that both the optimal loan and deposit rates are positively related to the cost of bond insurance (through higher premium) under the negative elasticity effect. Our findings reveal that the bank passes the burden of issuing insurance expenses to borrowers, if the bank chooses this alternative, by widening its interest margin at an increased loan rate. If not, the bank will reallocate its funding sources by reducing its interest margin at an increased deposit rate. Insofar as such an increase in the cost of bond insurance affects the bank's optimal spread decisions, these effects are relevant considerations in any restructuring of the banking management process.

Our model also shows that both the optimal loan and deposit rates are positively related to the capital-to-deposits ratio under the positive elasticity effect. When the capital-to-deposits ratio is increased, the scale of the bank is reduced as a result of higher loan rate (and thus higher interest margin), whereas the scale of the bank is increased as a result of higher deposit rate (and thus lower interest margin) under the positive elasticity effect. Our findings provide an alternative explanation for the theoretic evidence concerning bank spread and bond insurance behavior.

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