Modeling Put-Option Margin and Default Risk When Labor Has a Voice in Bank Governance Mechanism

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Abstract: Although considerable research effort has been put toward modeling governance mechanisms for the purpose of valuing investment decisions written on them, little attention has been paid to the effects of governance mechanisms by labor voice on bank operations management. Like entrenched operations management, entrenched labor cannot be gotten rid of easily. This paper demonstrates how labor voice determines the optimal bank interest margin and default risk decisions. Our model is based on a regime giving corporate governance power to current labor and then labor's objective is equivalent to minimizing the equity value of the put option. We show that the governance voice pushes bank interest margin determination toward shareholder value maximization. However, an opportunity cost of bank governance from listening labor voice is increasing the bank's default risk in equity returns.

Keywords: Bank Interest Margin, Default Risk, Labor Voice, Put Option

1 Introduction

Governance mechanisms modeling have gains increasing prominence over the years. [1] Basically, two broad categories have been classified in the literature to model firm-level governance mechanisms, internal and external ones. Block holders and the board of directors are often seen as the primary internal monitoring mechanism, while takeovers and the market for corporate control are the primary external mechanism.[2]

An alternative legal regime gives corporate governance power to current labor for internal monitoring purposes. For example, German corporate governance law goes far in this direction for its codetermination rules grant half the seats on corporate supervisory boards to employee representatives (Faleye, Mehrotra, and Morck, 2006). Further, employee-owned equity blocks are commonplace, which can translate into a significant tier of employee-owned stock in many large, publicly traded companies and give employees a substantial voice in operation decisions through governance

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[1] For a survey on corporate governance, see Shleifer and Vishny (1997). Also, see Cremers and Nair (2005) for governance mechanisms and equity valuation.

[2] For evidence on monitoring role, see Kaplan and Minton (1994) and Kang and Shivdasani (1995). For evidence on external mechanism, see Jensen (1993).

of such firms. However, there has been little evidence documenting the consequences of bank governance by labor voice in the interest margination determination. For internal operation purposes, this paper attempts to provide a better understanding of how labor voice affects the optimal interest margin and its associated default risk decisions.

In their paper on "When Labor Has a Voice in Corporate Governance," Faleye, Mehrotra, and Morck (2006) show that labor-controlled publicly traded firms deviate more from equity value maximization, invest less in the long-term assets, and take fewer risks. Furthermore, they propose that labor uses its corporate governance voice to maximize the combined value of its contractual and residual claims, and that this often pushes corporate policies away from, rather than toward, shareholder value maximization. The principal advantage of their approach explains why labor-controlled firms are allowed to make their corporate governance voice decisions, but not their own operating (price and output) decisions, which may not be consistent with banking firm literature. If the assumption of perfectly competitive markets is made, their approach would be appropriate. This assumption may be not applicable to loan markets faced by, for example, money-center banks since such markets are always highly geographically concentrated where the banks set their own loan rates (prices) and face random loan levels (see Baltensperger, 1980; Wong, 1997; Kashyap, Rajan, and Stein, 2002). The argument of this assumption is crucial to not only loan market structures but also bank operations management. The rational is that labor voice creates an entrenched workforce with bank governance power. Entrenched labor, like entrenched bank operations management, can distort value as it strives to maximize its benefit. Moreover, like entrenched management, entrenched labor cannot be gotten rid of easily. This is a dark side from labor voice as argued by Jensen and Meckling (1979). In other words, we still know very little about how bank governance from labor voice affects interest margin and related default risk determinations.

The purpose of this paper is to address precisely this question. Instead of relying on interest rate taking from a perfectly competitive loan market, we analyze bank governance from labor voice taking into account interest rate-setting behavior. Bank interest margin and its associated default risk are nonlinear functions of bank governance from labor voice. They are calculated using the contingent claims methodology of Black and Scholes (1973) and Merton (1974). We find that bank governance from high labor voice earns high margin and sequentially high default risk. Inconsistent with Faleye, Mehrotra, and Morck (2006), this paper argues that bank governance from high labor voice pushes interest margin determination toward shareholder value maximization. The opportunity cost of high labor voice makes the bank take high risks in its equity returns.[3] In this regard, our model should be viewed as confirmations of Baltensperger (1980) that results derived from our price setting model do not extend to the case of Faleye, Mehrotra, and Morck (2006) when the bank is a price taker in the loan

[3] Labor voice is the explicit treatment of the put-option pricing valuation in our paper. In bank operations management with labor voice governance, the earning-asset portfolio reallocation is inevitable. Results to be derived from our model do not extend to the case where the default-free asset is the swapped high-yield bond (see Lee and Cheng, 2008). Further, the borrower acceptance in risky lending is not explicitly taken into account in our paper Asosheha, Bagherpour, and Yahyapour, 2008). Our results do not extend to this particular case either.

market, and of Jensen and Meckling (1979) that results derived from our entrenched management do not extend to the case when entrenched labor is gotten risk of.

This paper is organized as follows. The following section develops the basic structure of the model. Selection III derives the solution of the model and the comparative static analysis. The final section concludes the paper.

2 The Model

A. Concept

The model is designed to capture in a minimalist fashion the following characteristics of a bank with labor voice governance.

First, the bank's role is to provide partial funds to its customers on demand in an imperfectly competitive loan market.

Second, employee equity block holdings of the bank create an entrenched workforce with bank governance power. Like entrenched management in lending activities, entrenched labor cannot be ignored. This labor governance is associated with significantly depressed risk-taking since loans are long-term and risky because they are subject to non-performance.

Third, in general, labor does not gain bank control rights without acquiring an equity stake, for example, in the United States (see Faleye, Mehrotra, and Morck, 2006). However, if other shareholders' stakes are small, as is often the case in large U.S. banking firms, equity ownership might give labor a bank governance voice out of proportion to equity block holding. For simplicity, labor equity holding of the bank is ignored.

Four, as long as the bank's value exceeds the value of labor's claim in bankruptcy, the value of labor's earnings (contractual claims) is invariant to bank value.

Fifth, we apply Black and Scholes' (1973), Merton's (1974) models by explicitly linking the risk of the bank's default process to the variability in the bank's loan value and viewing the market value of the bank's equity as the put option on the market value of the bank's loans with strike price equal to the net promised payment of bank liabilities for labor's objective. We propose to incorporate a labor voice in bank governance on the market value of the bank's loan asset for triggering default only at maturity.[4] As a result, the put option is proposed to model the bank's equity value (which labor seeks to minimize), and the default can be calculated from the put option pricing model.

B. Framework

We consider a single-period ($t \in [0, 1]$) put option model of a banking firm. At $t = 0$, the bank accepts D dollars of deposits and provides depositors with a rate of return equal to riskless market rate R_D . Equity capital K held by the bank is assumed to be tied by regulation to be a fixed proportion q of the bank's deposits; that is $K \geq qD$. The required capital-to-deposits ratio q is assumed to be an increasing function of the amount of the loans L held by the bank at $t = 0$, $\partial q / \partial L = q' > 0$ (see Zarruk and Madura, 1992).

[4] Black and Cox (1976), Brochman and Turtle (2003), and Chou and Wang (2007) point out one possible weakness of this approach used in our model that default only occurs at maturity of the debt. They propose to incorporate a barrier on the market value of firms' asset for triggering default prior to the maturity. As a result, the down-and-out option is proposed to model the firm's equity value, and the default risk can be formulated from the down-and-out option pricing model. Of course, the down-and-out approach can be applied to our setting. However this alternative is not addressed here. What this paper does demonstrate is the important role played by labor voice in affecting bank governance under the put-option-based equity valuation.

The bank can hold an amount B of liquid assets, for example, central bank reserves or Treasury bills, on its balance sheet during the period horizon. These assets earn the security-market interest rate of R. In addition to liquid assets, the bank can also make term loans L at $t=0$ which mature and are paid off at $t=1$. The interest rate on these loans is R_L. We assume that the bank has some market power in lending (see Wong, 1997; Cosimano and McDonald, 1998), which implies that $\partial L/\partial R_L<0$. Loan demand faced by the bank is a downward-sloping function of the loan rate. In addition to loan rate, loan demand is also a function of the bank governance degree α where equity ownership gives labor both a fractional stake in the bank's residual cash flows and a voice in corporate governance.[5] Faleye, Mehrotra, and Morck (2006) argue that a long-standing labor voice in corporate governance is associated with significantly depressed long-term investment and risk taking. Using their argument, we can assume $\partial L/\partial\alpha<0$ since loans are long-term and risky because they are subject to non-performance. Thus, the demand for loans can be expressed as:

$$L=L(R_L,\alpha)\ \frac{\partial L}{\partial R_L}<0,\ \frac{\partial L}{\partial\alpha}<0 \qquad (1)$$

The value of the bank's equity returns at $t=1$ is the residual value of the bank after meeting all of the obligations:

$$S=\max[0,(1+R_L)L+(1+R)B-(1+R_D)D-C(L)] \qquad (2)$$

s.t.

$$L+B=D+K=K(\frac{1}{q}+1)$$

where $C(L)$ is the administrative cost of loans $\partial C/\partial L>0$. The administrative cost of deposits and the fixed costs are omitted for simplicity because adding this complexity affects none of the qualitative results. The balance sheet constraint of equation (2) captures the bank's operations management in lending since the total assets on the left-hand side are financed by demandable deposits and equity capital on the right-hand side.

C. Labor objective

Santomero (1984) points out that the choice of an appropriate goal in modeling the bank's optimization problem remains a controversial issue. The selection of our model's objective function follows the conceptual framework of Faleye, Mehrotra, and Morck's (2006). They argue that current labor rationally uses its voice to maximize the value of its equity stake plus the present value of expected contractual wages and benefits. Alternatively, as noted earlier, we argue that as long as the bank's current market value exceeds the value of the labor's claim in bankruptcy, the value of the labor's wages is invariant to bank value. In other words, if the bankruptcy is unlikely, employees are usually contractual claimants, who receive a fixed wage and need no voice in corporate governance. Under our argument, labor's objective is equivalent to minimizing the value of the put option. Specifically, applying Black and Scholes (1973) and Merton (1974), the value of the labor's objective P can be viewed in terms of a non-exotic put option written on the underlying risky assets of the bank. According to this framework, the value of P is identical to the price

[5] Morck, Shleifer, and Vishny (1998), and Faleye, Mehrotra, and Morck (2006) argue that labor equity ownership might lead to labor gaining a controlling voice in corporate governance for a small share of a firm's residual cash flows.

of a put option on the bank's loan repayments V with exercise price Z equal to the promised payments to the depositors and the administrative costs net of the liquid-asset repayments. We note that the labor's wage claim can be treated as a part of the administrative costs in our model.

As noted earlier, the bank has two operations management opportunities: one instantaneously risky and the other riskless. The vector of instantaneous net returns on the two opportunities follows the dynamics:[6]

$$\begin{pmatrix} dV = \mu V dt + \sigma V dW \\ dZ = \delta Z dt \end{pmatrix} \tag{3}$$

where

$$V = (1 + R_L)L$$

$$Z = [\frac{(1+R_D)K}{q} + C(L)] - (1+R)[K(\frac{1}{q}+1) - L]$$

$$\delta = R - R_D$$

In vector (2), V follows a geometric Brownian motion with an instantaneous drift coefficients $\mu \equiv (\mu_1, \mu_2)$ and an instantaneous volatility matrix $\sigma \equiv \{\sigma_{ij}, i = 0,1; j = 0,1\}$ where the subscripts indicate the bank's operation opportunities. W is a standard Wiener process. δ is the riskless spread rate between R and R_D.

In a risk-neutral state, the expected P value of the put option at $t = 1$ (maturity) is defined as $\hat{P}[\min(Z - V), 0]$. From the risk-neutral valuation argument, the put option price, P, is the value of the discounted at the spread of δ; that is, $P = e^{-\delta}\hat{P}[\min(Z - V), 0]$, where $\ln V$ has the probability distribution of the form: $\ln V \sim \phi(\ln V + (\delta - (\sigma^2/2)), \sigma)$. $\phi(\cdot)$ denotes a normal distribution with mean $\ln V + (\delta - (\sigma^2/2)$ and standard deviation σ.

Evaluating $e^{-\delta}\hat{P}[\min(Z - V), 0]$ is an application of integral calculus. With this approach, the labor's objective of the bank can be explicitly expressed as:

$$\underset{R_L}{Min}\, P = Ze^{-\delta}N(-d_2) - VN(-d_1) \tag{4}$$

where

$$d_1 = \frac{1}{\sigma}(\ln\frac{V}{Z} + \delta + \frac{1}{2}\sigma^2)$$

$$d_2 = d_1 - \sigma$$

$N(\cdot)$ = the cumulative density function of the standard normal distribution

The bank minimizes the market value of P by setting the optimal loan rate. The function $P(\cdot)$ is assumed twice continuously differentiable, strictly convex, and to satisfy the Inada conditions, $\lim_{X\to 0} P'(x) = 0$ and $\lim_{X\to\infty} P'(x) = \infty$. A convex objective function renders our analysis widely applicable as it allows us to represent the objective function of any option-based contingent-claim-minimizing agent (as in, e.g., Mullins and Pyle, 1994; Vassalou and Xing, 2004).

Additionally, using information about equation (4), we can further apply Vassalou and Xing (2004) and define the default probability of the bank as follows. The default probability is the probability that the bank's risky assets

[6] Labor strike is one of the possible corporate governance mechanisms by labor voice. If this is the case, the market values of V follows a geometric Brownian motion with fat-tail distribution. See, for example, Lin, Lin, and Jou (2009) for structural fat-tail breaks. Alternatively, see Agliari, Gardini, Gatti, and Gallegati (2000) for dynamic dispersion distribution; Villarroel (2006) for time-dependent variance; Gontis, Ruseckas, and Kononovičius (2010); Power and Turvey (2010) for long-range memory in volatility. Such concerns about nonlinear, discontinuous dynamics are beyond the scope of this paper and so are not addressed here.

will be less than the book value of the bank's net obligations. In other words,

$$\begin{aligned} &P_{def}(t=0) \\ &= prob(V(t=1) \le Z(t=0) \mid V(t=0)) \\ &\qquad = prob(\ln V(t=1) \\ &\qquad \le \ln Z(t=0) \mid V(t=0)) \end{aligned} \tag{5}$$

Since the value of the loan repayments follow the geometric Brownian motion of vector (3), the value of the loan repayments at $t \in [0, 1]$ is given by:

$$\begin{aligned} &\ln V(t=1) \\ &= \ln V(t=0) + (\mu - \frac{\sigma^2}{2}) + \sigma\varepsilon(t=1) \end{aligned} \tag{6}$$

where

$\varepsilon(t=1) = W(t=1) - W(t=0) \sim N(0,1)$

Therefore, we can rewrite the default probability as follows:

$$\begin{aligned} &P_{def}(t=0) \\ &= prob(\ln V(t=0) \\ &\quad - \ln Z(t=0) + (\mu - \frac{\sigma^2}{2}) + \sigma\varepsilon(t=1) \le 0) \\ &= prob(-\frac{\ln(\frac{V(t=0)}{Z(t=0)}) + (\mu - \frac{\sigma^2}{2})}{\sigma} \\ &\quad \ge \varepsilon(t=1)) \\ &= prob(-\frac{\ln(\frac{V}{Z}) + (\mu - \frac{\sigma^2}{2})}{\sigma} \\ &\quad \ge \varepsilon(t=1)) \end{aligned} \tag{7}$$

We can define the distance to default d_3 as follows:

$$d_3 = \frac{1}{\sigma}(\ln\frac{V}{Z} + (\mu - \frac{1}{2}\sigma^2)) \tag{8}$$

d_3 takes place when the ratio of V and Z is less than 1, or its log is negative. The d_3 tells us by how many standard deviations the log of this ratio needs to deviate from its mean in order for default to occur. Notice that although the value of the put option in equation (4) does not depend on μ, d_3 does. This is because d_3 depends on the future value of loan repayments which is given in d_1 and d_2 in equation (4).

We use the theoretical distribution implied by Merton's (1974) model, which is the normal distribution. In that case, the theoretical probability of default can be expressed as:[7]

$$\begin{aligned} P_{def} &= N(-d_3) \\ &= N(-\frac{\ln(\frac{V}{Z}) + (\mu - \frac{1}{2}\sigma^2)}{\sigma}) \end{aligned} \tag{9}$$

3 Solution and Results

A. Equilibrium

Partially differentiating equation (4) with respect to R_L, the first order condition is given by

$$\begin{aligned} \frac{\partial P}{\partial R_L} &= \frac{\partial Z}{\partial R_L} e^{-\delta} N(-d_2) - Z e^{-\delta} \frac{\partial N(d_2)}{\partial d_2} \frac{\partial d_2}{\partial R_L} \\ &\quad - \frac{\partial V}{\partial R_L} N(-d_1) + V \frac{\partial N(d_1)}{\partial d_1} \frac{\partial d_1}{\partial R_L} \\ &= 0 \end{aligned} \tag{10}$$

To simplify equilibrium condition (10), we state

$$\begin{aligned} d_2^2 &= d_1^2 + \sigma^2 - 2d_1\sigma \\ &= d_1^2 - 2(\ln\frac{V}{Z} + \delta) \end{aligned} \tag{11}$$

Further, we follow Hull (1993) and use the following numerical procedures to calculate $N(d_2)$. One such

[7] Lin, Chang, and Lin (2009) develop a default risk model of a bank with exactly this structure.

approximation is

$$N(d_2) = 1 - (b_1 k + b_2 k^2 + b_3 k^3)\frac{\partial N(d_2)}{\partial d_2} \qquad (12)$$

where

$k = 1/(1 + 0.33267 d_2)$

$a_1 = 0.436183$, $a_2 = -0.1201676$, $a_3 = 0.937280$

$$\frac{\partial N(d_2)}{\partial d_2} = \frac{1}{\sqrt{2\pi}} e^{(-d_2^2/2)}$$

We note that $\partial N(d_2)/\partial d_2 > 0$. Further, imposing conditions (11) and (12), $\partial N(d_2)/\partial d_2$ can be restated as:

$$\frac{\partial N(d_2)}{\partial d_2} = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}(d_1^2 - 2(\ln\frac{V}{Z} + \delta))} = \frac{\partial N(d_1)}{\partial d_1}\frac{V}{Ze^{-\delta}} \qquad (13)$$

Using the conditions above, we can have

$$Ze^{-\delta}\frac{\partial N(d_2)}{\partial d_2}\frac{\partial d_2}{\partial R_L} = V\frac{\partial N(d_1)}{\partial d_1}\frac{\partial d_1}{\partial R_L} \qquad (14)$$

where

$$\frac{\partial d_1}{\partial R_L} = \frac{\partial d_2}{\partial R_L}$$

Accordingly, equilibrium condition (10) can be simplified as:

$$\frac{\partial P}{\partial R_L} = \frac{\partial Z}{\partial R_L} e^{-\delta} N(-d_2) - \frac{\partial V}{\partial R_L} N(-d_1) = 0 \qquad (15)$$

where

$$\frac{\partial Z}{\partial R_L} = [\frac{(R - R_D)Kq'}{q^2} + \frac{\partial C}{\partial L} + (1 + R)]\frac{\partial L}{\partial R_L} < 0$$

$$\frac{\partial V}{\partial R_L} = L(1 + R_L)\frac{\partial L}{\partial R_L} < 0$$

The second order condition for a minimum of equation (15) is $\partial^2 P/\partial R_L^2 > 0$. The term $(\partial Z/\partial R_L)e^{-\delta}N(-d_2)$ is negative in sign, which is defined as the risk-adjusted present value for the marginal liability payments of loan rate, and the term $(\partial V/\partial R_L)N(-d_1)$ is also negative in sign, which is defined as the risk-adjusted present value for the marginal loan repayments of loan rate. Equation (15) implies that the bank sets its optimal loan rate at the point where both the risk-adjusted present values are equal. We further substitute the optimal loan rate to obtain the default probability in equation (9) staying on the minimum optimization.

B.Iimpact on loan rate

Consider next the impact on the bank's loan rate (and thus on the bank's interest margin) from changes in the corporate governance degree. Implicit differentiation of equation (15) with respect to α yields:

$$\frac{\partial R_L}{\partial \alpha} = -\frac{\partial^2 P}{\partial R_L \partial \alpha} / \frac{\partial^2 P}{\partial R_L^2} \qquad (16)$$

where

$$\frac{\partial^2 P}{\partial R_L \partial \alpha} = [\frac{\partial^2 Z}{\partial R_L \partial \alpha} e^{-\delta} N(-d_2) - \frac{\partial^2 V}{\partial R_L \partial \alpha} N(-d_1)] + [\frac{\partial Z}{\partial R_L} e^{-\delta}\frac{\partial N(-d_2)}{\partial(-d_2)}\frac{\partial(-d_2)}{\partial \alpha} - \frac{\partial V}{\partial R_L}\frac{\partial N(-d_1)}{\partial(-d_1)}\frac{\partial(-d_1)}{\partial \alpha}]$$

$$\frac{\partial^2 Z}{\partial R_L \partial \alpha} = (\frac{\partial^2 C}{\partial L^2} - \frac{2(R - R_D)K(q')^2}{q^3})\frac{\partial L}{\partial \alpha}\frac{\partial L}{\partial R_L}$$

$$\frac{\partial^2 V}{\partial R_L \partial \alpha} = \frac{\partial L}{\partial \alpha} < 0$$

$$\frac{\partial Z}{\partial R_L} e^{-\delta} \frac{\partial N(-d_2)}{\partial(-d_2)} \frac{\partial(-d_2)}{\partial \alpha}$$

$$- \frac{\partial V}{\partial R_L} \frac{\partial N(-d_1)}{\partial(-d_1)} \frac{\partial(-d_1)}{\partial \alpha}]$$

$$= \frac{\partial V}{\partial R_L} \frac{\partial N(-d_1)}{\partial(-d_1)} (\frac{VN(-d_1)}{Ze^{-\delta} N(-d_2)}$$

$$-1) \frac{\partial(-d_1)}{\partial \alpha} < 0$$

$$\frac{\partial(-d_2)}{\partial \alpha} = \frac{\partial(-d_1)}{\partial \alpha} = -\frac{1}{\sigma\alpha} (\frac{\alpha}{V} \frac{\partial V}{\partial \alpha} - \frac{\alpha}{Z} \frac{\partial Z}{\partial \alpha})$$

$$\frac{\partial V}{\partial \alpha} = (1 + R_L) \frac{\partial L}{\partial \alpha} < 0$$

$$\frac{\partial Z}{\partial \alpha} = [\frac{(R - R_D)Kq'}{q^2} + \frac{\partial C}{\partial L}$$

$$+ (1 + R)] \frac{\partial L}{\partial \alpha} < 0$$

The sign of equation (16) is governed by the term $\partial^2 P / \partial R_L \partial \alpha$ since the denominator is positive. The first [·] of $\partial^2 P / \partial R_L \partial \alpha$ represents the marginal profit effect on $\partial P / \partial R_L$ from a change in α of the put option valuation. The sing of $(\partial^2 Z / \partial R_L \partial \alpha) e^{-\delta} N(-d_2)$ is indeterminate and the sign of $(\partial^2 V / \partial R_L \partial \alpha) N(-d_1)$ is negative. The former can be recognized as an indirect effect and the latter can be recognized as a direct effect since loan demand is the explicit treatment of the labor voice in bank governance. The indirect impact on $\partial Z / \partial R_L$ form a change in α is in general insufficient to offset the direct impact on $\partial V / \partial R_L$. As a result, the difference term of the first [·] is negative in the put option valuation.

The second [·] of $\partial^2 P / \partial R_L \partial \alpha$ captures the variance or “risk” effect on $\partial P / \partial R_L$ from a change in α. $\partial(-d_1) / \partial \alpha$ of the second [·] is positive since labor voice in bank governance to risky-loan repayments is recognized more significantly than that to riskless net-obligation payments since employees who receive fixed wages (payments) are usually contractual claims, at least in the short run. Consequently, the second [·] is negative in sign.

The result of equation (16) is stated in the following proposition.

Proposition 1: An increase in the labor voice in bank governance increases the bank’s interest margin.

Intuitively, as the bank faces an increasing degree of bank governance by its labor voice, it must now provide a return to a less P base evaluated at the optimal loan rate. One way the bank may attempt to augment its total surplus (returns) or to reduce its total deficits is by shifting its investments to the liquid assets and away from its loan portfolio. If loan demand is relatively rate-elastic, a less loan portfolio is possible at an increased margin. Faleye, Mehrotra, and Morck (2006) argue that labor-governed firms would avoid some long-term investments and deviate from their equity maximization. However, this cannot be a complete solution since the price-setting behavior of the firms in their study is ignored. Alternatively, Proposition 1 demonstrates that the labor-governed bank may use its loan rate-setting strategy to decrease its long-term loan investments to minimize its put-option value of equity. Accordingly, we show that labor utilizes its governance voice to minimize the put-option residual claims, and that this pushes bank interest margin toward, rather than away from, shareholder value maximization. Therefore, from operations management perspective, labor voice in corporate governance is encouraged.

C. Impact on default risk

Having examined the solution to the impact on the bank's optimal interest margin from change in α, we further consider the impact on the bank's default risk in equity returns from changes in α of the put option valuation. Totally differentiating equation (9) evaluated at the optimal loan rate, we obtain the following expression:

$$\frac{dP_{def}}{d\alpha} = \frac{\partial P_{def}}{\partial \alpha} + \frac{\partial P_{def}}{\partial R_L}\frac{\partial R_L}{\partial \alpha} \tag{17}$$

where

$$\frac{\partial P_{def}}{\partial \alpha} = -\frac{\partial N(d_3)}{\partial d_3}\frac{\partial d_3}{\partial \alpha}$$

$$\frac{\partial d_3}{\partial \alpha} = -\frac{\partial(-d_3)}{\partial \alpha} < 0$$

$$\frac{\partial P_{def}}{\partial R_L} = -\frac{\partial N(d_3)}{\partial d_3}\frac{\partial d_3}{\partial R_L}$$

$$\frac{\partial d_3}{\partial R_L} = \frac{1}{\sigma R_L}\left(\frac{R_L}{V}\frac{\partial V}{\partial R_L} - \frac{R_L}{Z}\frac{\partial Z}{\partial R_L}\right)$$

The first term on the right-had side of equation (17) is positive in sign. The term $\partial d_3 / \partial R_L$ is negative in sign since the net-obligation payment elasticity is generally less sensitive than the risky-loan repayment elasticity. Consequently, the second term on the right-hand side of equation (17) is positive in sign as well since the result of $\partial R_L / \partial \alpha$ in equation (16) is positive. Accordingly, we establish the following proposition.

Proposition 2: An increase in the labor voice in bank governance increases the bank's default risk in equity returns.

An explanation of the result of Proposition 2 is possible in terms of the direct effect on P_{def} from a change in α and the indirect effect through adjusting its optimal loan rate in the put-option valuation. The direct effect captures an increase in the bank's default risk due to an increase in its labor voice to bank governance, holding the optimal loan rate constant. The indirect effect also reinforces the direct effect. From the risk management perspective, listening labor voice may not be an effective to bank management. As stated earlier, a higher degree of corporate governance by labor voice implies a higher bank margin. The indirect opportunity cost of a higher bank margin (bank equity return) is associated with a higher default risk in the bank's equity return. Both the direct ineffective management and the indirect opportunity cost make the bank take on greater risk.

4 Conclusion

In this paper, we have developed a simple firm-theoretical model to study the optimal bank interest margin and its related to default risk of a bank using its labor voice in corporate governance to minimize the equity value of put option. The results imply that changes in the bank governance voice have a direct effect on the bank's profits and risks. We show that a long-standing labor voice in bank governance is associated with increased the optimal bank interest margin and default risk in equity return in the put-option valuation. We argue that labor uses its corporate governance voice to minimize its equity in the put-option valuation, and that this often pushes the optimal bank interest margin toward, rather than away from, shareholder value maximization. However, listening to labor voice has to pay the opportunity cost of default risk in the bank's equity returns. This paper fills a gap in literature by focusing a pattern of bank interest margin and default risk decisions with bank governance by labor voice.

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