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監理姑息與存款保險定價：兼論Ronn-Verma以選擇權爲基礎之評價模型

Regulatory Forbearance and Deposit Insurance Pricing : A Comment on the Ronn-Verma Option-Based Model

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摘要

本文以台灣上市銀行為樣本檢視監理姑息與存款保險定價兩者間之關係。首先回顧以選擇權定價模型評估風險基準保險費率之文獻；接著，應用 Ronn-Verma 選擇權定價模型分析台灣上市銀行在不同的監理姑息環境下對存款保險費率之影響效果；我們發現所估計出來的保險費率不僅隨著時間的經過而增加，也隨著監理姑息的程度而增加，且不同的監理姑息程度將導致定價過高或過低不同的推論；因此，我們的結論是存款保險機構是否高估或低估存款保險費率端視其監理姑息程度而定。監理姑息程度愈高，被保機構承擔的風險愈高，則將被索取較高的費率；監理姑息程度低者，被保機構承擔的風險較低，則被收取的費率會較低。

【關鍵字】監理姑息、選擇權定價模型、風險基準之存款保險費、定價過低或過高

Abstract

This paper examines the relationship between regulatory forbearance and the pricing of deposit insurance for listed commercial banks in Taiwan. After first reviewing the literature regarding the application of the option pricing models to assess the risk-based deposit insurance premiums, we then apply the Ronn-Verma option pricing model to empirically examine the effect of alternative schemes of regulatory forbearance on the deposit insurance premiums of Taiwan's listed commercial banks. We find that the estimated deposit insurance premiums, in addition to increasing with time, are also increasing with the degree of regulatory forbearance, and different degrees of regulatory forbearance will lead to different inferences regarding over-or under-charging. Thus, we conclude that the extent to which the deposit insurance agency under-or over-prices the deposit insurance premiums will depend on the degree of regulatory forbearance. If there is a high degree of regulatory forbearance, the risk that insured institutions bear will be higher, and consequently a higher premium will be charged. However, when the degree of regulatory forbearance is lower, the risk that the insured institutions bear will be lower and hence lower premiums will be assessed.

【Keywords】regulatory forbearance, option pricing model, risk-based deposit insurance premium, under- or over-pricing

A. Introduction

When estimating risk-based deposit insurance premiums, Merton (1977) suggested using the analogous relationship between deposit guarantees and put options to value FDIC insurance, and hence offered an approach to determine the proper insurance premium. Many authors have followed Merton's suggestion in computing bank-specific estimates of the appropriate premium for deposit insurance (Merton, 1978; Marcus & Shaked, 1984; Ronn & Verma, 1986, 1989; Pennacchi, 1987a, 1987b, 2004; Allen & Saunders, 1993). The use of the option-pricing approach as compared with the use of historical, system-wide loss experiences to estimate deposit insurance premiums allows bank-specific estimates of the correct premium to be made and hence the appropriate premium can be computed using data collected over a short time period. The deposit insurance agencies have historically set deposit insurance premiums without considering a bank's potential liability to the insuring agency. Hence, some low-risk banks may have been "overcharged" for deposit insurance while other high-risk banks may have been undercharged. By demonstrating an isomorphic correspondence between loan guarantees and common stock put options, Merton (1977) derived the value of fixed-term deposit insurance in a manner analogous to the Black and Scholes (1973) pricing of put options. Then, by assuming that the insuring agency audits banks at random time intervals, Merton (1978) also derived a fair one-time payment by banks, i.e. a chartering fee, for deposit insurance.

Many studies (Merton, 1977, 1978; Marcus & Shaked, 1984; Ronn & Verma, 1986; Pennacchi, 1987a) have priced the deposit insurance premiums as a put option on bank assets written by the insuring agency and held by the shareholders of the bank, with an exercise price equal to the face value of the insured deposits. However, bank shareholders may choose not to exercise the put option since exercising it implies voluntary bank closure. On the other hand, market discipline and capital requirements have also been included in the pricing process to make it work better (Buser, Chan, & Kane, 1981; Ronn & Verma, 1986, 1989; Pennacchi, 1987b, 2004; Flannery, 1991). Allen and Saunders (1993) have pointed out that the issue of closure and forbearance is important in the context of insurance valuation, especially in valuing the size of insurance subsidies due to fixed-price insurance.

Ronn and Verma (1986) modified Merton's model to take into explicit consideration market perceptions of the regulatory agencies' implementation of the bank closure rule. Thereafter, in their 1989 paper, they showed that with only small modifications to the approach developed by the 1986 paper they could arrive at the capital adequacy standard that an individual bank should be required to maintain. These market-based capital adequacy standards have been translated into book value capital-asset ratios, thus facilitating regulatory action. Buser, et al. (1981), in recognizing the existence of implicit as well as explicit prices for FDIC insurance, concluded that the FDIC achieved a comparable effect by employing a risk-rated structure of implicit premia in the form of regulatory interference and hence viewed capital standards as risk-rated implicit premia.

In an earlier study, Pennacchi (1987b) used an expanded model of deposit insurance pricing and bank equity valuation to analyze the effect of alternative regulatory policies on bank risk-taking incentives. In that paper, he showed that, consistent with Merton's (1978) model, if the insuring agency followed a policy of resolving bank failures by making direct payments to insured depositors, sufficient monopoly rents would induce banks to prefer greater capital. He then generalized Merton's (1978) model to enable us to consider additional characteristics of banks' financial structures and alternative policy assumptions concerning an insuring agency's pricing of insurance and the method to be used for handling bank closures. Thereafter, Pennacchi (2004) argued that if risk-based insurance premiums were integrated with risk-based capital requirements, bank regulation would create fewer distortions and would emulate the market discipline that investors impose on non-banking firms.

Having the same conception as those of the authors mentioned above, Flannery (1991) argued that regulation must incorporate both risk-based capital requirements and risk-based deposit insurance premiums if a government intends to minimize deposit insurance subsidies. He also pointed out that if the deposit insurer could observe bank risks without error, it could attain actuarial soundness equally well with either risk-related premium assessments or risk-related capital standards. Since many bank assets are difficult to evaluate, their true value and risk cannot be priced without error. Since the insurance pricing error will increase with bank leverage, the impact of these errors on private-sector allocations can be minimized with a combination of risk-related capital standards and risk-related premia.

Acharya and Dreyfus (1989) showed that optimal dynamic regulatory policies for closing ailing banks as well as deposit insurance premiums were functions of the rate of flow of bank deposits and interest paid on deposits and the regulators' bank audit/administration costs. In addition, they also showed that the optimal deposit insurance premiums and probabilities of bank closure were non-decreasing in terms of the bank's investment risk and non-increasing in terms of the bank's current assets-to-deposits ratio. Chan, Greenbaum, and Thakor (1992) analyzed risk-sensitive, incentive-compatible deposit insurance in the presence of private information and moral hazard. Acharya (1996) showed that an optimal level of forbearance for an insolvent bank with a large enough charter value alleviated the moral hazard problem.

Allen and Saunders (1993) pointed out that deposit insurance can be modeled as a callable put, i.e. a put option where the deposit insurer retains a valuable call provision to control the timing of the exercise of the put via closure decisions. They claimed that the value of the deposit insurance subsidies could therefore be measured as the net difference between the put and call features of the insurance contract, and hence forbearance could be viewed as forfeiture by the deposit insurance agency of the value of the call component of the deposit insurance option.

Duan, Moreau, and Sealey (1993) developed a model of bank behavior under regulatory constraints within a framework of moral hazard and showed that if the deposit insurance contracts took into account incentive compatibility, then the policy goals pursued by the regulatory authorities could be achieved. This implies that, under existing regulatory policies, a ceteris paribus move toward the adoption of risk-adjusted deposit insurance premiums may actually make banks riskier. Duan and Yu (1994) incorporated capital forbearance and moral hazard into their model and showed that the fairly-priced premium rate was not neutral to forbearance policy even in the absence of moral hazard. Duan and Yu (1999) proposed a multi-period deposit insurance pricing model that simultaneously incorporated a capital standard and the possibility of forbearance. They used the model to study the effects of capital forbearance and moral-hazard behavior in a multi-period deposit insurance setting.

Dreyfus, Saunders, and Allen (1994) examined the desirability of establishing caps on the scope of insured deposits, given the existence of a flat / mispriced premium schedule for deposit insurance. They showed that the optimal setting of caps on insured deposit coverage cannot be analyzed independently from either the FDIC's bank closure policy or the nature of the deposit insurance premium. Hwang, Lee, and Liaw (1997) performed logistic regressions to estimate the probability of bank failure. By providing a numerical illustration, they calculated the actuarially fair deposit insurance premiums.

Marcus and Shaked (1984) claimed that the FDIC charged insured institutions deposit insurance premiums that were too high. However, Ronn and Verma (1986) concluded that the FDIC undercharged the insured institutions and hence recommended that the premium rates should be increased. Even though the models they used were very similar[1] , the conclusions were very different. The basic point underlining the argument was concerned with the standard of regulatory forbearance. If the standard of regulatory forbearance was high, this meant that the risk borne by insured institutions would be higher and that a higher premium rate would be charged. However, when the standard of regulatory forbearance was lower, then the risk borne by the insured institutions would be considered to be lower and hence smaller premiums would be assessed.

Therefore, the argument as to whether the insuring agency will over- or under-charge the insured institutions centers around the issue of regulatory forbearance. In this paper, we use Taiwan Stock Exchange (TSE) data for listed commercial banks to empirically estimate the deposit insurance premiums by applying the Ronn-Verma option-based model to assess the deposit insurance premiums, and conclude that the appropriateness of the risk-based deposit insurance premiums will depend on the degree of regulatory forbearance. Without considering the factor of regulatory forbearance, one cannot jump to the conclusion that the insuring agency will either under- or over-charge the insured institutions. Ronn and Verma (1986) have shown that the problem of empirically estimating risk and the deposit insurance premium were tractable when time series data on the market value of the bank's equity and the book value of its debt were available. So we mainly apply their model to perform our estimation.

B. Using the Ronn-Verma Option Pricing Model to Price Risk-Based Deposit Insurance Premiums

By following Merton's model, Ronn and Verma (1986) argued that the isomorphic relationship could reasonably be applied to deposit insurance even though the assumption of a single homogeneous-term debt issue was not strictly valid for banks issuing mostly demand deposits. As pointed out by Ronn and Verma, if the maturity of the debt is reinterpreted as the length of time until the next audit of the bank's assets by the insurer, then we will have an analytic representation of the value of deposit insurance. In their model,

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1 Marcus and Shaked (1984) added the value of deposit insurance to the asset side and claimed that the sum of the assets and the deposit insurance would be equal to the sum of the liabilities and equity. Hence, in computing the market value of bank assets, M-S deducted the insurance value from the sum of $D+E$, i.e. $D+E-I$, where I was the value of deposit insurance. In Ronn and Verma (1986), they not only took into account the deposit insurance value on the bank asset side, but also considered the degree of regulatory capital forbearance. Hence, in the normal case, the values of deposit insurance estimated by Ronn and Verma will be higher than those estimated by Marcus and Shaked.

Ronn and Verma use the following notations:

V= the unobserved post-insurance value of the bank's assets

B_1= the face value of the insured deposits

B_2= the face value of all debt liabilities other than the insured deposits

$B \equiv B_1+B_2$ = the face value of total debt liabilities

σ_V= the instantaneous standard deviation of the rate of return on the value of the bank's assets

T= the time until the next audit of the bank's assets

δ= the dividend per dollar of the value of the assets, paid n times per period.

By assuming that all pre-insurance debt is of equal seniority, Ronn and Verma (1986) claim that holders of deposits would be entitled to either the future value of their deposits or to a prorated fraction of their value if the value is less than the total debt. In other words, deposit holders will receive

$$\min\left\{FV(B_1), \frac{V_T B_1}{B}\right\}$$

upon the maturity of the debt, where denotes the future value operator, and V_T is the terminal value of the bank's assets. Thus, the maturity value of the deposit insurance is given by

$$\max\left\{0, FV(B_1) - \frac{V_T B_1}{B}\right\}$$

Then, based on Merton (1977) and Ronn and Verma (1986), the value of the deposit insurance is equivalent to the value of a put, which is denoted by P. This put is written with an exercise price equal to the total debt, which should be scaled down by the proportion of demand deposits to total debt, B_1/B.[2] Therefore, the per dollar deposit insurance premium, denoted by d, is then given by

2 According to Ronn and Verma (1986),

$$P \equiv B_1 N\left(y + \sigma_V \sqrt{T}\right) - \frac{(1-\delta)^n V B_1}{B} N(y)$$

where

$$y \equiv \frac{\ln\left[\frac{B_1}{(1-\delta)^n V B_1/B}\right] - \sigma_V^2 T/2}{\sigma_V \sqrt{T}} = \frac{\ln\left[B/V(1-\delta)^n\right] - \sigma_V^2 T/2}{\sigma_V \sqrt{T}}$$

Defining $d \equiv P/B_1$ yields Equation (1) in the text.

$$d = N\left(y + \sigma_V \sqrt{T}\right) - (1-\delta)^n (V/B) N(y) \tag{1}$$

where

$$y \equiv \frac{\ln\left[B/V(1-\delta)^n\right] - \sigma_V^2 T/2}{\sigma_V \sqrt{T}}$$

and $N(.)$ is the cumulative density of a standard normal random variable.

Letting V' denote the value of the assets before insurance, the value of the assets after insurance, V, will be given by

$$V = V' + P(V) - C$$

where $P(V)$ stands for the accretion in value on account of the insurance, and C denotes the reduction in the value due to competition (Ronn & Verma, 1986).

With the assumption of the Black-Scholes option pricing model, the value of the bank equity E will be,

$$E = VN(x) - \rho BN\left(x - \sigma_V \sqrt{T}\right) \tag{2}$$

where

$$x \equiv \frac{\ln(V/\rho B) + \sigma_V^2 T/2}{\sigma_V \sqrt{T}}$$

and

$$\sigma_v = \frac{\sigma_E E}{VN(x)} \quad (3)^3$$

where σ_E is the instantaneous standard deviation of the return on E .

As Ronn and Verma (1986) noted, when the insuring agency observes that a bank's net worth has been fully eroded, it will do its best to revive that troubled bank either by directly infusing funds, or by what amounts to a temporary respite from closure before liquidating its

3 It can be shown that $\sigma_E = \eta_{E,V}\sigma_V$ where $\eta_{E,V}$ denotes the elasticity of equity to asset value, i.e. $\eta_{E,V} = (V/E)(\partial E/\partial V)$ (cf. Bensoussan, Crouhy, & Galai, 1994). In Merton's framework, the partial derivative $\partial E/\partial V$ is simply the delta (i.e.$N(x)$) of the call with respect to the underlying asset of the firm.

assets. However, it is reasonable to suppose that there will be a preset limit beyond which erosions in value, should they occur, will make the revival efforts excessively costly, and therefore beyond this limit liquidation of assets will be the only feasible alternative. For the purposes of this study, we have followed Ronn and Verma (1986) to let this preset limit be expressed as a percentage of the total debt of the bank, i.e. as ρB where $\rho \leq 1$. Then, if the value of the bank happens to fall between ρB and B, the insuring agency will infuse up to $(1-\rho)B$ to make the value equal to B. Should the value fall below ρB, the insuring agency will set about dissolving the assets of the bank.

While ρ can conceivably be estimated from past histories of failure, or near-failure where direct assistance or purchase and assumption options were resorted to, ρ is essentially a policy parameter and is accordingly not easy to estimate empirically. A higher ρ means a lower degree of regulatory forbearance and vice versa.

With this modified closure condition,

$$E = VN(x) - \rho BN\left(x - \sigma_V \sqrt{T}\right)$$

where now

$$x \equiv \frac{\ln\left(V/\rho B\right) + \sigma_V^2\, T/2}{\sigma_V \sqrt{T}} \tag{2'}$$

and

$$\sigma_v = \frac{\sigma_E E}{VN(x)} \tag{3'}$$

and given the solution pair (V, σ_V)[4], we then get the result of the risk-adjusted deposit insurance premium, d .

The insurer's obligation is modeled as writing a European put option, with an exercise price of $FV(B)$, where $FV(.)$ denotes the future value operator at $T\equiv 1$. This put option is contrasted with the equity holders' call option, with $K=\rho\, FV(B)$. The asymmetry between the two is deliberate; when $\rho\, FV(B) \leq V_T < FV(B)$, the insurer provides a payment of $FV(B)-V_T$, but equity holders retain ownership of the firm (Ronn & Verma, 1986).

4 How to get this solution pair (V, σ_V) will be described in the next section.

The modeling implicit in this analysis is an approximation of the insurer's option to close down the banking operation at any time $t \leq T$, if $V_t < FV_t(B)$, where $FV_t(.)$ denotes the future value operator for any time $t \leq T$. In this case, optimal behavior, which is equivalent to loss-minimizing insurer action, implies bank closure when $V_t = FV_t(B)$. The rationale for such optimality is that, at best, the insurer can gain nothing; at worst, it might lose max $\{0, V_t - FV_t(B)\}$. Thus, it should take whatever action possible to ensure against a positive loss. This is done by its exercising its bank closure option whenever $V_t = FV_t(B)$ (Ronn & Verma, 1986). However, in reality, the deposit insurer is unwilling to invoke bank closure for statutory, political, and institutional reasons, and so we follow Ronn and Verma (1986) to model the FDIC's policy as approximated by the "European put policy," i.e. it will close the bank if $V_T = \rho FV(B)$, while it will provide direct assistance if $\rho FV(B) \leq V_T < FV(B)$.

C. Empirical Estimation of Regulatory Forbearance and Pricing of Deposit Insurance Premiums

(A) Data

In this study, we performed the empirical analysis using a sample of 32 TSE-listed commercial banks for which a full set of data is available in the Taiwan Economic Journal (TEJ) data bank. That is, we collected the data mainly from the TEJ data bank. The data period extended from 1999 to 2001 and the reason why this period was chosen is described as follows. In 1999, the CDIC started to adopt a risk-based premium system for insured institutions.[5] For this reason, we chose this year as a starting point so that we could contrast the empirical estimates with the actual premium rates charged by the CDIC. In late 2001, as the Financial Holding Company Act took effect and financial holding companies began to operate, many banks had to compile their financial statements with their parent holding company so that independent data regarding the banks' assets and liabilities might not be acquired. Thus we chose 2001 as the final year of our data period. Based on this empirical analysis, we would like to examine whether the risk-based premiums that the CDIC charged

5 The CDIC in Taiwan implemented a deposit insurance risk-based premium system on July 1, 1999. This risk-based premium system regards the "capital adequacy ratio" of each financial institution as well as the "overall grade it has received based on the Examination Data Rating System under the National Financial Institutions' Early Warning System (NFIEWS)" as the indicators of risk. There are three-tiered assessment rates, which were 0.015%, 0.0175% and 0.02% of insured deposits before January 1, 2000. Thereafter, the three rates were raised to 0.05%, 0.055% and 0.06%, respectively.

were appropriate and how the regulatory forbearance affected the level of risk of the insured institutions as well as deposit insurance pricing through varying the regulatory forbearance parameter ρ with three different values.

The face values of total debt liabilities, and the values of the bank equities collected from TEJ were used as the empirical counterparts of B and E , respectively. Furthermore, the risk-free rates were represented by the 91-180-day NCD rates, also collected from TEJ.

Since the market values of bank assets were not available, we applied the Merton (1977) and Ronn and Verma (1986) models to solve equations (2') and (3') simultaneously for two unknowns, V and σ_V, by means of a numerical routine for each observed E and σ_E (where the latter was estimated from the daily return time series for the quarter concerned). Then, given the solution pair (V, σ_V) , an estimate of the deposit insurance premium could be computed using equation (1).

We followed the procedure described above for each of the banks in our sample on an annual basis over the study period. Again, we set the value of T at 1 year, implicitly assuming that, in purchasing deposit insurance, banks buy a net put every year with a maturity of 1 year, and that the debt is rolled over every year so that its maturity at the beginning of each year is 1 year.

Ronn and Verma (1986) assumed in their paper that there was a fixed, known and cross-sectionally constant ρ. However, the uncertainty in ρ can be analyzed using Fisher's (1978) model. In this study, we perform an empirical estimation with three values of ρ, which are 95, 97 and 99 percent.

(B) Empirical Findings

Deposit insurance is priced as a perpetual American put option with a call provision to allow for insurer-mandated closure. The call provision allows the insurer at any point in time to force the deposit insurance put option to be exercised, thereby closing the bank. By incorporating a bank self-closure rule as well as a divergent regulatory closure rule for banks in the valuation of deposit insurance, Allen and Saunders (1993) have shown that the call provision has value if the insurer-induced closure policy is stricter than the self-closure policy. Since forbearance can be defined as the delay in implementing an insurer's optimal closure policy, it can be regarded as the insurer selling the call provision of the deposit insurance put to the bank, and forbearance can be evaluated by pricing the call provision. If one neglects the value of the insurer's call provision, then one will tend to overestimate the value of deposit insurance subsidies to stockholders.

According to Ronn and Verma (1986), though ρ can conceptually be estimated from past histories of failure or near-failure where direct assistance or Purchase and Assumption (P&A) options were resorted to, ρ is a police parameter which is not easy to estimate empirically. So here by assigning ρ three different values, we examine the position that the insuring agency is in when determining its value by balancing the additional risk it is exposed to against the objective of avoiding broader secondary repercussions and possibly a bank failure. Since the deposit insurer may be unwilling to close the bank for statutory, political, and institutional reasons, we model the insurer's policy as approximated by the "European put policy," i.e. it will close the bank if $V_T = \rho FV\ (B)$, while it will provide direct assistance if $\rho FV\ (B) \leq V_T < FV(B)$.

In Tables 1 to 3, we summarize the estimates of the risk-adjusted deposit insurance premium for Taiwan's TSE-listed commercial banks in 1999, 2000 and 2001 with ρ equal to 0.99, 0.97 and 0.95. We discover that the deposit insurance premium rates will be higher when the regulatory forbearance is increased from 0.99 to 0.95 (a higher ρ means a lower degree of regulatory forbearance). For example, the deposit insurance premiums for the Bank of Kaohsiung will be 0.77333, 23.716 and 141.76 dollars per ten thousand deposits when ρ is equal to 0.99, 0.97 and 0.95, respectively.

Secondly, taking the year 1999 as an example, if the regulatory forbearance is set at ρ =0.99, which is the lowest degree in this paper, then our estimation, compared to the actual premium rates, will lead to the inference that the CDIC over-prices the deposit premiums. However, if the regulatory forbearance is set at ρ=0.95, which is the highest degree in this paper, then the inference will be that the CDIC under-prices the deposit premiums (see Table 4). Thus, it can be proved that whether or not the insurer is over- or under-charging the risk-based deposit insurance premiums will depend on the degree of regulatory forbearance exercised by the insurer. Different degrees of regulatory forbearance will lead to different inferences.

Besides, we plot the risk-adjusted deposit insurance premium rates for all TSE-listed banks in 1999, 2000, and 2001 for various ρs (see Figures 1, 2 and 3). For example, in Figure 1 we can see that the deposit insurance premium rates for each bank will be higher when ρ is equal to 0.95 than when ρ is equal to 0.99. In addition, for the same degree of regulatory forbearance (e.g., where ρ is equal to 0.95), the deposit insurance premium rates are increasing with each year from 1999 to 2001 (see Figure 4). This is consistent with the fact that the risks being faced by Taiwan's banks overall have been successively increasing in these three years.

On the other hand, since the premium rates charged by Taiwan's CDIC in 1999 ranged from 0.015% to 0.02%, it is interesting to find that when ρ is equal to 0.97, the range of the premium rates estimated for that year, which extends from 0.0013% to 0.23%, can cover the actual range set by the CDIC. The ranges of the two other ρ s are either too low[6] or too high[7] to overlap the actual range. Hence, we can infer that the regulatory capital forbearance for Taiwan in 1999 might be around 0.97 on the premise that neither over-charging nor under-charging existed at that time. However, if the results of the two other years, 2000 and 2001, are considered, the inference will be different. The range of the premium rates estimated when ρ is equal to 0.99[8] is much more closer to the actual range set by the CDIC, which is between 0.05% and 0.06% (see Table 4). Thus, based on this empirical result, we know that despite the rise in the premium rates from 2000 on, the regulatory forbearance implied for 2000 and 2001 is closer to 0.99, which could be viewed as a reflection of the regulator's change in attitude or the undercharging of the premium rates.

Finally, from Table 4 and Figure 5, we discover that not only the levels of the estimated deposit insurance premium rates are increasing with each year from 1999 to 2001, but also the gaps[9] between the estimated premium rates of good banks and bad banks are expanding with time and with the degree of regulatory forbearance. Apparently, while comparing Taiwan's present risk-based assessment rates with our results, problems such as the level of rates being too low, the range too narrow, the tiers too few, and low-risk banks being overcharged while the high-risk banks are undercharged become increasingly serious in such a volatile financial situation. So the very meaningful hint that these empirical results give us is that, in order to ensure the fairness and effectiveness of the deposit insurance system, raising the premium rates, expanding the range of premium rates and increasing the number of tiers are all tasks of great importance.

6 When ρ is equal to 0.99, the range of the premium rates estimated for 1999 is between 0.0000109% and 0.01432%.

7 When ρ is equal to 0.95, the range of the premium rates estimated for 1999 is between 0.02419% and 1.4176%.

8 The ranges for these two years when ρ =0.99 are 0.00025% to 0.0887%, and 0.0029499% to 0.15704%, respectively.

9 The gap is defined as the difference between the highest and the lowest premium rates.

D. Conclusion

Marcus and Shaked (1984) claimed that the FDIC charged insured institutions deposit insurance premiums that were too high and argued that they should lower the insurance premium rates. However, Ronn and Verma (1986) concluded that the FDIC undercharged the insured institutions and hence should have increased the premium rates in order to accumulate sufficient funds. Since both studies applied the option pricing model approach and are hence very similar, the fact that they arrived at quite different conclusions is somewhat surprising. Thus, the key issue underpinning their conclusions is concerned with what the standard of regulatory forbearance should be. If the degree of regulatory forbearance is high (a lower ρ), this means that the risk that the insured institutions bear will be higher and the premium rates will be higher. However, once the degree of regulatory forbearance becomes lower, then the risk that the insured institutions bear will be regarded as being lower and hence lower premiums will be assessed.

Therefore, the argument as to whether the FDIC is over- or under-charging the insured institutions will be determined by the degree of regulatory forbearance. In this paper, we apply the Ronn-Verma model and use the data for Taiwan Stock Exchange (TSE) listed commercial banks to estimate the deposit insurance premiums. We find that the estimated deposit insurance premiums, in addition to increasing with time, are also increasing with the degree of regulatory forbearance, and different degrees of regulatory forbearance will lead to different inferences regarding over- or under-charging. These implications are all consistent with the rationale stated at the beginning of this study. So we conclude that whether or not the insuring agency is over- or under-charging the risk-based deposit insurance premiums will depend on the degree of regulatory forbearance exercised by the insuring agency. Without taking into consideration the extent of the regulatory forbearance, we cannot jump to the conclusion that the insurer is either under- or over-charging the insured institutions. Furthermore, when this vital factor, i.e. regulatory forbearance, is considered, we can see why the claims made by Marcus and Shaked (1984) and Ronn and Verma (1986) in their respective models appear to be so different.

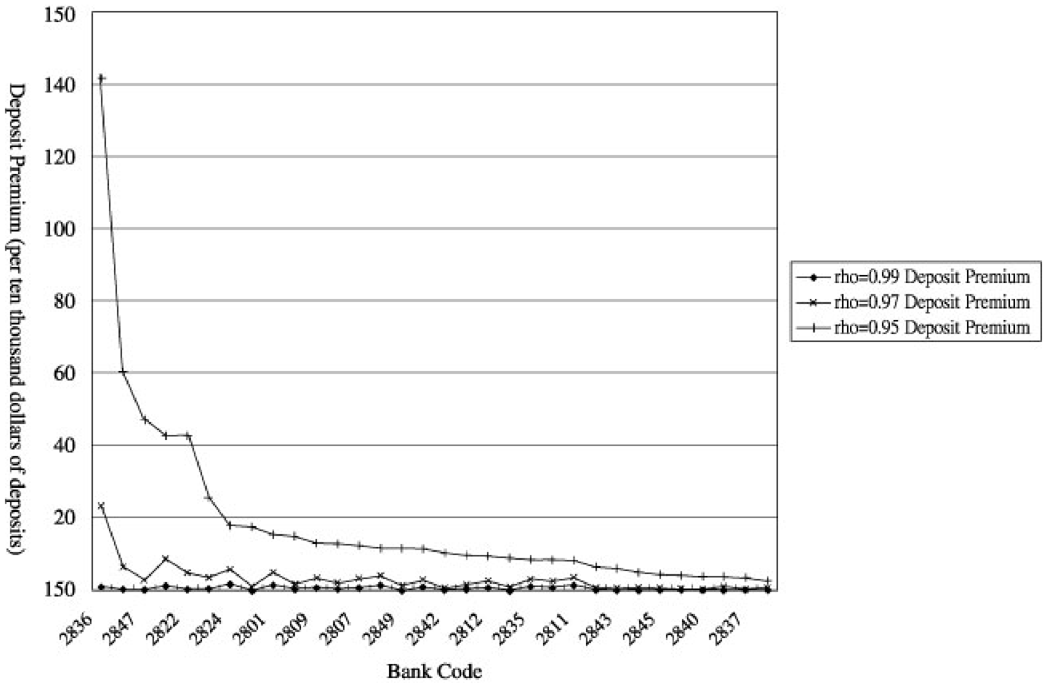

Figure 1 Risk-adjusted Deposit Insurance Premium, 1999, under various ρs

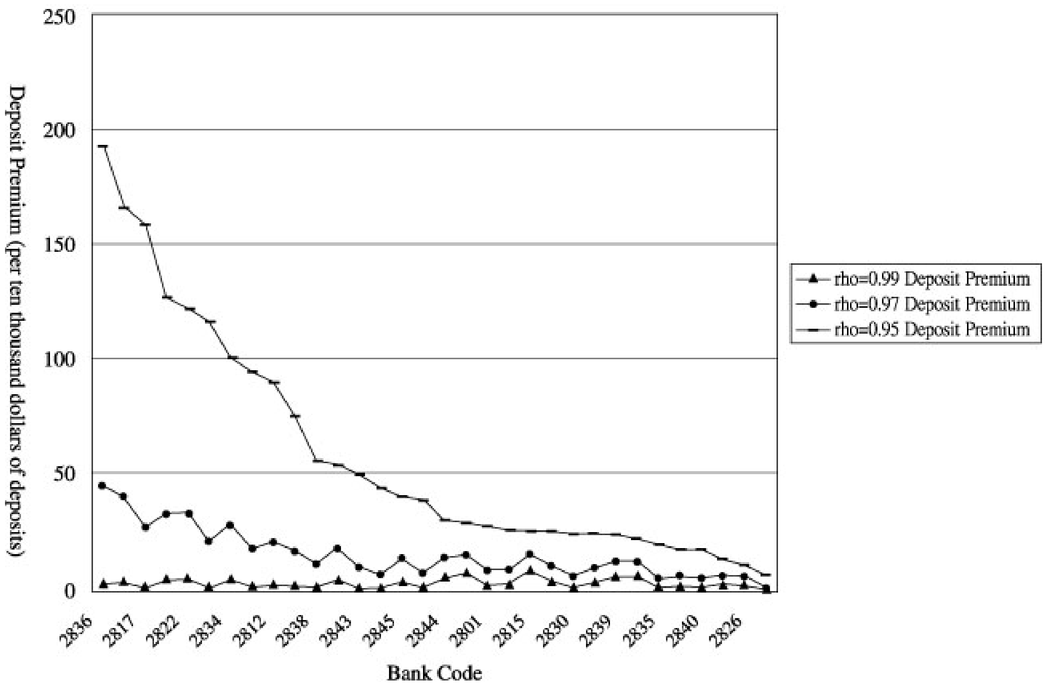

Figure 2 Risk-adjusted Deposit Insurance Premium, 2000, under various ρs

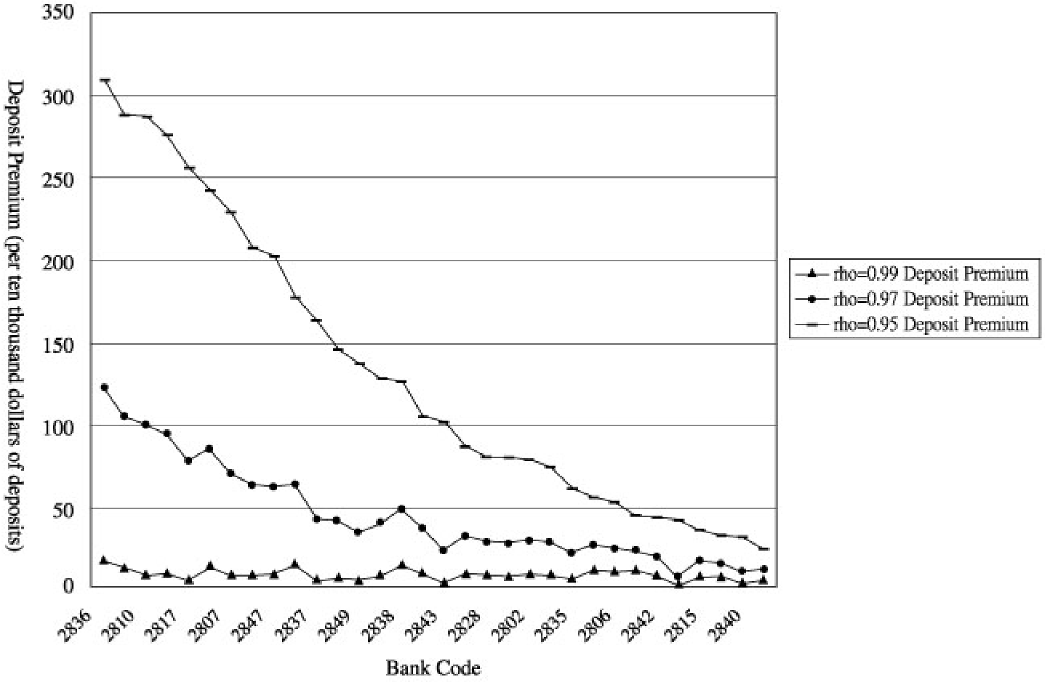

Figure 3 Risk-adjusted Deposit Insurance Premium, 2001, under various ρs

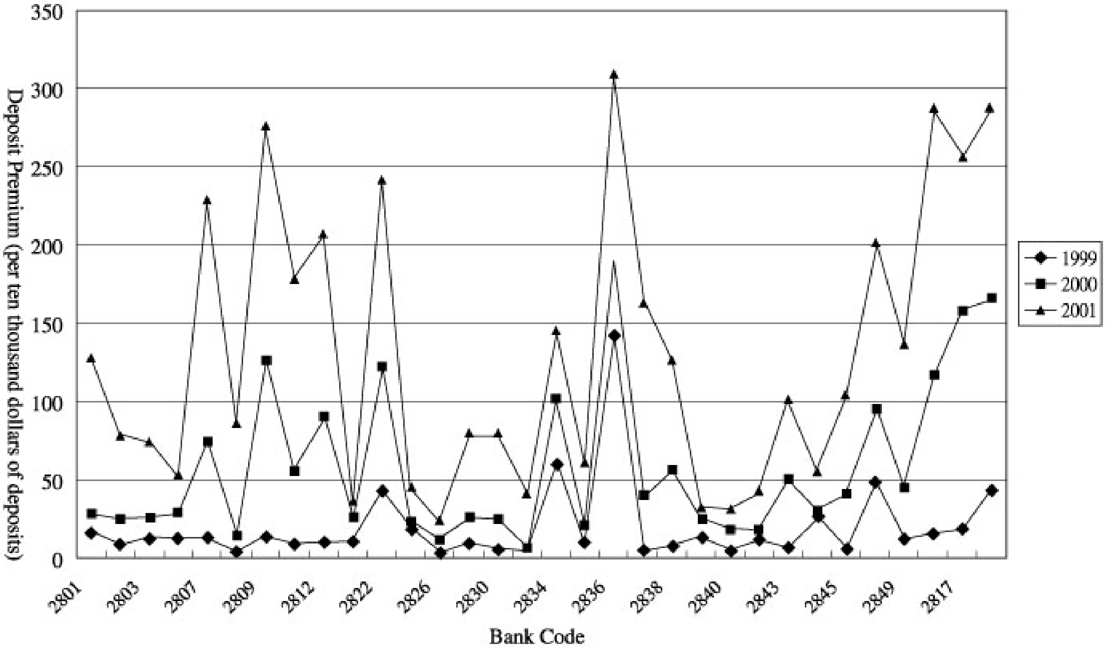

Figure 4 A Comparison of Risk-adjusted Deposit Insurance Premiums for the Three Years, ρ=0.95

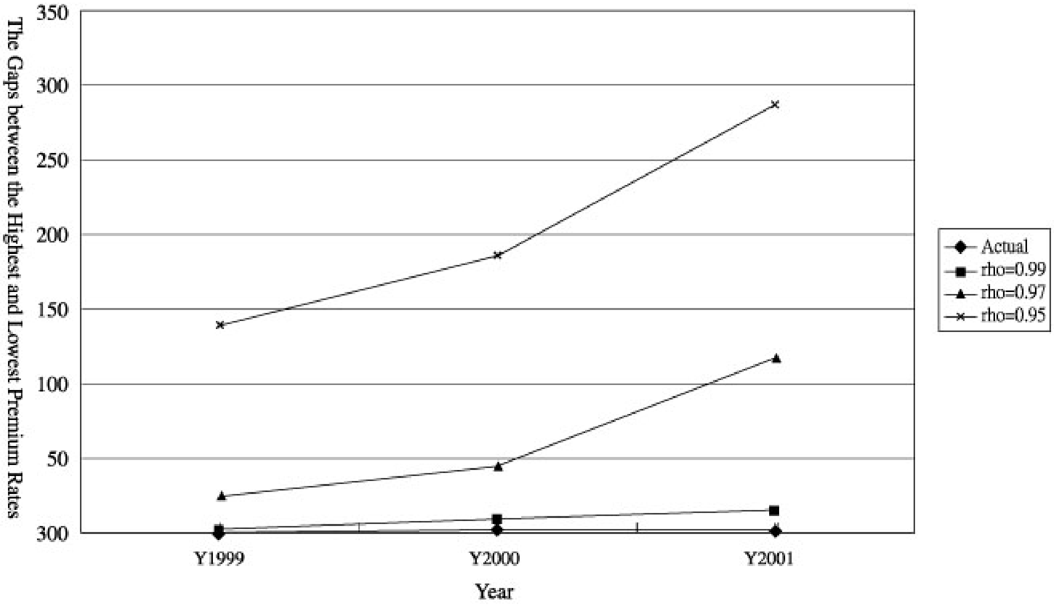

Figure 5 A Comparison of the Gaps under various ρ s for the Three Years

Table 1 Risk-adjusted Deposit Insurance Premiums (per ten thousand deposits), 1999

Ranked in Descending Order of the Deposit Insurance Premium when $\rho = 0.95$

		$\rho = 0.99$			$\rho = 0.97$			$\rho = 0.95$		
	Bank Names	Market Value of Assets	σ_V	Deposit Premium	Market Value of Assets	σ_V	Deposit Premium	Market Value of Assets	σ_V	Deposit Premium
2836	Bank of Kaohsiung	1.8338	0.0125	0.77333	1.7981	0.0127	23.716	1.7625	0.013	141.76
2834	TBB	8.623	0.0145	0.15534	8.4576	0.0148	6.3016	8.2922	0.0151	60.398
2847	TC Bank	1.8523	0.0123	0.019059	1.8167	0.0125	2.613	1.7811	0.0128	47.064
5818	Bank of Overseas Chinese, BOOC	2.6083	0.0227	0.88469	2.5587	0.0232	8.4232	2.5092	0.0236	42.753
2822	The Farmers Bank of China	5.3162	0.0163	0.15219	5.2145	0.0166	4.5731	5.1129	0.0169	42.659
2844	Taishin International Bank	2.6193	0.0201	0.18722	2.5697	0.0205	3.2765	2.5201	0.0209	25.497
2824	Chiao Tung Bank	5.5354	0.0398	1.432	5.4349	0.0406	5.6796	5.3344	0.0413	17.825
5817	Jih Sun International Bank	1.5432	0.0144	0.0073231	1.5139	0.0147	0.80881	1.4846	0.015	17.63
2801	Chang Hwa Bank	11.348	0.0409	1.2339	11.143	0.0417	4.8328	10.937	0.0425	15.284
5810	Bowa Bank	1.6337	0.0194	0.056712	1.6029	0.0198	1.4563	1.5721	0.0201	14.923
2809	Tainan Business Bank	1.2892	0.0337	0.56723	1.2656	0.0343	3.1363	1.2419	0.035	12.968
2839	Bank Sinopac	2.2855	0.0235	0.12925	2.2429	0.024	1.7795	2.2003	0.0244	12.853
2807	HIB	2.7751	0.0347	0.57753	2.7244	0.0354	3.1037	2.6736	0.036	12.248
2803	Hua Nan Bank	12.378	0.0468	1.2011	12.158	0.0476	4.0308	11.937	0.0485	11.626
2849	ETB	1.8955	0.0191	0.03046	1.8599	0.0195	0.94983	1.8244	0.0199	11.477
2806	I.C.B.C.	8.7872	0.0331	0.43875	8.6267	0.0338	2.6473	8.4662	0.0344	11.333
2842	Fubon Bank	2.512	0.0138	0.0014529	2.4644	0.014	0.28942	2.4168	0.0143	10.297
2815	China Trust Commercial Bank	7.0619	0.0265	0.13954	6.9312	0.027	1.4655	6.8005	0.0276	9.5271
2812	TCCB	2.1159	0.0389	0.55301	2.0777	0.0396	2.5372	2.0395	0.0404	9.3154
2828	Grand Commercial Bank	2.0468	0.0207	0.033308	2.0085	0.0211	0.81362	1.9703	0.0215	8.8628
2835	Cathay United Bank	1.2498	0.0491	0.87362	1.2277	0.05	2.9183	1.2057	0.0509	8.3539
2802	First Bank	12.774	0.0394	0.49434	12.545	0.0401	2.2615	12.315	0.0409	8.3259
2811	Taitung Business Bank	0.41864	0.0601	1.2764	0.41144	0.0612	3.4122	0.40424	0.0622	8.1161
2838	Union Bank of Taiwan	1.8615	0.02	0.014564	1.8268	0.0204	0.47134	1.792	0.0208	6.3134
2843	Fuhwa Bank	1.5414	0.0176	0.0048126	1.5125	0.0179	0.28924	1.4837	0.0183	5.8698
2830	Taipei Bank	5.7695	0.0234	0.025739	5.663	0.0239	0.4975	5.5565	0.0243	4.836
2845	Far Eastern International Bank	1.6411	0.0229	0.017833	1.6108	0.0233	0.37735	1.5804	0.0238	4.1834
2831	The Chinese Bank	2.1185	0.0198	0.0063164	2.0791	0.0202	0.25332	2.0396	0.0206	4.0627
2840	E.Sun Bank	2.3021	0.0165	0.0010935	2.259	0.0169	0.12682	2.2159	0.0172	3.6636
2808	International Bank of Taipei	3.262	0.039	0.15811	3.204	0.0397	0.84972	3.146	0.0404	3.5806
2837	Cosmos Bank	1.7899	0.0173	0.0014096	1.7565	0.0177	0.12765	1.7231	0.018	3.2683
2826	United World Chinese Commercial Bank	6.7533	0.0367	0.076801	6.6337	0.0373	0.4883	6.5141	0.038	2.419

Note: The unit of all market values of assets is 100 billion, and the deposit premiums are expressed as NT dollars per ten thousand NT dollars of deposits.

Table 2 Risk-adjusted Deposit Insurance Premiums (per ten thousand deposits), 2000

Ranked in Descending Order of the Deposit Insurance Premium when $\rho = 0.95$

		$\rho = 0.99$			$\rho = 0.97$			$\rho = 0.95$		
	Bank Names	Market Value of Assets	σ_V	Deposit Premium	Market Value of Assets	σ_V	Deposit Premium	Market Value of Assets	σ_V	Deposit Premium
2836	Bank of Kaohsiung	1.5759	0.0124	2.3821	1.545	0.0126	44.947	1.5142	0.0129	192.85
5818	Bank of Overseas Chinese, BOOC	2.8399	0.015	3.2962	2.7845	0.0153	40.323	2.7291	0.0156	165.72
5817	Jih Sun International Bank	1.5774	0.0115	0.70741	1.5466	0.0117	26.959	1.5158	0.0119	158.33
2809	Tainan Business Bank	1.3075	0.019	4.071	1.2822	0.0194	32.879	1.2569	0.0197	126.51
2822	The Farmers Bank of China	5.4422	0.0204	4.7956	5.3373	0.0208	33.343	5.232	0.0212	121.96
5810	Bowa Bank	1.6165	0.0146	1.007	1.5851	0.0149	20.489	1.5538	0.0152	116.67
2834	TBB	8.224	0.0228	4.6112	8.0653	0.0232	28.269	7.907	0.0237	101.26
2847	TC Bank	1.706	0.0167	1.1546	1.673	0.0171	17.522	1.6401	0.0174	94.726
2812	TCCB	2.0368	0.0199	2.2396	1.9977	0.0203	20.35	1.9585	0.0207	89.904
2807	HIB	2.6477	0.0203	1.6781	2.5969	0.0207	16.048	2.5461	0.0211	75.424
2838	Union Bank of Taiwan	1.8631	0.0211	1.0689	1.8275	0.0215	10.829	1.792	0.0219	55.51
2811	Taitung Business Bank	0.38038	0.0322	4.2687	0.37325	0.0328	17.648	0.36609	0.0334	54.351
2843	Fuhwa Bank	1.4678	0.0218	1.0083	1.4398	0.0222	9.7918	1.4119	0.0226	49.981
2849	ETB	1.7876	0.0187	0.37594	1.7535	0.019	6.2791	1.7194	0.0194	44.197
2845	Far Eastern International Bank	1.627	0.0359	3.5347	1.5968	0.0366	13.526	1.5665	0.0373	40.317
2837	Cosmos Bank	1.8308	0.022	0.65834	1.7961	0.0224	6.9947	1.7613	0.0228	38.939
2844	Taishin International Bank	2.4387	0.0546	5.4901	2.3951	0.0556	13.605	2.3515	0.0566	30.029
2806	I.C.B.C.	7.5695	0.0702	7.4246	7.4386	0.0714	15.08	7.3063	0.0727	28.822
2801	Chang Hwa Bank	10.829	0.0346	1.8208	10.629	0.0352	8.0449	10.429	0.0359	27.335
2828	Grand Commercial Bank	1.9545	0.0382	2.1524	1.9186	0.039	8.4191	1.8826	0.0397	25.771
2815	China Trust Commercial Bank	6.9396	0.0935	8.8727	6.825	0.095	15.271	6.7093	0.0966	25.406
2803	Hua Nan Bank	11.417	0.0498	3.6699	11.212	0.0507	10.236	11.006	0.0517	25.162
2830	Taipei Bank	5.5917	0.0301	0.98164	5.4876	0.0307	5.8582	5.3834	0.0313	24.151
2802	First Bank	12.134	0.0467	3.0681	11.915	0.0476	9.3031	11.695	0.0485	24.143
2839	Bank Sinopac	2.1074	0.0688	5.8442	2.0709	0.07	12.288	2.0344	0.0712	23.925
2824	Chiao Tung Bank	5.7193	0.0731	5.8299	5.6217	0.0744	11.855	5.5241	0.0757	22.47
2835	Cathay United Bank	1.2036	0.0311	0.79381	1.1813	0.0317	4.6849	1.159	0.0323	19.482
2842	Fubon Bank	2.2445	0.0432	1.7255	2.2039	0.044	6.0485	2.1633	0.0448	17.592
2840	E.Sun Bank	2.1552	0.0348	0.97823	2.1156	0.0355	4.8138	2.076	0.0361	17.588
2808	International Bank of Taipei	3.0758	0.0607	2.3435	3.0225	0.0617	5.8002	2.9691	0.0628	13.13
2826	United World Chinese Commercial Bank	6.6853	0.0738	2.528	6.5737	0.0751	5.4616	6.4621	0.0764	10.977
2831	The Chinese Bank	1.954	0.0215	0.025207	1.9176	0.0219	0.59005	1.8812	0.0223	6.4993

Note: The unit of all market values of assets is 100 billion, and the deposit premiums are expressed as NT dollars per ten thousand NT dollars of deposits.

Table 3 Risk-adjusted Deposit Insurance Premiums (per ten thousand deposits), 2001

Ranked in Descending Order of the Deposit Insurance Premium when $\rho = 0.95$

		$\rho = 0.99$			$\rho = 0.97$			$\rho = 0.95$		
	Bank Names	Market Value of Assets	σ_V	Deposit Premium	Market Value of Assets	σ_V	Deposit Premium	Market Value of Assets	σ_V	Deposit Premium
2836	Bank of Kaohsiung	1.8063	0.0119	15.704	1.7707	0.0121	121.81	1.735	0.0123	310.25
5818	Bank of Overseas Chinese, BOOC	2.5041	0.012	11.427	2.4548	0.0122	103.81	2.4052	0.0125	287.31
5810	Bowa Bank	1.5562	0.0102	7.033	1.5255	0.0104	98.575	1.4947	0.0106	287.08
2809	Tainan Business Bank	1.197	0.0115	8.3268	1.1734	0.0117	93.44	1.1497	0.012	275.58
5817	Jih Sun International Bank	1.4877	0.0106	4.3266	1.4584	0.0109	76.534	1.4291	0.0111	255.71
2822	The Farmers Bank of China	5.1749	0.0159	12.607	5.0725	0.0163	84.615	4.9709	0.0166	241.68
2807	HIB	2.5822	0.0136	6.6746	2.5316	0.0138	68.695	2.4808	0.0141	228.64
2812	TCCB	1.9488	0.0153	7.084	1.9107	0.0156	61.711	1.8725	0.0159	206.66
2847	TC Bank	1.8166	0.0159	7.4329	1.7811	0.0162	60.537	1.7455	0.0166	201.46
2811	Taitung Business Bank	0.36936	0.022	13.789	0.36227	0.0223	62.577	0.35508	0.0228	176.97
2837	Cosmos Bank	1.7132	0.0158	3.8575	1.6799	0.0161	41.04	1.6465	0.0164	162.59
2834	TBB	8.5175	0.019	5.4825	8.3516	0.0194	40.545	8.1862	0.0198	144.74
2849	ETB	1.8294	0.0176	3.6104	1.7939	0.0179	33.561	1.7584	0.0183	135.72
2801	Chang Hwa Bank	10.628	0.0226	7.0378	10.422	0.023	38.884	10.217	0.0235	126.75
2838	Union Bank of Taiwan	1.807	0.0289	13.214	1.7728	0.0294	47.43	1.7382	0.03	125.27
2845	Far Eastern International Bank	1.5837	0.0277	8.4799	1.5536	0.0282	35.363	1.5234	0.0288	103.65
2843	Fuhwa Bank	1.4914	0.0182	1.9879	1.4626	0.0186	21.647	1.4338	0.019	100.73
2808	International Bank of Taipei	3.0524	0.0313	8.214	2.9949	0.0318	30.407	2.937	0.0325	85.49
2828	Grand Commercial Bank	2.017	0.0303	6.6798	1.979	0.0308	26.748	1.9408	0.0314	78.952
2830	Taipei Bank	5.6106	0.0295	6.1712	5.5047	0.0301	26.139	5.3984	0.0307	78.921
2802	First Bank	12.107	0.0323	7.3887	11.876	0.0329	27.647	11.647	0.0335	77.368
2803	Hua Nan Bank	11.658	0.0335	7.2564	11.437	0.0342	26.491	11.217	0.0349	73.141
2835	Cathay United Bank	1.168	0.0326	5.0619	1.1461	0.0332	19.967	1.1241	0.0339	59.675
2844	Taishin International Bank	2.6953	0.0501	10.178	2.6463	0.051	24.796	2.5961	0.052	54.309
2806	I.C.B.C.	8.7414	0.0479	8.8622	8.5805	0.0488	23	8.4201	0.0497	51.608
2824	Chiao Tung Bank	5.6079	0.0585	9.7553	5.5081	0.0595	21.536	5.4067	0.0606	43.783
2842	Fubon Bank	2.5996	0.0477	6.7732	2.5523	0.0486	18.14	2.5049	0.0495	42.039
2831	The Chinese Bank	2.0668	0.0185	0.29499	2.0274	0.0188	5.3943	1.988	0.0192	40.484
2815	China Trust Commercial Bank	7.2827	0.0547	6.5594	7.1527	0.0557	15.917	7.0211	0.0568	34.915
2839	Bank Sinopac	2.3742	0.0563	5.9846	2.3319	0.0573	14.332	2.2895	0.0584	31
2840	E.Sun Bank	2.3145	0.0333	1.9093	2.2715	0.0339	8.7835	2.2285	0.0345	30.187
2826	United World Chinese Commercial Bank	6.7632	0.0567	4.0916	6.644	0.0577	10.16	6.5247	0.0588	22.776

Note: The unit of all market values of assets is 100 billion, and the deposit premiums are expressed as NT dollars per ten thousand NT dollars of deposits.

Table 4 Comparisons of the Ranges and Gaps of the Rise-adjusted Deposit Insurance Premiums (per ten thousand NT dollars of deposits)

1999	Actual	$\rho = 0.99$	$\rho = 0.97$	$\rho = 0.95$
Min	1.5	0.0010935	0.12682	2.419
Max	2.0	1.432	23.716	141.76
Gap	0.5	1.430907	23.58918	139.341
2000	Actual	$\rho = 0.99$	$\rho = 0.97$	$\rho = 0.95$
Min	5.0	0.0252	0.59	6.4993
Max	6.0	8.8727	44.947	192.85
Gap	1.0	8.8475	44.357	186.3507
2001	Actual	$\rho = 0.99$	$\rho = 0.97$	$\rho = 0.95$
Min	5.0	0.29499	5.3943	22.776
Max	6.0	15.704	121.81	310.25
Gap	1.0	15.40901	116.4157	287.474

Note: $Gap = Max - Min$, i.e., the difference between the highest premium rate and the lowest premium rate.

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