Deposit Insurance Pricing and Model Selection for Chinese Commercial Banks

Xuemin Chen

Abstract Along with the further comprehensive deepening of reform in China, the introduction of explicit deposit insurance system has been formally put on its official agenda. This paper brings forward two new perspectives about deposit insurance pricing model, which one is based on utility functions and another is based on No-Claim Discount (NCD) system. Deposit insurance rates and premiums of each commercial bank are actually measured & calculated with expected loss model; furthermore, this paper gives and designs NCD model embedded rate mode and reference rates for Chinese commercial banks based on hybrid approach in consideration of the premium rate determined using expected loss model.

Keywords Deposit insurance • NCD • Expected loss • Hybrid approach

1 Introduction and Literature Review

The conditions for establishing an explicit deposit insurance system in China have basically been satisfied. It should be particularly noted that Chinese Premier Li Keqiang pointed that "establish deposit insurance system and improve risk handling mechanism for financial institutions" [1], indicating that deposit insurance system has been formally put on the official agenda of Chinese government. From the perspective of technical practice for sound operation of deposit insurance system, the design of deposit insurance rate is taken as a core task.

Ronn and Verma [2], Pennacchi [3], Allen and Saunders et al. [4] investigated deposit insurance pricing model, which has developed into an important approach in deposit insurance pricing model based on option theory. This method, however, has to be based on market indicators, and its role is limited. First of all, it is extremely difficult for market-based model to estimate asset risks of countries with less developed capital market; secondly, not all banks are accessible to

X. Chen (✉)
China Center for Industrial Security Research, Beijing Jiaotong University, Beijing 100044, China

School of Economics, Tianjin University of Finance and Economics, Tianjin 300025, China
e-mail: chernxm@126.com

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market-based information. Drehmann [5] considered deposit insurance pricing model based on the consideration of total social cost from the perspective of social welfare.

In practice, the International Association of Deposit Insurance Agencies (IADI) presented deposit insurance pricing method based on risk measurement by quantitative and qualitative hybrid methods, and this pricing method has been applied for deposit insurance in the United States, Canada and other countries. The deposit insurance rates used in the United States were calculated & determined by financial ratio method and debt rating method based on CAMELS rating and supervisory rating through the necessary adjustment of insured financial institutions. The differential rates design for Canada is referred to as "SCORING" model, which is built through composite scoring of quantitative (capital quantitative indicators and other quantitative indicators) and qualitative factors.

The contribution of this paper is mainly that proposes NCD model embedded hybrid approach based on internationally practical hybrid deposit insurance pricing method, and presents the reference rate and rate mode for deposit insurance of Chinese commercial banks by making further use of actually determined rate derived from expected loss model.

2 Two New Perspectives of Deposit Insurance Pricing

2.1 Deposit Insurance Pricing Based on Utility Theory

Assuming that the initial fund of deposit insurance agency is υ while the value of asset of insured agency or commercial bank before insured is w, such asset is faced with some certain potential loss; such risk is expressed as random variable X and its probability distribution is $F(x)$. Utility function for insured agency is $u(x)$, while the utility function for deposit insurance agencies is $u_1(x)$.

The insurance premium H should satisfy inequality:

$$u(w - H) \geq E(u(w - X)) \equiv U(w - X) \tag{1}$$

And the contracting insurance premium G for deposit insurance agencies should satisfy:

$$U_1(\nu + G - X) \equiv E(u_1(\nu + G - X)) \geq u_1(\nu) \tag{2}$$

An insurance contract could be concluded at a price there-between only if H^* is greater than G_*. Only such price point P (greater than net premium $E(X)$) is beneficial and reasonable.

As for deductible, the amount paid by deposit insurance agency is expressed as I_d, where $I_d = \begin{cases} 0, & x \le d \\ x - d, & x > d \end{cases}$; the loss assumed by insured agency is $X - I_d$, and the net premium is $E(I_d(X))$.

If maximum expected utility is taken as an evaluation criterion, it's natural to reach the following conclusion.

Theorem 1 Assuming that the asset of insured financial institution is w, which is faced with potential loss X; the insured agency is risk-averse, that is to say, its utility function $u(x)$ satisfies $u'(x) > 0, u''(x) < 0$; deposit insurance agency provides policy at the price $E(I_d(X))$; if the premium that insured agency is willing to pay is P, the optimal policy for insured agency should be (re)insurance with deductible d^*, where the optimal deductible d^* is determined by the following equation.

$$P = \int_{d^*}^{\infty} (x - d^*) f(x) dx \tag{3}$$

When considered from the perspective of insurance limit, if maximum insurance limit is expressed as e, the compensation pay-out of deposit insurance agency should be $I_e = \begin{cases} x, & x < e \\ e, & x \ge e \end{cases}$; accordingly, the loss assumed by insured agency should be $X - I_e$. The comparison with foregoing retention model indicates that both models show a symmetric similarity. The same conclusion as reached in previously described deductible model could be reached by exchanging the roles of deposit insurance agency and insured financial institution (i.e. insurer and insurant).

2.2 NCD System Embedded Deposit Insurance Pricing

NCD system translation rule could be described using transition probability matrix of Markov Chain. Assuming that the premium is adjusted once a year, and that whether the premium level of policy holder changes in each premium adjustment period depends on its claim record in previous period; Assuming that Y_t means the premium level of insured agency at time point t; if the premium level at time point t is C_i where $Y_t = C_i$, the premium level would turn into C_j in next year, where $Y_{t+1} = C_j$. If transition probability is expressed as p_{ij}, $p_{ij} = P\left(Y_{t+1} = C_j | Y_t = C_i\right)$.

Divide insurance premium into a number of "large" classes that represent the premium rate range determined every year by some certain pricing method; some "small" groups are defined under each of the large classes. NCD system is designed to adjust the "small" groups.

3 Estimation of Deposit Insurance Rate and Model Selection

3.1 Fundamental Model of Deposit Insurance Rate in China

At present, the different types of financial institutions show systematic difference in terms of risk characteristics. Hierarchical difference exists between the four state-owned commercial banks, the joint-stock banks, the city commercial banks and the urban and rural credit cooperatives in respect of risk level. For this reason, we could make use of the merits of risk-adjusted rate mode so as to adopt a simplified risk-adjusted differential rate mode based on the respect for China's current objective conditions. Specifically, qualified deposit insurance policy holders could be divided into three levels: At the first level are the four state-owned commercial banks, i.e. BOC, ICBC, ABC, and CCB; at the second level are joint-stock commercial banks including Bank of Communications, China Merchants Bank, Shanghai Pudong Development Bank, Industrial Bank, Huaxia Bank, CITIC Bank, China Everbright Bank, China Minsheng Bank, Shenzhen Development Bank and Guangdong Development Bank, and some city commercial banks in good condition like Bank of Shanghai, Bank of Beijing, Bank of Nanjing, Bank of Tianjin, and Bank of Ningbo; at the third level are city commercial banks and urban and rural credit cooperatives etc.

Therefore, simplified hierarchical rates for deposit insurance in China could be designed as Table 1.

3.2 Extended Mode of Deposit Insurance Rate in China

We start with the estimation of deposit insurance rates and premiums of some domestic commercial banks by expected loss method. Expected loss pricing model is to work out deposit insurance rate by determining the expected loss of deposit, that is to say, premium income is greater than or equal to expected loss. This is given by the following equation:

$$\text{Expected loss} = \text{Risk exposure} \times \text{Expected default rate} \times \text{Loss given default}$$

Expected default rate refers to the default probability of commercial banks, i.e. the probability of unplayable deposit induced liquidity crisis, and is dependent on historical factors and expected factors. It could be calculated through

Table 1 Simplified hierarchical discriminating rate of deposit insurance in China (Unit: Bp)

Insurance premium level	The first level		The second level		The third level	
Rate	I	0.1	II	0.5	III	1.0

Table 2 Relationship between credit rating and default rate

Credit rating	AAA	AA	A	BBB	BB	B	CCC	D
Expected default rate (%)	0.02	0.02	0.03	0.07	1.32	5.58	18.6	100

Table 3 The five-level deposit insurance premium rates in China (Unit: Bp)

Capital classification based on "CAMELS"	Regulatory rating					
	A		B		C	
Capital in good condition	I	0.25	II	0.5	III	1
Adequate capital on the whole	II	0.5	III	1	IV	3
Inadequate capital	III	1	IV	3	V	5

Table 4 The NCD system embedded five-level deposit insurance premium rates in China (Unit: Bp)

Capital classification	Regulatory classification					
	A		B		C	
Capital in good condition	I	0.15, 0.25, 0.3	II	0.4, 0.5, 0.7	III	0.8, 1, 2
Adequate capital on the whole	II	0.4, 0.5, 0.7	III	0.8, 1, 2	IV	2, 3, 4
Inadequate capital	III	0.8, 1, 2	IV	2, 3, 4	V	4, 5, 10

fundamental analysis, rating analysis of credit institutions or capital market analysis. According to the Credit Metrics Technical Manual of Riskmetrics Group, the relationship between default rate and rating level is shown in Table 2.

The bankruptcy (default) loss rate could only be estimated by statistical method. Loss given default is normally determined through regression analysis of historical data, implied market data analysis or recovery data discounting. . According to foreign empirical studies on bank failure liquidation rate, the loss given default is 25 % .

Given risk exposure, expected default rate and loss given default, we can get insurance premium rates of Chinese commercial banks by expected loss approach.

It's possible to realize the deposit insurance rates of China show in Table 3 by adopting the quantitative-qualitative hybrid approach and referring to previously calculated results. The regulatory rating is obtained through weighted identification of six risk indicators in accordance with CAMELS rating system, Capital classification is realized depending on total risk ratio and the risk capital ratio. The rates set forth in Table 4 can be realized in the case of embedded NCD system.

The values shown in Tables 3 and 4 were obtained after adjustment based on measured results of expected loss model. Table 4 indicates NCD system embedded rates. The difference of rate between levels in Table 4 could be seen as the refining of capital condition and regulatory rating in practical affairs. For example, "capital in good condition" is divided into two grades, while "regulatory rating A" is refined into two grades. The premium rate of 0.15 is allowable if the rating is at higher part of both levels; the premium rate of 0.25 is allowable if one is at the higher part and the other is at lower part and et.al.

In practice, the determination of rate is relative to the statutory reserve ratio of deposit insurance agency (i.e. the fund size to be kept by deposit insurance agency), which could fluctuate within a certain range. The deposit insurance rate should be finally determined based on the interaction between overall statutory reserve ratio and individual commercial banks' risk profile.

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