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Does China Require an Explicit Deposit Insurance System?

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Abstract

This study indicates that there is no explicit evidence supporting the fact that banks in China lack strength and are exposed to the risk of bankruptcy. That is, the financial industry structure in China is healthy and an increased investment and facilities in this industry should be considered. However, the empirical results of the deposit insurance pricing model show that it is necessary to establish a deposit insurance system for the banks in China as all the estimated deposit insurance premiums are significantly positive. It is suggested, therefore, that an explicit deposit insurance system should be introduced in China. Without establishment, the cost that should be borne by the banks will be shifted to the public and thus lower the operation costs of banks.

JEL classification numbers: G14, G15, G21
Keywords: China, deposit insurance system, financial distress, option pricing model, Z-Score

1 Introduction

According to information from the International Association of Deposit Insurers (IADI)[2], up to 30 September 2010, there are 106 countries adopting an explicit deposit insurance system (EDIS) and 19 countries, including China, are currently considering establishing an EDIS. An EDIS provides the function of protecting the benefits of depositors with the ultimate goal being to stabilize the financial system. It must be assessed, however, whether or not the financial system in China is unstable and likely to experience financial distress. Also, does China even require an EDIS? These questions are investigated in this study.
Since the majority of deposit accounts in Chinese banks belong to small depositors, if a

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[2]IADI, Deposit Insurance Systems. http://www.iadi.org

bank is on the brink of bankruptcy, it may induce panic amongst these small depositors that may cause a bank run. Such a crisis could affect the confidence of the depositors of other financial institutions and provoke a Domino effect. Such consequences can affect the stability of a banking system and lead to financial crises. This means that, the risk associated with an individual bank can develop into the systematic risk of the industry and, as a result, will not just effect depositors, but can also lead to economical and social fluctuation. Therefore, protecting the benefits of depositors is always a concern to governments of different countries. This issue is especially urgent in China as it is now in the period of transformation. As a result, as it is a crucial topic for China, the motivation of this study is how to fully utilize an EDIS.

Since 2007, the subprime mortgage crisis in the US has provided a good example that has illustrated how a well-developed EDIS has a huge effect on improving public confidence in financial institutes, reducing financial risk, protecting depositors' benefits, establishing efficient exit market mechanisms and maintaining financial safety. The international experience of the US demonstrates that a well-designed EDIS is beneficial to the stability of a financial system. EDIS, however, does also bring with it moral hazard issues (Laeven, 2002) and the core problem is whether or not the pricing of deposit insurance premiums are fair (VanHoose, 2007). A fair and reasonable deposit insurance premium should not only reflect the risk of banks accurately, but also restrain the banks' moral hazard effectively, improve the market and avoid cross subsidization between banks. Therefore, we should discuss the matter in two different parts – the first being the prediction of financial distress and the second being the pricing of deposit insurance.

Since Beaver (1966) and Altman (1968) applied the multiple discriminant analysis to construct the financial distress prediction model, there were many papers that aimed to explore corporate financial distress and construct the distress prediction model. The purpose is to predict the occurrence of financial distress of a company, no matter whether we analyze the crisis factors or use other prediction methods. Altman (1968) developed a corporate bankruptcy prediction model with high accuracy, with the accuracy of this model still being relatively high despite being applied for thirty years.

Afterward, Altman (2000) applied Z-Score model again to test its validity. He took the samples between 1969 and 1999 and used 2.675 as the critical value to test the long-term prediction of corporate distress at one year prior to bankruptcy. The results show that the accuracy of the samples between 1969 - 1975 and 1997 – 1999 are 85% and 94% respectively. It illustrates that, even though the Z-Score model has been applied over 30 years, it still retains its integrity and high accuracy.

Since then, there have been various identifications of the variables and extensions of the model. Altman (1993) computes the Z-score based on working capital, total assets, earnings before interest and taxes, sales, and other financial variables. For the industry of financial intermediation, Edmister and Schlarbaum (1974), Sinkey (1975, 1977), Martin (1977), Santomero and Vinso (1977), Pettway and Sinkey (1980) discussed the issue on the banking industry, while Altman (1977) did on savings and loan institutions

Except for the multiple discriminant analysis, Z-score has also been renovated into Distance-to-default ratio. This ratio measures the market value of a bank's assets in relation to the book value of its liabilities. (Boyd and Runkle, 1993; De Nicoló et al., 2004; Uhde and Heimeshoff, 2009). Gropp, Vesala and Vulpes (2002) show that an unbiased equity-based fragility indicator, a Z-score, can be derived from a Black-Scholes (1973) type of option-pricing model. The larger the Distance-to-default ratio, the lower the probability of bankruptcy. Liu, Papakirykos, and Yuan (2006) used the Canadian banks as example and found that their distance-to-default ratios are relatively high and, therefore, have a very low insolvency risk. These cases illustrate the widespread usage of Z-score.

This paper, however, is not going to examine the accuracy of Z-Score model on the prediction of banks in China. In fact, this model is treated as a suitable distress prediction model and hence will be applied to investigate if banks in China have any financial.

Moreover, for the pricing of deposit insurance, since Merton (1977) suggested the European put option pricing, other scholars have developed many revised models and new option pricing model (OPM). For example, Ronn and Verma (1986) considered the influence of capital forbearance. Kerfriden and Rochet (1993) proposed the stochastic interest rates model. Duan and Yu (1994) analyzed the multiperiod framework model. Duan and Yu (1999) applied the model of Generalized Autoregressive Conditional Heteroskedasticity (GARCH) and, diverging from the European put option pricing, extended the volatility of asset pricing into stochastic volatility. Furthermore, Allen and Saunders (1993) not only analyzed the capital forbearance of the deposit insurance company, but also examined the two factors that may cause early exercise of the option. These included the regulatory closure policy of the FDIC and the self-closure point of insured banks based on the banks' self interest, and suggested the callable perpetual American put option to assess the premium of deposit insurance. On the other hand, Hwang et al. (2009) examined the cost of bankruptcy and re-confirmed the capital forbearance[3], proposed that the policy of self-closure does not exist and suggested the Barrier option for pricing deposit insurance. This study aims to apply the three different option pricing models (OPMs) from Merton (1977), Allen and Saunders (1993) and Hwang et al. (2009) as the empirical models. The other models extended from Merton (1977) would provide similar conclusions under the setting of this study without the loss of generality.

The remainder of this paper is organized as follows: Section 2 – Methodology and Hypothesis. Section 3 – Data and Empirical results. Section 4 – Conclusion and suggestions.

2 Methodology and Hypothesis

Altman (1968) applied multiple discriminant analysis (MDA) to predict if a firm is going to go bankrupt. The variables are classified into five standard ratio categories including liquidity, profitability, leverage, solvency and activity ratios. Among these variables, 5 representative ratios are selected from 22 financial ratios to construct the following discriminant function[4]:

$$Z_{nt} = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5 \quad (1)$$

where

X_1 = working capital / total assets

X_2 = retained earnings / total assets

[3]Kane (1986) stated that considering the cost of monitoring, FDIC would further forbear the banks beyond the original condition of capital forbearance. Also, Allen and Saunders (1993) at note 12 explained that capital forbearance is the case where FDIC does not execute the regulatory closure point under the known situation.

[4]The main results are unchanged in Altman (1993) models.

X_3 = earnings before interest and taxes / total assets

X_4 = market value equity / book value of total liabilities

X_5 = sales / total assets

Z_{nt} = overall index

Since there is no information on bankruptcy of Chinese banks, the aim of this study is not to examine the accuracy of prediction of Eq. (1). Instead, the equation is treated as a proper distress prediction model and hence applied to assess whether there is any financial risk to the banks in China. In this paper, the Z-Score of each bank in each year will be calculated. $\overline{Z}_n \equiv \sum_{t=1}^{T_n} Z_{nt} / T_n$ is defined as the average Z-Score of bank n over time and $\overline{Z}_t \equiv \sum_{n=1}^{N_t} Z_{nt} / N_t$ is defined as the average Z-Score of all the banks in year t, where T_n is the number of samples for bank n, N_t is the number of samples of the banks in year t. The following are the hypotheses according to this setting and the model of Eq. (1):

Hypothesis 1 (H1): at year t, the observed samples indicate that the banks in China have potential financial distress, i.e., to test whether $\overline{Z}_t$ is less than 2.675.

Hypothesis 2 (H2): the observed samples indicate that bank n has potential financial distress, i.e., to test whether $\overline{Z}_n$ is less than 2.675.

As discussed in the previous section, this study will apply various OPM models to calculate the deposit insurance premium for the banks in China and examine if China requires the establishment of an EDIS. First, to apply OPM on the pricing of deposit insurance premium, Merton (1977) proposed using European put option pricing. The value of the option at maturity is $(0, D-A_T)^+ = \max(0, D-A_T)$ where A_T is the price of the bank's asset at time T, D is the total deposit which is the face value of the bank debt, that, in the OPM setting, is the strike price. In this paper, we standardize the bank's asset to total deposit ratio, i.e., at time t, under a given bank asset to debt ratio $a_t = A_t/D$, the exercise price of the option is 1. At the same time, A_t should be assumed as stochastic. According to Merton (1977), the price of the bank's asset to debt ratio is assumed to follow the geometric Brownian motion[5] as shown below:

$$d \ln A_t = \mu dt + \sigma dW_t, \tag{2}$$

where μ is the instantaneous expected return on assets, σ is the instantaneous expected standard deviation of asset returns, and W_t is the standard Brownian motion.

However, risk-neutral transformation should be preformed on Eq. (2) for option pricing. The calibration of density transformation is $dW_t^Q = dW_t + (\mu - r)dt$, and hence, the process of the bank's asset to debt ratio after risk adjustment is:

[5]For simplicity, this paper assume that dividends are zero.

$$d\ln A_t = rdt + \sigma dW_t^Q, \tag{3}$$

For Eq. (3), the pricing of deposit insurance under the structure of the European put option in Merton (1977) is as follows:

$$i^{Merton}(a_0, T;\ 1) = \Phi(h_1 + \sigma\sqrt{T}) - a_0\Phi(h_1), \tag{4}$$

where

$$h_1 = \frac{\ln(1/a_0) - 0.5\sigma^2 T}{\sigma\sqrt{T}},$$

and $\Phi(\bullet)$ is the cumulative density of a standard normal random variable.

Moreover, Allen and Saunders (1993) believed that the previous papers did not sufficiently consider the characteristics of deposit insurance. After examining the capital forbearance, regulatory closure policy and self-closure point, they proposed using callable perpetual American put option to assess the value of deposit insurance. The intrinsic value of the option for early exercise within the duration is $(0, D\text{-}A_t)^+$, and hence, the assessment of the value of deposit insurance can be derived as:

$$i^{AS}(a_0, \infty;\ 1) = (1 - \bar{a})(\frac{a_0}{\bar{a}})^{-\gamma_1}, \tag{5}$$

where $\bar{a}$ is the regulatory closure point, and $\gamma_1 = 2r/\sigma^2$. The resulting premium values, $i^{AS}(a_0, \infty;\ 1)$, are treated as lump-sum perpetuities and multiplied by a quarterly yield rate to derive an equivalent quarterly payment amount.

Finally, Hwang et al. (2009) applied the structure in Allen and Saunders (1993) to analyze the cost of bankruptcy and derived the value of the deposit insurance premium as:

$$i_{bc}^{AS}(a_0, \infty;\ 1) = (1 - k_{\bar{a}}\bar{a})(\frac{a_0}{\bar{a}})^{-\gamma_1}, \tag{6}$$

where i_{bc}^{AS} is the deposit insurance premium in Allen and Saunders' model with the consideration of bankruptcy cost, $k_{\bar{a}}$ is the discount factor under regulatory closure point, i.e., the cost of bankruptcy $(1\text{-}k_{\bar{a}})\bar{a}$, in which $0 < k_{\bar{a}} \le 1$, to be taken into account by the FDIC if the FDIC executes its authority. After investigating the regulatory closure policy of FDIC, Hwang et al. (2009) extended the OPM pricing method further and suggested that the regulatory closure policy is just the lower bound of the threshold of the barrier option. Under the setting of Eq. (3), the deposit insurance premium can be derived as:

$$i_{bc}^{MDOP}(a_0, T;\ 1) = e^{-rT}E^Q\left[(1 - k_{\bar{a}}\bar{a}) \cdot 1_{\{\tilde{a}_T < \bar{a}\}}\right], \tag{7}$$

where i_{bc}^{MDOP} is the modified down-and-out put option (MDOP) which is the deposit insurance premium with the consideration of bankruptcy cost and $\tilde{a}_T = \min_{0 \le s \le T} a_s$. With the former assumptions, the closed-form solution is:

$$i_{bc}^{MDOP}(a_0, T;\ 1) = (1 - k_{\bar{a}}\bar{a})e^{-rT}\left[\Phi(h_2) + (\bar{a}/a_0)^{2\gamma_2}\Phi(h_3)\right], \tag{8}$$

where

$$h_2 = \frac{\ln(\bar{a}/a_0) - (r - 0.5\sigma^2)T}{\sigma\sqrt{T}},$$
$$h_3 = \frac{\ln(\bar{a}/a_0) + (r - 0.5\sigma^2)T}{\sigma\sqrt{T}},$$
$$\gamma_2 = \frac{r}{\sigma^2} - \frac{1}{2}.$$

On the other hand, according to Ronn and Verma (1986), there are two parameters, A_0 and σ, that have to be estimated prior to compiling the deposit insurance premium using Eq. (4), Eq. (5), and Eq. (8). These two parameters can be estimated by the following two non-linear equations:

$$E = A_0\Phi(h_4 + \sigma\sqrt{T}) - \bar{a}D\Phi(h_4), \tag{9}$$

and

$$\sigma = \frac{\sigma_E E}{A_0\Phi(h_4 + \sigma\sqrt{T})}, \tag{10}$$

where

$$h_4 = \frac{\ln(A_0/\bar{a}D) - 0.5\sigma^2 T}{\sigma\sqrt{T}},$$

E is the equity of the bank and σ_E is the instantaneous standard deviation of the return on E.

As discussed in the former session, regardless of whether we use the models of Merton (1977), Allen and Saunders (1993) or Hwang et al. (2009), there exists a closed-form solution of the stochastic process of Eq. (3). This study will determine the deposit insurance premium under different OPMs, i.e., i^{Merton}, i^{AS}, and i^{MDOP}, by applying the empirical method. In this paper, $\bar{i}_n^m \equiv \sum_{t=1}^{T_n} i_{nt}^m / T_n$ is defined as the average deposit insurance premium of bank *n* for each quarter and $\bar{i}_t^m \equiv \sum_{n=1}^{N_t} i_{nt}^m / N_t$ is defined as the average deposit insurance premium of all the banks in quarter *t*, where m=*Merton*, *AS*, and *MDOP*, and bankruptcy cost is not taken into account, i.e., $k_{\bar{a}}$ is assumed to be 1 ($k_{\bar{a}} = 1$). This is because, if the hypothesis is accepted in the latter analysis without considering bankruptcy cost, then the same conclusion can be drawn even with bankruptcy cost. Therefore, referring to the former empirical findings, we can test each bank or the banks in each year and estimate whether the deposit insurance premium differs from zero. If the estimate is greater than zero, it means costs that should be borne by banks in China have been shifted to the public. On the other hand, it means an EDIS should be established for these banks in order to remove the cost borne by the public. Therefore, the assumption for this paper is as follows:

Hypothesis 3 (H3): The deposit insurance system should be established in quarter *t* in order to transfer the cost back to the banks instead of shifting the cost to the public, i.e., to test whether $\bar{i}_t^m$ is greater than 0.

Hypothesis 4 (H4): Since the bank *n* has been listed, it did not pay for its payable deposit insurance premium and hence its operation cost is under-estimated, i.e., to test whether $\bar{i}_n^m$ is greater than 0.

In the next part of this paper, we will make use of the information of 14 listed banks in China to test the mentioned hypotheses and hence prove whether China requires an EDIS and if there is any potential financial distress.

3 Data and Empirical Results

This study takes Chinese banks which were listed in the third quarter of 2009 as the research sample and mainly uses the information of each bank after its listing. Since some banks were listed in the early days, information in early periods is unable to be obtained. For example, the IPO date of Shenzhen Development Bank Co. is 1991/4/3 but the earliest quarterly data that can be obtained is from quarter one of 2002. The data sources of this study are the Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE) while the research period is from the listing date of each bank to quarter three of 2009. The listing date and period of research data is shown in Table 1.

Table 1: The listing schedule of Chinese banks and the research period

Bank	IPO date	Code	Period
China Minsheng Banking Co.	2000/12/19	CMSB	2001q1~2009q3
Shanghai Pudong Development Bank Co. Ltd.	1999/11/10	SPDB	2001q3~2009q3
Shenzhen Development Bank Co.	1991/04/03	SHDB	2002q1~2009q3
China Merchants Bank Co.	2002/04/09	CMCB	2002q3~2009q3
Hua Xia Bank Co. Ltd.	2003/09/12	HXB	2003q4~2009q3
Bank Of China Ltd.	2006/07/05	BC	2007q1~2009q3
Industrial & Commercial Bank Of China Ltd.	2006/10/27	ICB	2007q1~2009q3
Industrial Bank Co. Ltd.	2007/02/05	IB	2007q2~2009q3
Bank of Communications Co. Ltd.	2007/05/15	BCC	2007q3~2009q3
China Citic Bank Corp. Ltd.	2007/04/27	CCTB	2007q3~2009q3
Bank Of Beijing Co. Ltd.	2007/09/19	BBJ	2007q4~2009q3
Bank Of Ningbo Co.	2007/07/19	BNB	2007q4~2009q3
Bank Of Nanjing Co. Ltd.	2007/07/19	BNJ	2007q4~2009q3
China Construction Bank Corp.	2007/09/25	CCSB	2007q4~2009q3

Note: 2002q1 represents quarter 1 of 2002 and so on.

Table 1 is ranked by period and from it we can find that amongst all the collected data, the information for 2007 and 2008 is the most integrated. Therefore, testing for H1 and H2 using data from 2007 and 2008 would provide more relevant results.

First, when testing H1 and H2, the sample used is annual data. Then, the Altman Z-Score is calculated for each bank by year and tested against the hypotheses mentioned previously. Since the 5 representative financial ratios proposed by Altman is not the focus of this study, the summary statistics of these 5 variables are not reported. The results of the tests are shown in Table 2.

Table 2: Altman *Z*-Score of the banks in China

	Year	Bank														Test of H1			
		CMSB	SPDB	SHDB	CMCB	HXB	BC	ICB	IB	BCC	CCTB	BBJ	BNB	BNJ	CCSB	Mean	Std	t-value	p-value
	2001	3.6579	4.3900	3.7495												3.9325	0.3989	5.4599	**0.0160**
	2002	2.8410	3.6089	3.6574	3.0002											3.2769	0.4169	2.8871	**0.0316**
	2003	3.1515	3.8481	3.4209	3.0379	3.4141										3.3745	0.3127	5.0026	**0.0037**
	2004	3.8630	4.2065	4.2277	3.6737	3.5548										3.9052	0.3053	9.0087	**0.0004**
	2005	4.1275	4.2905	3.9121	3.7357	3.8103										3.9752	0.2298	12.6536	**0.0001**
	2006	3.8857	4.8016	4.5817	3.8028	4.0436	4.2120									4.2212	0.3965	9.5520	**0.0001**
	2007	5.0205	4.7533	5.8147	5.0256	4.8165	5.9927	4.9553	5.3980	5.1577	4.9345	4.2069	5.2474	5.1714	5.2661	5.1258	0.4388	20.8968	**0.0000**
	2008	6.1514	4.6826	6.2749	5.6776	5.6294	5.8547	5.4100	5.9002	5.0717	5.7723	5.2708	5.9599	5.8826	5.6966	5.6596	0.4283	26.0711	**0.0000**
Test of H2	Mean	4.0873	4.3227	4.4549	3.9934	4.2114	5.3531	5.1827	5.6491	5.1147	5.3534	4.7389	5.6037	5.5270	5.4813				
	Std	1.0581	0.4306	1.0506	1.0005	0.8524	0.9907	0.3215	0.3551	0.0608	0.5924	0.7523	0.5038	0.5029	0.3044	All samples			
	t-value	3.7752	5.4110	4.7916	3.2276	5.0984	7.1525	11.0300	11.8450	56.7301	6.3945	3.8799	8.2214	9.8226	13.0367	Mean	Std	t-value	p-value
	p-value	**0.0035**	**0.0582**	**0.0010**	**0.0116**	**0.0007**	**0.0002**	**0.0288**	**0.0268**	**0.0056**	**0.0494**	**0.0803**	**0.0385**	**0.0051**	**0.0244**	4.5983	0.9357	15.3814	**0.0000**

Note: Words in bold indicate significance at least at the 0.1 level.

Table 2 indicates that when testing against H1 or H2, all the results do not support the hypotheses of H1 and H2 and they are significant at the 0.1 level. In other words, financial risk does not exist amongst the banks in China. Table 2 also shows that the average values of Altman Z-Score for all the banks in 2007 and 2008 are 5.1258 and 5.6596 respectively and both of them are significant at the 0.01 level. The average value of Altman Z-Score for 2008 is higher than that for 2007 implying that the banks in China were not affected by the global subprime mortgage crisis and their financial condition became even more stable. The result also indicates that China is now an important field which all foreign banks want to seize. However, due to the deficiency of the institutions and legal system, foreign banks are often earning less profit than the Chinese banks. Therefore, results not supporting H1 and H2 do not mean that China does not require an EDIS. We will then apply the deposit insurance pricing model from Merton (1977), Allen and Saunders (1993) and Hwang et al. (2009) to examine the essentiality of an EDIS in China.

Differing from the characteristics of data for calculating Altman *Z*-Score, quarterly data is used to calculate deposit insurance premium. The results of deposit insurance premium for i^{Merton}, i^{AS}, and i^{MDOP} are consolidated in Table 3, Table 4 and Table 5. In these tables, the unit of deposit insurance premium per dollar is the basis points (bps) and $\overline{\alpha} = 0.97$.

Table 3: Deposit insurance premium for the banks in China, i^{Merton} (bps)

Quarter	Bank														Test of H3			
	CMSB	SPDB	SHDB	CMCB	HXB	BC	ICB	IB	BCC	CCTB	BBJ	BNB	BNJ	CCSB	Mean	Std	t-value	p-value
2001q1	1.2635														1.2635	N.A.	N.A.	N.A.
2001q2	536.2192														536.2192	N.A.	N.A.	N.A.
2001q3	182.0651	5.6335													93.8493	124.7560	1.0639	0.2402
2001q4	85.7771	7.0068													46.3919	55.6990	1.1779	0.2241
2002q1	0.0081	6.9191	25.9717												10.9663	13.4467	1.4126	0.1467
2002q2	450.9241	176.8699	228.3891												285.3944	145.6490	3.3939	**0.0385**
2002q3	263.2786	154.0938	420.8369	5.1995											210.8522	175.4581	2.4034	**0.0478**
2002q4	432.2493	183.0514	80.5433	187.4137											220.8144	149.3568	2.9569	**0.0298**
2003q1	3.0920	0.0000	162.1304	0.0996											41.3305	80.5461	1.0263	0.1901
2003q2	504.5802	241.6953	67.3389	73.2341											221.7121	205.1751	2.1612	**0.0597**
2003q3	271.3252	67.2977	104.1217	92.0260											133.6927	93.0261	2.8743	**0.0319**
2003q4	0.0000	184.3888	0.0000	51.3848	120.8072										71.3162	80.3182	1.9855	**0.0590**
2004q1	107.8738	25.4380	34.7464	0.0000	0.0000										33.6116	44.2788	1.6974	**0.0824**
2004q2	61.5723	3.8653	301.3223	131.5669	24.8806										104.6415	120.1883	1.9468	**0.0617**
2004q3	7.9815	0.0034	0.0000	21.2485	119.8732										29.8213	51.0838	1.3054	0.1309
2004q4	170.1002	60.1595	56.3469	55.6407	47.8353										78.0165	51.6707	3.3762	**0.0139**
2005q1	6.4992	0.0000	2.9324	242.4735	0.0006										50.3811	107.4162	1.0488	0.1767
2005q2	266.3750	12.0810	126.1947	5.7093	67.0224										95.4765	107.2060	1.9914	**0.0586**
2005q3	0.0000	18.6209	0.4417	0.4076	28.0244										9.4989	13.0510	1.6275	**0.0895**
2005q4	16.6453	93.2440	5.6022	41.5426	5.0570										32.4182	37.0795	1.9550	**0.0611**
2006q1	0.0571	39.9251	4.6632	0.0000	0.0000										8.9291	17.4436	1.1446	0.1581
2006q2	104.3584	3.5722	0.0000	108.5620	31.7436										49.6473	53.3211	2.0820	**0.0529**
2006q3	74.1410	0.3344	24.0560	78.4910	0.0000										35.4045	38.6301	2.0494	**0.0549**
2006q4	363.8278	37.9208	38.2597	11.6140	234.1657										137.1576	155.0644	1.9778	**0.0595**
2007q1	0.4392	74.2801	291.8107	1.9168	5.9548	0.8221	4.2579								54.2117	108.1333	1.3264	0.1165
2007q2	224.4635	241.2901	75.2115	19.7151	197.6585	0.0000	2.2126	192.1185							119.0837	105.0075	3.2076	**0.0075**
2007q3	170.0993	29.4266	72.6463	105.6656	40.3305	0.0006	0.2644	5.2861	0.4244	0.0302					42.4174	57.6433	2.3270	**0.0225**
2007q4	10.1036	130.3691	228.9059	22.4116	148.2406	0.0000	0.0000	0.0000	0.4606	17.6216	156.0506	0.0000	0.0114	0.0043	51.0128	78.5464	2.4301	**0.0152**
2008q1	132.5581	4.8972	306.2315	63.9595	254.4484	0.0324	0.0471	0.0277	96.4808	0.2644	0.9202	0.6053	3.6630	22.4660	63.3287	101.4847	2.3349	**0.0181**
2008q2	0.5427	232.2513	154.8878	0.0000	144.5940	0.0000	0.0000	5.8769	68.0803	2.0433	0.0000	2.6923	0.0000	0.0039	43.6409	76.8896	2.1237	**0.0267**
2008q3	0.0000	199.1732	0.0000	12.6454	144.8078	0.0000	0.0000	26.7642	0.3973	0.0000	26.4473	32.2986	0.0127	0.1152	31.6187	61.5579	1.9219	**0.0384**
2008q4	0.0000	303.8577	4.9417	0.0000	66.4059	1.9315	0.0000	89.4316	4.9017	2.4408	0.0000	0.0000	0.0000	0.0003	33.8508	82.6266	1.5329	**0.0746**
2009q1	99.2815	97.5145	61.9872	56.8338	0.0017	110.2009	18.1606	61.6162	92.5839	0.0094	0.2543	50.6555	116.4521	203.0082	69.1829	56.5771	4.5753	**0.0003**
2009q2	350.9110	270.1632	28.8667	94.8591	28.0124	0.0006	1.0404	54.2318	192.3084	52.7523	2.9789	5.9033	52.0769	0.1828	81.0205	111.0459	2.7300	**0.0086**
2009q3	0.0000	0.0649	0.0000	32.5354	0.0004	0.0272	0.0000	0.2162	0.0000	0.0000	6.1675	48.8828	10.9729	0.0781	7.0675	14.9545	1.7683	**0.0502**
Test of H4: Mean	139.9604	88.0427	93.8512	52.3157	71.2444	10.2741	2.3621	43.5569	50.6264	8.3513	24.1023	17.6297	22.8986	28.2323				
Test of H4: Std	164.9053	96.2393	113.9006	60.1606	79.5964	33.1474	5.4094	60.9663	67.5047	17.5920	54.0525	22.5348	41.7683	71.0539	All samples			
Test of H4: t-value	4.7255	2.5875	4.7334	4.2602	5.2953	1.6691	1.2351	2.2593	2.1212	1.4242	1.4789	2.2128	1.8183	1.1920	Mean	Std	t-value	p-value
Test of H4: p-value	**0.0000**	**0.0180**	**0.0000**	**0.0001**	**0.0000**	**0.0531**	0.1283	**0.0251**	**0.0358**	**0.0961**	**0.0850**	**0.0313**	**0.0495**	0.1337	67.4731	102.0054	10.1185	**0.0000**

Note: 2002q1 represents quarter 1 of 2002 and so on. Words in bold indicate significance at least at the 0.1 level.

Table 4: Deposit insurance premium for the banks in China, i^{AS} (bps)

Quarter	Bank														Test of H3			
	CMSB	SPDB	SHDB	CMCB	HXB	BC	ICB	IB	BCC	CCTB	BBJ	BNB	BNJ	CCSB	Mean	Std	t-value	p-value
2001q1	0.7541														0.7541	N.A.	N.A.	N.A.
2001q2	1.6761														1.6761	N.A.	N.A.	N.A.
2001q3	1.6452	1.4517													1.5485	0.1368	16.0104	**0.0199**
2001q4	1.6232	1.4012													1.5122	0.1570	13.6254	**0.0233**
2002q1	0.4205	0.6760	1.3508												0.8158	0.4806	2.9398	**0.0494**
2002q2	1.4741	1.4519	1.4605												1.4622	0.0112	226.4623	**0.0000**
2002q3	1.4588	1.4477	1.4749	1.2511											1.4081	0.1053	26.7541	**0.0001**
2002q4	1.4793	1.4496	1.2664	1.4444											1.4099	0.0969	29.1025	**0.0000**
2003q1	0.9699	0.0000	1.2031	1.0306											0.8009	0.5430	2.9499	**0.0300**
2003q2	1.4764	1.4622	1.3762	1.4128											1.4319	0.0461	62.1827	**0.0000**
2003q3	1.4601	1.3360	1.4179	0.8200											1.2585	0.2969	8.4786	**0.0017**
2003q4	0.0000	1.3000	0.0000	1.4118	1.4359										0.8296	0.7590	2.4439	**0.0355**
2004q1	1.3582	1.2821	1.3800	0.0518	0.4164										0.8977	0.6204	3.2353	**0.0159**
2004q2	1.3617	1.1991	1.4748	1.3873	1.3714										1.3589	0.0999	30.4043	**0.0000**
2004q3	1.0930	0.5387	0.3007	1.2417	1.3149										0.8978	0.4516	4.4450	**0.0056**
2004q4	1.5909	1.5337	1.2294	1.3475	1.5654										1.4534	0.1576	20.6251	**0.0000**
2005q1	1.3090	0.0000	0.4569	1.6435	0.3189										0.7456	0.6973	2.3911	**0.0375**
2005q2	1.6541	1.4716	1.5191	1.3963	1.5592										1.5201	0.0964	35.2536	**0.0000**
2005q3	0.0511	1.3942	1.1434	1.1763	1.1714										0.9873	0.5329	4.1426	**0.0072**
2005q4	1.4759	1.5987	1.1696	1.3767	1.3917										1.4025	0.1573	19.9424	**0.0000**
2006q1	0.4228	1.4090	1.2442	0.0000	0.2059										0.6564	0.6325	2.3205	**0.0405**
2006q2	1.5992	1.2905	0.0327	1.6159	1.5175										1.2112	0.6714	4.0334	**0.0078**
2006q3	1.7768	0.0995	0.4261	1.6768	0.0935										0.8146	0.8443	2.1573	**0.0486**
2006q4	1.8669	1.6869	1.5985	1.5809	1.8404										1.7147	0.1334	28.7494	**0.0000**
2007q1	1.3174	1.1622	2.0517	1.4742	1.5135	1.4278	1.4670								1.4877	0.2763	14.2474	**0.0000**
2007q2	2.2379	2.2191	2.0858	2.0545	2.2124	0.8573	1.5625	2.2131							1.9303	0.4875	11.1989	**0.0000**
2007q3	2.7326	2.4753	2.5485	2.6431	2.5350	0.6573	1.1343	1.8648	1.3286	1.7202					1.9640	0.7341	8.4604	**0.0000**
2007q4	1.2373	2.8102	2.7941	2.4370	2.8997	0.0000	0.0000	0.0000	1.7731	2.5195	2.9333	0.1367	1.5817	0.6200	1.5531	1.2031	4.8301	**0.0002**
2008q1	2.8330	1.5323	3.0230	2.3304	1.4352	1.6565	1.5542	0.1307	2.6965	1.9015	0.7305	2.2804	2.6137	1.9105	1.9020	0.8149	8.7329	**0.0000**
2008q2	1.8528	2.9163	2.8392	0.0029	2.6802	0.0313	0.2761	2.1027	2.6205	1.4562	0.0000	2.1274	0.4644	0.5123	1.4202	1.1581	4.5883	**0.0003**
2008q3	0.0000	2.9437	0.0000	2.5925	2.4950	0.0084	0.0000	0.0119	0.7727	0.3217	2.6713	2.7792	1.4797	1.1687	1.2318	1.2243	3.7645	**0.0012**
2008q4	0.0003	1.6629	1.4299	0.1071	1.5961	1.2700	0.7965	1.5950	1.4298	1.4483	0.6206	0.0742	0.0045	0.6901	0.9090	0.6565	5.1807	**0.0001**
2009q1	1.6007	1.6207	1.5742	1.6025	0.8157	1.6230	1.5565	1.5446	1.6149	1.1350	1.2356	1.6048	1.6377	1.6459	1.4865	0.2472	22.5015	**0.0000**
2009q2	1.6679	1.6547	1.2818	1.5935	1.4351	0.7748	1.1178	1.5790	1.6276	1.5866	1.4357	1.4763	1.6035	1.1569	1.4280	0.2595	20.5928	**0.0000**
2009q3	0.0000	0.4865	0.3605	0.9716	0.6425	0.2692	0.1897	1.0910	0.0000	0.0662	1.3090	1.5810	1.5539	0.7407	0.6615	0.5599	4.4207	**0.0003**
Test of H4: Mean	1.2994	1.4232	1.3392	1.3681	1.4360	0.7796	0.8777	1.2133	1.5404	1.3506	1.3670	1.5075	1.3674	1.0557				
Std	0.7179	0.7222	0.7961	0.7012	0.7680	0.6469	0.6512	0.8632	0.8359	0.7614	1.0008	0.9672	0.7972	0.5099	All samples			
t-value	10.0766	5.5740	9.6637	9.5582	11.0621	6.4897	3.8121	4.4445	5.2123	5.3214	4.5303	4.4085	5.6891	6.2107	Mean	Std	t-value	p-value
p-value	**0.0000**	**0.0004**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0033**	**0.0008**	**0.0006**	**0.0004**	**0.0005**	**0.0016**	**0.0001**	**0.0001**	1.3113	0.7564	26.5216	**0.0000**

Note: 2002q1 represents quarter 1 of 2002 and so on. Words in bold indicate significance at least at the 0.1 level.

Table 5: Deposit insurance premium for the banks in China, i^{MDOP} (bps)

Quarter	Bank														Test of H3			
	CMSB	SPDB	SHDB	CMCB	HXB	BC	ICB	IB	BCC	CCTB	BBJ	BNB	BNJ	CCSB	Mean	Std	t-value	p-value
2001q1	0.0080														0.0080	N.A.	N.A.	N.A.
2001q2	185.6254														185.6254	N.A.	N.A.	N.A.
2001q3	120.7974	3.3439													62.0706	83.0522	1.0569	0.2412
2001q4	60.4510	3.4415													31.9462	40.3118	1.1207	0.2319
2002q1	0.0000	0.0351	18.6180												6.2177	10.7390	1.0028	0.2108
2002q2	179.5405	116.7076	133.6876												143.3119	32.5033	7.6369	**0.0084**
2002q3	203.5606	104.9147	232.5008	2.4544											135.8576	104.3671	2.6035	**0.0401**
2002q4	270.4252	128.5078	41.9919	143.6239											146.1372	94.1822	3.1033	**0.0266**
2003q1	0.2136	0.0000	70.5752	0.0099											17.6997	35.2505	1.0042	0.1946
2003q2	218.8932	136.6845	51.7018	56.8757											116.0388	78.8349	2.9438	**0.0302**
2003q3	218.0281	46.2251	82.2525	4.6462											87.7880	92.4359	1.8994	**0.0769**
2003q4	0.0000	114.4700	0.0000	39.1660	89.1112										48.5494	51.9445	2.0899	**0.0524**
2004q1	79.7067	14.0443	26.4909	0.0000	0.0000										24.0484	33.0172	1.6287	**0.0894**
2004q2	45.7206	1.3589	280.4034	104.8915	18.6569										90.2063	113.3388	1.7797	**0.0749**
2004q3	1.4473	0.0000	0.0000	9.6278	76.5781										17.5307	33.2505	1.1789	0.1519
2004q4	141.5757	44.7819	13.9602	22.5825	36.8599										51.9521	51.5207	2.2548	**0.0436**
2005q1	2.1116	0.0000	0.0007	203.2964	0.0000										41.0817	90.6853	1.0130	0.1842
2005q2	210.1593	7.6487	91.4722	2.7469	51.9115										72.7877	84.8597	1.9180	**0.0638**
2005q3	0.0000	8.9238	0.0537	0.0609	4.8829										2.7843	4.0225	1.5477	**0.0983**
2005q4	10.6793	72.9871	0.8668	18.7510	2.3867										21.1342	29.8578	1.5828	**0.0943**
2006q1	0.0000	20.3833	1.0826	0.0000	0.0000										4.2932	9.0069	1.0658	0.1733
2006q2	82.4662	1.0503	0.0000	82.1459	22.7385										37.6802	41.7366	2.0187	**0.0568**
2006q3	56.9782	0.0000	0.0127	56.0176	0.0000										22.6017	30.9447	1.6332	**0.0889**
2006q4	170.7082	27.4336	22.6266	6.5249	174.6732										80.3933	84.6223	2.1243	**0.0504**
2007q1	0.0574	8.0679	221.5074	0.4913	1.7868	0.1741	1.0756								33.3087	83.0351	1.0613	0.1647
2007q2	126.5339	192.0890	58.2470	14.6214	141.4248	0.0000	0.5576	134.6645							83.5173	74.4985	3.1708	**0.0078**
2007q3	129.6162	21.1471	55.0847	82.0289	29.9609	0.0000	0.0080	1.5257	0.0270	0.0060					31.9405	44.3580	2.2770	**0.0244**
2007q4	0.5448	103.0046	190.2204	13.7244	110.8182	0.0000	0.0000	0.0000	0.0906	11.6871	108.9939	0.0000	0.0013	0.0000	38.5061	62.3398	2.3112	**0.0189**
2008q1	104.1463	0.5681	191.6667	34.6354	78.3039	0.0047	0.0052	0.0000	73.3457	0.0687	0.0046	0.3059	2.5662	6.2963	35.1370	57.5496	2.2845	**0.0199**
2008q2	0.1277	199.4489	124.1646	0.0000	110.2116	0.0000	0.0000	2.2617	49.2170	0.1861	0.0000	1.0767	0.0000	0.0000	34.7639	63.7619	2.0400	**0.0311**
2008q3	0.0000	148.3650	0.0000	8.8326	94.4681	0.0000	0.0000	0.0000	0.0023	0.0000	19.3041	23.6030	0.0011	0.0037	21.0414	44.5022	1.7691	**0.0502**
2008q4	0.0000	188.3599	2.7137	0.0000	50.9143	0.5066	0.0000	70.1699	2.6904	1.4319	0.0000	0.0000	0.0000	0.0000	22.6276	52.5096	1.6124	**0.0654**
2009q1	77.8828	70.9386	48.2716	42.4704	0.0000	80.4849	13.6619	46.7523	68.9591	0.0010	0.0539	37.2987	75.4913	140.5228	50.1992	39.6085	4.7421	**0.0002**
2009q2	193.3676	221.4058	8.5907	74.9214	15.7007	0.0000	0.1100	41.9632	156.6495	40.5220	1.6712	3.7886	38.5769	0.0238	56.9494	76.6547	2.7798	**0.0078**
2009q3	0.0000	0.0000	0.0000	1.9333	0.0000	0.0000	0.0000	0.0183	0.0000	0.0000	2.0023	37.6227	8.1888	0.0003	3.5547	10.0513	1.3233	0.1043
Test of H4: Mean	82.6107	60.7981	63.5085	35.4166	46.3079	7.3791	1.4017	29.7356	38.9980	5.9892	16.5037	12.9620	15.6032	18.3559				
Test of H4: Std	86.6322	70.9952	81.2546	49.3168	51.5083	24.2470	4.0807	44.9326	54.1018	13.4994	37.9476	17.0515	27.5502	49.4120	All samples			
Test of H4: t-value	5.3093	2.4222	4.4899	3.5182	5.3188	1.6389	0.9715	2.0927	2.0388	1.3310	1.4424	2.1501	1.8784	1.1145	Mean	Std	t-value	p-value
Test of H4: p-value	**0.0000**	**0.0230**	**0.0000**	**0.0009**	**0.0000**	**0.0562**	0.1818	**0.0329**	**0.0404**	**0.1099**	**0.0899**	**0.0343**	**0.0449**	0.1487	44.0648	64.7961	10.4028	**0.0000**

Note: 2002q1 represents quarter 1 of 2002 and so on. Words in bold indicate significance at least at the 0.1 level.

From the above tables, it can be found that the results for i^{Merton} and i^{MDOP} are exactly the same except for quarter 3 of 2009. In the tests against H3, the results support the hypothesis since quarter 4 of 2007 meaning that DSI should be established for banks in China in order to transfer the cost back to them instead of the cost being borne by the public. Moreover, in the tests against H4, apart from ICB and CCSB, the operation costs of all the other 12 banks are under-estimated. In Table 4, the results of i^{AS} support both H3 and H4. Besides those results, there is a question of how to establish a high-quality EDIS. The study suggested that the focus of an EDIS should be on the exit mechanism for banks with serious problems and on the brink of bankruptcy. Also, the legislation of deposit insurance systems is another key issue as it may provide the legal ground for assisting banks, guiding the process of bankruptcy and preventing the misuse of forbearance policy. Furthermore, the standard deviation of all samples indicates that the discretion power of the model of Allen and Saunders (1993) is the lowest as its result is 0.7564bps, far lower than the 102.0054bps from the model of Merton (1977) and 64.7961bps from the model of Hwang et al. (2009). Similar results can also be found in Table 6.

The results of deposit insurance premium for i^{Merton}, i^{AS}, and i^{MDOP} are consolidated and expressed as quantile in Table 6 in order to support the suggestions of the EDIS establishment in China as proposed.

Table 6: Quantile of deposit insurance premium for the banks in China (bps)

Quantile	i^{Merton}	i^{AS}	i^{MDOP}
min	0.0000	0.0000	0.0000
0.10	0.0000	0.0686	0.0000
0.25	0.0835	0.8013	0.0016
0.50	17.8911	1.4325	6.4106
0.75	96.0753	1.6224	72.4750
0.90	218.0269	2.4051	141.5304
max	536.2192	3.0230	280.4034

As mentioned, the results in Table 6 demonstrate that calculation using the model of Allen and Saunders (1993) provided a range of deposit insure premia that is very small. For example, 0.9 quantile is higher than the 0.1 quantile by only 2.3365bps. According to the current assessment rate schedule issued by the Federal Deposit Insurance Corporation (FDIC), the difference between the highest and lowest total base assessment rate is 70.5bps. Apparently, the Allen and Saunders (1993) model is not an appropriate standard for deposit insurance pricing.

4 Conclusion and Suggestion

First, according to the empirical results, up to 2008, there is no risk of bankruptcy for Chinese banks. Moreover, Chinese banks were not affected by the global subprime mortgage crisis in 2007 and 2008, and their financial condition became even more stable. This indicates that the structure of the Chinese financial industry is very healthy and, therefore, it is worthwhile to invest in the industry and set up offices. However, this does not imply that China does not require a deposit insurance system.

On the other hand, the results that support H3 and H4 implied that the operation costs of Chinese banks are under-estimated and, as result, China really needs to establish an EDIS promptly. Though, practically, the implicit DIS (IDIS) has been operated all the way, such a situation was created by the uniqueness of the Chinese banking industry. In China, banks are actually national banks. The government controls and owns the banks directly or indirectly and is the biggest owner of Chinese banks. It is inevitable that the government would interfere and get involved into the normal operations of these banks. Therefore, if there were any problem with the bank's assets, it would be rectified by the government. This, obviously, is an unreasonable phenomenon as the risks of the banks are, in fact, borne by the public.

Finally, there are some suggestions about the establishment of EDIS:

a. There are two common types of EDIS. The first one is to set up and run the EDIS through the government, such as the FDIC and the Canada Deposit Insurance Corporation (CDIC). The second one is to set up the EDIS by the government and the banks, just like the Deposit Insurance Corporation of Japan (DICJ). According to the political system in China, it is suggested that the deposit insurance institution should be set up and run by the government.
b. Determination of deposit insurance premium: it is recommended to refer to the setting of the range by Merton (1977) and Hwang et al. (2009) in Table 6, or the current assessment rate schedule published by the FDIC.
c. International Monetary Fund (IMF) suggested to members that the maximum settlement of claims should be set at around double of per capita GDP. However, data shows that the 2009 per capita GDP in China is only USD3,678. According to IMF's recommendation and the exchange rate at that time, the amount is only around CNY50,000 which, obviously, is too low in China. Since one of the reasons of an EDIS is to protect small depositors, it is recommended that the maximum amount of settlement of claims should be set at 99% of the deposit in the accounts of such depositors.

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