

Banks' Lending under the Capital Adequacy Supervision¹

LE PRÊT DES BANQUES SOUS LA SUPERVISION DE LA SUFFISANCE DU CAPITAL

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Abstract: Due to the profound influence of banking crisis on economic growth, the capital adequacy has been closely concerned by financial authorities in many nations. Thanks to globalization of business, the financing environment has improved. Therefore, a number of restrictions on banking sectors has been not as tough as once were.

However, the requirements on capital adequacy have been stricter than ever. Yet the behavior adjustment of banking sectors and its effects on every aspects of national economy still provokes controversy. As various theories and abundant evidences indicate --- the implementation of Basel Agreement would lead to social credit crunch due to the fact that national commercial banks reduce credit transaction in order to meet the requirement of capital regulation(8%), which would negatively affect the stability of macro-economy.

This thesis intents to answer, via theoretical analysis and demonstration in banking system of Hubei Province, the question of potential adjustment and shrinking effects after implanting Capital Regulation of Commercial Banks. We believe since the implementing of new principle in 2004, each bank has adjusted their gross and structure of credit. The effect of credit crunch is mainly seen by the impacts on small and middle sized enterprises.

Key words: capital adequacy, risk-taking incentives, credit crunch

Résumé: En raison de l'influence profonde de la crise bancaire sur la croissance économique, les autorités financières de beaucoup de pays prêtent une grande attention à la suffisance du capital. Grâce à la globalisation du commerce, l'environnement financier s'est amélioré. Donc, de nombreuses restrictions dans le secteur bancaire ne sont plus aussi dures qu'elles étaient autrefois.

Cependant, l'exigence de la suffisance du capital est plus stricte qu'auparavant. L'ajustement du secteur bancaire et son influence sur tous les aspects de l'économie nationale provoquent quant même des controverses. De diverses théories et des preuves abondantes indiquent que l'application de Basel Agreement pourrait conduire au resserrement de crédit dû au fait que les banques commerciales réduisent leur offre de crédit afin de répondre à la demande de la régulation du capital(8%), ce qui pourrait affecter négativement la stabilité de la macro-économie.

L'essai présent tente de répondre, par le biais de l'analyse théorique et la démonstration du système bancaire de la province du Hubei, à la question de l'ajustement potentiel et des effets diminutifs après la mise en oeuvre de la Régulation du Capital des Banques Commerciales. Nous croyont, depuis la mise en application du nouveau principe en 2004, chaque banque a ajusté leur total et structure du crédit. Les effets du resserrement de crédit se voient principalement dans ses influences sur les petites et moyennes entreprises.

Mots-Clés: suffisance du capital, motivation de la prise de risque, resserrement de crédit

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1. INTRODUCTION

Banking crisis has profound influence on a nation's economy. Consequently, the capital adequacy has been the key issue of financial authorities. Thanks to globalization, many previous restrictions on banking sectors have been removed whereas more severe restrictions on capital are introduced. Capital management is currently strengthened in China as well. According to Capital Regulation of Commercial Banks issued in 2004, the first day of January was the deadline of capital adequacy, since when China's banking management has been a new stage. The adequacy of capital of banks, however, has been commonly low, which breeds high stress to each bank which has to adapt to risk-taking incentives and credit behavior. This factor has been included in share redistribution of commercial banks.

A question, naturally, arise: is credit crunch a necessary outcome by capital adequacy management? Is credit crunch unavoidable when carry out Capital Regulation of Commercial Banks? This paper intends to offer an answer, via theoretical analysis and examples in banking system of Hubei Province, to these questions. The rapidly-changing financial innovation of international banking has produced complicated financial risks, which is out of control of the old Basel Agreement. Therefore, a supplement was added by Basel Committee in 1996, which put market risk into capital management. They proposed the *The new Basel Capital Accord II* in 2004, which is composed by three major sections: the minimum capital adequacy, management of authorities, and market discipline. The new agreement offers more comprehensive techniques to handle various, including credit, market, and operational, risks.

2. RISK-TAKING INCENTIVES UNDER CAPITAL REGULATION

The requirement of capital requirement would reduce bank's risk-taking incentives (Furlong and Keeley,1989).On the contrary, Jurg Blum (1999) believe it would increase risks via a dynamic analysis. As a reference of Jurg Blum's structure (1999), we establish a one-period model in order to analyze the impacts of capital adequacy regulation on bank risk taking.

Hypothesis:

(1) Banking capital is W, deposit is D, the duration of deposit and loan are one period , when time t = 0, banks absorb deposit and invest on loan. If T = 1, banks take back loan and pay for deposit rates C (D).

(2) The competition of banking is incomplete because every single banking sector would change its

interest rate accordingly (China's banks apply floating range rate). Increasing rate (dominant and recessive trait) would increase overall deposit. As a result, $C'(D) > 0$, $\exists C'(D) > C(D)/D$.

(3) Customers are not sensitive to capital volume of banks and the determining factor is interest rate.

(4) If capital is fully used for loan, the rate of return from a loan is a random variable of the binomial distribution:

$p(\tilde{R}=x) = p(x)$, $p(\tilde{R}=0) = 1-p(x)$, $p'(x) < 0$. Here, $p(x)$ is the probability of event x; x is the expected return of related loan with random risk. The higher x is, the lower probability of keeping contract is -- that is, the potential risk is higher. The option of x reflects risk-taking incentives of a bank.

(5) The cost rate of capital is ρ , ρ is exogenous quantitative (the return on social average share ownership before tax), and for random x, $\rho > p(x)x$.

Because x (the expected return of the loan with random risk selected by banks) is unlikely to be lower than $C'(D)$ (marginal cost of deposit of any unit), $x - C'(D) \geq 0$. In the following analysis, we take total asset as risk asset so it is easy to understand.

The regulation of capital adequacy requires

$$W / (W+D) \geq 1/k$$

that is, $D \leq (k - 1)W$

k is The inverse of capital adequacy rate. A comparatively lower k means higher capital adequacy.

Here, the optimization issue of bank is:

$$\text{Max } p(x)[x(W+D) - C(D)] - \rho W \tag{1}$$

$$x, D$$

$$s.t. D \leq (k - 1)W$$

The objective function is the non-decreasing function of D, which is:

$$\partial \{p(x)[x(W + D) - C(D)] - \rho W\} / \partial D = p(x)[x - C'(D)] \geq 0 \tag{2}$$

In the condition allowed by capital adequacy , banks definitely try to absorb deposit as much as they could. For this reason, the restricting condition is changed to $D = (k - 1) W$. At the same time, Lagrangian function is formed :

$$\text{Max } p(x)[x(W + D) - C(D)] - \rho W + \lambda[D - (k - 1)W] \tag{3}$$

$$x, D$$

The derivative of x in (3) is given by :

$$p'(x)[x(W + D) - C(D)] + p(x)(W + D) = 0 \tag{4}$$

The derivative of D in (3) is given by :

$$p(x)[x - C'(D)] + \lambda = 0 \tag{5}$$

The derivative of λ in (3) is given by :

$$D - (k - 1)W = 0 \tag{6}$$

The optimized value induced from previous formation is marked as x_r and D_r .

For a bank, if the restriction on capital adequacy is tight, there must be $D_r = (k - 1)W$, and take it into (4), the

$$\begin{aligned} \frac{dx_r}{dk} &= - \frac{p'(x_r)x_r - p'(x_r)C'[(k-1)W] + p(x_r)}{(1/w) \bullet p''(x_r)\{x_r kW - C[(k-1)W]\} + p'(x_r)k + p'(x_r)k} \\ &= - \frac{p'(x_r)\{\frac{C[(k-1)W]}{kW} - C'[(k-1)W]\} + p(x_r)}{(1/w) \bullet p''(x_r)\{x_r kW - C[(k-1)W]\} + p'(x_r)k + p'(x_r)k} > 0 \end{aligned}$$

As a result, the higher requirement the capital adequacy is (the lower k is, the higher $1/k$ is), the lower requirement of a bank has on the expected return. In a simpler term, banks prefer items with lower risk loan. It can be safely concluded that higher requirement on capital adequacy and wide introduction of accurate evaluation model on credit risk would take effects on risk-taking incentives and reduce bank's choice for potential risk.

3. CREDIT CRUNCH UNDER THE REGULATION OF CAPITAL ADEQUACY

Apart from reducing loan risk-taking incentives, another essential effect of capital adequacy regulations credit crunch, which has been widely researched by economists. The demonstration on American bank data by Hancock and Wilcox (1997) shows requirement of capital adequacy will cause a decline of loan to real estate. The same result is obtained by the Peek and Rosengren(1997) demonstration on Japan's estate. Also, the demonstration of Korea's banks and macro-economic data by G. Choi (2000) indicates capital adequacy regulation conducted after financial crisis led to a drop of banking loan, which had a direct negative effect on small and middle sized enterprises relying on them. Similarly, Maria C. (2002) investigated some developing countries and this phenomenon was also revealed in those countries, where regulation of capital adequacy was implemented. No wonder why Basel Committee claimed in a report in 1999: "Some evidence show that during economic recession in U.S. and Japan, the pressure on regulation of banking capital, to some degree, limited the loan of these time period and resulted in downturn of other economic body." Mr. Richard Syron, president of the Federal Reserve. Bank of Boston, coined the expression "capital crunch"

In order to analyze the variations of capital adequacy, especially the effects when increase requirement of it, the following model is taken into account:

Hypothesis:

following will be achieved:

$$p'(x_r)\{x_r kW - C[(k-1)W]\} + p(x_r)kW = 0 \tag{7}$$

By differential of (7), the relation between the requirement of capital adequacy and bank's choice of optimized risk-taking is given by :

(1) All assets of banking sectors is loan only and the loan is distributed to two kinds of enterprises: high-risk and high-profit; low-risk and low-profit. So there is :

$$L = L_1 + L_2 = W + D$$

L indicates Loan issued by a bank, W represents Bank capital funds and D is the savings sponged up by a bank.

(2) The return on loans is a discrete, dense, and listing random variable within the interval $[0, 1]$ and function increases by degrees. The loan is only

distributed to two kinds of enterprises, so the sample \tilde{R} is 2, the returning ratio of high return loan is α ... the ratio of low return loan is ... β . In this condition, the

probability of related event is $P(\tilde{R} = \alpha) = p(\alpha)$,

$$P(\tilde{R} = \beta) = p(\beta) .$$

(3) Suppose average interest rates of banks is φ , the payment of interest rates is $\varphi L = \varphi(W + D)$.

(4) Suppose the ratio of capital adequacy is $u = \frac{1}{k}$, and $k > 1$, obviously a comparatively lower k means higher capital adequacy

When ignoring other weak related conditions, the profit of banks is

$$\Theta = p(\alpha)\alpha L_1 + p(\beta)\beta L_2 - \varphi(W + D) \tag{8}$$

Because L_1 and L_2 are unlikely more than L , while the requirement for ratio of capital adequacy is $\frac{W}{L} \geq u$, So the optimizing profit of banks will convert into the following linear programming:

$$\max \Theta = p(\alpha)\alpha L_1 + p(\beta)\beta L_2 - \varphi D - \varphi W$$

(9)

$$\begin{aligned}
 &L_1 < L \\
 \text{s.t.} &L_2 < L \\
 &D \leq (k-1)W
 \end{aligned}$$

In order to use pure matrix to make a solution for the foresaid question, three relaxation variables $\varepsilon_1, \varepsilon_2, \varepsilon_3$ are introduced to change inequality into equality. The initial equation equals extremum of solution

$$\max \Theta = p(\alpha)\alpha L_1 + p(\beta)\beta L_2 - \varphi D - \varphi W + 0\varepsilon_1 + 0\varepsilon_2 + 0\varepsilon_3 \quad (10)$$

whereas the limitation is:

$$\begin{pmatrix} 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} L_1 \\ L_2 \\ D \\ \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \end{pmatrix} = \begin{pmatrix} L \\ L \\ (k-1)W \end{pmatrix} \quad (11)$$

The pure matrix is listed as follows in Table 1:

Θ	L_1	L_2	D	ε_1	ε_2	ε_3	Max
1	0	0	0	$p(\alpha)\alpha$	$p(\beta)\beta$	-	$Lp(\alpha)\alpha - \varphi W$
0	1	0	0	1	0	0	L
0	0	1	0	0	1	0	L
0	0	0	1	0	0	1	$(k-1)W$

This matrix means :

$$\begin{aligned}
 \Theta = &L[p(\alpha)\alpha L_1 + p(\beta)\beta L_2] - \varphi W - \varphi(k-1)W \\
 &- p(\alpha)\alpha \varepsilon_1 - p(\beta)\beta \varepsilon_2 + \varphi \varepsilon_3 \quad (12)
 \end{aligned}$$

According to the initial assumption , here is. Equation (12) indicates increasing ε_3 is an effective method to obtain more profits after enhance the requirement of capital adequacy. As the foresaid assumption , increasing ε_3 means constricting D. Since $L=W+D$, L is constricted accordingly,Here is:

$$u \uparrow \longrightarrow \varepsilon_3 \uparrow \longrightarrow D \downarrow \longrightarrow L \downarrow$$

Credit scale and capital adequacy ratio vary in the

$$\text{adverse direction , } \frac{dL}{du} < 0 \text{ or } \frac{dL}{dk} > 0 .$$

It is reasonable for a bank to reduce scale of liability so as to meet higher ratio of capital adequacy. Also, it is easy and convenient for a bank to adjust scale of liability since the cost is lower than capital funds, which

Θ	L_1	L_2	D	ε_1	ε_2	ε_3	Max
1	$-p(\alpha)\alpha$	$-p(\beta)\beta$	φ	0	0	0	$-\varphi W$
0	1	0	0	1	0	0	L
0	0	1	0	0	1	0	L
0	0	0	1	0	0	1	$(k-1)W$

Table 1 shows us that when

$$(L_1 \ L_2 \ D \ \varepsilon_1 \ \varepsilon_2 \ \varepsilon_3) = (0 \ 0 \ 0 \ 0 \ 0 \ 0)$$

The equation has a BFS (Basic Feasible Solution) , and $BFS = -\varphi W$,but obviously it is not the optimal one .From this BFS , we can get the optimal answer via the technological method of Pivot Step. We have noticed that the modulus of L_1 is negative , by some transactions ,Table 2 is given :

enables banks to increase ratio of capital adequacy even without supplementing funds. Therefore, here is a condition of one-way intersection with absolute

value: $\left| \frac{dL}{du} \right| > \left| \frac{dW}{du} \right|$. This means facing the variations of capital adequacy, scale of liability is more sensitive than capital funds. This passive solution is a headache of regulation authorities, which is far away from initial expectations.

4. LENDING OF BANKS UNDER REGULATION OF CAPITAL ADEQUACY

As discussed above, regulation of capital adequacy would affect credit behavior of banks in two ways: one is to reduce risk-taking incentives of loan option; the other is to cause credit crunch. What we are now to analyze is this contraction is a same-rate one to all loans or it is selective. What the criterion are if it's selective?

This involves analysis on loan option with regulation of capital adequacy.

We set a simple linear programming model to analyze bank behavior on loan under capital adequacy regulation.

Hypothesis:

(1) L indicates Loan issued by a bank, W represents Bank capital funds and D is the savings sponged up by a bank;

(2) The loan is distributed to two enterprises : a small sized one and a large sized one;

(3) On account of borrower's default and recovery of loan has intense relation with borrower's scale, take all sorts of risk elements into account , the risk and the enterprise scale are proportional;

(4) X_1 represents the distribution to the large sized enterprise and X_2 indicates the distribution to the small sized one .Both of them depend on b: incentives for risk-taking. To the management of bank, different b represents different risk-taking incentives. As the risk and the enterprise scale are proportional , while banks are born to be risk averse , that is why $X_1 / X_2 = f(b) \geq 1$;

(5) profits Z: net income of loan subtracts loss on loan.

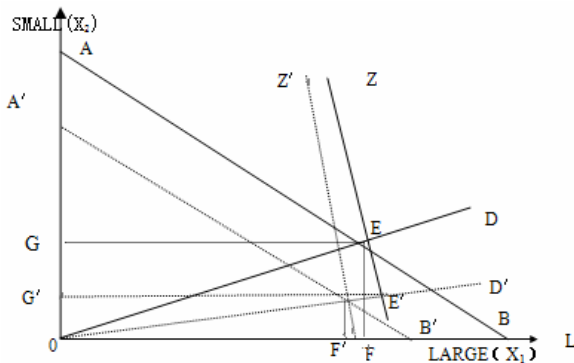
Assume the ratios of net income on loans to small sized enterprises and large sized enterprises are r_1 and r_2 , the ratios of loss on loans to small sized enterprises and large sized enterprises are s_1 and s_2 .

The target function and conditions are as following:

$$Z_{MAX} = (r_1 - s_1)X_1 + (r_2 - s_2)X_2 \quad (13)$$

$$\begin{cases} X_1 + X_2 \leq L \\ f(b) \geq 1 \\ X_1 \geq 0, X_2 \geq 0 \end{cases} \quad (14)$$

To be more visual, we can get geometrical Figure 1.



The triangle area BOE includes all values that satisfy the three limitations. So as to obtain the optimal loan combination, profit functional curve Z move to right, which means more total profits. At point E , not only the

loan combination satisfy the three limitations but also maximize profit.

But how dose the loan combination change after capital adequacy regulation is strengthened? Following the preceding analyses, when capital adequacy regulation is strengthened, bank is like to change in two aspects: one is risk-taking incentives, the other is credit crunch . How do this two aspects influence the loan combination? f(b) is positively related to incentive for risk-taking. In other words, bank would like to loan to large sized enterprises as much as possible, Line OD would become more flat. Credit crunch means less total loan , line AB move to left. In the Figure 2 broken line shows us this change. By error testing ,we get E' . At point E , the selected loan combination satisfies the condition of strengthening capital adequacy regulation and other two limitations ,maximizes profit as well . Here, at E', OF' indicates loan to the large sized enterprise, OG' indicates loan to the small sized enterprise. Obviously, OF' is similar to OF , while OG' is conspicuous different from OG.

As can be seen, when regulation of capital adequacy is strengthened, given lower risk-taking incentives and credit crunch, banks will considerably reduce loan to small sized enterprises with potential high risks while at the same time the loans to large enterprises are almost non-affected.

5. DATA IN HUBEI PROVINCE

The following analyses of credit behavior in Hubei Province are based on Capital Supervision of Commercial Banks issued in March, 2004. Compared with the Principle and Discipline of Supervision on the Ratio of Assets and Liability issued in 1996, the new Supervision is much stricter on calculation of capital adequacy, which requires the calculation of commercial banks to be based on the fact that loan loss is ready for sufficient balance. This also requires a stricter criterion when estimating credit risk. As a consequence, the ration of capital adequacy will accordingly decline when the new Supervision is implemented. Except for commercial banks in Wuhan, all the other banks in Hubei province are the branches of state-owned or share-holding companies. This determines that the effects on strengthening capital adequacy would be seen from transactions by those branches. Therefore, the credit behavior in branch banks could also reflect the trend of whole enterprise.

The credit crunch in banks of Hubei Province adopt the index of international cases --- the ratio of loan in asset. The variation of index could indicate the bank's preference of credit. We choose ten banks, they are China Construction Bank Hubei branch, Agricultural Bank of China Hubei branch, Bank of China Hubei

branch, Bank of Communications Hubei branch, China Everbright Bank Hubei branch, Huxia Bank Hubei branch, Shanghai Podong Development Bank Hubei branch, China Merchants Bank Hubei branch, WuHan City Bank Hubei branch respectively, the data are pooled over five years which from 2002-2006. Table 3 below mainly describes the change of credit percentage in asset of sample banks in Hubei Province. It can be observed that in the process of adjusting capital adequacy, the decline of credit scale in asset is regular. The falling range of banks with different features is not obvious. All these illustrate that the adjustment of capital adequacy give a rise to a common credit contraction of banks.

Sample	2002	2003	2004	2005	2006
Bnak 1	60.03	61.54	60.33	58.89	56.32
Bnak 2	63.43	63.77	58.96	54.02	52.35
Bnak 3	65.23	66.32	65.85	62.65	56.34
Bnak 4	58.46	57.04	55.72	54.31	53.23
Bnak 5	74.14	71.57	68.45	66.43	62.65
Bnak 6	68.01	69.43	66.77	65.12	64.87
Bnak 7	69.56	67.85	67.33	65.06	62.79
Bnak 8	68.67	65.08	63.94	62.43	60.11
Bnak 9	65.34	66.43	64.28	61.21	60.98
Bnak 10	69.48	65.74	60.44	57.43	55.93

Source: Bankscope

Influenced by capital adequacy adjusting, when reducing credit scale, each commercial bank focuses on high profit and low ratio of credit risk. They have severe censorship on new loan and controlling the increase of risk capital. According to our investigation with branch banks of Hubei Province, each bank improves their credit criterion in order to profit of risk asset. Take a branch as an example, its main business is to take asset to make up for debit. Its gross risk capital is large and their return of asset is comparatively low. After carrying out new Supervision, the branch began to re-arrange its structure and its gross risk capital declined. Thus, after the new Supervision, the choice of credit clients has been narrowed although in this cut-throat competitive market, each share-holding bank has to maintain capital accumulation so as to survive and develop. As the data of financial monitoring authority shown, the huge clients and small sized clients are unbalanced. Until the end of June, the radio of the former accounts for 58.8 per cent while the latter compose only 10.27 per cent. This explains that the credit crunch takes major effects on middle and small sized enterprises.

6. CONCLUSION AND SUGGESTIONS

The above analyses have shown the tight link between supervision of capital adequacy and banking loan option. The decline of risk-taking incentives and credit crunch under the supervising are mainly shown on loan option, especially take effects on the loan for small and middle sized enterprises. Currently in China, the compensatory system is absent and the access to adequate capital is limited. This explains why the effects are strikingly obvious.

The following measures can be taken to relieve contraction effects so as to reduce impacts on small and middle sized enterprises and national economy.

6.1 Fully developing capital market and promoting direct financing

The status quo and current goal of capital mark of China determines the following considerations: enlarge stocks scale on the basis of economic redistribution and share reform, which encourage capital collecting from market and promote non-state owned outlet of financing; improve and optimizing structure of capital market, enlarge enterprise stocks, funding and circulation; strengthen system reform and establish capital market supervision and transaction which adapt to market economy.

6.2 Introducing foreign-funding banks and broaden loan outlets

Generally, the ratios of capital adequacy in foreign-funding banks are far higher than the minimum requirement (8%). According to data of Banker Magazine in 2003, the average ratio of 26 international banks was up to 11.61%, (the highest was 18.20%). SHBC was 13.30%, Societe Generale contributed 12.51% , Union Bank of Switzerland accounted for 15.70% . Sufficient funds enable these banks to be free from adjustment in a large scale when being supervised. Thus, the supervision of capital adequacy produces less contractual effects on foreign-funding banks. It has to be admitted that the importing of foreign-funding banks after joining in WTO takes significant role in reliving contractual effects of capital adequacy monitoring.

In order to avoid macro-economic recession resulting from capital adequacy supervision on state-owned commercial banks, it is necessary to absorb foreign-funding banks. In short-term, it would increase competitive pressure of national banks. But in the long run, their entering into China's market not only improve management of national banks but their high capital adequacy would effectively reduce contractual effects of capital supervision. This is also helpful for a stable macro-economy. Practically, Shanghai Bank transferred 13% of equity to three foreign-funding banks in 2001.

Among them, SHBC participated the investment of shares for Shanghai Bank (8%), Shanghai Bank of Commerce (HK) made up 3%, and International Finance Corporation increased to 7%. This was proved to be an effective and efficient approach to attract foreign investment.

6.3 Conducting elastic regulation of capital adequacy

It is probability to conduct elastic supervision in china, namely different bank adopt different ratio .According to current situation , at the present stage , capital adequacy ratio of 8% is not compulsive to achieve and adopt a interim period .During this period ,with the ratio within 6%-7.5%,banks should adjust and establish capital base, enhance competitive strength ,accumulate experience, so as to be a commercial bank which manage independently. Finally achieve requirement level.

After this interim period , our commercial banks are required to adopt minimum capital adequacy ratio of 8%.Simultaneously,different bank adopt dissimilar risk-weighted assets ratio which higher than 8% actually.

6.4 Introduce deposit insurance prudently

The reputation guarantee offered by a nation and the deposit insurance have an identical capital structure effect, the asset effects of banks are totally different. That is to say, both will strengthen the loan encouragement and reduce the capital ratio. However, the former, due to the fact the national guarantee cannot form a supervision on capital adequacy, causes the regular actual capital to change into being aimless. At the same time, the bank owner is also the one to offer financial security, which separate the financial provider and owner. This extends the agency chain hence the investment of high risk, which produce current 25% bad debt of national banks. On the contrary, the latter one solved the constant deposit of bank clients. Also, it supervises capital adequacy, that is to increase capital adequacy to eliminate high risk investment and limit banking speculation, to reduce the possibility of bankruptcy. Therefore, when the property right is confirmed by national banks and commercialized banking is launched, to replace national reputation guarantee with deposit insurance is a necessity to fully utilize capital adequacy and transfer national capital into market.

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