

# The Game Analyses of the Effect of Bank Claim, Penalty and Compensation to High Educational Aid-Loan

## ANALYSES DE JEU SUR LES EFFETS DE LA RECLAMATION, LA PENALITE ET LA COMPENSATION DE LA BANQUE AU PRET D'ETUDES SUPERIEUR

Huang Duo<sup>1</sup>      Zhang Daohong<sup>2</sup>      Chen Aijuan<sup>3</sup>

**Abstract:** The paper mainly researches behavior of banks and students which affects the efficiency of Chinese high-educational aid-loan. Using the game theory, the paper analyzes the behavioral selection of bank and students in the domestic process of education aid-loan. The paper emphatically anatomizes the impact of the reliability of the bank's claim, the intensity of penalty and the degree of the compensation to the behavior of banks and students. Gets the conclusion that, under the condition of the credit system lagging, the government should intervene to reduce the cost of the claim, raise the success probability of the claim and increase the degree of the penalty to the students who default in loan contract, to ensure the healthy development of the education aid-loan.

**Key words:** Behavior Analysis, Educational Aid-Loan, Game Theory

**Résumé:** Cet article examine principalement les comportements des banques et des étudiants qui influent l'efficacité du prêt d'études supérieur chinois. Utilisant la théorie du jeu, l'article analyse la sélection comportementale des banques et des étudiants dans le processus du prêt d'études. Il dissèque catégoriquement les impacts de la fiabilité de la réclamation de la banque, l'intensité de la pénalité et le degré de la compensation sur les comportements des banques et des étudiants. Il en résulte que, dans le contexte du système de crédit en retard, le gouvernement doit intervenir pour réduire le coût de la réclamation, augmenter la probabilité de succès de la réclamation et élever le degré de la pénalité infligée aux étudiants qui ne s'acquittent pas de leur prêt, et enfin pour assurer le développement sain du prêt d'études.

**Mots-Clés:** analyse comportementale, prêt d'études, théorie du jeu

### 1. DEVELOPING STATUS OF HIGH-EDUCATIONAL AID-LOAN IN CHINA

The student loan institution had been established along with the developing of charging institution of higher education in China. In China the high-educational aid-loan institution has been established since 1999, State Department, Ministry of finance and others relative governments issued a series of documents (for example State department issued documents of [1999]58, [2000]6,[2000]27, and Ministry of finance issued documents of [2000]158 and [2000]1 ) to push

and fulfill the high-educational aid-loan program. Those works energetically promoted the aid-loan project, unified the understanding and defined the aim. .

However as entering the repaying period, the risk of default in repaying is emerging. According to the incomplete statistic, by the end of the May 2003, in the 884 universities which issued the aid-loan, there were 540 thousand students should repay the principal and interest, but there were 130 thousand students who can't repay the principal and interest according to the contract, involving 227 universities; 9 thousand students defaulted more than 90 days, involving 188 universities, the defaulting ration of more than 90 days reached 16.7%. According to the reports of the banks, the ratio

<sup>1</sup> School of Business Administration, Xi'an University of Technology, China.

<sup>2</sup> School of Business Administration, Xi'an University of Technology, China.

<sup>3</sup> School of Business Administration, Xi'an University of Technology, China.

\*Received 17 August 2006 ; accepted 22 November 2006

of the students who did not contact with banks forwardly more than 10%, even exceeded 50%.

The reasons of students can't repay according to the contracts includes two kinds reasons. One kind is the credit consciousness of student is lacking, considering the aid-loan is "policy" loan, not will and not want to repay, so form the mind of default in repaying; another kind is lacking the impersonal ability of repaying, due to students can't find job in time so no income or a little of income.

The process of the high-educational aid-loan can be seen as a game process between the bank part and the student part. The improving direction of the high-educational aid-loan institution should be changing the pay-off matrix of two parts in order to ensure the banks want to loan and the students like to repay loan.

## 2. ANALYZE THE BEHAVIOR OF THE PRINCIPAL PARTS OF HIGH EDUCATIONAL AID-LOAN WITH GAME THEORY

During the process of the aid-loan, two principal parts (the banks and the students) of the game continue to make decisions basing on the change of the pay-off matrix in a dynamic process. In high-educational aid-loan project, loan banks and students are principal parts. The government provides the interest assistance but doesn't join the game process. Assume the banks and students are rational. If the loan were nonprofit the banks should not issue loan. However the high-educational aid-loan has some features of policy loan, the banks have no more selection when decide whether loan or not, so the game should begin from the decisions of student part. If the benefits of the default were higher than that of the repaying, students would not repay. Also assume that: there would be no opportunity loss if the banks would not issue the loan; opportunity cost of the loan is zero, the bank can obtain the risk compensation only when students default. So can get a complete but imperfect dynamic game process, assume the principal is B; the total interest is I, where  $I_g$  is the interest assistance given by the government which is the interest generating when the students are in universities,  $I_s$  is the interests paid by the students-self after they left universities,  $I = I_s + I_g$ ;  $U_s$  is the utility of the students finish school work; the cost of the banks for claiming for debt is  $C_B$ ; L is the penal sum if the banks successfully claim; E is the risk compensation. The game process is described as the following figure 1:

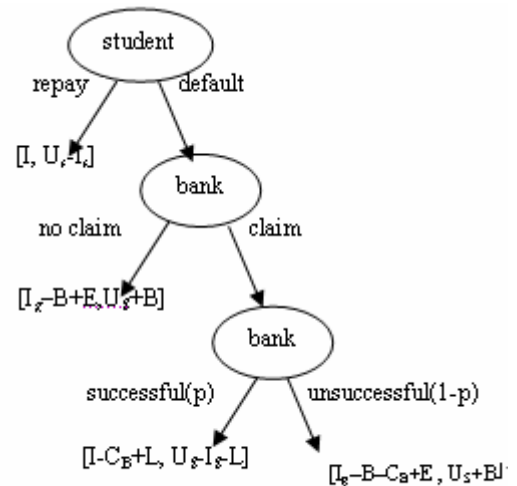


Table 1 Game analysis of high-educational aid-loan

In order to facilitate analyzing the behavior of students and banks, also give the following assumptions:

- 1st. Not consider the effect of credit to students;
- 2nd. Not consider students' imitation behaviors;
- 3rd. The probability (p) of the banks claim is the function of perfect extent and executing intensity of law;
- 4th. There is direct ration between the claiming cost and claiming amount, the coefficient is  $a(0 \leq a \leq 1)$ ;
- 5th. The penal sum is n times of arrearage,  $0 \leq n < \infty$ , the banks stipulate the amount of n in advance;
- 6th. The essential life requirement is Q in the period of repaying.

### 2.1 Pure strategy game condition

The principal and interests repaid by students can not be subdivided i.e. student only has two selections: completely repay or completely default; and the bank also only has two selections: claim or not claim.

There are two preconditions of student repay:

- 1st. The expect benefits is greater than that of default, i.e.

$$U_s - I_s \geq U_s - (I_s + L)p + (1 - p)B$$

Simplifying get:  $p \geq \frac{B + I_s}{L + B + I_s}$  or  $L \geq \frac{1 - p}{p}(B + I_s)$

- 2nd. The income of student after graduation is greater than the sum of principal and interest. Under the condition of student default, the

incentive-compatible condition of bank claim:

$$I_g - B + E \leq p(I + L) + (1 - p)(I_g + E - B - C_B)$$

Simplifying get:  $p \geq \frac{C_B}{I_s + L + B - E}$ .

Under the pure strategy game condition, L and CB can be thought decided in advance, so can get the following consults:

(1) When  $\frac{B + I_s}{L + B + I_s} \geq \frac{C_B}{I_s + L + B - E}$  ;

i If  $\frac{B + I_s}{L + B + I_s} \geq p \geq \frac{C_B}{I_s + L + B - E}$ , the equilibrium of game would be the student will default and the bank would claim;

ii If  $p \leq \frac{C_B}{I_s + L + B - E}$ , the equilibrium of game would be the student would default and the bank would not claim.

(2) When  $\frac{B + I_s}{L + B + I_s} \leq \frac{C_B}{I_s + L + B - E}$  ;

i If  $p \geq \frac{B + I_s}{L + B + I_s}$ , though the anticipation of bank claim is letter than the anticipation of bank do not claim, the threat of bank claim would be effective, the equilibrium of game would be the student would repay and the bank withdraw all principal and interests.

ii If  $p \leq \frac{B + I_s}{L + B + I_s}$ , the threat of bank claim and penalize would not be effective, the equilibrium of game would be the student would default and the bank would not claim.

## 2.2 Mix strategy game condition

Under the mix strategy game condition, student can select to partly repay debt, bank can also select to drawback part of principal and interests, and completely repayment and completely default are special cases. Under this condition, the law support all claim decisions of banks, and assume the rate of repayment or claim is  $\mu$ .

(1) The benefits of student

The benefit of student default is:

$$U_s - \mu I_s - L - (1 - \mu)B,$$

and  $L = n(1 - \mu)(I_s + B)$ , so the benefits can also be:

$$U_s - [\mu + n(1 - \mu)]I_s + (1 - n)(1 - \mu)B$$

The rate of repayment of student should maximize the benefits of default or repayment, i.e.:

$$\text{Max } \Pi \equiv U_s - [\mu + n(1 - \mu)]I_s + (1 - n)(1 - \mu)B - [U_s - I_s]$$

After simplified:  $\Pi \equiv (1 - \mu)(1 - n)(I_s + B)$

Then calculate the first rank derivative of  $\Pi$  about

$$\mu : \frac{\partial \Pi}{\partial \mu} = -(1 - n)(I_s + B)$$

i. When  $n < 1$ ,  $\frac{\partial \Pi}{\partial \mu} < 0$ ,  $\Pi$  is decreasing function of  $\mu$ , student would select  $\mu = 0$  ;

ii. when  $n = 1$ ,  $\frac{\partial \Pi}{\partial \mu} = 0$ , the amount of  $\mu$  has nothing with the selection of student;

iii. when  $n > 1$ ,  $\frac{\partial \Pi}{\partial \mu} > 0$ ,  $\Pi$  is increasing function of  $\mu$ , the student would select  $\mu = 1$ .

(2) The benefits of bank when student default

Assume E has direct proportion relationship with arrearage, its coefficient is b,  $0 \leq b \leq 1$ , and

$$C_B = a\mu(B + I_s),$$

at same time  $E = b(1 - \mu)(B + I_s)$ .

When student default, the benefit of bank should be:

$$\begin{aligned} E &= I_g + \mu I_s + L + E - (1 - \mu)B - C_B \\ &= I_g + [n\mu + (1 - \mu)b - a\mu](B + I_s) - B \end{aligned}$$

Calculating the first rank derivative of E about  $\mu$  :

$$\frac{\partial E}{\partial \mu} = n - b - a$$

Where a、bare uncontrollable variables, n should be the main control variable :

i. When  $n > a + b$ ,  $\frac{\partial E}{\partial \mu} > 0$ , E is increasing function of  $\mu$ , bank would select  $\mu = 1$  ;

ii. When  $n = a + b$ ,  $\frac{\partial E}{\partial \mu} > 0$ , the amount of  $\mu$  has nothing with the selection of bank;

- iii. When  $n < a + b$ ,  $\frac{\partial E}{\partial \mu} < 0$ , E is decreasing

function of  $\mu$ , bank would select  $\mu = 0$ .

From above analysis can know the reliability (p) of bank claim and the penalty intensity (n) will directly affect the decisions of both parts. The policy significance of this result is, under the condition of lacking credit, the institution arrangement should lean to safeguard though increase penalty intensity when require banks to loan. At present the probability of increasing penalty intensity is not great, because banks can not control the claim and penalty, it need the government intervenes, to reduce the claim cost of banks, to increase executing intensity of law, at the same time, banks can enhance the nonmonetary penalty intensity, in order to avoid the fluky mind.

### 3. THE SUGGESTIONS FOR THE HIGH-EDUCATIONAL AID-LOAN INSTITUTION

For the aid-loan taking the credit as basis, the default has subjective reason and objective reason. Reducing the objective reason should mainly consider the students' ability of repaying. However the default caused by the subjective reason should be the result of the moral risk and the information asymmetry, for the banks, the keys is the cost of tracking and claiming. Because, in China now, the aid-loan is not allowed to claim the guarantee and increasing L also be limited by law, increasing p, L and decreasing  $C_B$  is difficult. Therefore, if we want to improve the pay-off matrix of this game, make the high-educational aid-loan institution develop along a right orientation, should effort at following factors.

1st. Decrease the possibility of the students' default behaviors. The moral culture of the students is the key to improve the high-educational aid-loan project. The universities should teach and cultivate the students'

credit consciousness, make the students treasure own credit standing, build up the Victorianism of insisting on honesty and keeping credit.

2nd. Increase the successful probability of the banks' claim (p) and decrease the cost of tracking and claiming ( $C_B$ ). There are two effort orientations: short-term effort and long-term effort. In short term, can build common information database providing relative information about the students who default in repaying loan among all relative banks, using the real name depositing institution. In order to decrease the claiming cost of the banks, increase the successful probability of the claim and decrease the students' expectative benefit.

For long term, build up the individual credit system is the key to resolve this problem. And can consider to combine the individual credit system with the guarantee system, in order to increase the intensity of tracking the defaulted students, increase the successful probability of the claim and decrease the tracking cost of the banks.

3rd. Increase the penal sum (L), increase the punishment intensity to the students who default in repaying

The punishment to the students defaulted in the repaying should include monetary punishment and non-monetary punishment.

For monetary punishment, due to the banks provide the loan without guarantee requirement, providing more credit to the students, can consider to increase the punish sum befittingly, increase the punishment intensity to the students who default in repaying.

For the non-monetary punishment, can build relative "blacklist" system, and improve the relative statistic system, information exposing system and punishment system. The banks and universities can expose the information about the students who default in repaying debt in different ways and different range. And replant the "blacklist" system to the individual credit system when it begins to start-up.

### REFERENCES

- Zhang Weiyang. *Game Theory and Information Economics*. Sanlian Bookshop, People Publishing House, 1996
- Dai Shuang-xing. 'Development of State's Students Loan and Establishment of the Consciousness of Confidentiality and Trust for College Students'. *Journal of China Youth University For Political Sciences*, No.2, 2004.
- Wang Xiaoping. 'Risk Prevention of National Student Loan'. *Economy and Finance*. No.6, 2004.
- Shen Hua, Shen Hong, Huang Wei. 'A Comparative Study of Student Loan Repayment Debt and Empirical Studies in China'. *Comparative Education Review*, No.10, 2004.
- Yangjun (2004). *The Credit Risk of The Bank--- Theory, Model and Empirical Research [M]*, China Finance & Economic Publish House.

- Chen Aijuan, Ren Xiaoyan. 'The measures of Chinese Educational Service Trade in Opening Economy Environment'. *International Trade Journal*, 2004.12
- Li Wenli. 'The Promotion of Education Loan to Faire Opportunity of Education and maintainable Development'. *Chinese higher education*,2003
- Zhang Minxuan. 'International Perspective: The Reform and Developing of Academician Aid-loan'. *The Transaction of National High Education Administration College*,2000.5
- Chen Diqu. 'Risk Analysis of National Educational Aid-loan.' *Jiaotong High-education Research*. No.4 2004.
- He-Xiaobo, Wang Chun-ming. 'Study on Risk-prevention Mechanism of Student Loan'. *Journal of Beijing University of Technology(Social Science Edition)*. Vol.4 No.2, 2004.
- Jiang Fengsheng, He Cui, Yang Wenjun. 'Analysis of the Development Strategy of Our State-Owned Commercial Banks regarding Student Loan'. *Finance Forum*, No.3, 2004.
- Geng Jian, 'An Analysis of the Problem of University Student's Being in Arrears with Tuition fee and Outstanding Loans and Its Solution'. *Journal of BUPT(Social Science Edition)*, Vol.6, No.3, 2004.

### THE AUTHORS

**Huang Duo** (1974—) , male , Penglai, Shandong Province, Xi'an University of Technology, PHD candidate , field: Finance innovation.

**Zhang Daohong**(1959—),male, Qing-xian,Hebei Province, Xi'an University of Technology, professor.

**Chen Aijuan**, School of Business Administration, Xi'an University of Technology, PHD, professor.

Address: Box 1203,Qu-jiang Campus, Xi'an University of Technology, 58 Yan-Xiang Road, Xi'an, Shaanxi 710054, P.R.of China.

Email : hbigbell@126.com.