

Evolutionary Game Analysis of Leverage Manipulation of State-owned Enterprises

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ABSTRACT

Under the background of the steady progress of China's "deleveraging policy", based on the "bounded rationality" hypothesis, this paper analyzes the leverage manipulation of state-owned enterprises and the audit behavior of CPAs, and constructs a two-party evolutionary game model between state-owned enterprises and CPAs. The result shows that enterprises do not implement leverage manipulation and strict audit by CPAs are the choices to maximize the interests of both parties.

Keywords: *Leverage Manipulation, Bounded Rationality, CPA, Evolutionary Game.*

1. INTRODUCTION

Since deleveraging was clearly proposed at the Central Economic Conference in 2015, deleveraging has become one of the important economic tasks in China at this stage. However, deleveraging of high leverage enterprises is not easy under many constraints. Zhang and He (2013) pointed out that deleveraging means that non-financial enterprises need to reduce their debt level, which will lead to business shrinkage, less economic activity and smaller investment scale^[1]. State-owned enterprises have large historical debts, and the larger they are, the more difficult it is to adjust them^[2]. Statistics show that the tax burden of State-owned enterprises is 2.5 times higher than non-State-owned enterprises, accounting for about one third of the country's employment. Facing deleveraging pressure, enterprises may implement leverage manipulation out of various motives to reduce leverage ratio. Landsman (2008)^[3], Scott, etc. (2011)^[4], Lin (2010)^[5] and other scholars from domestic and abroad found that some enterprises deliberately reduce the level of book leverage^[6].

In the case of information asymmetry, the public cannot supervise the behavior of the management and grasp the real leverage ratio of the enterprise. Therefore, external CPAs' supervision are very important. CPAs audit enterprises' financial statements and can find whether there is leverage manipulation to a certain degree. However, as CPAs with bounded rationality, their personal characteristics will have an impact on

audit quality (Meng etc. 2019)^[7], and not all accountants will carry out audits in accordance with auditing standards.

With in-depth study of the leverage ratio and CPAs, some scholars used the evolutionary game to study the issues above. The problem of leverage ratio is actually the problem of capital structure. Yan and Li (2011)^[8] used evolutionary game theory to construct the game model of dynamic adjustment of capital structure among different enterprises in the industry, showing that both finance-conservative strategy and finance-radical strategy are stable strategies for the selection of capital structure among enterprises. Zhang (2014)^[9] constructed a two-party game between CPAs and professional managers. After considering audit costs quality, he concluded that high-quality audit strategies are positively correlated with audit costs, reputation gains, and collusion gains, and negatively correlated with regulatory punishment and reputational rewards. Some scholars believe that corporate managers will use earnings management to manipulate corporate leverage^[10]. Hao and Li(2019)^[11] used bounded rationality to analyze the motives of earnings management of state-owned enterprises, and then used evolutionary game to build an evolutionary game model between audit departments and state-owned enterprises. The results showed that state-owned enterprises choosing low-earnings management and audit departments choosing audit are a strategic choice to maximize the interests of both sides.

Literature shows that high leverage in state-owned enterprises is still common, and it is difficult to reduce leverage. Therefore, enterprises have the motives to manipulate leverage to reduce leverage ratio. Due to the bounded rationality, CPAs will choose the strategy that is most beneficial to his own interests during audit. At present, there are few literature on the direct study of corporate leverage manipulation and CPAs, which provides space for this study. Based on bounded rationality, this paper constructs an evolutionary game model between CPAs and state-owned enterprises, and discusses the evolutionary trend of leverage manipulation of enterprises.

2. AN OVERVIEW OF LEVER MANIPULATION UNDER BOUNDED RATIONALITY

The concept of leverage manipulation was first proposed by team of Xu Xiaofang (2020). In a narrow sense, leverage manipulation refers to the use of off-balance-sheet liabilities and fake-equity-but-real-debt, other financial activities to cover up the company's leverage risk. In a broad sense, leverage manipulation refers to reduce the leverage level shown in the balance sheet by using financial activity arrangements of above, as well as other accounting means of manipulating assets upward or liabilities downward or both. The common means of leverage manipulation are off-balance sheet liabilities, fake-equity-but-real-debt, other accounting manipulation and so on, which actually do not really reduce enterprises' leverage ratio.

As managers of bounded rational, decision-making is not completely rational^[12]. From the perspective of behavioral finance, Wu and Zhang(2015)^[13] empirically concluded that over-confident managers would choose a higher leverage ratio. Xiong and Liu (2019)^[14] found that the CEO's experience would influence the company's financing decisions, thus influencing the company's capital structure. In state-owned enterprises, managers play a leading role in decision-making. As early as in 2012, the government issued a document emphasizing that state-owned enterprises should strictly control their corporate debts, incorporate the indicator of asset-liability ratio into the performance assessment of state-owned enterprises' directors, and interview relevant directors who are ineffective in debt-risk control and whose asset-liability ratio continues to rise. Under the influence of policy pressure and managers' own bounded rationality, enterprises are likely to implement leverage manipulation. Through leverage manipulation, first, enterprises can reduce book leverage ratio rapidly to meet the assessment requirements; second, it will be beneficial to enterprises' external financing.

CPAs also have bounded rationality. Faced with the temptation of enterprise interests, either adhering to strict auditing standards or abandoning principles and choosing loose audit depends on the consideration of CPAs themselves. Wang (2012)^[15] showed in his research that CPAs would collude with enterprises when being audited, and they may face the risk of dismissal if they do not collude with enterprises. If the CPAs collude and are verified by the regulatory authorities, the CPAs will undertake losses. Because both parties have bounded rationality, the most suitable behavioral strategy can't be determined at the beginning of the game. The players of the game seek for a relatively stable behavioral strategy through continuous trials, and the behavior of choice and decision becomes a process of long-term dynamic game.

3. AN EVOLUTIONARY GAME MODEL OF CPAS' AUDITING AND STATE-OWNED ENTERPRISES' DELEVERAGING

According to the theory of bounded rationality, this paper analyzes the leverage manipulation of state-owned enterprises and the CPAs. Managers of state-owned enterprises implement leverage manipulation in order to meet the assessment requirements and CPAs seek to maximize their own interests. Under this premise, the game strategy and parameters are set as follows:

State-owned enterprise managers have two strategies: non-leverage manipulation A_1 and leverage manipulation A_2 ; CPAs have two strategies: strict audit B_1 and loose audit B_2 .

State-owned enterprises adopt strategies A_1 to reduce the leverage ratio to a reasonable range, and their earnings are recorded as S_1 ; state-owned enterprises adopt strategies A_2 to reduce the leverage ratio to a reasonable range, and their earnings are recorded as S_2 and $S_1 > S_2$. The cost of adopting the strategy A_1 is recorded as C_1 , and the adjustment cost of adopting the strategy A_2 is recorded as C_2 , and $C_1 > C_2$. V indicates the penalty for leverage manipulation after it is discovered.

The profit of the strategy B_1 , adopted by the CPAs is W_1 , and the profit of the strategy adopted by the CPAs is W_2 (mainly referring to the enterprises' bribery to the accountants and the normal audit income), and $W_1 < W_2$. The audit cost of strategy B_1 is H_1 , and the audit cost of strategy B_2 is H_2 , and $H_1 > H_2$. Z indicates loss that the CPAs failed to audit the enterprises implement leverage manipulation (mainly referring to the credit loss from the public). Under the strategy B_1 , the probability of CPAs discovering enterprises' leverage manipulation is α ; under the strategy B_2 ; the

probability of management department finding that the enterprise colludes with the CPA is β , and at this time, the losses caused to the enterprise and the CPA are Q and P respectively.

It should be noted that the parameter $S_1, S_2, C_1, C_2, W_1, W_2, H_1$, and H_2 are all positive. To keep things

simple, we make $S_2 - C_2 = U_2, S_1 - C_1 = U_1, W_1 - H_1 = T_1$, and $W_2 - H_2 = T_2$.

According to the premise hypothesis of evolutionary game model, we construct the game payoff matrix of CPA audit and state-owned enterprises' leverage manipulation, as shown in Table 1

Table 1 the Game Payoff Matrix of CPA Audit and State-owned Enterprises' Leverage Manipulation

		CPA	
		Strict Audit B_1	Loose Audit B_2
State-owned enterprises	Non-leverage Manipulation A_1	U_1, T_1	$U_1 - \beta Q, T_2 - \beta Q$
	Leverage Manipulation A_2	$T_1 - (1 - \alpha)Z, U_2 - \alpha V$	$U_2 - \beta Q, T_2 - \beta Q$

The probability of non-leverage manipulation is x , and the probability of leverage manipulation is $1 - x$; the probability of strict audit by CPAs is y , and the

probability of loose audit is $1 - y$. According to the data in Table 1, the replicated dynamic equations are as follows:

$$\begin{cases} \frac{dx}{dt} = x(1-x)[y\alpha V + U_1 - U_2] \\ \frac{dy}{dt} = y(1-y)[(1-\alpha)Z(x-1) + T_1 - T_2 + \beta Q] \end{cases} \quad (1)$$

According to the Replicator Dynamics Equation, we know that both $\frac{dx}{dt}$ and $\frac{dy}{dt}$ are equal to zero by solving them and we can obtain the possible stability of enterprises and CPAs. The possible Replicator Dynamics Stability Point is: $D_1(0,0), D_2(0,1), D_3(1,0), D_4(1,1), D_5(x^*, y^*)$, where

$$x^* = \frac{T_2 - T_1 - \beta Q}{Z(1-\alpha)} + 1 \quad \text{and} \quad y^* = \frac{U_2 - U_1}{V\alpha}$$

In this paper, we use the local stability of Jacobi matrix to calculate the Evolutionary Stability Strategy (ESS) by referring to the calculation method of Evolutionary Stability Strategy (ESS) by Friedman.

Jacobi matrix is:

$$J = \begin{bmatrix} (1-2x)[y\alpha V + U_1 - U_2] & x(1-x)V\alpha \\ y(1-y)(1-\alpha)Z & (1-2y)[(1-\alpha)Z(x-1) + T_1 - T_2 + \beta Q] \end{bmatrix} \quad (2)$$

According to the evaluation conditions of the evolutionary stability strategy, when the determinant of the Jacobian matrix $DET J > 0$ and the trace $Tr J < 0$,

the point is asymptotically stable. The five points are calculated and analyzed below, and the stability analysis of the equilibrium point is shown in Table 2.

Table 2 Local Stability of Equilibrium Point in the Game Between CPA Audit and State-owned enterprise

Equilibrium Point	Evaluation Conditions	DET J	Tr J	Results
(0, 0)	$U_1 - U_2 > 0, (\alpha - 1)Z + T_1 - T_2 + \beta Q > 0$	+	+	Unstable Equilibrium Point
	$U_1 - U_2 > 0, (\alpha - 1)Z + T_1 - T_2 + \beta Q < 0$	-	/	Saddle Point
	$U_1 - U_2 < 0, (\alpha - 1)Z + T_1 - T_2 + \beta Q > 0$	-	/	Saddle Point
	$U_1 - U_2 < 0, (\alpha - 1)Z + T_1 - T_2 + \beta Q < 0$	+	-	ESS
(0, 1)	$\alpha v + U_1 - U_2 > 0, -[(\alpha - 1)Z + T_1 - T_2 + \beta Q] > 0$	+	+	Unstable Equilibrium Point

Equilibrium Point	Evaluation Conditions	DET J	Tr J	Results
	$\alpha v + U_1 - U_2 > 0, -[(\alpha - 1)Z + T_1 - T_2 + \beta Q] < 0$	-	/	Saddle Point
	$\alpha v + U_1 - U_2 < 0, -[(\alpha - 1)Z + T_1 - T_2 + \beta Q] > 0$	-	/	Saddle Point
	$\alpha v + U_1 - U_2 < 0, -[(\alpha - 1)Z + T_1 - T_2 + \beta Q] < 0$	+	-	ESS
(1, 0)	$-(U_1 - U_2) > 0, T_1 - T_2 + \beta Q > 0$	+	+	Unstable Equilibrium Point
	$-(U_1 - U_2) > 0, T_1 - T_2 + \beta Q < 0$	-	/	Saddle Point
	$-(U_1 - U_2) < 0, T_1 - T_2 + \beta Q > 0$	-	/	Saddle Point
	$-(U_1 - U_2) < 0, T_1 - T_2 + \beta Q < 0$	+	-	ESS
(1, 1)	$-(\alpha V + U_1 - U_2) > 0, -(T_1 - T_2 + \beta Q) > 0$	+	+	Unstable Equilibrium Point
	$-(\alpha V + U_1 - U_2) > 0, -(T_1 - T_2 + \beta Q) < 0$	-	/	Saddle Point
	$-(\alpha V + U_1 - U_2) < 0, -(T_1 - T_2 + \beta Q) > 0$	-	/	Saddle Point
	$-(\alpha V + U_1 - U_2) < 0, -(T_1 - T_2 + \beta Q) < 0$	+	-	ESS
(x*, y*)	Any Conditions	Uncertain	0	Central Point

When $DET J > 0$ and the trace $Tr J < 0$, this point is stable and is analyzed combined with Table 2.

Compared with enterprises implementing leverage manipulation, enterprises without leverage manipulation has less net earnings, that is $U_1 < U_2$. In the case of leverage manipulation, when the net profits of strict audit by CPAs is less than that of loose audit, that is $T_1 - (1 - \alpha)Z < T_2 - \beta Q$, it tends to be the stable strategy (0,0). At this time, enterprises will implement leverage manipulation to deleverage, and CPAs will carry out loose audit. Obviously, this strategy is not advisable.

Compared with enterprises implementing leverage manipulation, enterprises without leverage manipulation has more net profits, that is $U_1 > U_2$. In the absence of leverage manipulation, when the net profits of strict audit by CPAs is less than that of loose audit, that is $T_1 < T_2 - \beta Q$, it tends to be the stable strategy (1,0). At this time, enterprises will not take leverage manipulation to deleverage, and CPAs will conduct loose audit. In the absence of effective audit for a long time, enterprises may change their strategies to implement leverage manipulation.

Under the strict audit of CPAs, the net profits of enterprises without leverage manipulation is less than that with leverage manipulation, that is $U_1 < U_2 - \alpha Z$. In the case of leverage manipulation, when the net profits of strict audit by CPAs is more than that of loose audit, that is $T_1 - (1 - \alpha)Z > T_2 - \beta Q$, it tends to be the stable strategy (0,1). At this time, the enterprises implement the leverage manipulation, and the CPAs carry out strict audit. It indicates that the net profits from leverage manipulation is too high, which makes enterprises

willing to risk punishment for manipulation, and the CPAs conduct strict audit. Such a state will make enterprises trapped into a cycle and increase the risk.

Under the strict audit of CPAs, the net profits of enterprises without leverage manipulation is more than that with leverage manipulation, that is $U_1 > U_2 - \alpha Z$. In the absence of leverage manipulation, when the net profits of strict audit by CPAs is more than that of loose audit, that is $T_1 > T_2 - \beta Q$, it tends to be the stable strategy (1,1). At this time, enterprises do not carry out leverage manipulation and CPAs carry out strict audit, which can form a good business atmosphere.

4. SUGGESTIONS

Through the analysis, it can be concluded that enterprises do not implement leverage manipulation and CPAs conduct strict audit according to auditing standard agrees with the principle of maximizing the interests of both parties. According to the results, we give some suggestions on enterprises deleveraging. First, we need to improve enterprise-governance mechanisms. The existence of bounded rationality makes it possible for enterprises to conduct leverage manipulation in order to reduce leverage ratio. The internal governance mechanisms of enterprises should give full play to its role and we should punish the departments that have such phenomena. Second, the government should increase support for deleveraging enterprises. We should help enterprises speed up the debt-for-equity swaps and provide multiple financing channels so that truly deleveraging enterprises can reap profits. We should help enterprises make use of idle assets and reduce adjustment costs in the process of deleveraging. Third, we should strengthen external supervision. We should

punish enterprises with leverage manipulation to achieve clear reward and punishment. We should regularly publicize the deleveraging of enterprises to enhance the public's trust in enterprises.

5. CONCLUSION

All in all, that enterprises do not implement leverage manipulation and CPAs conduct strict audit is the choice to maximize the interests of both parties. The result of this strategy is related to $T_2 - \beta Q$, T_1 , U_1 and $U_2 - \alpha Z$, and the net profits when enterprises do not implement leverage manipulation and CPAs adopt strict audit is higher, the result is more stable. Since the value of each parameter is uncertain, we can better discuss the evolutionary trend of strategy through the evolutionary game.

REFERENCES

- [1] Zhang,M, He,J.(2013) Potential Risks of China's Economic Deleveraging .J. Financial Market Research, 5: 3-9.
- [2] Zhong,C.P.(2018)Enigma of “High Leverage” and Difficulty of “Deleveraging” in State-owned Enterprises.J. People’s Tribune,27: 70-71.
- [3] Landsman,W. R., Peasnell, K. V.,Shakespeare, C.(2008). Are Asset Securitizations Sales or Loans?The Accounting Review, 83(5), 1251–1272.
- [4] Scott, T.W., Wiedman,C.I., Wier,H.A. (2011)Transaction structuring and Canadian convertible debt J. Contemporary Accounting Research, 28(3): 1046-1071.
- [5] Lin,D.P.(2010) Nature, Capital Structure, and Earnings Management of Controllers.J. Friends of Accounting (late-ten-day periodical), 8: 86-88.
- [6] Chen,M.(1995)Discussion on off-balance-sheet Financing of Enterprises.J. Accounting Research, 11: 6-10.
- [7]Meng,Q.B.,Shi,J.H.,Song,Z.J.(2019)Does “Credulous” CPA Affect Audit Quality?— An Empirical Study Based on Chinese General Social Survey (CGSS).J. Accounting Research,7: 12-20.
- [8] Yan,T., Li,F.(2014)Evolutionary Game Analysis of Capital Structure Adjustment among Enterprises in Industry. Research on Economics and Management. 11: 39-45.
- [9] Zhang,Z.Y.(2014)Research on Audit Quality Control under Principal-agent Relationship. Contemporary Economic Research. 11: 88-94.
- [10] Xu,X.F., Lu,Z.F., Tang,T.J.(2020)Research on Means, Measure and Inducement of Leverage Manipulation of Listed Companies in China.J. Journal of Management Sciences in China,23(07):1-26.
- [11] Hao,S.L.Li,M.Q.(2019)Evolutionary Game Analysis of Chinese Audit Supervision’s Restraint on STATE-OWNED ENTERPRISES’ Earnings Management.J. Audit & Economy Research,34(06): 10-18.
- [12] Simon, H.A.(1955)A Behavioural Model of Rational Choice.J. The Quarterly Journal of Economics, 69(1): 99-118.
- [13] Wu,D.H.,Zhang,K.(2015)Study on Influence of Managers’ Overconfidence on Corporate Capital Structure. Journal of Regional Financial Research,2: 14-20.
- [14] Xiong,W.,Liu,F.Y.(2019) Descriptive Statistical Study of CEO’s Financial Experience and Capital Structure Decisions.J. Business & Economy,10: 152-155.
- [15] Wang,M.H.(2012) The Economic Theory Analysis of CPA Audit Collusion.J. Journal of Chongqing University of Science and Technology (Social Sciences Edition), 19: 99-101.