Analysis of Accounting Fraud in Enterprises Based on Game Theory——Take the Case of Geeya Technology Company Limited Fraud as an Example

Shali Liu*
Shandong University, Weihai, China, Sallyliugz@outlook.com

ABSTRACT

Based on the game theory, focusing on the analysis of various factors affecting the financial fraud of domestic enterprises and the collusion of auditors make it possible to find out the dominant influencing factors and to put forward suggestions to reduce the possibility of financial fraud of enterprises. The game shows that the probability of fraud or collusion between the enterprise and the auditor mainly stems from the game between the benefit and the cost, which conforms to the "rational person" assumption. From the perspective of enterprises, progressive punishment can be set to increase the cost of fraud, improve the remuneration system and use the reward reporting function of blockchain technology to reduce the motivation of fraud; from the perspective of auditors, the mandatory rotation system can be implemented to increase the cost of non-compliance, enhance the independence of auditors and use the reward mechanism of blockchain audit to reduce the probability of collusion.

CCS CONCEPTS

• **Social and professional topics** → Professional topics; Computing and business; Economic impact.

KEYWORDS

Game Theory, Financial Fraud, Geeya Technology Company Limited, Blockchain Technology

ACM Reference Format:
Shali Liu and Shandong University, Weihai, China, Sallyliugz@outlook.com. 2021. Analysis of Accounting Fraud in Enterprises Based on Game Theory——Take the Case of Geeya Technology Company Limited Fraud as an Example. In *2021 2nd Asia-Pacific Conference on Image Processing, Electronics and Computers (IPEC2021), April 14–16, 2021, Dalian, China.* ACM, New York, NY, USA, 4 pages. https://doi.org/10.1145/3452446.3452542

** Corresponding author

IPEC2021, April 14–16, 2021, Dalian, China

ACM ISBN 978-1-4503-8981-5/21/04…$15.00
https://doi.org/10.1145/3452446.3452542

1 CASE BACKGROUND OF GEEYA TECHNOLOGY COMPANY LIMITED

Geeya Technology Company Limited (hereinafter referred to as "Geeya Technology") is one of the first listed companies on the gem. Its main business is related business of software and hardware products of digital TV system, including research and development, production, sales and service and is committed to becoming a leader in the field of digital multimedia in China [1]. On June 3, 2015, the abnormal asset restructuring action of Geeya Technology, which acquired Tianxiang Hudong at a high price, was suspected of profit transfer, which attracted the attention of the China Securities Regulatory Commission (CSRC) and was required to supplement materials. As a result, the CSRC found that it was suspected of financial fraud, so it launched an investigation. Since June 9, 2015, Geeya Technology has suspended trading and self-examination. In January 2016, it released its self-examination report and admitted that there was a huge amount of inconsistency between accounts and reality.

2 THE BASIC ASSUMPTIONS OF GAME THEORY

There are three basic assumptions in game theory. One is "rational man hypothesis", meaning that the game participants are all rational persons, including cognitive rationality and behavioral rationality. The second is the "assumption of pursuing maximum self-interest". Assuming the players in the game will choose the actions that can maximize their personal interests, there will inevitably be divergence of interests among the players in the game. The third is "common knowledge assumptions". The players in the game reach a consensus on the "rationality" of the participants and the rules of the game and know each other is rational or each other knows the rules [2].

3 GAME ANALYSIS OF FRAUD

3.1 Game Premise Assumption

First, it is assumed that the cost of blockchain audit is higher than that of traditional audit. However, the use of blockchain technology can reduce information asymmetry. As the reward mechanism of blockchain technology is that the one who first calculates the results and successfully adds them to the account book will receive certain reward first, other auditors will eventually find out the enterprise fraud under the reward mechanism.

Secondly, under the traditional audit, if the entrusted auditor does not find any fraud, the enterprise fraud will not be found within a certain period. At the same time, it is assumed that other auditors are not aware in advance of whether the enterprise is

fraudulent or whether the enterprise and the entrusted auditor are collusive.

Thirdly, assuming the strategy of the enterprise is S= (fraud, non-fraud), the probability of selecting fraud is α; assuming the strategy of the entrusted auditor is S= (select collusion after fraud detection, refuse collusion after fraud detection, no fraud is found), the probability of fraud detection is γ and the probability of selecting collusion after fraud detection is β; assuming the strategy of other auditors is S= (detect fraud).

3.2 Expected Utility of Game Participants

(1) 1. Suppose that the utility function of an enterprise is expressed as: U1=MAXF (basic revenue A1, fraud revenue A2, cost saving of Distributed Ledger Technology A3, reward for correcting recording of Distributed Ledger Technology A4, additional cost of Distributed Ledger Technology A5, amount of audit fee paid A6, additional cost of purchasing audit opinion A7, additional cost of modifying records A8, fine and reputation loss A9).

(2) Suppose that the utility function of the entrusted auditor is expressed as: U2 = MAXF (audit fee revenue B1, cost saving of blockchain audit B2, additional reward for blockchain audit detecting fraud and properly recording B3, reputation improvement for fraud detection B4, revenue from audit opinion purchased A7, additional cost of blockchain audit B5, additional cost of modifying records B6, future fine for not detecting fraud and reputational loss B7).

(3) Suppose that the utility function of other auditors is expressed as: U3 = MAXF (additional reward and reputation improvement for fraud detection C)

3.3 Game Analysis

3.3.1 Game Analysis under Blockchain Audit. (1) The revenue function of an enterprise is as follows:

$$\begin{aligned} E_\alpha = {} & \alpha\gamma\beta\,(A_1 + A_2 + A_3 - A_5 - A_6 - A_7 - A_8 - A_9) \\ & + \alpha\gamma\,(1-\beta)\,(A_1 + A_2 + A_3 - A_5 - A_6 - A_9) \\ & + \alpha\,(1-\gamma)\,(A_1 + A_3 + A_4 - A_5 - A_6) \end{aligned} \tag{1}$$

In order to make the game reach equilibrium, the first partial derivative of Eα with respect to α is 0,$E'_\alpha(\alpha) = 0$,then we get $\gamma\beta = \frac{A_2 - A_4 - A_9}{A_7 + A_8}$. β is the probability of discovering fraud and collusion. According to the formula, we can infer that the probability of collusion is directly proportional to the fraud revenue (A2) and inversely proportional to the reward for correcting recording of Distributed Ledger Technology (A4), the additional cost of purchasing audit opinion (A7), the additional cost of modifying records (A8) and the fine and reputation loss (A9).

(2) The revenue function of the entrusted auditor is as follows:

$$\begin{aligned} E_\beta = {} & \alpha\gamma\beta\,(B_1 + B_2 + A_7 - B_5 - B_6 - B_7) + \alpha\,(1-\beta)\,\gamma\,(B_1 + B_2 \\ & + B_3 + B_4 - B_5) + \alpha\,(1-\gamma)\,(B_1 + B_2 - B_5 - B_7) \\ & + (1-\alpha)\,(B_1 + B_2 - B_5) \end{aligned} \tag{2}$$

The conditions for the game to reach equilibrium are as follows:$E'_\beta(\beta) = 0$,then we get $E'_\beta(\beta) = \alpha\gamma(A_7 - B_6 - B_3 - B_4)$. α is inversely proportional to γ if and only if $A_7 - B_6 - B_3 - B_4 = 0$, i.e. $A_7 - B_6 = B_3 + B_4$. For the entrusted auditor, when the cost of collusion is equal to the reward obtained without collusion, the probability of fraud (α) is inversely proportional to the probability of whether the auditor can detect fraud (γ). At this time, there will be a game between the auditor and the enterprise. When the probability of fraud (γ) increases, the probability of corporate fraud (α) decreases, but the increase of γ will lead to the increase of audit cost.

Let $E'_\beta(\gamma) = 0$, then we get $\beta = \frac{-(B_3+B_4+B_7)}{A_7-B_6-(B_3+B_4+B_7)} = \frac{1}{1-\frac{A_7-B_6}{(B_3+B_4)+B_7}}$. $(A_7 - B_6)$ is the fraud revenue obtained from the collusion between the entrusted auditor and the enterprise. When the fraud revenue is higher, the probability of collusion is greater; $(B_3 + B_4 + B_7)$ is the reward obtained by the entrusted auditor after issuing the non-unqualified opinion, that is, the reward for the entrusted auditor not to collude with the enterprise. The richer the reward is, the smaller the probability β is for the entrusted auditor to choose collusion.

3.3.2 Game Analysis under Traditional Audit. (1) The revenue function of an enterprise is as follows:

$$\begin{aligned} E_\alpha = {} & \alpha\gamma\beta\,(A_1 + A_2 - A_6 - A_7 - A_9) + \alpha\gamma\,(1-\beta)\,(A_1 + A_2 - A_6 - A_9) \\ & + \alpha\,(1-\gamma)\,(A_1 + A_2 - A_6 - A_9) + (1-\alpha)\,(A_1 - A_6) \end{aligned} \tag{3}$$

Let $E'_\alpha(\alpha) = 0$, then we get $\gamma\beta = \frac{A_2 - A_9}{A_7}$. According to the formula, it can be concluded that the probability of whether the enterprise chooses to collude is directly proportional to the total fraud revenue $(A_2 - A_9)$and inversely proportional to the additional cost of purchasing audit opinion (A7).

The revenue function of an enterprise is as follows: [3].

$$\begin{cases} \alpha\gamma\beta\,(A_1 + A_2 - A_6 - A_7 - A_9) + \alpha\gamma\,(1-\beta) \\ \qquad (A_1 + A_2 - A_6 - A_9) + \alpha\,(1-\gamma) \\ \qquad (A_1 + A_2 - A_6 - A_9)\,, fraud \\ \qquad (1-\alpha)\,(A_1 - A_6)\,,\ non-fraud \end{cases} \tag{4}$$

If and only if the enterprise fraud revenue and non-fraud revenue are equal, the game is balanced. Then we get $\alpha = \frac{1}{2+\frac{-(A_2-A_9-\beta\gamma A_7)}{-(A_1-A_6)}}$.

The probability of fraud is inversely proportional to the basic revenue of daily operation$(A_1 - A_6)$ and is directly proportional to the total revenue of fraud$(A_2 - A_9 - \beta\gamma A_7)$.

The revenue function of the entrusted auditor is as follows:

$$\begin{aligned} E_\beta = {} & \alpha\gamma\beta\,(B_1 + A_7 - B_7) + \alpha\,(1-\beta)\,\gamma\,(B_1 + B_4 - B_7) \\ & + \alpha\,(1-\gamma)\,(B_1 - B_7) + (1-\alpha)\,B_1 \end{aligned} \tag{5}$$

Let $E'_\beta(\beta) = 0$, then we get $\beta = \frac{1}{1-\frac{A_7}{B_4}}$. The probability of collusion between the entrusted auditor and the enterprise β is inversely proportional to the reputation of fraud detection and is directly proportional to revenue from audit opinion purchased (A7).

3.4 Game Analysis Conclusion

Whether in the blockchain audit or in the traditional audit mode, the fraud probability of an enterprise α is directly proportional to the total fraud revenue; it is inversely proportional to the basic revenue when there is no fraud and is inversely proportional to the probability that the auditor of the entrusted party can find the fraud. The probability of collusion β is directly proportional to the total revenue of collusion and inversely proportional to the reward of

non-collusion. This conclusion is consistent with "rational person hypothesis" and "pursuit of maximum interest hypothesis".

Under the blockchain audit model, due to the existence of competition mechanism and incentive mechanism, other auditors hope to find out the financial fraud information as soon as possible for the sake of obtaining a larger share in the limited incentive pool. Theoretically, there is only a time difference between the entrusted auditors and other auditors when they fail to find out the fraud. However, there is no probability that other auditors fail to find the fraud.

4 GAME ANALYSIS OF GEEYA TECHNOLOGY FRAUD CASES

(1) When the total revenue of corporate fraud is far greater than the consequences of fraud, the probability of corporate fraud α is larger [3].

Illegal occupation of funds is one of the main means of Geeya Technology fraud. In February 2015, Geeya Technology wanted to acquire all the equity of Tianxiang Hudong and purchased it at a price nearly 20 times higher than the company's fair value. As a result, the retail investors who did not understand the essence even felt that it was a situation of strong and powerful cooperation, which promoted the share price of Geeya Technology to rise rapidly from 15 yuan to 68 yuan. If the restructuring is successful, Geeya Technology will have to pay nearly 100 million yuan in cash and 121 million yuan in shares to Zhou Xuhui, the major shareholder of Geeya Technology [4]. It can be said that "getting something from nothing", it will obtain huge benefits. The second means is to increase operating revenue and profit. The actual interest rate of installment sales contract signed between Geeya Technology and Nanchong Hongye is 17.34%, which is far higher than the loan interest rate of the bank and the financing revenue obtained is far more than the contract price [5].

According to the administrative punishment decision of China Securities Regulatory Commission, the punishment for fraud is only a fine of 600000 yuan for Geeya Technology, a total of 900,000 yuan for Zhou Xuhui, who is acted as the person in charge directly responsible and the actual controller; the amount of fine for the rest of the personnel involved in forging financial data is less than 500,000 yuan.

Compared with the price paid by fraud, the benefits of fraud to individuals and enterprises make Geeya technology desperate. The punishment, which should have been "negative utility", has become "positive utility" in disguise.

(2) When the total profit of collusion is far greater than the cost of collusion, the probability of collusion is high; when the profit of collusion obtained by the entrusted auditor is far greater than the cost of collusion, the probability of collusion is high.

The signing accountants of Geeya Technology have been engaged in continuous auditing for many years, such as Zou Junmei and Cheng Jin and their audit fees are significantly higher than the market average [6]. However, after the fraud cases were exposed, only the accounting firms were given a warning and fined 2.7 million yuan; the punishment for individuals was also relatively low and the penalty for the directly responsible personnel was less than 500,000 yuan [7].

At this stage, the punishment of audit collusion is mild and the revenue obtained after breaking the law far exceeds the cost of violation, which has become an important reason for audit collusion.

5 MEASURES TO REDUCE THE RISK OF CORPORATE FRAUD BASED ON THE CASE OF GEEYA TECHNOLOGY FRAUD

5.1 Enterprise Level

The motivation of corporate fraud mainly comes from the fact that the revenue obtained by fraud far exceeds the cost of fraud. On the other hand, it is difficult for external regulators to find fraud, so we can start from these two aspects.

Increase the cost of corporate fraud and set progressive Punishment [6]. Different levels of punishment should be set from the administrative, economics and legal perspectives to make all personnel aware of their legal responsibilities, abide by professional ethics and improve their sense of social responsibility. At the same time, the improvement of enterprise value comes from the trust of investors and consumers to a certain extent. After the disclosure of corporate fraud, if the reputation loss of the enterprise and the top management is heavy, the probability of fraud can be reduced from the subjective level.

Improve the enterprise salary system. If there are interests, fraud may occur. When the distribution of interests is unreasonable or the assessment mechanism attaches too much importance to business performance, it may lead to fraud motivation.

The traditional profit distribution mode is more likely to breed fraud, while the anonymity and openness of blockchain technology can protect the privacy of personnel and reduce the probability of fraud. At the same time, due to the hidden nature of the blockchain and Smart Contract, the reward reporting function can be easily produced. When the masses have no real evidence to show that a company has the possibility of fraud, funds can be injected into the reward fund pool and the reward can be obtained proportionally if the report is successful and the reward fund can be traced by using blockchain technology. The increasing number of people who believe that there is fraud in enterprises gradually makes the reward fund pool accumulate rich rewards to encourage those who have the evidence of fraud to report.

5.2 Auditor Level

Improve the independence of auditors. Geeya Technology has been cooperating with BDO China Shu Lun Pan Certified Public Accountants for five consecutive years and its signing accountant has been reappointed for five consecutive years. To a certain extent, its independence is affected by the long term of office. Therefore, from the perspective of pre engagement, enterprises may be required to compulsorily rotate the auditors they employ or even the audit firms that provide audit services, so as to improve the independence of auditors to a certain extent and reduce the possibility of abandoning independence and choosing collusion.

Increase the cost of the auditor's non-compliance. In the case of Geeya Technology fraud, after the collusion between the auditors and the enterprise is exposed, the cost of non-compliance is relatively low. Therefore, from the perspective of post engagement, we

can start from improving the cost of non-compliance, such as the bargaining power of the accounting firm, the professional qualification of the auditors and the restrictions on future development of the industry, so as to improve the accountability system [8]. It urges auditors to reduce the probability of collusion on the subjective level under the tendency of pursuing maximum interests after considering the opportunity cost.

Under the traditional audit model, the entrusted auditors, who subjectively underestimating the possibility and consequences of the future collusion after it is disclosed, may have a fluke mentality and choose to collude. However, under the blockchain audit model, it is difficult to tamper with the transaction records of a certain node through collusion. In general, a single node is protected by the hashing algorithm, unless there is more than "51%" of computing power attack; at the same time, if a block needs to be modified, it needs to verify the block generated from the block, which costs a lot [9], [10]. It is difficult to tamper with Transactions unless they are recorded "erroneously" in the up-chain stage. In addition, the party who records information correctly can obtain digital currency reward, thus reducing the motivation of modifying block records. Therefore, the application of blockchain technology audit can, to a certain extent, reduce the probability of auditors choosing collusion from an objective level.

6 SUMMARY

Based on the game theory and combined with the case of Geeya Technology, the analysis of the various influencing factors of the domestic enterprises' financial fraud and auditor collusion through game theory leads to a consistent conclusion: the probability of fraud or collusion between enterprises and auditors mainly comes from the game between benefits and costs, which is consistent with the basic assumptions of game theory; under the blockchain audit model, the existence of competition mechanism and incentive mechanism makes the probability of fraud undetected tends to zero. In view of this conclusion, it would be a good choice to increase the cost of non-compliance and reasonably use the incentive mechanism to reduce the probability of fraud or collusion.

REFERENCES

[1] Fu J P. Presumption and Governance analysis of Audit Collusion. Finance & Accounting Communications, 2020, 841(5): 125-128, 133. (in Chinese)
[2] Deng Xiaodong, Li Fang. Financial Fraud Case Study of "Jinya Technology" – Based on the GONE theory of fraud.Jiangsu Business Theory,2019(10):111-114.
[3] Luan Fugui, Tian Liyuan.Game Analysis of whistleblower, Company and Auditor – A Study based on whistleblower Protection System .Audit and economic research,2017,32(01):38-48.
[4] Fan Bin, LI Yin. Block Chain and Accounting, Auditing. Journal of Finance and Accounting, 2018, 822(2): 39-43.
[5] Yuan Yong, WANG Feiyue. Development Status and Prospect of Block chain Technology. Journal of Automation, 2016, 42(4): 481-494.
[6] Niu Yiheng. Research on Motivation and Governance of Financial Fraud in Listed Companies – Based on the common Perspective of Fraud risk Factor Theory and Game Theory.Finance and Accounting Newsletter, 2020(12): 99-103.
[7] Jin Lei. Motivation analysis and Case Enlightenment of Jinya Technology Financial Fraud based on GONE Theory.Heilongjiang Bayi Agricultural Reclamation University,2018.
[8] Wang Jiaqi. A Case Study of Lixin's Failed Audit of Jinya Technology. Hunan University,2018.
[9] Meng Binglan. Analysis of Accounting Fraud and Supervision based on Dynamic Game. Academic Forum, 2016, 39(9): 59-62, 72.
[10] Zhang Yue-ling, Wang Xiaojing. Analysis of networked Audit Framework in the Blockchain Technology Environment. Finance and Accounting Newsletter, 2019, 804(4): 82-86.