

# Analysis of Financial Fraud Supervision of Listed Companies Based on Game Theory ——Take Luckin Coffee as an Example

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**Abstract.** In the development of the capital market, financial fraud of listed companies often occurs, which leads to the untrue disclosure of information. It seriously affects the stability and fairness of the market. The financial fraud involving listed companies and regulators is also a typical game problem, and the ultimate goal of game analysis is to make all parties reach an ideal equilibrium state. Therefore, this paper conducts an in-depth case study on the social issue of Luckin Coffee's financial fraud and builds a specific regulatory game model. The conclusion is that the probability of choosing financial fraud by listed companies is affected by four factors: the cost of supervision, the probability of being accused, the fine and the reputation loss to the regulator. Reducing supervision costs and increasing fines can effectively prevent the occurrence of financial fraud. So this paper also puts forward some suggestions, in order to promote the healthy development of Chinese financial market.

## 1 Introduction

China's capital market has been developing for more than 30 years. During this period, financial fraud of listed companies has emerged in endlessly. For example, Green Earth, Yinguangxia, Wanfu Biotech, etc. In 2010-2019, there were 104 listed companies punished by the CSRC for financial fraud, of which 3 were also involved in repeated fraud. In addition, 9 companies to be listed were also involved in financial fraud, so they failed to list [1]. Financial fraud, as an illegal act, not only destroys the fairness of economy, but also misleads investors and even causes huge losses due to untrue information disclosure. This situation discourages investment enthusiasm and seriously hinders the healthy development of the capital market.

As a branch of economics, game theory has become one of the commonly used scientific tools to analyze

economic problems. Establishing a game model is convenient to clarify the relationship between participants and propose effective counter measures.

Falsification of financial reports of listed companies is not an accidental phenomenon. On February 1, 2020, Muddy Waters Research released a report, pointing out that Luckin Coffee Company had financial fraud. After that, on April 2, Luckin Coffee Company submitted an announcement to the Securities and Exchange Commission (SEC), admitting that it had financial fraud. The occurrence of this hot event aroused great concern of the society.

## 2 Literature Review

### 2.1 Foreign literature review

Table 1. Literature review of foreign scholars

Author	Literature summary
Fellingham, Newman (1985)	Game theory was first used to analyze the relationship between business operators and audit institutions and built a complete information static game model.
Baiman (1991)	It regards the enterprise as two different participants and accordingly constructs a tripartite game model of the owner, the operator and the auditor.
Tucker, Matsumura (1992)	On the basis of Fellingham and Newman, a dynamic game model with incomplete information between business operators and auditors is more directly constructed. The conclusion is that the probability of financial fraud can be reduced by increasing the penalties for auditors and the audit fees.
Bloomfield (1997)	Establishing the Game Matrix between Enterprise Managers and Auditors

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Fischbacher, Stefani (2007)	Establishing the game matrix between enterprise managers and auditors and using the method of payment maximization to prove the number and effort of auditors are proportional to the audit quality.
Mathew, Rahul (2010)	Establishing a Dynamic Stochastic Game Model between Enterprise Managers and Auditors
Nikolaos, Markos (2011)	The evolutionary game model is established, which believes that the auditor's expectation is to eliminate misstatement and reduce workload, and the business operator's expectation is to obtain benefits through financial fraud.

## 2.2 Domestic literature review

Table 2. Literature review of domestic scholars

Author	Literature summary
Yao Haixin, Yin Bo, Li Zheng (2003)	Taking listed companies and regulatory authorities as participants, this paper proposes a static supervision game model with incomplete information and points out that supervision is of great significance [2].
Song Zaike (2007)	Use game theory to dynamically analyze the cost-benefit relationship between accounting information disclosure party and regulator [3].
Qin Le (2012)	According to the complete information static game theory, a game model is established for listed companies and government regulators, who believe that only increasing the punishment for financial fraud of listed companies can not completely curb the occurrence of this behavior [4].
Long Zhengwei (2013)	Establishing a complete information static game model between listed companies and regulatory authorities, which believes that improving the punishment of financial fraud and reducing the regulatory cost of regulatory authorities are the key to optimizing China's accounting regulatory system [5].
Yao Haixin, Leng Jun (2016)	Building an external static game between the regulatory authorities and the management of listed companies in stages and an internal dynamic game model between the management of listed companies and auditors to analyze the accounting information disclosure and the strategic choices of game participants [6].

## 3 Building a game model for both sides

### 3.1 Building a regulatory game model

As there is no direct evidence to show the audit institutions have obvious dereliction of duty, this paper will mainly conduct further analysis by building a regulatory game model with listed companies and regulators as participants. Basic segments of game theory include: Finding out the basic elements; Confirming the type of game; Using model to analyze and predict game results. Basic elements of game theory include participants, action space, information, results and benefits.

In the case of financial fraud of Luckin Coffee, the participants are Luckin Coffee (a Chinese company listed in the United States) and regulators (China Securities Regulatory Commission and the United States Securities Regulatory Commission), and their action plans are fraud, no fraud, supervision and no supervision. Game type is static game with complete information. Specific contents are as follows:

### 3.1.1 Basic assumptions

(1) H1: The participants in the game, listed companies and regulators, are "rational people", both parties will make strategic choices to maximize their own interests.

(2) H2: The action space of listed companies is fraud and non fraud. The action space of regulators is supervision and non supervision. Both parties know that the other party only has these two alternative strategies.

(3) H3: Financial fraud and supervision is effective. If a listed company conducts financial fraud, it will succeed in fraud without any technical problems. Similarly, if regulators take regulatory actions, they can also detect fraud of listed companies.

### 3.1.2 Parameter Setting

After putting forward the above specific assumptions, we can see the following table for specific parameters and their meanings:

Table 3. Parameter Settings of the Regulatory Game Model

Parameter	Meaning
$\alpha$	Probability of listed companies choosing financial fraud.
$\beta$	Probability of regulators choosing supervise.
$\gamma$	Probability of financial fraud of listed companies being reported.
R	Additional income of listed companies from financial fraud.
F	Fines imposed by regulators after finding financial fraud of listed companies.
C	Supervision cost of regulators (cost is 0 when no supervision is selected).
S	Reputation loss when the regulators do not supervise but the public know the financial fraud of listed companies

### 3.1.3 Payment Matrix

Table 4 Payment Matrix of the Regulatory Game Model

listed company Regulators	supervise	Non regulatory	
		Reported	Not reported
Fraud	(-F, F-C)	(R-F, F-S)	(R, 0)
No fraud	(0, -C)	(0, 0)	(0, 0)

When a listed company's financial fraud penalty (F) is less than the supervision cost (C), the regulator will not supervise by eliminating the bad strategy. In this situation, as long as additional income (R) of fraud is larger than F, listed company will choose fraud. The equilibrium solution is (non supervision, fraud). But there is no evidence to support F must be smaller than C and R must be larger than F, so the game problem is actually a mixed strategy game rather than a simple pure strategy game.

### 3.2 Equilibrium solution of game model

As mentioned above, the game problem is a mixed strategy game. So it is necessary to establish the utility function of each participant to find the equilibrium solution. U1 is used to represent the utility function of listed companies, and U2 is used to represent the utility function of regulators.

$$U_1 = \alpha\beta(-F) + \alpha(1-\beta)\gamma(R-F) + \alpha(1-\beta)(1-\gamma)R$$

$$U_2 = \alpha\beta(F-C) + \beta(1-\alpha)(-C) + \alpha(1-\beta)\gamma(F-S)$$

It can be seen that:

$$U_1'(\alpha) = \beta(-F) + (1-\beta)\gamma(R-F) + (1-\beta)(1-\gamma)R$$

$$U_2'(\beta) = \alpha(F-C) + (1-\alpha)(-C) - \alpha\gamma(F-S)$$

Separate orders  $U_1'(\alpha) = 0$ ,  $U_2'(\beta) = 0$ , then: 
$$\begin{cases} \beta^* = \frac{R-\gamma F}{(1-\gamma)F+1} \\ \alpha^* = \frac{C}{(1-\gamma)F+\gamma S} \end{cases}$$

Under above conditions, the probability of listed companies to choose financial fraud is  $\alpha^*$ . The probability that the regulators choose to supervise is  $\beta^*$ .

#### 3.2.1 Analyze the equilibrium solution $\alpha^*$

After reaching equilibrium, we can see the probability of listed companies choose to financial fraud ( $\alpha^*$ ) is influenced by four factors: supervision cost(C), probability of being reported ( $\lambda$ ), Fines to be borne if fraud is found (F) and reputation losses to be borne by regulators (S).

It can be seen that C and  $\alpha^*$  has positive correlation. The range of C is (0,  $+\infty$ ). It means supervision cost is higher, listed companies are more likely to engage in financial fraud. Because the high supervision will affect the enthusiasm of the supervision department and reduce supervision efficiency.

The range of  $\lambda$  is (0,1). There is no direct relationship between  $\lambda$  and  $\alpha^*$ , but it can be analyzed when  $\lambda=0$  or  $\lambda=1$ . If  $\lambda=0$ , which means fraud will not be accused. Therefore, the probability of fraud can be reduced by increasing the fine amount and the reputation loss suffered by the regulators. If  $\lambda=1$ , the probability of fraud can be reduced only by increasing the reputation loss suffered by the regulators.

#### 3.2.2 Analyze the equilibrium solution $\beta^*$

After reaching the equilibrium, we can see the probability of supervision by regulators ( $\beta^*$ ) influenced by three factors: additional income of financial fraud (R), probability of being accused ( $\lambda$ ), fines to be borne if fraud is found(F).

The range of R is (0,  $+\infty$ ). When other variables remain unchanged, the greater R is, the bigger  $\beta^*$  is.

There is no direct relationship between  $\lambda$  And  $\beta^*$ ,but it also can be analyzed when  $\lambda=0$  or  $\lambda=1$ . No matter  $\lambda=0$  or  $\lambda=1$ , increasing the amount of fine(F) can reduce the supervision probability.

## 4 Introduction to Financial Fraud Cases of Luckin Coffee

The case is the hot event in 202, Luckin Coffee's financial fraud. In 2017, Luckin Coffee was founded. Its founding philosophy was to rapidly expand with huge funds. By the end of 2019, it had set up 4600 stores, surpassing Starbucks as the largest chain coffee brand with direct stores in China. On May 17, 2019, Luckin Coffee was successfully listed on NASDAQ.

On February 1, 2020, Muddy Waters Research, released an 89 page anonymous short selling report, pointing out that Luckin Coffee had financial fraud. The report used the evidence about more than 25000 tickets and 11000 hours of videos collected by 92 full-time employees and 1418 part-time employees to point out Luckin began to fabricate operational and financial data from the third quarter of 2019 to create a profit illusion<sup>[7]</sup>. On April 2, Luckin issued a statement acknowledging this accusation and disclosed that the amount of fraud was up to 2.2 billion yuan. On the same day, its share price plummeted by 75.57% and experienced six circuit breakers. The company's market value declined by 35.4 billion yuan. On April 7, Luckin announced the suspension of trading on NASDAQ.

Luckin's auditor is E&Y Huaming Certified Public Accountants. Its underwriters are Credit Suisse, Morgan Stanley, CICC and Haitong International. Its Chinese law team is Jindu Law Firm and Jingtian Gongcheng Law Firm,Its American law team is Davey Law Firm and Jiali Law Firm. They also have responsibility for the fraud.

Luckin is listed on the NASDAQ. However, listed companies in the United States rarely commit financial fraud. Because the United States imposes extremely strict penalties on listed companies and executives who commit fraud, which will not only face huge fines from the Ministry of Justice, but may even be sentenced to 10-25 years of imprisonment.

In the process of gradually changing from the approval system to the registration system, China securities market should also consider the issue of gradually establishing and improving the ethics of financial supervision. On April 22, 2020, the US SEC sent a letter to the CSRC to communicate about the cooperation between the two parties in conducting a thorough investigation of Luckin Coffee. CSRC expressed strong condemnation. CSRC would deepen cross-border regulatory and promote the improvement of the quality of financial information disclosure.

## 5 Conclusions and suggestions

The primary principle that all interest subjects follow is to maximize interests in the financial market. If financial fraud of listed companies wants to be eradicated, it needs the joint efforts of both listed companies and the

regulators. Therefore, this paper gives the following suggestions:

### 5.1 Improve regulatory system for listed companies

Firstly, accelerating the full implementation of the registration system is very important. After nearly 30 years of development, China's capital market is gradually implementing the registration system. The comprehensive implementation of the registration system will help strengthen information disclosure and reduce regulatory costs. Secondly, we will improve the delisting system. Compared with developed countries, the number of listed companies delisted is very low and the number of listed companies voluntarily delisted is even more rare. Therefore, it is necessary to refine the relevant provisions of the delisting system to eliminate the listed companies that violate the rules and fraud, so as to ensure the rational and healthy development of the capital market.

### 5.2 Improve relevant legal system and increase punishment

Financial fraud of listed companies needs not only ethics to restrain, but also legal norms to ensure the fairness of the system. For example, the Sarbanes Oxley Act of the United States has made clear provisions on the legal accountability of companies for financial fraud. It includes legal accountability of persons responsible for the fraud, the legal accountability of relevant intermediaries and individuals and the collective action that investors can take against them. The imprisonment time for the persons involved in the listed companies is up to 25 years. The amount of fines is up to 25 million dollars and the relevant intermediaries can be permanently revoked. By contrast, China's legal norms for financial fraud are not perfect and the accountability is not strong enough.

### 5.3 Listed companies should optimize their governance structure

First of all, it is necessary to optimize the ownership structure. For example, company should ensure the diversification of the ownership structure to avoid one dominant share and protect the rights of minority shareholders. Secondly, optimizing setting of functional organizations is crucial. According to relevant documents of China Securities Regulatory Commission and other departments, company should clarify the functions of organizations, strengthen the checks and balances supervision. Finally, a diversified executive evaluation system should be established to investigate whether senior executives have short-sighted behaviors at the cost of overdrawing the development of the company. The key personnel of listed companies also need to keep learning the securities law and other laws to enhance the awareness of responsibility.

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