Evolutionary Game Analysis on Auditing Collusion under Dual Auditing System

Luo Fu-bi
School of Economics and Management, Chongqing Normal University, Chongqing, 400030, China

Abstract: Dual auditing system can be seen as a system designed to prevent the auditing collusion. The players of auditing collusion are always bounded rationality. Based on the fact of bounded rationality, in this study, the strategy choices of the auditors' are studied by using evolutionary game theory. The results are: (1) If the auditors’ returns of auditing collusion are greater than the punishments arising from auditing collusion, the bounded rational auditors will select the collusion strategy after a long-term of repeated game. (2) Under the dual auditing system both reward and penalty existed, we can maximize the prevention of auditing collusion when the reward given to the non-conspirators is greater than the fine given to the conspirators, and the penalty given to the conspirators is more than the income of auditing collusion simultaneously. (3) Giving more rewards to the non-conspirators can also play the role of preventing auditing collusion.

Key words: Auditing collusion, evolutionary game, dual auditing system

INTRODUCTION

Kofman and Lawarree (1996) prove that a second appointed auditor is conducive to weaken the auditors’ collusion preference. Dual auditing system can be seen as a system designed to prevent the auditing collusion. A lot of auditing collusion scandals have been exposed during the past decades. The Enron scandal is simply one in a growing string of embarrassments for the auditing profession. The CSC international, which, prior to the Enron debacle, had been touted as the biggest case of accounting fraud (estimated at $19 billion), the SEC investigated the CSC international, the travel and transportation conglomerate that owns the Ramada hotel and Avis car rental chains. It is alleged that CUC fooled Ernst and Young auditors for a number of years and then conspired with them. Such examples typically show that an auditor initially gave a report of compliance for a firm, but subsequent evidence demonstrated wrongdoing by the firm and collusion between the auditor and the firm (Khalil and Lawarree, 2006). Auditing collusion makes the accounting information and the market price signal distortion, investors decision fault, even make the entire socio-economic order in chaos. So, analysis on the formation mechanism of auditing collusion and taking measures to prevent auditing collusion are necessary.

Since the social-economic phenomenon of auditing collusion is universal and critical, and it may lead to bad results, scholars have pay a great deal of attention to it. Kofman and Lawarree (1993) construct a mathematical model and prove that auditors have high existing value only when they have good message and the manager’s responsibility is very high. They also demonstrate that to use the external auditor randomly can prevent auditing collusion than internal auditor. Strausz (1997) finds that collusion may be optimal if the principal cannot commit not to renegotiate. In his model, an agent works on a project whose cost is known only to the agent and a supervisor but there is no explicit productive action. In contrast to the traditional timing of auditing models, Lambert-Mogiliansky (1994) introduces a monitor before the productive action takes place. In her model, not only can the principal not commit to audit probabilities, but he cannot even commit to the terms of the contract. Her results also emphasize the importance of rent dissipation. Kofman and Lawarree (1996) propose a prisoner's dilemma model to inhibit auditing collusion. Dittmann (1999) considers a principal-agent model with auditing and collusion, in which the audit costs are a convex function of the audit reliability. He turns out that the optimal audit reliability strongly depends on the given maximum punishment and on whether collusion is possible or not.

Kessler (2000) studies a stylized three-layer agency framework in which a principal hires a supervisor to monitor an agent's productive effort. He demonstrates that the possibility of collusion imposes no additional cost on the principal if the supervisor's report is “hard” information. Fahud and Lawarree (2006) study the optimal auditing contract when collusion between an agent and an auditor is possible. They show that the auditor can be totally useless if the auditor’s independence can be compromised with relative ease. Even very stiff sanctions on fraud will be unable to make auditing optimal. Chen and S.M. Liu (2007) generalize Khalil (1997) static model to a multi-period one in the tenure-track auditing. Three penalty systems considered are full-transfer-dependent,
Partial-transfer-dependent, and transfer-independent ones. It is found that the equilibrium under the tenure-track auditing is also an equilibrium under the periodic auditing. Kuhn and Siciliani (2013) model purchaser-provider contracts when providers can inflate reimbursable activity through manipulation. Providers are audited and fined upon detected fraud. They characterize the optimal price and audit policy both in the presence and absence of commitment to an audit intensity. Luo (2013) construct a evolutionary game model to analyze the strategy choices between the manager and the auditor, to discover the mechanism of auditing collusion.

On the whole, Kofman and Lawarree (1993, 1996) and Fahad and Lawarree (2006) focus on the introduction of multiple auditors to control collusion. Different from their researches, this article not only focuses on the introduction of multiple auditors to control collusion (dual auditing system), but also focuses on the auditing collusive participants’ bounded rationality. Using evolutionary game approach to analyze the mechanism of auditing collusion, and reveal the reasons for the formation of the auditing collusion, which can provide a theoretical basis for the relevant parties taking measures to prevent auditing collusion. The structure of the paper is as follows: The second part is the analysis on the strategy choice evolutionary stable equilibrium between the auditors under dual auditing system, and the last part is conclusion.

**ANALYSIS ON THE AUDITORS’ EVOLUTIONARY STABLE EQUILIBRIUM UNDER DUAL AUDITING SYSTEM**

Kofman and Lawarree (1996) prove that a second appointed auditor is conducive to weaken the auditors’ collusion preference. In China, with the China Securities Regulatory Commission’s request, some B shares and financial stock, H shares or other foreign shares listed overseas have all implemented the domestic and foreign dual auditing. That is necessary to hire domestic accounting firms to audit its statutory financial report, but also necessary to employ the special permission of the China Securities Regulatory Commission and the Ministry of Finance of international accounting firms to audit its financial statements based on international auditing standards. In addition, the company hires the internal and external audit simultaneously is also within the scope of dual auditing.

**Model construction:** Let’s suppose that two auditors do not conspire, their earnings are 0 (in fact, the earnings are not equal to 0, it is set to 0 because the study focuses on comparing benefit of different strategies rather than the specific benefit number). If the two auditors are both taking collusive strategy, then each will get income B. If one does not conspire but the other conspires, then reward R will be given to the not collusive auditor, and the punishment F will be given to the collusive auditor. The auditors’ payoff matrix is shown in Fig. 1.

Assuming that $r$ is the probability of taking collusive strategy and $1-r$ is the probability of not taking collusive strategy. The expected revenue of collusive auditor’s is $E_c = rE + (1-r)(B-F)$, the not collusive auditor’s expected revenue is $E_{nc} = rE - (B-F)$; the auditor’s average expected revenue for the mixed strategy (collusion and not collusion) is $E = rE_c + (1-r)E_{nc}$. The duplicate dynamic equation for the auditor’s collusion is:

$$
\frac{dr}{dt} = r(E_c - E) - r(1-r)[(F-R)r + (B-F)]
$$

**Analysis on evolutionary stable strategy:** If $\frac{dr}{dt} = 0$, we will get the possible steady-state of (1):

$$
\tau^*_r = 0, \tau^* = \frac{F-B}{F-R} \text{ when } 0 \leq \frac{F-B}{F-R} \leq 1
$$

If:

$$
G(\tau) = \frac{dr}{dt}
$$

according to the differential equation stability theorem and the nature of the evolutionary stable strategy, if $G(\tau^*_r) < 0$, $\tau^*$ is the evolutionary stable strategy.

If $R < B < F$, namely collusion punishment is greater than the gain of collusion, but at the same time, collusion benefit is greater than the reward for not collusive auditor, then:

$$
G(\tau^*_r) < 0, G(\tau^*) < 0, G(\tau^*_r) > 0, \tau^*_r = 0
$$

are stable state. The results of the game depend on the initial level of $r$, when $r \in (0, r^*)$, the bounded rational
auditor tends to give up the collusion strategy over the long period of repeated games. When \( r^c(\ r^*, 1) \), the bounded rational auditor tend to accept collusion strategy over a long period of repeated games.

If \( B \prec R \prec F \), that is to say, the fine given to the conspirator is more than the reward given to the non-conspirator. This usually happens in the case of using more stick for conspirators as well as more carrot for non-conspirators. Then:

\[
G'(r^c) < 0, \ G'(r^c') > 0, \ G'(r^t) < 0, \ r^c = \frac{F-B}{F-R}
\]

are stable state. Over a long period of games again and again, the bounded rational auditor may choose non-collusive strategy or may collude each other with a probability of \( r^c \).

If \( B \prec R \prec F \), it is say that the reward for non-conspirators is greater than the punishment for conspirators, and the punishment is more than the collusive earnings. In this situation, \( r^c \), does not exist,

\[
G'(r^c) < 0, \ G'(r^c') > 0, \ r^c = 0
\]

is the unique evolutionary stable state. The results of evolutionary game is: the bounded rationality auditors tend to give up collusion strategy. This evolutionary game result is the aim that we hope to obtain in the course of preventing audit collusion. Therefore, establishing dual audit system to precaution audit collusion needs to meet the requirements that we should give high reward to non-conspirators , heavy fine to conspirators and that the reward is supposed to be greater than the fine, to maximize the prevention of audit collusion , in the presence of both reward and punishment mechanisms exist.

If \( B \prec R \prec F \), namely the reward for non-conspirators is greater than the benefit for co-conspirators, and the return of co-conspirators is greater than the fine for conspirators. Then

\[
G'(r^c) > 0, \ G'(r^c') > 0, \ G'(r^t) < 0, \ r^c = \frac{F-B}{F-R}
\]

is the unique evolutionary stable state. The result of evolutionary game is that the bonded rationality auditor chooses audit collusive strategy with a probability of:

\[
\frac{F-B}{F-R}
\]

after a long-term of repeated games.

If \( B \prec R \prec F \), it is say that the return of co-conspirators is greater than the punishment given to them, and the punishment given to co-conspirators is more than the reward given to non-conspirators, then \( r^c \), does not exist,

\[
G'(r^c) > 0, \ G'(r^c') < 0, \ r^c = 1
\]

would be the only evolutionary stable strategy. If \( B \prec R \prec F \), that's to say that the co-conspirators' benefit is bigger than the reward given to non-conspirators, and the reward given to non-conspirators is greater than the penalty given to the conspirators, as a result:

\[
G'(r^c) > 0, \ G'(r^c') < 0, \ G'(r^t) > 0, \ r^c = 1
\]

is the unique evolutionary stable strategy. The result of evolutionary game is that the bounded rationality auditors will tend to select collusive strategy eventually after a long-term of repeated games.

The above evolutionary stable strategy analysis shows that if the auditors' returns of auditing collusion are greater than the punishments arising from auditing collusion, the bounded rational auditors will select the auditing collusion strategy after a long-term of repeated game. Under the dual auditing system both reward and penalty existed, we can maximize the prevention of auditing collusion when the reward given to the non-conspirators is greater than the fine given to the conspirators, and the penalty given to the conspirators is more than the income of auditing collusion simultaneously. Giving more rewards to the non-conspirators can also play the role of preventing auditing collusion.

**CONCLUSION**

Considering that the participants of auditing collusion are always bounded rationality. In this study, a evolutionary game model is constructed to analyze the mechanism of auditing collusion under dual auditing system. The following main conclusions can be drawn by the analysis of the evolutionary stable strategy under dual audit system: (1) If the auditors' returns of auditing collusion are greater than the punishments arising from auditing collusion, the bounded rational auditors will select the auditing collusion strategy after a long-term of repeated game. (2) Under the dual auditing system both reward and penalty existed, if the reward given to the non-conspirators is greater than the fine given to the conspirators and the penalty given to the conspirators is larger than the income of auditing collusion simultaneously, then the auditing collusion can be
maximized prevention. (3) Giving more rewards to the non-conspirators can also play the role of preventing auditing collusion.

Based on the above analysis, many measures can be taken to regulate the auditors’ action, and to prevent auditing collusion. Firstly, the regulatory authorities should strengthen supervision, and improve the professional skills of the supervising officer, so as to increase the probability of discovering accounting information manipulation; Secondly, giving heavy penalty to the auditors’ collusion, and using the role of reputation mechanism, all these can be used to bind the auditors’ collusion. Thirdly, reducing the auditors’ conspiracy earnings, and strengthening the supervision of auditing collusion behavior, once the auditing collusion is discovered, the partners all should be given heavy penalty. Finally, under dual audit system, when the punishment is given to the collusive audit, some rewards should be given to the non-collusive auditor at the same time.

ACKNOWLEDGMENTS

This study is supported by Natural Science Foundation of Chongqing(CSTC,2010BB9327), and the science and planning project of Chongqing(KJ100609), and the national soft science project of China(2012GXS4I097).

REFERENCES


