Research on Statistical Innovation Based on the Game between Central Government and Local Government[*]

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Abstract. Much of state statistical work is done by the local statistical organizations. The reliability of local statistical data is the core of statistical innovation. But, the care of local government and enterprises may be not identical with the target of statistical work. Statistical products must affect utilities of some people, so they may have motives to interfere with statistical affairs. The paper started with dominant rationality, and some game models were built based on the relationship between central government and local government. After analysis on these models, it points out that the new statistical system should be built to make benefit-related people separated from statistical work. That the benefit-related people have no access to interfering with statistical work is essential to ensure the statistical data quality.

Introduction

In a game, if players always choose dominant-strategy, they have dominant rationality. In the real society, dominant rationality is often used by players. That is why people would fall into the dilemma.

Dominant-strategy and dominant-equilibrium

Definition 1（dominant-strategy, Zhang Weiying, 1996）According the strategies of all other players s_{-i}, s_i* is the best choice of player i, that is:

$$u_i(s_i*, s_{-i}) > u_i(s_i', s_{-i}) \forall s_{-i}, \forall s_i' \neq s_i* \tag{1}$$

thus, s_i* is called dominant-strategy of player i.

Definition 2（dominant-equilibrium） To all players i, s_i* is the dominant-strategy of player i, then, strategy set $s* = (s_1*, s_2*, ..., s_n*)$ is called dominant-equilibrium.

Traditional game theory states that "if all the players have dominant-strategy, dominant-equilibrium is the only equilibrium that can be forecast."

In fact, dominant-equilibrium is often not efficiently. Choosing dominant-equilibrium is not the certain behavior of people with complete rationality. They will not have so short sight that makes them into a dilemma. This is a kind of dominant rationality.

Dominant rationality and complete rationality

Every equilibrium is a kind of game state that players reach by using some rationalities. So, dominant equilibrium is a game result inducted by dominant rationality of the players.

Definition 3（dominant rationality） In a game, if the player i always chooses dominant strategy s_i*, the player has dominant rationality in this game.

Dominant rationality is based on comparison between rows or columns, ie. $u_i(s_i*, s_{-i}) > u_i(s_i', s_{-i})$, $\forall s_{-i}, \forall s_i' \neq s_i*$. Players with this rationality choose strategy on others' uncertain strategy s_{-i}. In the real society, dominant rationality is often used by players. That is the main reason why people would fall into the dilemma.

Many researches think dominant rationality as complete rationality. In fact, it is not. In new classical economics and game theory, that people have complete rationality is a basic assumption under the ideal state.

Definition 4（complete rationality） In a game, if the player i can always find the strategy that leads the highest utility, $s_i{}^* = \arg\max_{s_i \in S_i} u_i(S_i, C_p, C_r, C_e)$, this player has complete rationality in this game.

Complete rationality must have the following conditions :

（1）the player can know the game environment completely;

（2）the player can analyze the information correctly, and choose the right strategy;

（3）the player can reach the optimal game result;

The conditions are very difficult to be met. In "prisons dilemma" game, the rationality of prisons is no complete rationality, because the game result is so bad, we can not believe that the prisons have full rationality.

Obviously, dominant rationality is not complete for the players to choose strategies. It is often used under the condition that the dominant strategy exists. But when the players have no dominant strategy, how to make decisions in a game? It is a important question needing further study.

Impendent-dominant-strategy and impendent-equilibrium

To the following game, D is a dominant strategy for player 1. But player 2 has no dominant strategy.

Table 1 Profile of an impendent game

		Player 2	
		L	R
Player 1	U	1, 0	3, 2
	D	2, 1	4, 0

In this game, the rules determine the different position of two players. Player 1 has dominant strategy, but Player 2 has no dominant strategy. So, Player 1 chooses D firstly, then Player 2 chooses L to coordinate with Player 1. Strategy L is called impendent-dominant-strategy for Player2.

Definition 5 (impendent-dominant-strategy) A game with n players $G = \{S_1, S_2, ..., S_n; u_1, u_2, ..., u_n\}$, only part of the players $i_{(0)} \subset [1, n]$ have dominant-strategy as $s^*_{(0)}$; to other players $i_{(1)}$,, s^*_i is the best strategy for player $i \in i_{(1)}$ under the given dominant strategies set $s^*_{(0)}$, then s^*_i is called impendent-dominant-strategy。

Statistical Game between central government and local government

Suppose a game with two players, central government and local government. Local government may have two kinds of actions: cheat or not. The central government also has two actions: supervise the local government or not.

The game profile table is as follows:

Table 1 Profile rules of Statistical Game

		Local government	
		Cheat (AL1)	NotCheat (AL2)
central	Supervise (AC1)	a-d4, b+d2-d1	a-d4, b
government	NotSupervise(AC2)	a-d3, b+d2	a, b

d1: Punishment of Local government when cheating was found

d2: Income of local government by cheating

d3: Loss of central government because of being cheated by local government

d4: Cost of central government for supervising

In general, $d3 > d2$, cheating behavior of local government is based on local benefits . The effect of cheating is negative for the whole society, so cheating behavior of local government brings more loss to the central government than benefits to the local government.

Case 1：d1>d2, and d3>d4

This is the most common case：

（1）$d1 > d2$：Punishment of Local government must be higher than Income of local government by cheating. Otherwise, punishment can do no limitation on local government.

（2）$d3 > d4$： When central government is cheated by local government, its loss must higher than cost of central government for supervising. Only in this way can supervising be efficient. Otherwise, if cost of central government for supervising is high enough, the central government will choose NotSupervise, and the local government will choose cheating. It may leads a Nash equilibrium （AC2, AL1）, which is not fair and not efficient.
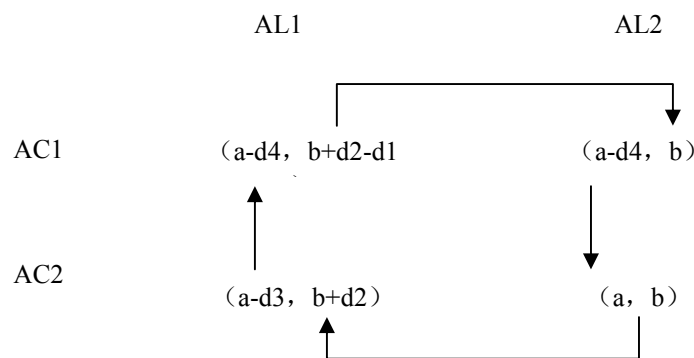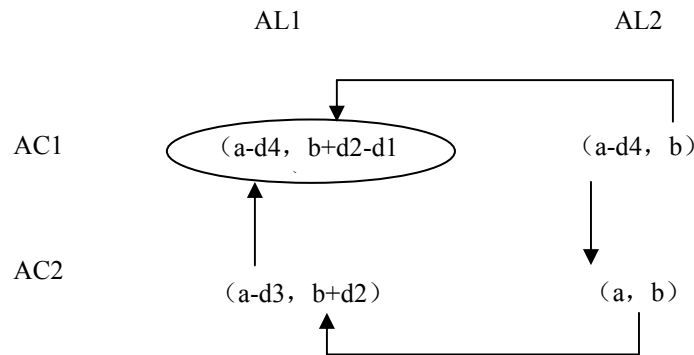

Fig.1 Behavior deviation analysis (d1>d2, and d3>d4)

From the point of central government, （AC2, AL2）is best for the whole society. But at this point, local government has the motivation of deviation.

So, in this case, both players of this game have no dominant strategy.

Case 2：d1<d2, and d3>d4

If the punishment for cheating is lower than income, local government will have strong motivation to take cheating behavior. Cheating will be the dominant strategy for local government. Central government is forced to take the action of supervising. （AC1, AL1）becomes an impendent-dominant-equilibrium.

AL1   AL2

AC1   (a-d4，b+d2-d1   (a-d4，b)

AC2   (a-d3，b+d2)   (a，b)

Fig.2 Behavior deviation analysis (d1<d2, and d3>d4)

Case 3：d1>d2, and d3<d4

When the cost of central government for supervising is larger than the loss of central government because of being cheated by local government, central government is like to take the action of NotSupervise. Of course, local government will choose cheating. An impendent-dominant-equilibrium（AC2, AL1）will be reached.

AL1   AL2

AC1   (a-d4，b+d2-d1   (a-d4，b)

AC2   (a-d3，b+d2)   (a，b)
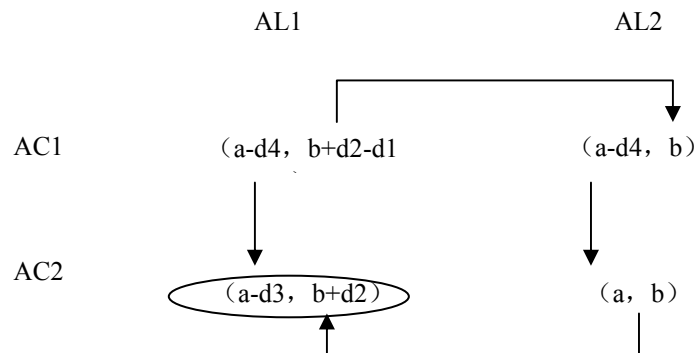
Fig.3 Behavior deviation analysis (d1>d2, and d3<d4)

Case 4：d1<d2, and d3<d4

To central government, the cost of central government for supervising is higher than the loss of central government when being cheated, it will choose NotSupervise as dominant strategy. And, to local government, cheating punishment is lower than cheating income, cheating is an optimal choice. The game will get a dominant equilibrium （AC2, AL1）.

AL1   AL2

AC1   （a-d4，b+d2-d1   （a-d4，b）

AC2   （a-d3，b+d2）   （a，b）
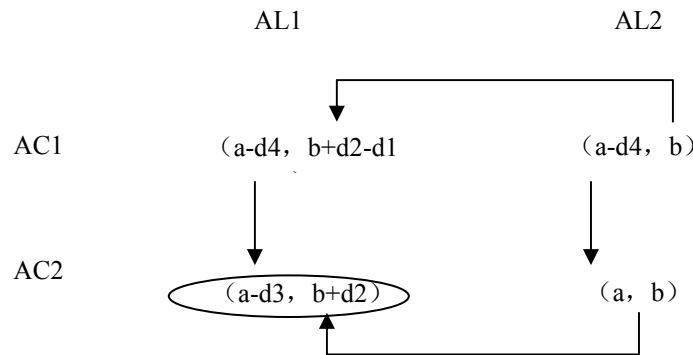
Fig.4 Behavior deviation analysis (d1<d2, and d3<d4)

Case 5：d2<0

d2 can be divided into two parts, d2=d21-d22, here, d21 is cheating income and d22 is cheating cost. If d22>d21, d2<0. That's to say, though cheating is not found by central government, local government can benefit nothing by cheating. The result is that local government doesn't cheat, while central government will not supervise.

AL1   AL2

AC1   （a-d4，b+d2-d1   （a-d4，b）

AC2   （a-d3，b+d2）   （a，b）
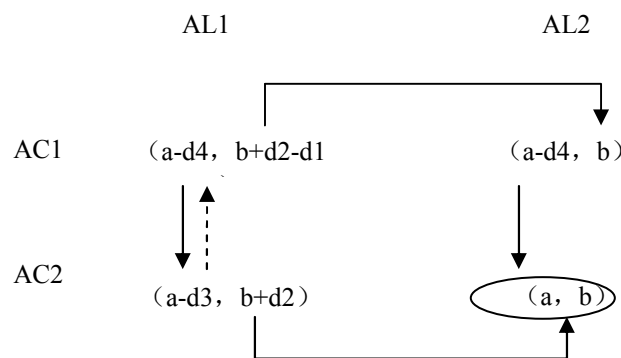
Fig.5   Behavior deviation analysis (d2<0)

Conclusion

In general condition, local government tends to do some cheating on statistical data. This leads to some statistical data faults. To realize the optimal equilibrium (AC2, AL2), d2 must lower than zero. In this way, local government can refuse to cheat in statistical data processing.

Here, we have two suggestions:

(1)Raise the cheating technical cost of local government. A efficient way is to form a local statistical cooperating system, data processing and submitting is done by a team instead of only one person or an organization. Thus, it will reduce the possibility of cheating success, and make it easy for cheating to be found.

(2) Reduce cheating income of local government efficiently. The benefit-related people should be avoided to interfere local statistical affairs. So, in the process of statistical data forming, operators will have no motivation to cheat.

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