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Research on the Water Resource Manegement Based on Game Model

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Abstract

It is a principal-agent relationship in the process of the implementation of water resource management in China, which causes the game between the different governments inevitably. Game theory is a method that explains the decision makers' behavior under different conditions. Traditionally, in the finite repeated prisoner's game, the Nash equilibrium of the "prisoner dilemma" is the only equilibrium of prisoners. This result seems to be inconsistent with the true choices in the water resource governance. From analyzing the game model with complete information and incomplete information, it finds the Nash equilibrium under the different conditions between the central government and the local governments. In order to strengthen the cooperation of all levels of government, it is absolutely essential that the central government provide complete information and increase the punishment probability, improve the incentive mechanism and reform the local government's performances evaluation in the future.

Keywords: Nash equilibrium; Principal-agent; water resource; complete information; incomplete information

1. Introduction

With the degraded water quality and pollution of the rivers, conflicts often arise when different water and environmental users compete for a limited water supply, especially in the watershed zone. In China, for water resource the state applies the system under which management of river basins is combined with management of administrative regions. The administrative department of the water under the State Council is responsible for unified management and supervision throughout the country. The local people's governments within the limits of their specified powers are responsible for unified management and supervision over the water resources. The state formulates strategic plans for the water resource and the river ecology across the land. The plans for a region within a river basin shall be subordinated to the plans for the river basin. The central government is the principal, and the local

governments are the agents for getting the information of the water ecological environment more fully. Because it takes the scale of investment and the growth rate of GDP as the core performance criteria, the local governments will try to accelerate the regional economic growth. So, the local governments won't implement the central government policies for water resources protection usually. The results of governing the river water resources are not very ideal. Here we use game theory to analyze the problem.

Game theory is shown in the literature to be a useful approach to resolve the watershed water resource conflicts 1. Games are decision problems with multiple players whose decisions impact one another. Game theory is divided into two general branches: cooperative and non-cooperative games. In the water resource governance, we should get the reasons why the central government and the local governments choose the cooperative or non-cooperative strategies.

2. Model constructions

2.1. Players

In this paper, we will divide the numerous governments into two categories: the central government and the local government. The central government that refers to the state council and the department of water administration represents national interests. The local government (both the provincial governments and the county governments) refers to the local governments and administrative departments of watershed.

2.2. Strategies

Game strategies refer to the two kinds of governments action rules in the river water resources governance[2]. As the representative of public interests, the central government's strategies are to maximize the interests of the whole basin. The central government has two strategies to supervise the implementation of water resources policies formulated by the state: supervision and no supervision. If it is found that the local government doesn't implement the policies of water protection, the central government will punish the local government. The local government has two strategies: implementation and non-implementation.

2.3. Model assumptions

The first assumption is that the players are involved in the central government and the local government. [3] The central government and the departments of water administration actions represent the biggest utility of the whole basin. The local government and the departments of water administration actions are on behalf of the local region in the utility. Of course, in the real world, there are different games between the different levels of government actions, but we don't discuss it anymore. The second assumption is the hypothesis of "economic man". The central government and local government are rational "economic man"; their pursuits are maximizing their own interests. The third assumption is computable of the ecological benefit. In order to facilitate research, we assume that the payoffs are computable.

3. Game models

3.1. Game model with complete information

First, it uses the static game model with complete information to analyze the two players' strategies. Assuming the game between the central government and the local government is a complete information game. The local government's decision-making has two options: implementation and non-implementation; the central government has two strategies: punishment and non-punishment. If the local government does not perform the policies and does not receive the punishment from the central government, the local government revenues are r; if the local government gets the penalty, the revenues are r-g, here g is the punishment; if local government implements the