

Game Analysis Based on Sino-British Nuclear Energy Cooperation

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Abstract: As the Sino-British relationship enters a new era, nuclear energy cooperation has entered a stage of high-quality development. In adhering to the idea of peaceful use of nuclear energy, it is necessary to put forward the proposition of cooperation to better meet the energy needs and environmental protection needs of the two countries. Based on the dynamic changes of nuclear energy cooperation, the theoretical analysis framework of game analysis of Sino-British relations constructed according to the internal logic of game theory can explain the game model and results generated by the interest demands and behavior assumptions of both China and Britain. In addition, from the perspective of game results, people can predict the possibility of moving towards high-quality cooperation. Nuclear energy cooperation between China and Britain aims to provide nuclear energy that meets safety standards and benefits. China is committed to continuously improving nuclear technology and improving cooperation satisfaction. To achieve high-quality nuclear energy cooperation and boost Sino-British relations to a new level, the government should take measures, including strengthening nuclear material control based on entity protection, building a mechanism for nuclear technical information exchange between China and the UK, and establishing an evaluation system for nuclear energy cooperation and third-party transfer, to achieve the purpose of making full use of nuclear energy.

1. Introduction

Nuclear energy cooperation is one of the scopes of Sino-British relations, and it is the general term for the peaceful use of nuclear energy between the two countries [1]. It can be divided into fundamental nuclear energy cooperation and non-basic nuclear energy cooperation, composed of nuclear power, nuclear fuel cycle, nuclear technology research and development, nuclear safety, nuclear decommissioning, and nuclear waste treatment. China and the UK have also commissioned their respective agencies and organizations to conduct joint nuclear technology research and intelligence transfer to promote exchanges and cooperation between the two countries in nuclear energy. Since the signing of the Sino-British Peaceful Uses of Nuclear Energy Cooperation Agreement in 1985, nuclear energy cooperation has become the key to Sino-British relations. The game analysis becomes an evaluation indicator. Unlike traditional cooperation, nuclear energy cooperation emphasizes equality, mutual benefit, security, and environmental protection. Therefore, China has put forward the issue of high-quality development, and game theory has become a new analytical tool for nuclear energy cooperation.

The game theory originates from the mathematical movement with von Neumann and Morganstein as the core. The theory and method contain logic, strategy, and optimization applicable to economics and politics. From the perspective of game theory structure, nuclear energy cooperation pursues Nash equilibrium, and the combination of interest demands and behavioral assumptions improves Sino-British relations. However, they only happen ideally. Currently, Sino-British relations have followed a unique path. The comprehensive promotion in the 'golden age' of Sino-British relations has changed the mode of cooperation between the two countries in the field of nuclear energy, reflecting the responsibility of the two countries in the international community. In addition, it will broaden the prospects of cooperation between the two countries in other fields and contribute to economic

development and world peace. Therefore, we must have a strategic vision and pattern to discuss Sino-British nuclear energy cooperation. Since President Xi Jinping's visit to Britain, China, and Britain have attached importance to high-quality development as cooperation between the two countries in the Hinkley Point C project has increased. However, conflicts of interest, risk challenges, and institutional differences remain.

Therefore, the proposition of high-quality development is put forward from the game theory perspective.

To sum up, high-quality development is a prerequisite and a guarantee for China-UK relations. Nuclear cooperation between China and UK has made progress, but there are also areas for improvement. China and the UK have yet to find a practical path for high-quality development and are still trying to move forward. High-quality development, therefore, requires a game analysis that helps to understand the premises of both countries' interests and actions in the nuclear energy sector and serves as the basis for proposals and development strategies [2]. Based on the above, this paper proposes an analysis method of high-quality development of Sino-British nuclear energy cooperation from the perspective of game theory, aiming to explore the interests and behavior assumptions of the two countries in the field of nuclear energy, evaluate the game results through the construction and solution of game model, and put forward suggestions and prospects for development. Through the game theory and case study, we can solve the problem of nuclear energy cooperation and quality development. The article includes a literature review, theoretical analysis, case studies, conclusions, and recommendations. They effectively deal with the risks in nuclear energy cooperation and show the theoretical significance and practical value.

2. Game Analysis of Sino-British Relations Based on Nuclear Energy Cooperation Case

2.1 The Importance of Nuclear Energy Cooperation in Sino-British Relations

Nuclear energy cooperation is a concept developed together with China-UK relations, reflecting the peaceful use of nuclear energy, highlighting the good wishes of the two countries, and reflecting the high-quality development strategy of the two countries since the China President visited the UK [3]. When people define nuclear energy cooperation and its nature by economic, political, or safety criteria, it isn't easy to get a consistent answer.

2.2 The Present Situation and Deficiency of the Game Analysis of Sino-British Cooperation at Home and Abroad

High-quality development is a criterion for nuclear energy cooperation and an objective expression of the effect on cooperation between the two countries. Scholars at home and abroad discussed definitions of high-quality development from the perspectives of economy, politics, and security. Some scholars believe that high-quality development refers to the degree of cooperation quality or benefits. High-quality development is universal and promotes cooperative science for the peaceful use of nuclear energy. The main activities of game theory include modeling, solving, and analysis. The concepts and methods of high-quality development are closely related to game theory. Through game theory, high-quality development has become an essential factor in nuclear energy cooperation. President Xi Jinping's main contribution during his visit to Britain is to put forward the proposition and strategy of high-quality development. Therefore, the concept of high-quality development initially focused on measuring nuclear cooperation based on the standard attributes of game theory.

3. The Foundation and Key of Game Analysis of Sino-British Relations Based on Nuclear Energy Cooperation Cases

3.1 Basic Concepts, Principles and Classification of Game Theory

Compared with cooperative theory, the game theory emphasizes the relationship between individuals and has strategic characteristics. Although some scholars doubt that game theory may not directly relate to nuclear energy cooperation, most argue that game theory can rationally evaluate

nuclear energy cooperation. Von Neumann et al. developed the concept of Nash equilibrium by proposing a classical mathematical game theory model that includes participants, strategies, and returns [4]. These scholars believe that game theory is predictive, a theory "can explain everything", and that games reach equilibrium only when all players choose the best strategy. Therefore, equilibrium is the outcome of the game. Some scholars divided game theory into two models: a static game model based on complete information and a dynamic game model based on incomplete information. The former focuses on one-time decision-making, while the latter focuses on multiple decision-making. Although game theory has experienced some practical failures, from a theoretical point of view, it can reveal the internal logic of individual behavior. The concept of game analysis has gradually influenced the research and practice of nuclear energy cooperation.

3.2 Application and Limitation of Game Theory in Nuclear Energy Cooperation Cases

The concept of high-quality development is closely related to nuclear energy cooperation. Game analysis is the application of game theory thinking in nuclear cooperation. To overcome the defects of cooperation theory, it enters the research field as a new analysis framework. The basic idea of the framework is as follows. First, nuclear energy cooperation should ensure that the interests of both countries are maximized. Second, set efficiency standards for nuclear energy cooperation output. Then, use the game model to conduct the interests of the two countries and behavior assumptions. They are using game theory methods to measure outcomes. The game analysis framework reconstructs nuclear energy cooperation, emphasizes strengthening cooperation, and improves the balance, stability, sustainability, and universality of nuclear energy cooperation.

3.3 Selection and Description of Sino-British Nuclear Energy Cooperation Cases

The primary practice of nuclear energy cooperation is embodied in the case of Sino-British nuclear energy cooperation, which reflects the willingness and effect of cooperation between the two countries in the field of nuclear energy. Game analysis directly reflects the interests and behavior assumptions [5]. Some elements of high-quality development are gradually taking shape, and evaluation systems connected with game theory are gradually being paid attention to. However, from the perspective of game theory analysis, some nuclear energy cooperation practices are in the low-quality stage, contrary to the logical framework and generation mechanism of high-quality development. It raises the topic of risks and challenges in nuclear energy cooperation.

4. Game Analysis Modeling and Application of Sino-British Relations Based on Nuclear Energy Cooperation Cases

4.1 Interest Demands and Behavioral Assumptions

From the perspective of game analysis, interest appeal and behavior hypothesis are the primary factors of nuclear energy cooperation and the embodiment of game theory. Therefore, game analysis is interested in appeal and behavior hypothesis as the leading generation logic. China and Britain are the participants in nuclear energy cooperation and the decision-makers of game theory. Currently, China and Britain strengthen the control of nuclear energy cooperation from economy, politics, and security [6]. There are three main ways: The first one is to sign a nuclear energy cooperation agreement. The agreement clarifies Sino-British cooperation in nuclear power, nuclear fuel cycle, and nuclear technology research and development. The second is to formulate nuclear energy cooperation standards. Therefore, standardized control of nuclear energy cooperation is achieved through the development of safety standards and disclosure to the international community. The third is to optimize the internal process of nuclear energy cooperation. In recent years, China and the UK have improved nuclear energy cooperation and efficiency through institutional construction, personnel training, and technological innovation. However, nuclear energy cooperation's balance, stability, and sustainability must be improved.

Interest demands and behavioral assumptions should consider the 'rationality' of participants in nuclear energy cooperation. In the game theory mechanism, interest demands and behavioral

assumptions are standard analysis tools and play an important role in nuclear energy cooperation. It also makes interest demands and behavioral assumptions both impact benefits. Therefore, the game analysis based on 'benefit maximization' has become the optimization mechanism of nuclear energy cooperation. In practice, the path of nuclear energy cooperation is gradually formed on the basis of game theory. Although the path contains risks and attempts. From the Hinkley Point C project to the Sino-British Nuclear Joint R & D and Innovation Center, interest demands and behavioral assumptions are closely related to the game results. Interest demands and behavioral assumptions should be committed to high-quality development to meet the requirements of peaceful use of nuclear energy. However, in the case of information asymmetry, there are difficulties, that is, equilibrium deviation phenomenon. To sum up, there is room for improvement in balance, stability and sustainability of interest demands and behavioral assumptions.

4.2 Game Model Construction and Solution

The fundamental difference between the game model and the game result lies in its information attribute. The information and game result criteria of the game model aim at maximizing benefits. In the analytical framework of game theory, accurate identification, prediction, evaluation and optimization reflect the core value and the highest criterion of game analysis. Currently, the diversity of nuclear energy cooperation types and the difference of interests between the two countries lead to the complexity of the game model. Game theory provides a variety of models and methods, but because the nuclear energy cooperation information is yet not perfect, the game analysis lacks an effective mechanism. Therefore, it has created a short board of game analysis and affected nuclear energy cooperation. The game model construction process is shown in Figure 1.

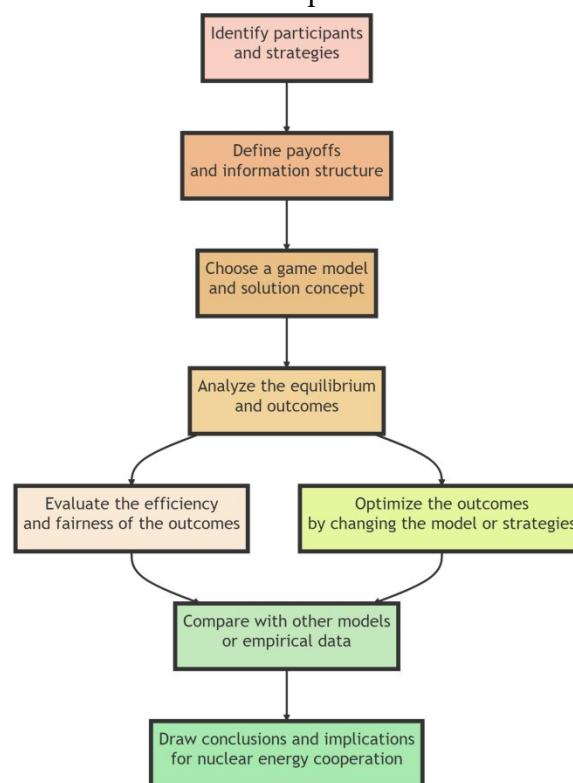


Figure 1 The game model construction process

The development of the game model aims to build mechanisms and optimization systems, provide game results that align with benefits to nuclear energy cooperation, and commit to high-quality development. Game models are not a new topic, but game analysis mathematically combines this model with various factors, such as interest requirements, to outline strategic aspects of nuclear energy cooperation. In addition, it expands the technical connotation of game theory and endows the game model, participants, and strategies with value. The game model has successful practical exploration in the static game, dynamic game, and repeated game, providing the experience for

nuclear energy cooperation. However, compared with the requirements of theoretical construction and mechanism design of high-quality development, the development path of the game model still needs to be further optimized. In addition, it needs to be closely integrated with nuclear energy cooperation information in depth to meet the purpose of peaceful use of nuclear energy.

4.3 Game Result Analysis and Evaluation

From the perspective of game results, game analysis takes benefit evaluation as the primary form of game results. Still, game analysis needs more relevant information and nuclear energy cooperation feedback mechanism. The core of the problem may be information asymmetry. In nuclear energy cooperation, the game result is usually described as 'Nash equilibrium', and its distribution of interests between the two countries directly reflects the strategy of the two countries. However, the game results primarily include income, cost and risk, lack of balance, stability, sustainability, and universality. Usually, high-quality development takes a lot of work to measure. Information asymmetry and imperfect game models lead to obstacles to high-quality development.

4.4 Suggestion and Expectation

From the perspective of game strategy, information asymmetry has restricted nuclear energy cooperation for a long time. Since the 21st century, nuclear energy cooperation has integrated economy, politics, and security, and researchers analyze Sino-British relations through games. However, the drawbacks of traditional cooperation theory still restrict high-quality development. Affected by conflicts of interest and risks, game analysis needs to be improved. Under the premise of high-quality development, the game model is regarded as the expression of game results. The practical effect of the mathematical game model on nuclear energy cooperation remains to be discussed. At the same time, the problem of nuclear energy cooperation information leads to the need for more feedback in-game analysis. Therefore, the game analysis does not consistently achieve the goal of high-quality development. The difficulty of game analysis not only lies in technology but also practice.

5. Conclusion

To sum up, nuclear energy cooperation has become essential to Sino-British relations, and the two countries are facing new challenges and requirements. High-quality development symbolizes the quality of nuclear energy cooperation and an essential means to enhance cooperation between China and Britain. In addition, it conforms to the urgent need to maintain world peace and international security, reflecting the inherent requirements of Sino-British relations. The game analysis is a theoretical framework and practical mechanism for the high-quality development of nuclear energy cooperation under the guidance of game theory. In recent years, modern information technology has promoted game analysis, enabling the accuracy and scientific nature of game results and game strategies through game models. Its value fits the internal logic of high-quality development. Therefore, game theory provides a new path for nuclear energy cooperation. In short, improving game analysis will help promote nuclear energy cooperation and Sino-British relations.

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