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Game Theory in Tendering: Analyzing Bidder and Tenderer Strategies

Yuxuan Cai[1,a,*]

[1]*Rosedale global high school, Unit 55, Courtyard 55, Guishui South Street, Yanqing District, Beijing, China*
a. bli@oct-ea.com
**corresponding author*

Abstract: In modern society, bidding and tendering have become an integral part of economic activities and are increasingly attracting public attention. This article innovatively combines game theory with bidding practice. Through extensive collection and analysis of network resources and in-depth research on real cases, it aims to deeply analyze the internal logic of the bidding mechanism and optimize bidding through the perspective of game theory. Tender design to significantly improve resource allocation efficiency and market fairness. Finally, this article emphasizes that game theory can deepen the understanding of bidding dynamics, optimize strategies, highlight the value of information transparency and long-term cooperation, propose policy and mechanism improvement suggestions, and promote a fair and efficient market environment. This article underlines the transformative potential of game theory as a tool for revealing hidden inefficiencies and corruption within bidding processes. By advocating for policies that foster open and transparent tender practices, it seeks to empower stakeholders to make more informed decisions, thereby nurturing a culture of integrity and ethical competition in markets worldwide.

Keywords: Bidder, Tenderer, Game Theory, Optimize bidding.

1. Introduction

In the modern market economy, bidding can ensure a certain degree of fairness, guarantee the effective allocation of resources, help buyers choose the most suitable sellers, and greatly reduce costs [1]. Because most bidding processes are open and transparent, corruption is also prevented [1]. Game theory can also play a great role in analyzing and optimizing the bidding process, greatly helping both parties to make the most favorable choice. For example, in the formulation of plans, game theory can analyze the needs of the bidder and evaluate the other party's strength to formulate a reasonable and reliable plan to increase the probability of winning the bid [2, 3]. At the same time, game theory can minimize the losses and risks that the bidder may suffer when the bidder formulates a plan.

In the existing literature, the main research results concerning the application of game theory to bidding and tendering processes are as follows. Initially, the establishment of a bidding game model provides a theoretical framework for understanding competitive behaviors. The application of Nash equilibrium in bidding allows for the prediction of bidder strategies that balance self-interest with optimal outcomes. Additionally, game theory has been utilized to reduce risks associated with bidding by modeling various strategic interactions and outcomes. Another significant area of application is

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the detection of bidding collusion, which leverages game-theoretic concepts to identify non-competitive practices among bidders. Furthermore, studies have explored the real-life application of game theory in bidding scenarios, providing practical insights and validation of theoretical models. Lastly, game theory has been shown to enhance the probability of winning a bid by optimizing bidding strategies and decision-making processes, highlighting its utility in improving outcomes in competitive tendering environments.

Looking at these existing papers, we can also find some obvious deficiencies that need to be addressed. For example, more empirical evidence is needed to test the predictive power and actual effect of game theory, so as to better adjust and improve the model for subsequent use. In addition, the models currently displayed are not simplified enough. In the future, the game model needs to be simplified to make it closer to the actual bidding environment while maintaining sufficient theoretical depth. In this way, the game model can better assist the bidding work. In addition, the applicability and operability of the theoretical model in the actual bidding environment also need to be verified and improved.

This article will conduct an in-depth study on how to optimize the bidding mechanism design of game theory in bidding and improve the efficiency of market resource allocation and market fairness. It will also conduct research through literature review, case study and data analysis to draw the required conclusions in the end, in order to get better results in bidding.

This article is divided into several parts, namely, case description - through some cases, problem analysis, suggestions, conclusion and summary. This article will first throw out a real case for illustration, find the part that needs to be solved in the case, and then analyze the problem to facilitate the subsequent repair of the current bidding problems. Finally, the above content will be used to make suggestions for the subsequent bidding content to optimize the bidding mechanism design and improve the efficiency of market resource allocation and market fairness. Then draw a conclusion.

2. Case Description

According to online research, a real and reliable case was found as an example for this part. This case is the bidding case of the US federal government cloud computing contract. At that time, the US federal government wanted to find a company to provide cloud computing services for national defense [4, 5] . The participants in this large project are also some large companies, such as Amazon, Microsoft, IBM, Oracle and other technology giants [6, 7]. This case occurred in 2018. The US Department of Defense (DoD) announced the tender notice for the Joint Enterprise Defense Infrastructure (JEDI), seeking a single supplier to provide cloud computing services for the Department of Defense. The total contract value is expected to be as high as US$10 billion for a period of 10 years [6, 7]. Bidders need to submit detailed plans, including cloud service architecture, security, compliance and price information [8, 9]. Finally, the US federal government will score. The scoring criteria at that time included technical capabilities, security, price and company performance [7]. The US federal government will conduct a comprehensive evaluation of the bidding plan. In this case, some problems and challenges still arise. For example, some companies have disputes over single suppliers, and there are also some political influences [10, 11] . The biggest challenge in this case is security and compliance. Since the contract involves sensitive government data, bidders must prove the security and compliance of their cloud service. These issues have also affected the strategies of various companies. For example, Microsoft and Amazon have adjusted their proposals in terms of security, compliance and price. Tenderers have also increased transparency and fairness measures.

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3. Analysis on the Problem

Game theory is a mathematical theory that studies how decision makers choose actions to maximize their own interests in the process of interaction. In the bidding process, the basic concepts and models of game theory, such as Nash equilibrium, zero-sum game and cooperative game, provide a framework for analyzing the strategies and behavioral choices of all parties. The following article will introduce some concepts of Nash equilibrium, zero-sum game and cooperative game. Nash equilibrium: In bidding, Nash equilibrium refers to the situation where all participants choose the optimal strategy and there is no motivation for unilateral change of strategy. For example, in the bidding process, if all bidders bid a price that is their cost plus a reasonable profit, and no one can profit by lowering the price, a Nash equilibrium is formed. Zero-sum game: In some cases, the relationship between the tenderer and the bidder can be regarded as a zero-sum game, that is, the gain of one party means the loss of the other party. However, in most bidding, both parties have the possibility to obtain common benefits through cooperation, which is closer to a cooperative game. Cooperative game: In a cooperative game, participants reach an agreement through cooperation and share the benefits together. In bidding, tenderers and bidders can achieve a win-win situation by establishing long-term cooperative relationships, sharing market information, and reducing transaction costs.

Next, taking the bidding case of the US federal government's cloud computing contract (JEDI) as an example, this article will use game theory to analyze the strategies and decision-making processes of all parties. For example, bidder strategy: bidders such as Amazon and Microsoft must find a balance between bidding strategy and risk management. Bidding too low may result in losses, while bidding too high may result in losing the contract. Through game theory models, bidders can simulate the possible behaviors of the tenderer and other bidders and evaluate their optimal strategies. Let's talk about the tenderer strategy: the tenderer (the US Department of Defense) must also be cautious in setting evaluation criteria and disclosing information. Overly strict or opaque criteria may cause bidders to give up bidding, while overly loose criteria may not guarantee the execution of the contract. By setting reasonable evaluation criteria and open and transparent information, the tenderer can attract more qualified bidders to participate, thereby achieving the best procurement results.

The application of game theory in bidding analysis reveals the decision-making logic and optimal strategies of participants. This article will find the importance of information symmetry through simulation and analysis - information transparency is crucial for both tenderers and bidders. Tenderers can attract more bidders by disclosing information, and bidders can make more reasonable bids by knowing more information. There is also the potential value of cooperative games - in some cases, establishing a cooperative relationship between tenderers and bidders and sharing market information can reduce transaction costs, improve contract execution efficiency, and achieve a win-win situation for both parties. Finally, there is the risk management strategy - bidders need to develop effective risk management strategies, including accurate cost assessment, prediction of market changes, and plans for dealing with emergencies. These findings have made important contributions to the theory and practice of bidding. They not only provide decision-making basis for all parties involved in bidding, but also provide guidance for governments and enterprises to optimize bidding processes and improve procurement efficiency.

In summary, the application of game theory in bidding analysis not only deepens the understanding of the bidding process, but also provides participants with tools to optimize strategies and improve the quality of decision-making. By deeply analyzing the strategies and behaviors of all parties, this article will better design and implement the bidding process and achieve both economic and social benefits.

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4. Suggestion

4.1. Strategic recommendations

For tenderers, the evaluation criteria should be clearly defined to ensure that they can attract high-quality bidders while ensuring fair competition. The criteria should include comprehensive factors such as technical capabilities, financial status, past performance, service quality, and price. In addition, the criteria should avoid being too harsh or biased towards specific bidders to ensure fair competition. It is also necessary to improve the transparency of the tendering process and make public tendering information, including evaluation criteria, timetables, and results. This will not only increase the participation of bidders, but also enhance the public's trust in the tendering process and reduce potential disputes and disputes.

Bidders should formulate quotation strategies based on cost analysis, market research and competition analysis to ensure that the quotation is both competitive and can guarantee reasonable profits. At the same time, the potential benefits of long-term cooperation should be considered to avoid over-bidding. Bidders should also conduct a comprehensive risk assessment before bidding, including project execution risk, market risk and financial risk. Develop a risk management plan, including response strategies and insurance measures, to reduce uncertainty and increase the success rate of the project.

4.2. Mechanism Optimization

When bidding, people can consider introducing an electronic bidding system to improve the efficiency and transparency of the bidding process. Use a scoring system and a comprehensive bid evaluation method to balance price and technical factors and avoid quality problems that may result from a single lowest bid. And use game models to predict the other party's behavior and evaluate the benefits and risks under different strategies, so as to make more informed decisions. For example, determine the optimal quotation strategy or bid evaluation criteria through simulation analysis.

4.3. Policy recommendations

In terms of policy, we should strengthen the construction of laws and regulations , improve the laws and regulations related to bidding, clarify the rights and obligations in the bidding process, crack down on unfair competition and corruption, and protect the legitimate rights and interests of participants . We should formulate and promote the best practice standards for bidding, including transparent bidding processes, reasonable bid evaluation criteria, and fair contract execution. We should improve the compliance awareness and professional ability of participants through training and education. Finally, the government should encourage market competition, prevent monopoly, and promote market innovation and technological progress through policy means. At the same time, an effective regulatory mechanism should be established to ensure market order and a fair competition environment.

5. Conclusion

This study explores the complex interaction between game theory and bidding practice through the JEDI contract case. Game theory, based on concepts such as Nash equilibrium and zero-sum games, provides a powerful framework for understanding bidding strategies, assists prediction and optimization strategies, and improves resource allocation efficiency. We highlight the central role of information transparency in the bidding process and the value of building long-term relationships. In

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addition, the application of game theory can help reduce risks, effectively detect collusion, and promote fairness and efficiency in the bidding environment.

Through the application of game theory, this study provides strategic insights into the field of bidding practice, promotes more informed decision-making, and improves contract acquisition rates while reducing risks. For bidders, it is recommended to design an efficient and fair mechanism. The research deepens the understanding of bidding dynamics, promotes industry innovation, and solves fair competition challenges. It is crucial to market health and has significant commercial value.

This paper mainly relies on secondary data. In the future, we can use primary data to deepen the practical understanding of game theory in bidding and improve the reliability of research. The dynamic impact of technologies such as AI and machine learning on bidding strategies needs to be explored to enrich theory and practice. In summary, this study reveals the potential of game theory to optimize bidding, aiming to stimulate continuous innovation and promote fairness, efficiency and competitiveness in bidding in various industries.

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