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Game Theory Analysis of Advertising Promotion and Business Strategy Optimization

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Abstract:

Advertising, a cornerstone of modern commerce, presents a complex strategic landscape where firms and consumers interact with conflicting and aligned interests. This paper employs game theory to analyze these dynamics and propose strategies for optimizing business outcomes. Advertising and promotion are of great importance, necessity, and value. It is everywhere in life and is related to the economic development of society and even the entire country. This paper explores and studies from the perspectives of both buyers and sellers, as everyone hopes to maximize their own interests. It can be said that game theory has become a very significant and common way of thinking and application in daily life. Through the research on this topic, people can effectively understand game theory in life, better think about its logic and advantages and disadvantages, and think about its positive and negative impacts from multiple perspectives, and find possible solutions. The findings offer practical value for businesses seeking to optimize advertising strategies and for policymakers aiming to foster a healthier, more transparent market ecosystem.

Keywords: Game Theory; Advertising Strategy; Prisoner's Dilemma; Coopetition; Nash Equilibrium

1. Introduction

The rapid development of digital media technology has made advertising and promotion an indispensable component of market competition. View the advertising and promotion of enterprises as participants in a game, the content, timing, and channels of advertising as strategies, and the spending effect of consumers after seeing the advertising and promotion as returns. Through the game relationship involved, some game models are constructed. Through psychological games and strategic games, clarify their respective strategy choices and interests equilibrium, and find the equilibrium point and the optimal strategy [1]. At the same time, more business optimization strategies with differentiation, clarity, and precision should be proposed so as to give the investment in advertising a more long-term competitive advantage. Advertising and promotion are of great significance, necessity, and value. They can be seen everywhere in daily life and are related to the economic development of society and even the entire country. Applying game theory to the field of advertising and promotion can provide practical and effective strategies for enterprises and consumers, avoiding unnecessary additional investment. This is precisely the core issue that this research aims to explore: How to apply game theory analysis and models in advertising campaigns and strategic optimization within business enterprises, taking into account the interests and competitive relationships of both parties, and striving to maximize the benefits of both.

Most articles and scholars have studied consumers' behavioral decisions, that is, the intense game of the same or different strategies and psychology among consumers [2]. Very few scholars and articles have learned behavioral decisions from the perspective of enterprises or other aspects, that means, strategies and psychological games of strategies, demands, interests, etc [3]. Of enterprises or other aspects. The paper first analyzes the strategic interaction and equilibrium results of advertising promotion competition by flexibly applying the game theory model, and explores the competitive interest relationship between enterprises and consumers. Secondly, based on actual cases, select the optimal strategy to make a decision that maximizes benefits. At the same time, identify the advantages and disadvantages of the choices made by both sides in this invisible competitive interest. Finally, attempt to further optimize the logical analysis in the game process, that is, the game of thinking and psychology, so as to optimize the strategic choices of both sides. In today's daily life, the application of game theory in advertising and promotion has become a very important way of thinking and decision-making. The main research focuses on the mutual influence and decision-making output among enterprises, media, and consumers, aiming to maximize the interests of both parties as much as possible. Nash equilibrium means that in advertising competition, the decision combinations chosen by all participants cannot maximize their own benefits by individually changing their strategies. For instance, there are many retailers in society nowadays. In the case of retailers competing with each other, advertising investment is positively correlated with the intensity of competition. This creates a classic prisoner's dilemma scenario: while collective rationality calls for reduced spending to maximize industry profits, individual rationality drives each firm to overspend to avoid losing market share, resulting in a Pareto-inefficient outcome for all. This often leads to a prisoner's dilemma. Although it may be beneficial for all enterprises to reduce their investment in advertising, in the absence of uncertainty about others' decisions, and in the absence of trust and adequate coordination, every enterprise or consumer will be afraid that they will reduce their investment while their competitors will increase it, thus falling into the predicament of overinvestment.

From a game theory perspective, this represents a short-sighted strategy in a non-cooperative game that inevitably leads to a breakdown in trust and long-term reputational damage, ultimately resulting in a suboptimal outcome for the entire market. Nowadays, advertising campaigns still take advantage of information superiority by screening, distorting, exaggerating, or even fabricating information to make it more attractive to consumers and deviating from their actual perception, thereby reaping more profits. Such advertising campaigns and incorrect information can indeed bring it more excess profits in the short term. However, when all the false content is exposed and the fabricated false perception is shattered by reality, it will only cause consumers to completely lose trust in this brand and even start to doubt a certain category or the entire industry. The short-term gains of excessive profits are met with permanent distrust and losses, which will greatly affect the overall market situation. This is not worth it and is not feasible.

2. Case Analysis: Advertising Investment Patterns of Industry Leaders

According to Table 1, these data illustrate the growth trend of digitalization; all industries need to reach all domestic and foreign consumers through advertising and promotion, and continuous advertising is required [4]. As shown in Table 1, industry giants such as P&G, Amazon, and L'Oréal allocate substantial capital—exceeding 66 billion RMB annually—to advertising campaigns aimed at preserving brand influence, securing market position, and cultivating consumer purchase intent.

Table 1. Advertising Expenditures of Major Global Corporations (2021)

Brand Name	Industry/Country	Recent Advertising Investment (RMB)	Details
Procter & Gamble (P&G)	Goods for everyday consumption/US	about 77.6 billion	One of the world's largest advertisers spent 11.5 billion dollars on advertising in 2021.

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Amazon	Electronic commerce/ US	About 73.5 billion	In 2021, it spent 10.9 billion dollars on advertising and has been advertising during the Super Bowl in the United States for many consecutive years.
L'Oréal	Cosmetic/France	About 66.8 billion	Advertising investment reached 9.9 billion dollars in 2021.

The magnitude of these investments empirically demonstrates the intense competitive dynamics theorized in the introduction, potentially leading to the 'prisoner's dilemma' scenario where firms feel compelled to overspend to avoid being outmatched. These cases raise a central question for our game-theoretic analysis: whether such high levels of spending represent a Nash equilibrium or if there exists a more optimal, cooperative strategy that could benefit all market participants.

3. A Dual-Perspective Analysis: Positive Influences and Inherent Risks

3.1 Strategic Advantages in Advertising Competition

3.1.1 Enterprise-level strategic optimization

The application of game theory principles compels a strategic paradigm shift for enterprises engaged in advertising. Firstly, game theory forces enterprises to shift from merely considering themselves to taking a multi-faceted approach, being more logical and strategic, and thinking from multiple perspectives, thereby reaching more rational and efficient decisions. At the same time, advertising and promotion will force enterprises and merchants to improve their core values and focus points around the needs of consumers in order to make their advertising and promotion have content to talk about, so as to attract more consumers, and also try their best to be as close as possible to what is described in the advertising and promotion. Secondly, in the highly competitive market, enterprises and merchants will, under the pressure of competition, improve and explore more novel, creative, and efficient promotional methods, such as interesting short videos, live streaming, 3D large screen playback, etc [5]. At the same time, by analyzing consumers' personal preferences through big data, we can reduce the wasteful approach of casting a wide net, lower costs, and enable advertising and promotion to be more precisely and effectively delivered to those consumers who truly need it.

3.1.2 Industry-level efficiency and collaboration

Game theory is not only about competition, but also about how to achieve better cooperation and enhance the efficiency of the entire industrial chain. This aligns with the concepts of cooperative game theory, where coalition-forming among players (e.g., firms in a supply chain) can lead to increased total value and Pareto improvements for the entire system. The competition and game among enterprises will drive advertising and promotion to shift from traditional media placement to digital and scenario-based models. Although enterprises and merchants are competing with each other, trying to be better than others, this kind of competitive game has instead driven and promoted the development and exploration of the entire industrial chain, achieving further technological upgrades. At the same time, better cooperation and communication can maximize the utilization rate of resources. Enhance the utilization rate of resources and activate some abandoned or forgotten resources at the same time, so as to truly achieve win-win cooperation among all parties.

3.1.3 Consumer welfare and experience enhancement

Relevant and friendly advertising campaigns will take into account consumers' feelings, improve their experience of watching advertisements, and give consumers more choices to compare with open and transparent information. The content and creativity of advertising and promotion are constantly upgrading. Enterprises and merchants are also constantly improving their products and services based on consumers' demands, understanding the interests of consumers and customers, reducing search costs, accurately pushing what people are interested in, and not overly disturbing them. Therefore, consumers will truly enjoy more benefits and discounts, have more choices, and meet their differentiated demands.

3.2 Market Failures and Strategic Risks

3.2.1 The auction mechanism and winner's curse

The competition for scarce advertising resources (e.g., prime physical locations) can be modeled as an auction, a fundamental tool in game theory [6,7]. This creates a strategic 'risk game' between firms (bidders) and the market/consumers. Advertising and promotion require the occupation of public resources, and public resources are limited. So the government often uses one of the most common methods to determine who will use the limited public resources: auctions. Perhaps a Dutch auction. People can see them everywhere, in shopping malls, underground, etc. But different places will get different evaluations. It totally depends on the visitors' or consumers' flow rate. Maybe these contents will come next, truly happening in daily life, but think about it. Try to think in this way, if a product publicity wants to show in a popular place where many people prefer to go. Absolutely, the evaluation must be higher than any other place, and the main reasons can be these two: the first one is that all of these advertisements occupy many public resources. The local government must bear the cost of this. The second one is that the advertisements shown in a popular place will catch plenty of people's attention. So, more and more people will notice them, and the purpose of the advertisements will be achieved. Maybe more people will have some consumption in these shops just because they saw these advertisements before. And the shops or enterprises will get more and more profits. So, think it more simply. To enterprises and merchants (sellers), what do they think? And to consumers or customers (buyers), how do they consider? Try to think about these two aspects. Both of them want their own profits as high as possible, and how do they do it, respectively? So, think about it from the sellers' perspectives first. How do they do? Maybe at first they will give a really high price, much higher than the seller's estimated value. And the purpose is that the final transaction price can be infinitely close to their estimated value. But the best way is to make a bargain with a higher value than the estimated price, cause this way can make the sellers get more profits. And the next thing, from another perspective, is from the buyers' perspectives. What do they consider? With a large probability, the buyers will not hand up as a really high price. If they want to face a high risk, they may hand it up when the price reaches their own estimated value or even shade more or less; thus, buyers can get as much profit as possible. But if not, if they do not want to face a high risk or they think this thing will get high income after using, they may hand up when the price reaches or doesn't fall to their estimated value, even much higher. And this situation is what sellers prefer to see. Because the buyers pay more to get this thing, the sellers will get more profits. This may cause over-investment, especially for consumers, as the interests of both have plummeted. From a game-theoretic perspective, this outcome is indicative of the 'winner's curse', a phenomenon common in common-value auctions where the winner tends to overpay due to imperfect information. Consequently, the winning firm incurs unsustainable costs that diminish its profits, while consumers ultimately bear these costs through higher prices, leading to a Pareto-inefficient outcome for the entire market.

3.2.2 Market concentration and barriers to entry

Excessively high costs can prevent some enterprises and merchants from bearing their expenses. Even if the quality of advertising and promotion is very high, it is difficult to gain high recognition in the market, leading to the failure of some demand signals. Eventually, this results in a monopolistic phenomenon where one company dominates the market and fewer and fewer enterprises enter it, thereby weakening the driving force for market innovation and development.

3.2.3 Information asymmetry and consumer distrust

Advertising and promotion will increase the cost of related products, and at the same time, consumers will be disturbed or deceived by some false advertising and promotion, as well as prices. Nowadays, on various software, the irregular advertising and promotion not only become a burden for people to use the software, but also disturb people's daily life and infringe upon consumers' privacy, which brings people great negative emotions and makes them more resistant to such advertising and promotion and related products [8].

In conclusion, while competitive advertising dynamics drive innovation, they also inherently carry risks such as market inefficiency, over-investment, and information asymmetry. A game-theoretic lens is crucial not only for identifying these problems but also for designing mechanisms and strategies that mitigate these risks, guiding the market towards a more efficient and sustainable equilibrium.

4. Strategic Recommendations: Towards Sustainable Advertising Equilibrium

4.1 Fostering Cooperative Mechanisms to Resolve the Prisoner's Dilemma

First of all, while breaking the "Prisoner's Dilemma", seek a new strategy to solve the internal and self-centered game fundamentally. Teamwork is necessary. "This is because sustained adversarial spending constitutes a non-cooperative Nash equilibrium that is Pareto-inefficient for the entire industry. To transition towards a superior cooperative equilibrium, firms should consider establishing industry-wide standards for data transparency and advertising expenditure disclosure (e.g., through industry associations) [9]. This shared information can reduce uncertainty, facilitate tacit collusion to avoid overinvestment, and enable collective price and product regulation, thereby maximizing overall industry benefits rather than engaging in destructive internal competition. In the same competitive market, the data between enterprises and advertising and promotion should be made open and transparent, and overall price and product regulation should be carried out to avoid internal price competition. Only in this way can the benefits be maximized. Secondly, the role of technological algorithms should be redefined from automated decision-makers to human-augmented tools. While algorithms excel at data processing and targeting, over-reliance can lead to creative stagnation and a failure

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to grasp nuanced consumer needs. Enterprises should prioritize human-centric creativity and strategic oversight in advertising design, leveraging algorithms for efficiency and insight generation while ensuring that final strategies are guided by human intuition and ethical considerations. This synergy ensures advertisements are not only precise but also genuinely resonant and trustworthy.

4.2 Embracing Coopetition for Market Innovation

Strive to achieve cooperation in competition and competition in cooperation, and realize true win-win cooperation. There are many benefits to doing this. First, it helps to cooperate in competition. This avoids a series of unnecessary competition, comparison, falsehood, and costs, which can maximize the interests of enterprises, make them more authentic, and prevent the prices of products from rising without limit [10]. Secondly, compete in cooperation. This will enable enterprises and merchants to seek common ground while reserving differences when doing self-advertising and promotion, and maximize their own creativity and innovation. This can not only help them attract a large number of customers and consumers themselves, but also boost the economic consumption of the entire market.

4.3 Strengthening Regulatory Frameworks and Rebuilding Trust

While internal cooperation is crucial, it is often unstable without external reinforcement. Therefore, constructing a robust regulatory framework is essential to safeguard market integrity and consumer trust. Improve all the rules and regulations and advertising campaigns for external display on major online platforms, etc., and strictly manage and supervise the authenticity and high quality of advertising campaigns 10]. All enterprises and merchants are required to have open and transparent data. Ensure the perception and experience of consumers and clients through open and transparent data analysis, data processing, and logical presentation, allowing consumers to truly understand that there is no difference between advertisements and products. Strike a balance between the interests of commercial enterprises and the experience and value of consumers and customers. Through these concerted efforts—internal cooperation, strategic coopetition, and external regulation—the advertising market can evolve from a short-sighted, non-cooperative game into a sustainable ecosystem where firm profitability and consumer welfare are aligned, achieving a long-term, efficient equilibrium.

5. Conclusion

This study has demonstrated that advertising, an inevitable force in the modern economy, is indeed a double-edged sword. Its impact—whether driving market efficiency and growth or fostering mistrust and inefficiency—is profoundly shaped by the strategic interactions between firms and consumers, as illuminated by game-theoretic analysis. By fully applying game theory and models, it can optimize the publicity and sales strategies to the extreme, optimize the allocation of resources to the extreme, and make full use of them, thereby reducing costs and increasing efficiency, promoting rapid economic development, and achieving win-win cooperation. Conversely, without the discipline of a long-term, strategic perspective that game theory encourages, advertising can devolve into a short-sighted, non-cooperative game. But it can also be merely for promotion, exaggeration, and false claims to attract more consumers and clients, only caring about the pretty fame and gain, and lacking foresight. This will lead to a complete collapse of trust between customers and business operators, causing a trust crisis, which in turn results in the waste of resources, the stagnation of economic development, or even a decline. Game theory should enable enterprises, merchants, and customers to achieve a true win-win situation, cooperating in competition and competing in cooperation. Beyond direct business applications, this research underscores the value of a game-theoretic mindset for consumers as well. It equips them to critically decode marketing strategies, make more informed choices, and thus resist manipulative tactics, fostering a more rational and transparent marketplace. The topic of game theory analysis and business strategy optimization research in advertising and promotion was chosen because it is closely related to daily life. It not only enables people to understand the application of game theory better, but also allows them to have a more thorough understanding of some sales operations in the market, so as not to be unquestioningly led astray.

A limitation of this study lies in its reliance on secondary data. Future research would benefit greatly from empirical validation through primary data collection methods, such as consumer surveys and experiments, to quantitatively test the game-theoretic models and equilibrium predictions proposed herein.

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