Proceedings of the 3rd International Conference on Business and Policy Studies
DOI: 10.54254/2754-1169/71/20241494

Strategies to Mitigate Cutthroat Competition in E-Commerce: Insights from Game Theory

Ruwei Yao[1,a,*]

[1]*SWUFE-UD Institute of Data Science, Southwestern University of Finance and Economics, Liutai Road, Wenjiang, Chengdu, China*
a. 42153014@smail.swufe.edu.cn
**corresponding author*

Abstract: As e-commerce industries advanced irresistibly in recent years, some platforms chose to reduce prices again and again to seize the market, which lead to vicious competition and price war. So, this article tried to find out the best method for different companies to deal with price war. Based on several articles about how to avoid price war for enterprises, this article analyzes price war from the game theory perspective by establishing static game models to analyze the feasibility of each method. The result show that the main reason of this phenomenon is people are trapped in a prisoner's dilemma, and price war is an economic necessity behavior. As a result, government is suggested to establish market superior department and companies are suggested to produce differential products and cooperate with each other to deal with price war. For different kind of enterprises, oligopolies can produce products suit for different people and collaborate with influential companies in different areas while supply chain companies should reach a cooperation treaty with upstream and downstream enterprises achieve win-win cooperation.

Keywords: price war, prisoner's dilemma, static game modules, oligopoly, supply chain enterprise

1. Introduction

With the development of Internet, e-commerce industries all around the country have had a rapid rise these years. However, as more and more people taking part in this market, some of the industries take measures to reduce their price maliciously to overtake the market share, which seriously disrupted market order. Some were so vicious that even lead to price war and cause huge losses. So, it is necessary to find ways to avoid this phenomenon happen. There were much research explored the issue before and they carried out several methods including market supervision, advertisements and financing. Those methods are useful to avoid the situation but not suit for all enterprises. This article aimed to analyze present and try to find another method for enterprises to avoid price war and vicious competition in e-commerce market from the perspective of game theory.

2. Price War

In a market, enterprises are always forced to reduce their price again and again to seize market. Although it is a common phenomenon in markets, there's exists a range for the value of price. If the

DOI: 10.54254/2754-1169/71/20241494

value is all inside the range, the market can regulate itself and maintain a dynamic balance. But some enterprises tried to grab most of the market and gave the commodity a very low price. This action could force many other enterprises in the same market to reduce the price of goods that would otherwise be at market value, which then lead to a vicious cycle and influence the stability of the market.

This process has several characteristics. Firstly, each enterprise pursues the maximization of personal interests rather than the maximization of market interests. Secondly, the action of reduce price has a sequential order. Those enterprises who didn't want to reduce the price were forced to do so after the market prices cannot adjust on their own. Thirdly, it is a repeated game. As a vicious competition, enterprises could reduce their price again and again until they adjust the price to suit the real-time market that is relatively stable [1].

3. Essence and Main Reason

According to the above characteristics analysis, this situation conforms to the assumptions of prisoner's dilemma model. Assume there exists a general market with two enterprises A and B, then assign values to the players as shown in table 1:

Table 1: Prisoner's Dilemma

		Enterprise B	
		Reduction	No Reduction
Enterprise A	Reduction	(14,10)	(20,6)
	No Reduction	(10,16)	(16,12)

This module assume that the present profit is (16,12) if all enterprises didn't reduce their price. When one enterprise reduce its price,it added 4 unit profit to the present profit, the other enterprises mines 6 unit profit from the present profit. So, enterprise A's profit 20 and enterprise B's profit is 6 when enterprise A reduce the price and enterprise B remain the present price, while enterprise A's value is 10 and enterprise B's value is 16 in the opposite situation. When all two enterprises reduce the price, each mine 8-unit profit from the present profit, enterprise A's profit is 8 and enterprise B's value is 4.

Now analyze the situation according to the line method in game theory. For B, if enterprise A doesn't reduce the price, enterprise B will choose to reduce the price; if enterprise A choose to reduce the price, enterprise B will choose to reduce price as well. For A, if enterprise B choose not to reduce the price, enterprise A will choose to reduce the price; if enterprise B choose to reduce the price, enterprise A will also choose to reduce the price.

So, the final Nash equilibrium for this game is (Reduction, Reduction). The result fit prisoner's dilemma model, which is the essence of this phenomenon.

4. Present Solutions

Nowadays, researchers have different views from different angles on this issue. This article analyzes solutions that are been mentioned for most of times here.

4.1. Participation of supervise department

Most articles mentioned the use of supervise department to deal with price war and the benefit matrix came up by Xinyi Wan show the essence of under supervising is showed as table 2:

DOI: 10.54254/2754-1169/71/20241494

Table 2: Game between regulators and companies.

		Supervision Department	
		Supervise	Doesn't Supervise
enterprises	Reduce Again	(-E, 0)	(F, -G)
	No Reduction	(0, 0)	(0, H)

The module assumes that in the situation of supervising, if enterprises reduce their price, the profit for them are -E; if enterprises keep the current price, the profit is 0. And in the situation of not supervising, if enterprises reduce their price, the profit for them are F while the profit for supervision department is -G, otherwise the profit for them are 0 and H.

There doesn't exist a Nash equilibrium in this module. But it shows that, under the situation G>H the market could become stable and avoid price war. In other words, the loss of price war should higher than the benefit that enterprises doesn't reduce the price in the situation that supervision department doesn't adjust and control the price.

Researchers have different ideas based on supervising department. Huimin Zhang adopted the dynamic game model and draw a conclusion that when the punish value of supervise department is higher than the difference value of extraneous income for reducing price and actual lose, supervising is efficient for avoiding price war, or enterprises will ignore the rules and reduce the price to get higher profit [2]. Yajing Yang pointed out that supervising department should also pay attention to some enterprises that sell inferior-quality products at the price of high-quality product to gain more profit. Supervising department should increase penalties for businesses with substandard products to maintain the market [3].

Accompanied by the establishment of regulatory authorities, the market mechanism is gradually improved, and the sales environment is guaranteed, vicious competitions could be avoided and controlled.

4.2. Develop Advantages and Manufacture Differentiated Products

Table 3: Game about whether enterprises produce differentiated products.

		Enterprise B's products	
		Differentiated	Universal
Enterprise A's products	Differentiated	(-1, -1)	(3,0)
	Universal	(0.3)	(2,2)

The basic module of producing differentiated product or not are represented in table 3 and the figures presented the earnings of both enterprises.

The Nash equilibrium for this game is (Differentiated, Universal) or (Universal, Differentiated). When both companies adopt a differentiated product strategy, their profits may decline because they both invest substantial resources to achieve differentiation, and the market demand for differentiated products is limited. When one company adopts a differentiation strategy while the other does not, the company that chooses differentiation may capture a larger market share and profit since it offers a unique product, while the company that does not differentiate have lower profit for reduction of market share. When neither company chooses a differentiation strategy, both can enjoy a steady market share and profit, but it might be lower than if only one company pursued a differentiation approach.

DOI: 10.54254/2754-1169/71/20241494

Regardless of the increase of customers who used to buy goods offline but now shopping online, the total share of the existing market is basically constant. If all companies produce products with many similarities, the product homogenization is serious. Therefore, once one firm begins to cut price, more firms need to make corresponding price reduction to maintain their market share [4]. So, it is necessary to figure out some characteristics that could attract customers to buy this kind of goods instead of others. The characteristics should not be the aspects of price without doubt. Researchers in different areas showed the feasibility of this idea and pointed out several aspects' enterprises could choose to improve. Shujie Yao and Yongyao Chen presented that enterprises could raise the quality of products to gain more profit. High quality products could make enterprises stay in the dominant position to achieve the climb to the high end of the value chain. It contributes to subdivision of consumer market and avoid the need of price war [5].

Advantages can be not only the quality of the product itself, but also value-added services and sources. An example came up with Liqiang Chen analyzed the price war of online book shops [6]. Online book shop Dangdang has the advantage of the resources of books, so it could buy books which could only be sold by itself. It can also provide customers with valuable service like peripheral freebies and the author's signatures.

Differentiated business operations enrich the market, offering customers more choices. This not only avoids price wars due to a large number of identical products but also enhances brand awareness, increase customer loyalty and expands the scale of product sales to gain more profit.

4.3. Cooperation and Mutual Benefits

Table 4: Game about whether enterprises cooperate with each other.

		enterprise B	
		cooperation	reduction
enterprise A	cooperation	(P, P)	(S, T)
	reduction	(T, S)	(L, L)

The model for this case is based on the static game model and is shown in table 4. Set P represents the reward when choosing a win-win cooperation. S represents the loss when company A chooses cooperation and company B chooses to reduce the price. T represents the loss when company A chooses to reduce the price and company B chooses cooperation. L represents the loss when both companies choose to reduce prices. If R>P and S>T, which means 2R>S+T, then win-win cooperation is a Nash equilibrium. This means that when win-win cooperation can bring greater benefits than a price war, both company A and company B will choose to cooperate. On the contrary, price war can bring greater benefit and both enterprises will choose to reduce price.

As a result, if both companies choose a win-win cooperation strategy, they can share the market and obtain some form of cooperative rewards. If one company chooses to reduce prices while the other chooses cooperation, the company with the lower prices will gain market share and profit, while the company with higher prices will suffer losses. If both companies choose to reduce prices, they will both suffer losses from a price war. Therefore, how to achieve cooperation and what kind of cooperation to achieve becomes crucial.

Huimin Zhang pointed out that for duopoly market like take-out industry, both parties could cooperate in shared infrastructure to reduce business costs [2]. Meituan and Ele.me have also adopted diversified cooperation, broadened their business models, carried out co-branded marketing activities and achieved mutual benefits. At the same time, they can prevent the entry of other enterprises and monopolize the market for a long time.

DOI: 10.54254/2754-1169/71/20241494

Yuan Chen suggested e-commerce companies should establish price strategy alliances, focusing their efforts on research and development, marketing and expanding new consumer groups to increase the market share of e-commerce companies [7].

Yi Liu pointed out that perhaps companies doesn't need to have a written contract but reach an unwritten agreement. Once the competitors cut the price, then you should follow the strategy and quickly send a market signal to your competitors that don not engaged in a massive market share battle, but just a trial price reduction, after several rounds of pricing, the two sides make a commitment to some degree, and achieve a "win-win" situation [8].

5. Suggestions for different kind of companies

Oligopolies can produce products at three levels - high, middle, and low to occupy a larger market share. At the same time, by collaborating with other companies to produce co-branded or multi-functional products, they would not be greatly threatened even when facing price wars.

However, for e-commerce market, the price change more rapid than real economy industry and lack of stability. After long-time and tough price wars, oligopolies can cease the fire of price and enjoy the high profits together, as long as the requirement of cooperation is met. For this reason, price collusion in private could happen very likely. So proper competition is still the mainstream while cooperation takes a back seat [9]. And it is more important for oligopolies to strengthen technological innovation and form a stronger product advantage.

Supply chain companies should reach a cooperation treaty with upstream and downstream enterprises, regulate the manufacturing process of goods, and form a complete enterprise chain to achieve win-win cooperation.

More realistically, it is always not such idealized to reach a win-win strategy, so companies should think about term cooperation which means looking for both win-win strategies and win-loss opportunities to avoid the situation of betrayal and sudden change [10].

6. Conclusion

This paper examines and consolidates various strategies that can prevent or effectively manage price wars in e-commerce, enabling businesses to select and implement the most appropriate approach for their operations. But the market is far more complex with many influence factors. For example, modules used in this article are games with two objects but there are hundreds of enterprises in real market, which means the influence between enterprises is not such simple. So, these methods just provide simple frame for enterprises, real strategies need to consider more factors.

References

[1] *Xinyi Wan. (2020) Analysis of E-commerce Price War from the Perspective of Game Theory. GUANGXI ZHILIANG JIANDU DAOBAO, 6, 223-224.*

[2] *Huimin Zhang. (2023) Game Analysis of E-commerce Price War. Co-Operative Economy & Science, 7, 97-99.*

[3] *Yajing Yang. (2023) Game Research on Decision-making Behavior of E-commerce Platform Price War. Modern Business, 10, 39-42.*

[4] *Y. Fu, Z. Jia. (2010) Game Analysis and Strategy Research of Price War in China Mobile Communication Industry Based on 3G Technology Application, 2010 International Conference on E-Product E-Service and E-Entertainment, 1-3.*

[5] *Shujie Yao, Yongyao Chen. (2022) Price Competition, Differentiation Competition and Decision-making Research on Chinese E-commerce Platform Competitive Strategy - Based on Game Analysis of Amazon "Fleeing" Chinese Market. Journal of Honghe University, 2, 101-107.*

[6] *Liqiang Chen. (2017) Game Analysis and Evasion Tactics Research on Online Bookstore Price War. New Media Research, 6, 40-42.*

DOI: 10.54254/2754-1169/71/20241494

[7] *Yuan Chen. (2019) Analysis of E-commerce Price War From the Viewpoint of Game Theory. China Collective Economy, 32, 107-108.*
[8] *Yi Liu. (2021) E-commerce Price War Based on Game Theory. Advances in Economics, Business and Management Research, 203, 3266-3271.*
[9] *Yue Hu, Manzhen Tang. (2014) Game Theory Analysis of E-Commerce's Price War, iBusiness, 6, 189-194.*
[10] *Adam M. Brandenburger, Barry J. Nalebuff. (1995) The Right Game: Use Game Theory to Shape Strategy, Harvard Business Review, 76, 57-71.*