

Analysis and Discussion of Stackelberg Competition

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Abstract. As a matter of fact, the Stackelberg competition is the hardest and most common model in Microeconomics. In reality, it still appears anywhere even in recent years, which has been widely implemented in various fields including economic, business, medical industry and so on. For corporations or individual businessman, one has to have some mind about Stackelberg competition in order to have a higher reward in the business area based on game theory. With this in mind, in this article, it mainly describes from a businessman's perspective in order to make it easier to understand. To be specific, the mathematical descriptions for Stackelberg competition are described and the different situations are compared and analyzed. According to the evaluations, the performances are clear for different conditions. At the same time, the limitations of the model as well as further development are also estimated and discussed. Overall, these results shed light on guiding further exploration of Stackelberg competition analysis.

Keywords: Stackelberg competition, microeconomics.

1. Introduction

Stackelberg competition is a common thing in Microeconomics [1, 2]. It happens everywhere on Earth, as there is economy there. The origin of Stackelberg competition is related to oligopoly [3]. In Microeconomics, there are four types of competition, i.e., a perfect competition and three imperfect competitions [4]. Perfect competition means there is a fair organized tradeoffs in the market. All sellers sell identical things, so the price won't vary a lot.

The market curve shows that as the price goes higher, there will be lower demand quantity. Making the price higher is undoubtedly accelerating a bankruptcy for a perfect competition company [5]. Imperfect competition, which is their meaning, companies have unfair advantages and disadvantages in the market. They can either get more profit in the market or gaining nothing from the tradeoffs [6] (Chapter 2, imperfect markets). One of the imperfect competitions is called monopolistic competition. In this competition, companies sell slightly different things. By observing the behavior of customers, both companies can choose to higher or lower their price for more benefit and sold quantity. Another imperfect competition is called Monopoly. In this market, there is only one company selling a unique good to the customers. The last imperfect competition is Oligopoly. It is the main focus of this study. Oligopoly is there are only a few companies, and each companies have a big share from the market. All of them are either looking for a bigger share or satisfied with their current scenario. If they are satisfied, they do nothing.

If they are looking for more profit, they will compete. Competitions are also classified - Cournot competition and Stackelberg competition. Cournot competition is there are two leaders in the market, and both are choosing their dominant strategy at the same time. Their choice will affect others payoff as well. In some scenario, there might not have a Nash Equilibrium in the competition because there is no optimum payoff. Stackelberg competition works in the same way, but there is a sequence between each other. There is a follower and a leader.

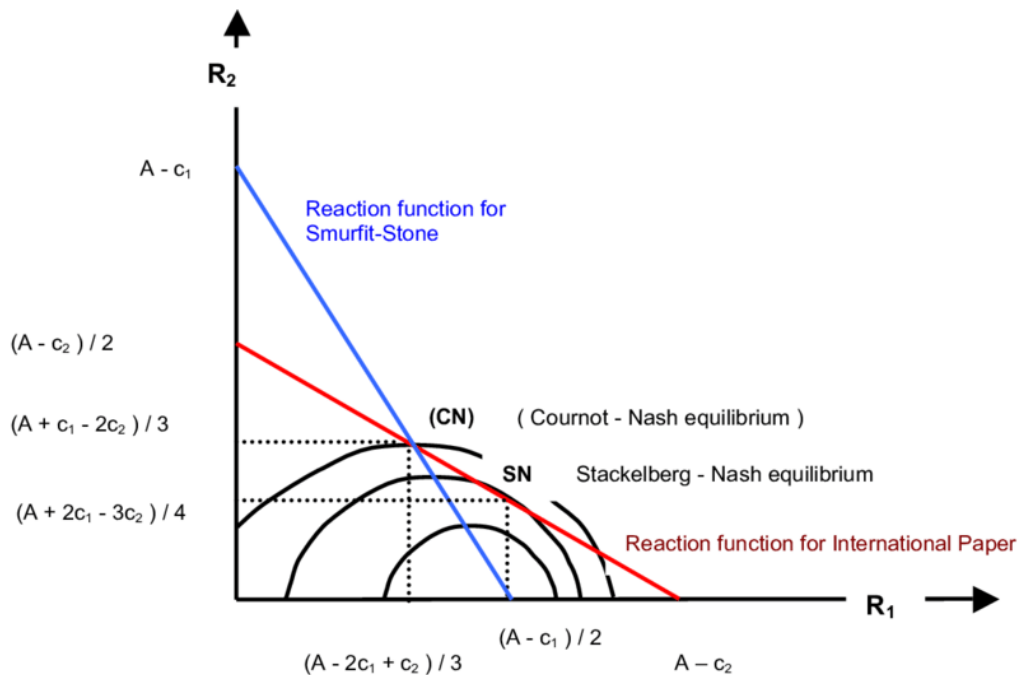


Figure 1. The Von-Stackelberg Nash equilibrium [7].

2. Competition Analysis

The relationship between follower and leader is based on their profits. It has an example as shown in Fig. 1 [7]. From the image above, one can see that there are some arcs on the graph. It is what one called “the benefit curve.” Leader industry’s market curve’s contact with the benefit curve is the individual’s max profit. It is what one called Nash Equilibrium in Stackelberg’s competition. What determines these “arcs” are the strategy both companies play. Their demand and price affect each other. It has a relationship with equation [8]:

$$P = 1 - Q / Q = 1 - P \quad (1)$$

Here, P stands for price and Q stands for quantity. To understand the equation, one needs to first know about the relation of price and quantity in the demand market. It is reversal. As the price goes down, the demand quantity goes up. For most situations, the relationship is linear. Therefore, two firms’ price and quantity can be concluded as this. In addition, the elasticity of the demand mentioned a few moments ago is the determinant to have a precise number of how precise the two variables are changed. Usually, it is better to make the elasticity of demand better, but in Oligopoly, there is few competitors. More elasticity in demand will end up a large amount of profit in Nash equilibrium because the same level of price has more quantity, which is more profit.

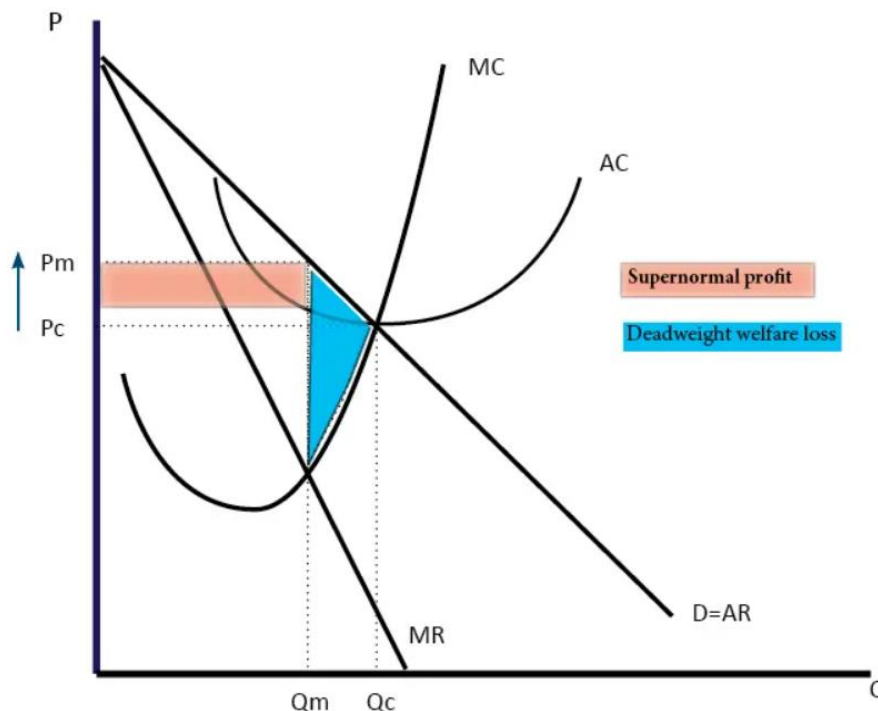


Figure 2. Oligopoly diagram [9].

Every strategy that makes these two variables change is the strategy in Stackelberg's competition. It doesn't have to be wise. As long as it is a change to alter a company's change, it is determined as a strategy. What common strategy is in the Stackelberg competition is to merge or not. Merging is an interesting process. It benefits the company with fewer competitors, more benefit, and a more reliable source of factors of work. Factors of work are land, labor, human and physical capital and the entrepreneur. However, it also hurts the company with more cost, harder to manage the company, and a potential acceleration to bankruptcy [8]. Both companies must need to determine the cost and benefit together to see their maximum profit. If they are unable to reach the max, they need to reach their max benefit as they could. The cost and benefit can be shown in industry's market curve. It displays as shown in Fig. 2 [9].

The price and quantity in the diagram work in the same way mentioned a few moments ago. What one needs to focus is the marginal revenue and marginal cost. These two variables indicate the max profit line. Others are explaining the final result of the strategy. Marginal revenue means the amount of change of output with the change of quantity. Marginal cost means the amount of change of input with the change of quantity. When these two contact together, it is the maximum benefit a company can reach. In Stackelberg game, most outcome is the leader company reaches the point and the follower company gets a close point to the maximum profit. Every company has its own way to run the company. Competing means they are trying to make the others not to surpass themselves. Sometimes they will give out incredible threat which is a threat to company that does nothing because it harms the threatener him or herself. If the threatened individual finds out that the threat is an incredible threat, they will not listen to it. But there are still loads of people unable to determine if the threat is incredible or not. That is why mostly the follower individual doesn't meet its maximum profit standard.

3. The Real World Example

This example is happened a year ago. It is about the technology oligopoly, the famous two groups looking for the bigger advantage. HUAWEI was one of the competitors. It was sanctioned by the United States government of chip importing. Usually, it was a great advantage for Apple which is the other competitor should take the advantage of being as a leader in the Stackelberg competition. Things didn't go like the hypothesis concluded just now. HUAWEI surprisingly made a new prototype of the

phone called Xmage. The phone has outstanding camera with the newest computer calculation and performance. These features introduced a lot of its customers to the market. The strategy of releasing the new phone soon after the sanction made Apple have to be the follower. The only two choices are being a follower itself, which has risk of being taken by HUAWEI. Otherwise, one finds somebody to merge with. What Apple did in last May is the second option. He merged with Broadcom, the most popular hardware retail and maker in the United States, for 430 billion dollars [10]. The benefit they can make together is the development of apple's own phone, iPhone, and other miscellaneous hardware (e.g., security protocols).

Soon after Apple made the move, the media was introducing the merging act. This is a wise move. Exposing oneself on a platform where everyone can see what is going on with the company will gain its popularity. For companies like apple, quantity of products sold is one of the most important factors to compete. So, the act makes the follower curve more elastic [8]. More elastic market curve will end up in a spectacular way.

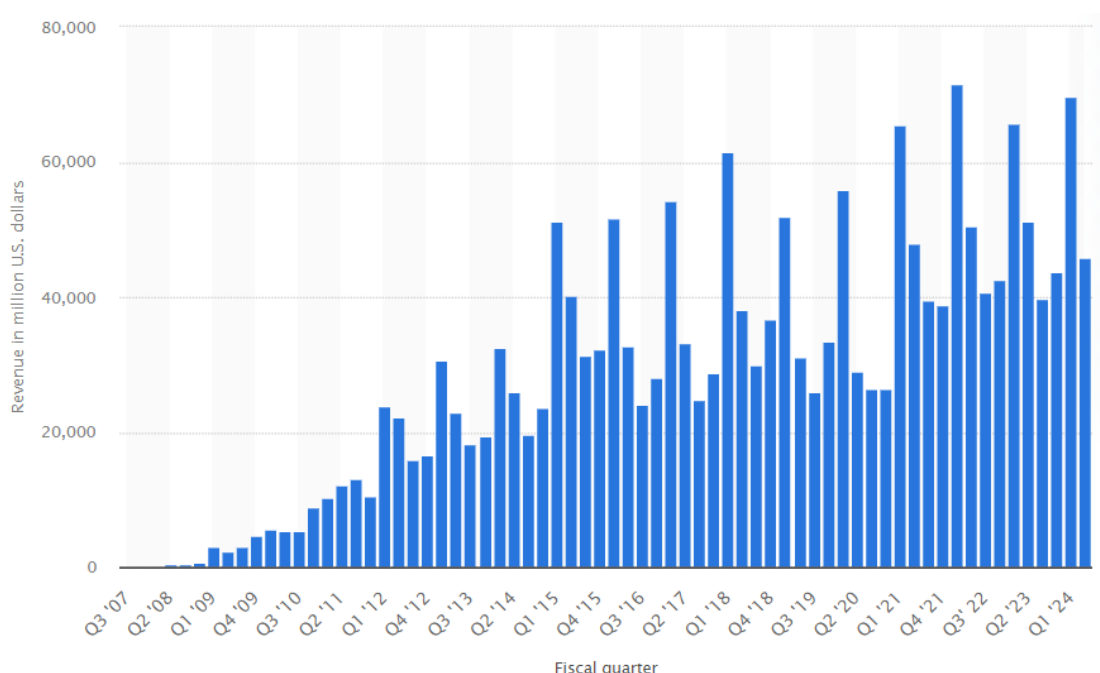


Figure 3. Apples iPhone revenue [10].

Seen from Fig. 3 [10], the quantity of Apple fell due to COVID but went back on sale just a year after cooperating with Broadcom. This is the definitive evidence to show that the merging is a successful move. Apple's benefit isn't stopped here. Nowadays, apple is looking for newest AI for further invention on iPhone. Broadcom is an expert on AI. It's hardware uses AI a lot. It knows how to make the Artificial intelligent instead of making it worse by having some test on its own hardware first. New AI means new features. Another factor that makes customers pay for iPhone. Also, with the propaganda on upcoming iPhone, the advantage gained on the move will have a terrific result. Just exactly as the graph tells us.

4. Conclusion

Stackelberg competition is one of the most interesting economic competitions existed on the world. Any move will make a drastic change on the situation and make it more interesting. The leader will be mostly in an advantageous situation, but if the follower plays well, leader is no longer the big-share oligopoly taker. It is also useful for both followers and leaders take the counteraction. Some strategies directly affect the output for the person, just like what they did in the Stackelberg Oligopoly with Apple and HUAWEI. Until today, the event continues and Apple is about to be ready with its new iPhone that has fascinating features within, and one can yet have the prediction on who will win

this Stackelberg competition. The goal to make this paper is to make the Stackelberg model clear to most people. Based on real life, competitions are often too complicated to understand at all. Stackelberg competition is one of the most difficult models in Economics. With this paper, everyone will have a basic view about this model and the thing, so they could have a clear shot between the profit and incentive of others to let them work for the readers for the most output of them.

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