Case Report

Pricing Games: Sony PlayStation and Microsoft XBox

ISOM3900 - Decision Analytics

Introduction

There are many complex decisions made daily. There are a multitude of factors to consider when making decisions and it gets even more complex when others' decisions will affect your decisions. Game theory serves as a model of an interaction situation among rational players. The key of game theory is that one player's playoff is contingent on the strategy implemented by the other player. Regardless of what the other player's decision is, your decision will always be made to maximize the payoff. Nash equilibrium is an outcome where, once achieved, no player can increase payoff by changing decision unilaterally. It is the outcome that players tend to gravitate towards. In the case example, two video game console developers (Sony and Microsoft) are given the option to price their video consoles. The price they set will impact their revenue, profit margin, and most importantly their market share. The companies will each have to make a decision on how to price their consoles to maximize their own payoff.

Assignment

1) Given the information in Exhibits 1, 2, and 3, would you predict that Sony and/or Microsoft will want to reduce prices by $100? Use a 2-by-2 simultaneous game to analyze this short-run situation. You can assume Nintendo monitors its competitors' actions, but has no plan to change its price. (Hint: for short-run decisions, you should exclude fixed costs in your calculations)

By using the information in *Exhibit 1*, we can form a table of projected sales for consoles at different prices - either reducing the price to $299 (low price) or keep the same price $399 (high price). Then calculate the projected profits of selling consoles from different companies. Profits are calculated with the formula Number of Units Sold x (Console Price - Per Unit Cost w/o Fixed Cost). The profits are as shown in *Exhibit 2*.

Assuming that both companies cannot communicate with each other, each player is self-interested and will need to make the decisions simultaneously. As a result, to maximize their profits, they will both have the strictly dominant strategy of cutting the price by $100 to $299, which is also where the nash equilibrium takes place. Therefore, we predict both Sony and Microsoft will cut the price of their consoles, PS4 and Xbox Elite, by $100 respectively.

2) Can you think of reasons why these firms would be particularly aggressive in pricing their consoles?

Although Microsoft and Sony are the oligopoly of the playstation market, they can maximize their profit by cooperating with each other to set a high price. However, because of **self-interest**, they both try to maximize their profit and market share individually to dominate the market,

which contribute to aggressive pricing. By looking at *Exhibit 2*, we can see that there are two situations that each company will have to consider.

For example, in Situation 1, assume that Microsoft keeps the same price of $399, then Sony will have the incentive to reduce the price to $299 because it results in higher profit due to the **larger market share** being captured with lower price. Therefore Sony will have the incentive to price aggressively to $299. On the other hand, Microsoft has the same consideration. For Situation 2, assume Microsoft reduces the price of Xbox Elite to $299, then Sony will also have the incentive to reduce the price to $299 because they will **lose market share** and result in lower profit if they do not reduce their price. For Microsoft, they also have this consideration.

As a result, both companies will have the **strictly dominant strategy** of reducing the price to $299, pricing aggressively in order to maximize their profit.

Also, when both firms aggressively pricing their consoles, the price will decrease and the quantity sold will increase. From *Exhibit 2*, when the quantity increases, the total cost per unit decreases, implying that both firms can enjoy economies of scale when they aggressively price their console.

3) Can you think of any way to help the firms break out of the vicious circle of price cutting? Please elaborate your reason with calculation if possible.

There are two notable strategies to help firms break out the vicious circle of price cutting – Price Matching or Tit-For-Tat Strategy

Price Matching

The principle of price matching is essentially matching the price of whatever your competitor prices. Previously, if Sony prices their consoles High (at $399), then Microsoft can undercut them by pricing their consoles Low (at $299), which will yield Microsoft a higher market share and more profits. However, with the **promise** of price matching a high price, Sony can now price their consoles High and Microsoft can match. With this strategy, it introduces a new Nash Equilibrium at High-and-match- High-and-match. In total there are two Nash Equilibriums at either Low-Low or High-and-match-High-and-match. If Sony or Microsoft were to individually compare the two Nash Equilibriums, both of them would prefer the High-and-match-High-and-match equilibrium because it yields a higher profit. Hence, both these companies will gravitate towards the High-and-match-High-and-match pricing through the price matching strategy. The Price Matching Game is illustrated in *Exhibit 3*.

Pricing Matching can also be modelled a Sequential Perfect Pricing Competition - either Microsoft or Sony prices their product first and the other will price accordingly. If it were a

sequential game, both companies cannot be committed to a high price because they may be exploited by the rival. However, they can both **promise** to match a High price. By doing so, the expected payoff Sony and Microsoft end up with the same as above. The Sequential Perfect Pricing Competition is illustrated in *Exhibit 4*.

Tit-For-Tat

To help firms break out of the vicious cycle of price cutting, we can use the Tit for Tat strategy, where the two firms cooperate in the first month, and from then on, mimic the rival's action from the previous month. In this way, both firms can benefit.

In the above example of Sony and Microsoft, we can see that the two firms would actually gain higher profits by keeping the high prices together, instead of both reducing the prices. Therefore, using the Tit for Tat strategy, one firm starts cooperation by keeping the high price. Then, the second firm responds by also keeping the high price. If the second firm reacts by reducing the price, the first firm defects by reducing the price too.

To put the Tit for Tat strategy in practice, the two firms can sign contracts secretly, this should be kept secret as it violates the anti-competition law. Also, firms should react immediately in case of defection and not let cheating go unpunished. Then, firms should also be forgiving and be willing to restore cooperation.

Exhibit 6 shows the expected value of both companies cooperating, cheating once, and cheating once and forever. The value involved is shown in *Exhibit 5*, which indicates the long term expected value of different pricing conditions for both companies, considered the fixed cost.

As shown in *Exhibit 6*, after calculating the rate of return constraint (r), we can conclude that when r is smaller than 0.72 and 0.35, the **expected value of cooperating to set a high price is larger than cheat once, and cheat once and forever for both companies** respectively. Hence, both companies will cooperate to set a high price when r is small.

Appendix

Exhibit 1: Total Projected Number of Units Sold for the consoles (in millions)

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		Microsoft			
		Low ($299)		High ($399)	
Sony	Low ($299)	11.25	11.5	11.75	7
	High ($399)	8.25	12.5	8.75	8

Exhibit 2: Total Profit for the consoles (in millions) in short run

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		Microsoft			
		Low ($299)		High ($399)	
Sony	Low ($299)	$978.75	$920.00	$1,186.75	$637.00
	High ($399)	$767.25	$1,012.50	$1,032.50	$960.00

Exhibit 3: Price Matching (in millions)

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		Microsoft					
		Low ($299)		High ($399)		High and Match ($399)	
Sony	Low ($299)	$428.74	$470.01	$636.73	$186.97	$428.74	$470.01
	High ($399)	$217.22	$562.50	$482.48	$510.00	$482.48	$510.00
	High and Match ($399)	$428.74	$470.01	$482.48	$510.00	$482.48	$510.00

Exhibit 4: Sequential Perfect Pricing Competition

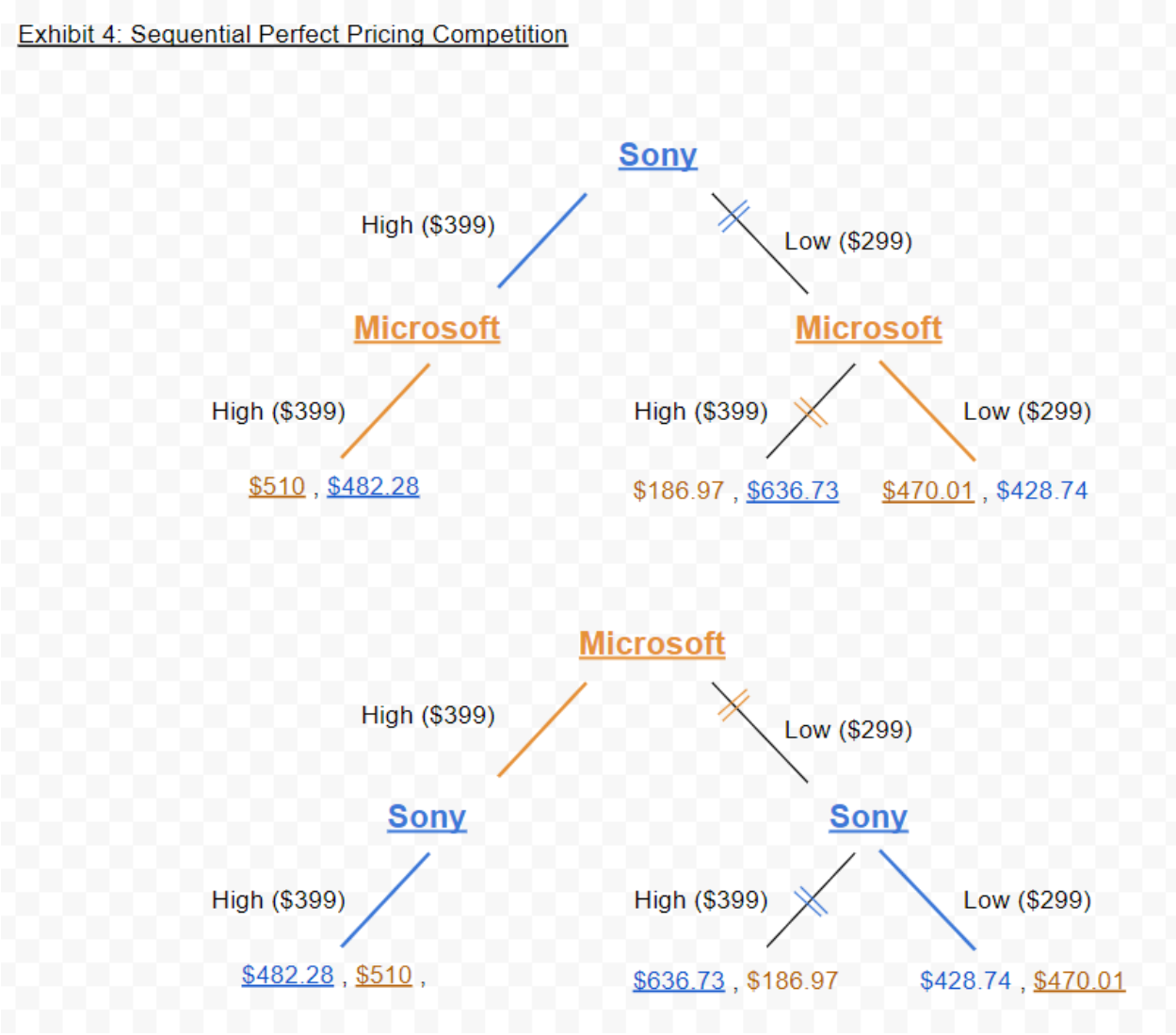

Exhibit 5: Total Profit for the consoles (in millions) in long run

*including the fixed cost

		Microsoft			
		Low ($299)		High ($399)	
Sony	Low ($299)	428.74	470.01	636.73	186.97
	High ($399)	217.22	562.50	482.48	510.00

Exhibit 6: Expected value of both companies cooperating, cheat once, and cheat once and forever

Sony:

If Sony cooperate (high price) in every period:

= 482.48 + 482.48/(1+r) + 482.48/(1+r)^2 + …

If Sony defect in the first period and get punished in the second period:

= 636.73 + 217.22/(1+r) + 482.48/(1+r)^2 + …

If Sony defect once in forever:

=636.73 + 428.74/(1+r) + 428.74/(1+r)^2 + …

If 482.48 + 482.48/(1+r) > 636.73 + 217.22/(1+r), i.e. r < 111/154.25 ~0.72, then it is better to always cooperate than defect only once

If 482.48 + 482.48/r > 636.73 + 428.74/r, i.e. r < 53.74/154.25 ~0.35, then it is better to always cooperate than defect once and forever

Microsoft:

If Microsoft cooperate (high price) in every period:

= 510 + 510/(1+r) + 510/(1+r)^2 + …

If Sony defect in the first period and get punished in the second period:

= 562.50 + 186.97/(1+r) + 510/(1+r)^2 + …

If Sony defect once in forever:

= 562.50 + 470.01/(1+r) + 470.01/(1+r)^2 + …

If 510 + 510/(1+r) > 562.50 + 186.97/(1+r), i.e. r < 270.53/52.5 ~5.15, then it is better to always cooperate than defect only once

If 510 + 510/r > 562.50 + 470.01/r, i.e. r < 39.99/52.5 ~0.76, then it is better to always cooperate than defect once and forever