GAME THEORY IN STRATEGIC MANAGEMENT. THEORETICAL AND PRACTICAL EXAMPLES

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Abstract*. Game Theory provides an analysis tool for describing the decision-making process of one or more players, their behavior when there are plenty of possible outcomes. Strategic behavior is a generic term that designates all concerted and consistent actions promoted by an enterprise in order to influence the competitive environment or at least to adapt to its evolution. This paper aims at exploring the real potential of strategic management based on game theory decisions and illustrates that the usefulness and power of game theory applied in strategic management lie in its ability to provide insights on competitive climate and strategies. In this paper, we will investigate some potential contributions of game theory to strategic management, especially with regard to applications in individual industries. The examples presented in the second part of the paper are based on strategic management decisions that involve dominant strategies.*

Keywords*: strategic management; game theory; dominant strategies; Nash Equilibrium; consumer behavior; oligopoly.*

Introduction

Strategy is known as a valid or applicable pattern of behavior in a given competitive context. It is a way of positioning the company, as a result of strategic thinking, at the intersection of the best solutions "matching" key competence of the company with a situation predictable competitive environment.

Over the years, there were many definitions of strategy. Chandler (1962) defined strategy as "`the determination of the basic long-term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out the goals". Ansoff (1965) comprised strategy in four components: growth vector, product market scope, synergy, and competitive advantage. Leonard et. al. (1969) defined strategy as a pattern of purposes, objectives, goals and major policies, as well as the plans for achieving the goals, determined in such a way the enterprise is or is going to be.

The strategy was also defined as the examination of the sources of efficiency which make enterprises successful, like innovation, diversification, new product development, acquisitions, corporate governance etc. (Camerer, 1991). In addition, Porter (1996) mentioned that strategy is realized fit between enterprises activities.

Organizational values are the preferences and beliefs of the leaders, while corporate social responsibility is about the ethics of the community in which the enterprise is embodied (Mitzburg, 1990). Strategy is further elaborated through generic strategy typologies of miles and Snow (1978) and Porter (1980, 1985).

Game theory is a branch of applied mathematics that addresses the problem of optimal behavior in games with 2 or n people. Game theory is an abstract model of decision making; should not be confused with an explanation of decision making in the social reality. The common point of all the imagined games within the theories is the idea of strategy. Game theory is an interdisciplinary approach to studying human behavior. The most involved disciplines in game theory are mathematics and economics, but also other social and behavioral sciences. Game theory was created by mathematician John von Neumann.

Shubik (1972) argues that the solution concepts resulted from game theory could be thought to us as descriptive view or normative of multi-person decision making. Game theory could also describe the analysis of rational behavior in situations where interdependence of outcomes is involved (Martin, 1991).

Game theory studies how decision-makers are making their decisions (Camerer, 2011). Game theory can be used to show how decisions are made in various areas, such as politics, economics or sports. In the last two decades, game theory has been used by economists to analyze a wide variety of interactions and economics (Myerson, 2013). The organization industry main interest is to analyze the competitive interactions between oligopolies and game theory helps us understand these interactions (McCain, 2014).

A game includes players, strategies, profits, result, and equilibrium. All these elements define the rules of the game. The following definitions help us to better understand the theories of games:
- Players are the decision makers. In our examples, players will be two or more oligopolies or a monopolist and a possible new entrant who is already on the market or about to enter.
- The actions include all the possible decisions of a player.
- Strategies are rules that tell every player what action to choose in each stage of the game.
- Profits are expected profits for each player to get at the end of the game.
- Equilibrium is the result of choosing the best strategy, a combination of strategy and that each player could choose.

Using game theory, the economists are seeing a picture with participants in the game, certain rules that define certain decisions (Colman, 2013). The results of the game - what each participant receives - refers to his earnings and depends on what each player does. Each participant in the game has a strategy and he decides what strategy to apply. In games where each participant has the chance to take more than one decision (where there is more than one round), decisions may depend on what happens in the previous round. The game theory begins with the hypothesis that every participant in the game is rational and knows that his rival is also rational (Aumann, 2017). Each competitor is trying to maximize his own gains. Theory tries, thus, to predict what each player will do. The answer depends on the rules of the game and its earnings.

Strategic thinking does not only help to "frame the way" like a television show. We all face situations that require strategic thinking. Economists are trying to understand the

choices that people and businesses make. The range of economists has spread to other areas (i.e. politics, sports) by studying strategic behavior (Jeung et. al., 2016).

Economists study the choices made by rational individuals and profit-maximizing enterprises. In the basic competition model (perfect competition), individuals and businesses do not need to act strategically. Consumers and businesses can buy and sell at the price of the market. An enterprise should not take into account the reaction of its competitors if it decides to produce more. The same situation could be true in a monopoly market, but for another reason: the monopolist has no competition. In the basic monopoly competitive model, the strategic behavior - decisions that take into account the possible reactions of others - does not play any role.

Things are different in the situation of an oligopoly. With only a few companies in the industry, each business must take into account the reaction of the competitors, whenever they think to expand the production or lower the price.

In game theory, to study the cooperation of the companies into an oligopoly market, the aim it is to understand strategic decisions and understand how the organizations would behave when they know that their actions are influencing the behavior of others. For example, when the managers of a major airline decide to modify the price of travel tickets on a particular route, they should consider how their competitors could react to this price change.

Similarly, the competitors should react when deciding how they will react, given that the company who was the first to change the price of the market, will react in some way to the decisions of the other company. These are strategic decisions, just like players' decisions in various game categories like chess, football or poker.

Dominant strategies

By strategic behavior, it means that each player needs to know what the other player is going to do. Will you or your accomplice confess? If you cut prices, will your competitor react the same way? The decision a player takes depends on how he thinks the other player will react.

In the prisoner's dilemma game, we assume that players are guiding by the following reason: "For every decision I make, what is the best choice the other player can make?". In analyzing the prisoner's dilemma, we ask:
- If Prisoner A does not confess, what is the best strategy for Prisoner B?
- If Prisoner A confesses, what is the best strategy for player B?
In both cases, we can conclude that confession is the best solution for Prisoner B. If B's best solution is to confess, no matter what prisoner A will do, then A will assume that B will confess, so A has to decide which is the best solution he can have if B confesses. So, the best solution for Prisoner A is also to confess.

Confession is the best strategy that both prisoners can follow, no matter what the other will do. This strategy - which works best no matter what the other player will do - is called dominant strategy. As we recall, the goal of game theory is to predict which strategy each player will choose. When a player has a dominant strategy, this is the strategy that a rational person should follow.

Nash equilibrium

It is easy to guess the end of the game - its equilibrium - whether the player has a strategy to do. Everyone will play his dominant strategy. Therefore, in the game of the prisoner's dilemma, equilibrium is achieved when recognition of their deed is made by the two players. The situation is not at all easy when only one of them has a dominant strategy or when none has such a strategy. To predict the final results in these complex games, we need to reconsider the reason why confession is a balance situation in the prisoner's dilemma.

In the prisoner's dilemma, each of the two prisoners confesses, because it is to his advantage to reach the optimal result - the lowest period spent in prison - taking into account the testimony of the other. The result is balanced, meaning that no one will change its strategy if he would get the chance. By confessing, both chose the best solution. Such a balance is called Nash equilibrium and is one of the basic tasks in studying game theory.

Prisoner's dilemma occurs in many situations, both in economy and social sciences. The following examples will demonstrate this.

Negative advertising campaigns

Why do companies engage in negative advertisement campaigns against each other, although they promise not to do so? Let's look at the case of two companies A and B which are selling a similar product on the same market. If none of them will run an advertisement campaign, the customers will have a good opinion of both, but none will gain an advantage over the other. If both are making negative advertising campaigns, the customers would percept both companies in a negative way and none will gain an advantage. Both are affected by each other's campaign. If the company A does a fair campaign, company B can gain an advantage carrying a negative campaign that affects A. Conversely, A wins conducting a negative advertising campaign if company B is running a fair campaign.

In Figure 1 we could see the payoff matrix for the advertising campaign.

		Company B	
		Positive campaign	Negative campaign
Company A	Positive campaign	X / X	+ / -
	Negative campaign	- / +	X / X

Figure 1. Advertising campaign

Every company would motivate its decision: "*If my opponent carries a negative campaign, I will gain a better image if I'll take a negative campaign. And if my opponent does not carry a negative advertisement campaign, then I can gain an advantage if I run a negative advertising campaign. In any case, I will be better off if I have a negative electoral campaign*". Each politician has a dominant strategy and there is only one Nash equilibrium in which both companies carry out a negative electoral campaign, despite promises not to do so.

Sports club managers and players employed

Sports teams compete for the best players. Suppose there are only two important teams in a national championship: A and B. If both teams make an agreement to keep small wages for their players, the owners will make big profits. If the owner of Team A, instead, provides high salaries, while owners of Team B does not, then Team A will attract all good players and generate large profits for their employer. Meanwhile, Team B will eliminate all the expensive players and will have a weak season. Low concern makes the sports club owner lose money. If Team B will offer high salaries and Team A not, then Team B will take all the good players and win big profits, while Team A will lose money. If both clubs offer high salaries, no team will have all good players, and employers will have lower profits due to wage growth.

In the Nash equilibrium, both team owners offer players high salary and get lower profits than they would be able to understand to keep wages low.

Zero-sum games

We consider a simple game played by two ice-cream managers: Dan and Paul. They both sell ice cream in a kilometer-long park. Everybody wants to park his truck at a point where he would have the best view. There are three possibilities for each truck parking: entry, mid and out of the park. Where will like each truck?

We consider the three possible locations. Table 1 shows the possible sales percentages for the two vendors, depending on the location chosen.

Table no.2. The profit matrix of the two sellers

		Truck Location 2		
		entry	**middle**	**exit**
Truck 1 location	**entry**	50, 50	25, 75	50, 50
	middle	75, 25	50, 50	75, 25
	output	50, 50	25, 75	50, 50

If both locate the same point, the vendor's sales fall 50-50. But if one sits in the middle and the other on one of the two ends, then the first one will get 75% of the sales, while the other will get the remaining 25%. Both vendors have the same possible options and think as follows: "*If the other ice cream truck sits in one of the two ends of the park, then for me the best thing would be to get positioned in the center and get 75% of sales. However, if another truck will sit in the center, then for me the best thing would be to get all position the center to split sales 50-50, otherwise, I only gain 25% of sales while my*

competitor would take the remaining 75%. So, no matter where you park the other truck, it's best for me to sit in the center".

Thus, the Nash balance is reached at the point where both sellers park their trucks in the center of the park.

The above game has an important feature: in each situation, the sum of the sales of the two ice cream trucks is 100%. For each 1 percentage point increase in sales of the first truck will be a 1 percentage point reduction in sales of the second truck. Such a game, in which the accumulation of a player is reflected in the loss of another, is called zero amount game.

A suitable solution for all zero amount of games is achieved using the so-called minimax strategy If the first seller chooses a strategy that minimizes the winnings of the second one, then he will have a dominant strategy. Thus, the first vendor finds out if he is parking in one of the two ends of the park, then the other seller will park in the middle and collect 75% of the sales. Therefore, the first seller 's minimax strategy is to locate in the middle, which minimizes sales of the second seller to a maximum of 50%. The same strategy, seen from the perspective of the second seller is to maximize the minimum achievements of every game possible. As low as 25% when located either at the beginning or at the end and 50% when it is located in the middle, means that the second seller will also be located in the middle.

Applications of Game Theory in strategic management

In the prisoner's dilemma, players have a dominant strategy. This is not the case in most games. What each player considers to be best for him, depends on what the other player does. This makes it even harder to predict the end of the game. But often, we can anticipate the end of the game thinking of the consequences for each player, as we did for prisoner's dilemma.

Games with one dominant strategy

To illustrate how we could foresee the end of a game, even when one player has a dominant strategy, we consider the case of two companies who decide on reducing or increasing prices. The two companies, Discounter Deluxe, and Quality Brands are rival and compete with each other. Deluxe promises to their customers the lowest prices and therefore will lose many customers if they fail to offer them. Brands have higher costs and would prefer not to reduce prices. However, if Brands does not align with Deluxe 's price reduction, it risks losing a big share of its turnover.

The results each one expects to have is shown in Figure 3. The annual turnover for Deluxe are shown below the diagonal line, and Brands are shown above the diagonal.

Figure 3. The game of price reduction

		Quality Brands	
		Reduces prices	Does not reduce prices
Discounter Deluxe	Reduces prices	\$2.5 mil / \$5 mil	\$1 mil / \$6 mil
	Does not reduce prices	\$3 mil / \$1 mil	\$3.5 mil / \$2 mil

Deluxe has a dominant strategy – to reduce prices. It has more to gain with this strategy than Quality Brands does. The later, on the contrary, does not have a dominant strategy. If Deluxe reduces prices, it's better for Quality Brands to reduce prices as well, given that otherwise it would lose too much in sales. Also, if Discounter Deluxe does not reduce prices, then for Quality Brands it would be much better not to reduce prices.

Even though Quality Brands does not have a dominant strategy, we could see the end of the game if we argue as follows. Quality Brands knows that Discounter Deluxe will reduce prices since this is Deluxe's dominant strategy. Therefore, the fact that Quality Brands would think it would be best to keep the prices high if Deluxe does the same thing, is irrelevant. Quality Brands knows that Deluxe will reduce prices. The best strategy of Quality Brands is to reduce prices as well. The outcome or the equilibrium in this game will have both companies if they will reduce their prices.

In this price reduction game, each company is following its best strategy, given that the other company follows its best strategy to reduce prices. Reducing prices is the only and only Nash equilibrium. Because of the strategy of the other player, none of them wants to change its strategy.

Games without dominant strategies

Both the game of the prisoner dilemma and the game of price reduction have a single Nash equilibrium. However, often a game will have more than one Nash equilibrium, as shown by the following example.

We will study the case where two friends decide to study together. Both are enrolled in the same physical and economics courses, and both believe that performance on future tests will improve if they study together. Still, John would prefer to use his time concentrating on physics, while Todd would prefer to devote his time to the economy. The game board for this case is shown in figure no. 4, where the notes express the environments obtained by the two students in the two subjects (the note written underneath each diagonal of each box is the reward for John).

		Todd	
		Studying physics	Studying economics
John	Studying physics	X / X	+ / -
	Studying economics	- / +	X / X

Figure 4. The game of the study

Has any of them a dominant strategy? Not. If John insists on studying physics, Todd would benefit if he would join John in studying physics books unless he continued to study the economy alone. On the other hand, if John consents to study economics, then Todd's best answer is to study economics. Similarly, the best strategy of John is to study economics if Todd does the same. No player has a dominant strategy, best for each being the same thing the other one does.

Even if there are no two dominant strategies in this game, there are two balances Nash - either physics learners or both studying economics. Although the concept of Nash equilibrium may not lead to a unique equilibrium in the game, it can help remove effects.

Neither the upper-right and bottom-left boxes on the chart do not represent a Nash equilibrium. If Todd is studying physics, John's best answer would not be to study economics.

Conclusions

In the markets with perfect competition, businesses and consumers can decide how much to produce and how much to consume, without taking into account how they can react the others. In markets with imperfect competition, firms need to keep in mind the way they react competitors in the company's production or price decisions. Companies have to behave strategically in such conditions. People also face many situations where they need to act strategically. Economists use game theory to predict how businesses and individuals act. In fact, the perfect competition model works only in theory.

The prisoner's dilemma shows that our own interest can prevent people from maintaining cooperation, even if it is in the common interest. The logic resulting from the prisoner's dilemma applies to many situations, including the arms race, advertisements, common resource issues, and oligopolies. A Nash equilibrium exists if all players do their best to know the choices their opponents have.

In the case of Nash equilibrium, each participant in a game follows the best strategy, taking into account the strategies followed by the other players. A game can have a unique equilibrium point or more equilibrium points.

A dominant strategy is the best strategy a player could follow, taking into account what the other players might choose. In a zero-sum game, the minimax strategy is the dominant strategy of the game. Oligopolies maximize their total profits by forming a cartel, behaving like a monopoly. Therefore, if oligopolies' individual decisions about production levels, the result is a lower price than that resulting from a cartel.

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