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Application of Game Theory to Strategic Decision-Making in Russian Companies

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Abstract: Relevance of the research due to the growing interest in game theory as a tool for making strategic decisions in Russian companies. Game theory involves the efficient and effective decision-making due to its Mathematical basis. The purpose of this study was to investigate the efficiency of the use game theory in "Svaznoy" to determine the optimal price and volume purchases two types of smartphones in 2016. We used Mathematical methods and market research in our study. The result of the research was to determine the exact price and the exact volume of purchases as well as the calculation of the effective and enforceable methods of using game theory. The developed method can be used by specialists in various industries to design and develop its activities in the field of strategic planning.

Key words: Game theory, strategic decision, evolution of game theory, competitive environment, optimal volume of purchases, purchases

INTRODUCTION

The evolution of competitive relations indicates increasing competitive pressures, the occurrence of a period of hypercompetition which exacerbates relations between producers. In this case, to achieve sustainable competitive advantage the producers are forced to engage in closer cooperation with each other to enhance the competitiveness of their products in relation to individual economic entities (Vinogradova, 2012).

Competitive interaction is a process in which independent participants in network structures cooperate through formal and informal rules, together creating the added value and arranging it on mutually beneficial terms (Basovskii, 2014).

Thus, recently in connection with the increase in competitive and crisis relations, interest in the theory of games has increased.

Game theory is a Mathematical method of studying of optimal strategies in games. Game is a competitive process in which two or more parties fighting for the realization of their interests. Each of the parties has its purpose and uses some strategy that can lead to winning or losing-depending on the behavior of other players (Alekhin, 2011). Game theory can help in building effective strategies and tactics in management, management accounting, applied marketing, allowing you to choose the best strategy based on the submissions of other participants, their resource capabilities and potential and their possible actions based on the existing risks (Petrosian *et al*., 2008).

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So, the optimal solution or strategy in the Mathematical modeling proposed in the 18th century. The problem of production and pricing under conditions of oligopoly which later became textbook examples of game theory was considered in the 19th century by A. Cournot and E. Bertrand. At the beginning of the 20th century, E. Lasker, E. Zermelo and E. Borel advanced the idea of a Mathematical theory of conflict of interest. The Mathematical theory of games originates from the neoclassical economy (Konjuhovskij and Malova, 2015). The Mathematical aspects and applications of the theory were first described in the classic book of 1944 by John Von Neumann and Oscar Morgenstern "Theory of Games and Economic Behavior". J. Nash has developed the principles of "management dynamics". The first concepts of game theory analyzed antagonistic games when there are losers and players who have won at their expense. Nash develops analysis methods in which all participants either wins or loses. These situations are called "Nash equilibrium" or "non-cooperative equilibrium" in a situation the parties use the optimal strategy which leads to the creation of a stable equilibrium. Players are advantageous to maintain this equilibrium as any change will worsen their situation. These researches of J. Nash made a serious contribution to the development of game theory; mathematical tools of economic modeling were

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Table 1: Evolution of game theory

Researchers	"Zero sum game"	"Variable sum game"	Optimal strategy	"Recurring cooperative games"	"Sustainable distribution"	"Optimal mechanisms for resource allocation"	"Non-cooperative games with incomplete information"	"Games with asymmetric information"
John Von Neumann, Oscar Morgenstern Alekhin (2011)	+	-	-	-	-	-	-	-
John Nash Shagin (2015)	-	-	+	-	-	-	+	-
Robert Aumann Nevezhin (2014)	-	-	-	+	-	-	+	-
Thomas Schelling Tikhomirov (2013)	-	+	+	+	-	-	-	-
Michael Spence Lavrienko and Zakharkina	-	-	-	-	-	-	+	+
Joseph Stiglitz Chelnokov (2015)	-	-	-	-	-	-	+	+
Janos Harsanyi Sigal (2014)	-	-	-	-	-	-	+	-
Reinhard Selten Pecherskij and Beljaeva (2011)	-	-	-	-	-	-	+	-
William Vickrey Shelekhova (2015)	-	-	-	-	-	-	-	+
James Mirrlees Vasina (2001)	-	-	-	-	-	-	-	+
George Akerlof Dubina (2010)	-	-	-	-	-	-	-	+
Leonid Hurwicz Owen (2008)	-	-	-	-	-	+	-	-
Eric Maskin Rumyantseva (2015)	-	-	-	-	-	+	-	+
Roger Myerson Williams (2009)	-	-	-	-	-	+	-	+
Lloyd Shapley Aleskerov and Kiselgof (2012)	-	-	-	-	+	-	-	-
Alvin Roth Gonchar (2011)	-	-	-	-	+	-	-	-

revised. J. Nash shows that the classical approach to Adam Smith's competition when everyone is for himself is not optimal. The more optimal are such strategies when everyone tries to do better for themselves, doing better for others (Romankov, 2005). Table 1 presents the evolution of game theory. Explain some of the principles of the researchers:

- Zero-sum game-the gain of one always assumes equal loss of another (Shirjaev and Shirjaev, 2009)
- A game with a variable sum-winning one does not mean losing another (Petrosjan *et al*., 2012)
- Recurring cooperative games-long-term cooperation (Kolobashkina, 2013)

Games with asymmetric information-the theory of information asymmetry says that in circumstances where the participants in the transaction do not have the same amount of information about the object of the transaction, the participant with more information will get the price above its optimal level.

As, we can see the evolution of game theory continues. Each scientist contributes to the development and improvement of this theory: from a formal instrument that is very difficult to apply in practice game theory has evolved into a complex method that helps to resolve conflict situations taking into account real factors not only in economic sciences but also in politics and international relations.

As examples of the application of game theory for the adoption of strategic management decisions, one can name decisions on the implementation of a pricing policy, entry into new markets, cooperation and joint ventures, the identification of leaders and executors in the field of innovations, vertical integration and so on. The provisions of this theory can be used for all types of decisions if their adoption is affected by other persons. These persons or players can be subcontractors, leading clients, employees of organizations as well as colleagues at research (Skutin, 2009). We will take the mobile and digital equipment store "Svyaznoy" as an object of research.

Table 2: Performance indicators of CJSC "Svyaznoy-Logistika"

Indicators, bln RUB	2011	2012	2013	2014
Revenues	70	92	108.0	111.00
Turnover	300	509	556.0	528.00
Turnover from online sales	-	9	17.0	22.00
EBITDA	-	-	4.7	4.42

Table 3: Costs incurred by "Svyaznoy" company to purchase smartphones and their selling price (USD)

Costs	iPhone 7	Samsung Galaxy S7
Purchase price	600	500
Sale price	750	600

CJSC "Svyaznoy-Logistika" is a Russian company, a federal retail chain specializing in the sale of cellular operators and wire internet access providers, personal communications, accessories, portable digital audio and photographic equipment. The company's performance indicators for the last 4 years are presented in Table 2.

The company's turnover includes revenue from VAT as well as payments to mobile operators. As can be seen from Table 2, the company's revenue and turnover from online sales are increasing every year. The turnover of CJSC "Svyaznoy-Logistika" in 2014 decreased compared to 2013. This is because in 2014 has stopped the payments for some mobile operators. Consider the application of game theory to select the optimal volume of purchases of smartphones by 2016.

Apple and Samsung are two of the main competitors in sales of smartphones in the world have announced the release of two new models of smartphones (iPhone 7 and Samsung Galaxy S7) in the Russian market in 2016.

Consider an example of an analysis of the problem situation of the company "Svyaznoy" which buys both smartphones (iPhone 7 and Samsung Galaxy S7) from Apple and Samsung. This example shows how game theory can really be applied in practice. The cost of buying and selling price of smartphones in "Svyaznoy" are presented in Table 3.

According to analysts on sales of smartphones of the previous generation in Russia, if Russian consumers prefer the iPhone 7 (since the products of this company are more prestigious and fashionable) then the sales volume of "Svyaznoy" at the end of 2016 will be: 900 thousand smartphones iPhone 7 and 450,000 smartphones Samsung Galaxy S7.

If consumers will prefer the Samsung Galaxy S7 at a lower price, then sales at the end of 2016 will amount to 600,000 smartphones iPhone 7 vs. 700,000 smartphone Samsung Galaxy S7.

The objective is to maximize the average value of income from sales of smartphones based on the opinions and behaviors of consumers. "Svyaznoy" has in these situations the two following strategies: in the calculation of the propensity of consumers to the iPhone 7 (Strategy A); in the calculation of the propensity of consumers to Samsung Galaxy S7 (Strategy B). If "Svyaznoy" builds Strategy A.

Table 4: Matrix of strategies during the conflict of interests between two market players

		Consumers		
Market players	Strategy	C	D	Min by row
"Svyaznoy"	A	180	135	135
	B	135	160	135
	Column max	180	160	-

If consumers are inclined to iPhone 7 (consumer strategy C) all smartphones will be fully realized and the company's profit will be:

$$900000\times(750-600)+450000\times(600-500)=180\ \text{mln USD}$$

With the consumer's predilection for Samsung Galaxy S7 (consumer strategy D) Samsung Galaxy S7 will be sold completely and the iPhone 7 only in the amount of 600000:

$$600000\times(750-600)+450000\times(600-500)=135\text{mln.USD}$$

If "Svyaznoy" chooses a strategy B. With the consumer's predilection for the iPhone 7 (consumer strategy C) the iPhone 7 will be sold completely and Samsung Galaxy S7 only in the amount of 450000:

$$600000\times(750-600)+450000\times(600-500)=135\ \text{mln. USD}$$

With the consumer's predilection for the Samsung Galaxy S7 (consumer D strategy) all smartphones will be fully realized and the company's profit will be:

$$600000\times(750-600)+700000\times(600-500)=160\ \text{mln.USD}$$

Considering "Svyaznoy" and consumers as two players we get the matrix of the following kind (Table 4).

ESTIMATION OF LOSSES THAT EXIST AS A RESULT OF A PROBLEM

From the matrix it is seen that "Svyaznoy" will never receive income of <135 mln. USD. But if the tastes of consumers coincide with the chosen strategy then the company's profit will be 180 or 160 mln. USD. If "Svyaznoy" will continuously apply Strategy A and

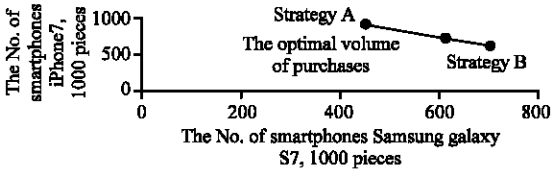

Fig. 1: Optimal volume of smartphones purchased by "Svyaznoy" company in 2016

consumers Strategy D, then the winnings will decrease by 45 mln. USD. Similarly, if "Svyaznoy" will constantly apply the strategy B and consumer strategy C shown in Fig. 1.

CONCLUSION

"Svyaznoy" will secure the most revenue if it alternately will use the Strategy A and B. Calculation of expenses necessary for the practical implementation of the proposed measures.

Let x be the frequency of Strategy A; (1-x), the frequency of applying Strategy B in "Svyaznoy". If "Svyaznoy" applies the optimal mixed strategy then under the C and D strategies of consumers, it should receive the same average income:

$$18x + 135\times(1-x) = 135x + 160\times$$
$$(1-x)x = 5/14;(1-x) = 9/14$$

Then with the strategy C the average income of "Svyaznoy" is:

$$180\times 5/14 + 135\times 9/14 = 151{,}07\text{mln. USD}$$

and with a strategy D the average income of "Svyaznoy" is:

$$135\times 5/14 + 160\times 9/14 = 151.07\text{mln.USD}$$

Consequently, "Svyaznoy" by applying pure strategy A and B in the ratio 5:9 will have the optimal mixed strategy providing it with a probable average income of 151,07 mln. USD (price of game).

Thus to obtain such income "Svyaznoy" must be purchased: (900+450)×5/14+(600+700)×9/14 = 707000 smartphones iPhone 7+611000 smartphones Samsung Galaxy S7, the optimal volume of purchases from foreign companies Apple and Samsung. Graphically the optimal volume of purchases.

Accordingly application of the methods of game theory will allow "Svyaznoy" company determine the optimal amount of purchases which will achieved the greatest profit.

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