DÉLKELET EURÓPA – SOUTH-EAST EUROPE
International Relations Quarterly
Vol. 2. No. 1. (Spring 2011/1 Tavasz)

APPLICATION OF GAME THEORY IN CASE OF THE US-IRAN RELATIONS

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Saeed Seyed Agha Banihashemi, Hungarian ambassador of Iran gave a lecture on game theory on March 3, 2011 at Hungarian Institute of International Affairs. The title of his presentation was *Application of the Game Theory on International Relations with a look on US-Iran relations* and after representing the main elements of game theory, he demonstrated its application by referring to the American-Iranian relations. The moderator was Tamás Magyarics Dr., director of the Institute.

The ambassador started his lecture with an introduction to game theory as a study. The theory is essentially based upon mathematical calculations that can be used for describing simple or really complicated events. With the help of game theory, various mathematical models can be created that describe situations and help to choose appropriate strategy. Due to this, it has a lot of fields of application; it can be applied in every case when a decision has to be made. It is primarily utilized in economics and politics but it can be used in sociology, law, military and biology too, moreover, in sports, modeling accidents and slightly in religion. The point is that the more prepared and qualified experts make calculations, the more effectively it can be applied. And, of course, decision-makers have to take the good advice.

Game theory models are always multi-player; in case of one player, it is only a decision-making problem, game needs at least two decision-makers.[1] They act and make their decisions in the light of the other players which means they follow a well-defined strategy. It is presumed that players behave rationally[2] thus parties having opposing interests try to win the biggest possible gain. The payoff or gain is a result of a particular strategy combination that can be numerical but not necessarily. It is usually represented in a matrix. General payoff matrixes of a two-player game look like as follows:

1st player's payoff matrix:

		other player's strategy	
		α	*β*
this player's strategy	*α*	B^-	A
	β	C	B^+

2nd players payoff matrix:

		other player's strategy	
		α	*β*
this player's strategy	*α*	B^-	C
	β	A	B^+

Possible common payoff matrix:

		2nd player	
		α	*β*
1st player	*α*	0, 0	3, -1
	β	-1, 3	1, 1

$A = 3; B^+ = 1; B^- = 0; C = -1.$

We say that the 1st player's *α* strategy strictly dominates his *β* strategy if his *α* payoffs are strictly greater than his *β* payoffs. In case of the example above[3], *α* strategy is strictly dominant for both players thus they choose (0, 0) payoff eventually. However, their common gain would be bigger if they both chose *β* strategy; the lesson is that strictly dominated strategy is better to be avoided.

[1] As his own example, the ambassador referred to the relations of the United States and Iran.
[2] Because of this, there is a close relationship between game theory and rational choice theory.
[3] This example is the classic payoff matrix of prisoner's dilemma where *α* is "confess" and *β* is "not confess".

Game theory cannot say what your goal should be. It can only help if you know the goal. This study orders numbers, payoffs to different international events to model them. Nowadays, payoffs are given with the help of computer programs since they work fast and objectively – there is no coffee or lunch break, there is no promotion. Because of this, they offer reliable results that underpin the choice for the best strategy.

Possible payoff matrix of another type of game:

		2nd player	
		α	*β*
1st player	*α*	0, 0	3, -3
	β	-1, -1	1, 1

In this case, the 1st player's *α* strategy dominates his *β* strategy but it is not true in case of the 2nd player. The 2nd player chooses his strategy depending on the decision of the 1st player; but he will clearly follow *α* strategy. So the final decision is (0, 0) payoff while – similarly to the previous example – it is not the optimal choice.

In the third example, the 2nd player has to choose from three options. At this point, there is not a clearly dominant strategy but we can choose in the relation of two decisions from the three. In this case, the two strategy sets are $S_1=\{a, b\}$ and $S_2=\{\alpha, \beta, \gamma\}$ and utilities are for example $U_1(a, \beta)=11$ and $U_2(a, \beta)=3$. Then *β* strategy dominates *γ* strategy but it does not dominate *α* strategy.

		2nd player		
		α	*β*	*γ*
1st player	*a*	5, -1	11, 3	0, 0
	b	6, 7	0, 2	2, 0

Expected payoffs can be calculated in case of every payoff matrix as the sum of payoff values weighted by probabilities. In the example above, *α* strategy's expected payoff is 0,5*(-1)+0,5*7=3, *β* strategy's is 0,5*3+0,5*2=2,5 and *γ* strategy's is 0,5*0+0,5*0=0. According to that, the 2nd player chooses *α* strategy since it has the highest expected payoff. For similar reasons, the 1st player follows *a* strategy thus the final payoff combination is (5, -1) which, however, does not result in the biggest total gain.

The next example was to illustrate Nash equilibrium. In this case, there is no dominant strategy, only optimal decisions. In case of the given decision of the 2nd player, the 1st player's decision is optimal, and in case of the given decision of the 1st player, the 2nd player's decision is optimal – keeping in mind that the players do not know each other's decisions, they only have ideas about them. A numeric example for Nash equilibrium:

		2nd player		
		α	*β*	*γ*
	a	0, ***4***	***4***, 0	5, 3
1st player	*b*	***4***, 0	0, ***4***	5, 3
	c	3, 5	3, 5	***6***, ***6***

Let us say that the 2nd player chooses *α* strategy then the 1st player follows *b* strategy. But if the 1st player followed *b* strategy, the 2nd player would choose *β* strategy, so there is not Nash equilibrium. In case of *β* strategy, the 1st player chooses *a* strategy; in case of *a* strategy, however, the 2nd player would decide on *α* strategy, so there is not Nash equilibrium either. In case of the 2nd player's *γ* strategy, the 1st player follows *c* strategy; in case of *c* strategy, the 2nd player would choose *γ* strategy. Thus in this case, we found Nash equilibrium that results in (6, 6) payoff.

After presenting the basics of game theory, the ambassador illustrated it by referring to the political relations of the United States and Iran. In the model, we describe Iran's behavior with two alternatives: acquiesce or rebel. The US can acquiesce or punish. They gain different payoffs depending on their actions; positive values represent gaining something, negative values represent losing something and the country does not get anything in case of zero.

		Iran: Acquiesce	Iran: Rebel
USA	Acquiesce	b, b-c	0, b
	Punish	b-p, -c-d	-p, -d

For Iran, the most profitable is to rebel because b > b-c and -d > -c-d; and for the US, acquiescing is the best since b > b-p and 0 > -p. Thus the final payoff combination is (0, b) which means the US does not get anything for being acquiescent while Iran benefits from its rebellious behavior. In case of mutual acquiescence, Iran would have smaller payoff because the US is a superpower and Iran is not thus the Americans would take more advantage of cooperation. If the US decides to punish, Iran gets lesser loss in case of rebelling than acquiescing. If Iran rebels and the US punishes, it involves considerable costs for the Americans. Thus the optimal solution is when the US does not do (and get) anything and Iran does not acquiesce.

An extension of this example is when there is a series of decisions and not only one decision is made. Because if we take the future consequences of our decisions into consideration, it can have an influence on our present decisions too. For example, if Iran rebels constantly, the US will have enough of it all at once and it will choose punishing instead of acquiescing – accepting the huge expenses and possible losses.

The third case of the US-Iran example is the conditional strategy when the US chooses its own strategy depending on Iran's actions. In the first case, the US acquiesces after both acquiescing and rebelling. In the second case, it acquiesces if Iran does so and punishes if Iran rebels. In the third case it is the opposite, it punishes if Iran acquiesces and acquiesces if Iran rebels.[4] According to the fourth option, the US punishes independently of Iran's behavior.

		Iran: Acquiesce	Iran: Rebel
USA	Acquiesce, Acquiesce	b, b-c	0, b
	Acquiesce, Punish	b, b-c	-p, -d
	Punish, Acquiesce	b-p, -c-d	0, b
	Punish, Punish	b-p, -c-d	-p, -d

The key to the successfulness of game theory is to put yourself into other players' shoes and imagine how they would decide. Applicability of the theory will not cease after making a decision since every decision generates necessity of others. Game theory can be used in almost all walks of life since nearly every action can be modeled or described as a strategy. For instance, religion is a strategy for life and cooking is a kind of model-creating although housewives hardly think with mathematician minds. However, it is also true that game theory does not give an exact answer to a question; it only helps to make decisions. It is considered to be approximately 90 percent precise but this certitude (or incertitude) is highly depends on the qualification of those experts that make models and calculations. Moreover, advisors' work is not worth much by itself if people in deciding positions – like managers, politicians, etc. – do not listen to them.

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[4] This version is the furthest from reality.