



A Credible Threat against Oil Sanctions for Iran

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Abstract

In this study, we use game theory to analyze the current situation of Iran and the United States as a result of the US withdrawal from the Comprehensive Plan of Action and the imposition of financial and oil sanctions on Iran and Iran's resilience to these sanctions. We also present an oil strategy, as a credible threat, that helps Iran to get out of the sanctions.

Keywords: game theory, politics, JCPOA, Iran, the United States.

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1. Introduction

Since game theory helps to understand situations in which decision-makers interact as players, it has many applications in economics, physics, psychology, political science, biology, etc. (see [2], [4], [5], [6], [7], [8], [9], [11], [12], [14], [17], [18], [19], [20], and [21]).

There are many forms of social behavior that occur frequently in social relationships. Game theory as a useful tool studies and analyzes many of these formats as models of strategic games. These models explain many reactions and behaviors such as trust and lack of trust, cooperation and non-cooperation, adherence to obligations, compromise or militancy, forming coalitions, etc. in different political, social and behavioral situations. So by using this theory, each player can gain more benefits. There are many famous games in game theory that have been used to study many political developments and situations. These include the Prisoner's Dilemma, the Security Game, the Hawk-Dove, and the War of Attrition, etc. (see [1], [10], [3], [13], [15], and [17]).

Considering the US withdrawal from the JCPOA and the imposition of severe financial and oil sanctions on Iran, despite Iran still adheres to the principles of the JCPOA, Iran has been plagued by difficult economic conditions and so we have decided to use game theory to analyze the current situation between Iran and the US and also, taking an idea from Thomas C. Schilling (see [16]), we present an oil strategy, as a credible threat, to get Iran out of the sanctions..

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2. Main results

On May 8, 2018, the United States unilaterally withdrew from the agreement of the Joint Comprehensive Plan of Action, JCPOA, between Iran and the P5 + 1 group consisting of Russia, China, France, Britain, the United States and Germany. Since then, with pressure on Iran, the United States has been trying to force Iran to negotiate with more concessions. In such circumstances, despite the economic hardship imposed, Iran wants to resist and actually defend its interests.

In this situation, the US has two options: one applying maximum pressure through more sanctions that we show it with H, and the other is to reduce the pressure, L. On the other hand, Iran has two choices: one being passive resistance to oil sanctions that we represent it with M and the other being active resistance to oil sanctions, S.

It should be noted that passive resistance means that, in the condition of oil sanctions, Iran will have only a marketing effort to sell its manufactured oil. Clearly finding specific customers and delivering cargoes and receiving money from them despite banking and oil sanctions is very difficult and the meaning of active resistance, in addition to marketing for the sale of produced oil, is to use strategies as credible threats that put a great deal of pressure on the international community such that this pressure is transferred to the US by other countries and it will force the US to reduce sanctions.

According to the above, the current situation between the United States and Iran can be modeled as a strategic game:

Players: The United States and Iran

Actions: The set of actions of the United States as the first player is $\{H, L\}$ and Iran's set of actions as the second player is $\{M, S\}$.

Preferences: Player 1's ordering of the action profiles, from best to worst, is

$$(H, M), (L, M), (H, S), (L, S).$$

and also payer 2's ordering of the action profiles, from best to worst, is

$$(L, M), (L, S), (H, S), (H, M).$$

In the following, we consider payoff functions that represent the players' preference orderings:

$$u_1(H, M) = 4, \quad u_1(L, M) = 3, \quad u_1(H, S) = 2, \quad u_1(L, S) = 1,$$

$$u_2(L, M) = 4, \quad u_2(L, S) = 3, \quad u_2(H, S) = 2, \quad u_2(H, M) = 1.$$

So the game between America and Iran is

Using the method of the best response functions, we find that (H, S) is the unique Nash equilibrium of the game. This option, which means maximum pressure from the US and active resistance from Iran, reflects the current situation between the US and Iran and it is in fact consistent with the present reality. But this game has a Pareto optimal option, and it is (L, M) , which means that if Iran and the US choose the actions M, L respectively for the game, both of them will increase their payoff compared to the Nash equilibrium and that indicates both players are reasonably motivated to change their approach. In this regard, it is valuable to find strategies that encourage both players to negotiation, agreement and the selection of (L, M) at the lowest cost. So in this article we are going to discuss the oil sanctions and how to deal with them. It should be noted that Iran has many options

Players	Iran		
	Actions	M	S
The US	H	(4,1)	(2,2)
	L	(3,4)	(1,3)

Table 1: The game between the United States and Iran

for active resistance, including reducing JCPOA commitments and moral supports from Yemen and Syria and disrupting the flow of tankers through the Strait of Hormuz, etc., all of which are worth discussing. But in this article, we will focus exclusively on oil sanctions and present a strategy for Iran that will result in a reduction in oil sanctions for Iran.

2.1. Oil Strategy

Although Iran's oil production quotas in Organization of Petroleum Exporting Countries, OPEC, is a certain amount and it have not declined during the sanctions, Iran has been forced to reduce its production due to sanctions and difficulties in selling, which hurts the Iran's Oil industry. So our proposed strategy is that Iran should produce all of its quota and and it use internal consumables or those that are marketable and destroy the excess amount of oil through burning it and also it simultaneously get out of the environmental treaties and greenhouse gas reduction treaties just like America, which has already get out of them and it is one of the largest greenhouse gas producer. Of course America is responsible for burning and getting out of the treaties because with economic pressure on Iran, Iran has to confront it. In this regard , another suggestion for Iran is that due to the sanctions and the impossibility of providing the required parts for cars and factories Iran should abolish the mandatory use of air pollution filters in cities with no pollution problem, that it leads to a huge reduction in domestic production costs.

Since Iran's surplus oil production is about 2 million barrels everyday and one barrel is about 200 kg then the amount of Iran's surplus oil is about 4×10^8 kg and since burning one gram of oil produces about 3 grams of carbon dioxide and other gases, then $4 \times 10^8 \times 3 = 1.2 \times 10^9$ kg of carbon dioxide and other gases are produced from burning Iran's surplus oil daily. On the other hand, we know that the world's oil consumption is about 100 million barrels everyday. Therefore, this additional 2 million barrels of oil consumption will increase greenhouse gas emissions from burning oil by about 2%. Since the relationship between the increase in greenhouse gases and the increase in temperature is exponential, the effect of burning these 2 million barrels on the Earth's temperature will be more than 2%.

So, in short, burning about 2 million barrels of oil daily will raise the Earth's temperature. Since burning this amount will be more than the world consumes so it imposes a huge cost on the international community that is merely the direct result of US sanctions against Iran. However, if the international community wants to prevent this, they can buy Iran's surplus Oil at a price cheaper than the market, or they can pre-buy Iran's surplus oil during the sanctions and prevent global warming. As this strategy will increase global warming and melt glaciers in Europe, China and the US, it will cause severe storms in the United States as well as rising sea levels in Europe however, due to the geographical area of Iran and the existence of the Alborz and Zagros Mountains, global warming will increase the rainfall in Iran, which is in Iran's favor. So if such a strategy is used, the damage to the world, and especially to the West, will be in excess of billions of dollars.

Clearly, the use of such strategies is causing a great deal of damage to the international community, but under the pressure of sanctions, countries will find ways to solve their economic problems, so they may prefer their financial interests over environmental issues, though such strategies contradict their inner beliefs.

3. Conclusion

According to the game of this model, the Nash equilibrium of this game which reflects the current state of relations between Iran and the US is (H, S) , which means maximum pressure from the US and active resistance from Iran, which is both very costly and this choice for both parties has a consequence of 2. But since this game has (L, M) as a Pareto optimal option, it is in the interest of both players to change their approach as soon as possible by negotiation or agreement. This article also presents an effective strategy for Iran based on burning oil surpluses that puts pressure on the US through the international community and encourages the US to reduce sanctions on Iran and this is in the interest of Iran, the international community and the United States. In other words, a win-win strategy that will lead Iran to sell its oil freely to world markets. It should be noted that even if Iran fails to implement this strategy, it can use it as an credible threat. As we know, during the sanctions period, the United States and Iran have threatened each other very much.

References

- [1] B.D. Bernheim, *Rationalizable strategic behavior*, *Econometrica: Journal of the Econometric Society*,52, no. 4 (1984)1007-028.
- [2] H. S.Bierman, L.Fernandez, *Game Theory with Economic Applications*, Addison Wesley Publishing Company Inc, 1997.
- [3] C.F.Camerer, *Behavioral game theory: Experiments in strategic interaction*, Princeton University Press, 2011.
- [4] A.K. Dixit, and S.Skeath, *Games of Strategy, Fourth International Student Edition*,WW Norton Company, 2015.
- [5] R.S.Gibbons, *Game theory for applied economists*, Princeton University Press, Harvester Wheatsheaf, 1992.
- [6] A.Javadian, E.Sorouri, *A Model for the Use of Facilities for the Treatment of Addiction*, *Journal of Neurodevelopmental Cognition*,2(2019)22-26.
- [7] V.Kaitala, *Game theory models of fisheries managementa survey*, a survey, *Dynamic games and applications in economics*, 265(1986)252-266.
- [8] j.M. Smith, *Evolution and the Theory of Games*, Cambridge University Press, 1982.
- [9] D.A.Meyer, *Quantum strategies*, *Phys.Rev.Lett.* 82, no. 5 (1999) 1052-1055.
- [10] J.F.Nash, *Non-cooperative games*, *Advances in Math.* 54,no. 2(1951) 286295.
- [11] J.F.Nash, *Equilibrium points in N-person games*, *Proc. Nat. Acad. Sci. U.S.A.* 36,no.1(1950)4849.
- [12] J.V.Neumann, and O. Morgenstern, *Theory of Games and Economic Behavior*, Princeton University Press,60(1953).
- [13] P.Ordeshook, *Game Theory and Political Theory*, Cambridge University Press, 1986.
- [14] M.J.Osborne, *An introduction to game theory*, Oxford University Press. New York, 2004.
- [15] M.J.Osborne, and A. Rubinstein, *A course in game theory*, MIT Press, 1994.
- [16] T.C.Schelling, *The strategy of conflict*, Harvard University Press, 1980.
- [17] D.Snidal, *The Game Theory of International Politics*, *World Politics*, 38,no.1(1985), 25-57.
- [18] U.R.Sumaila, *A review of game-theoretic models of fishing*, *Marine policy*, 23, no. 1 (1999)1-10.
- [19] N.Van Long, *Dynamic games in the economics of natural resources: a survey*, *Dynamic Games and Applications*, 1,no.1(2011)115-148.
- [20] J.Watson, *Strategy: An Introduction to Game Theory*, W. W. Norton Press,139(2002).
- [21] J.W.Weibull, *Evolutionary Game Theory MIT Press*, Cambridge, MA, 1995.