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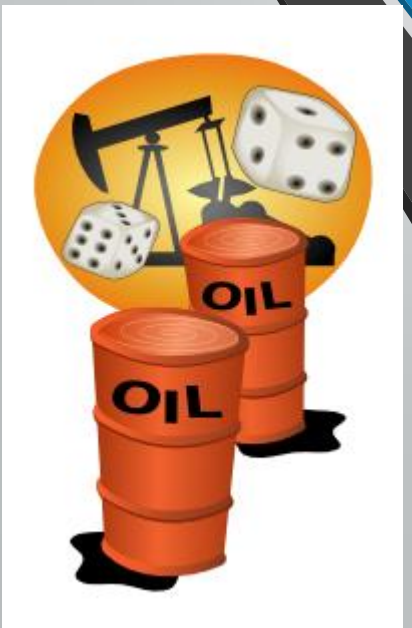
Game theory applications in negotiations on the oil market between Russia and OPEC



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Introduction

- Oil is one of the key resources widely used throughout the globe in industry and transportation, it is very valuable for the countries that have extensive extraction potential and their governments must find optimal solution for petroleum management, in order to create wealth.
- Major players on the international oil market often come into conflicts, as they all want to increase their production and acquire a bigger segment of the international market. This unilateral strategy has led to times of decrease in oil prices due to oversized supply, so all the producers were in disadvantage.

Literature review

- Game theory approaches can be used to model conflicts between two or more international actors (e.g. governments, companies) in order to better understand the dynamics of international relations, the possible outcomes and best alternatives for the „players”.
- An in dept perspective of the conflict, by using game theory, can offer each player a better understanding of his strategic options and the strategic options of his opponent. If both players take into account the game theory approach, the negotiation process between them can have an optimal result for all parties involved.

Classification of games

Players' strategies	• pure - single strategy choice; • mixed - two or more strategies according to a probability distribution.
Rules	• static - players' decisions are taken simultaneously, after which the game ends; • dynamic -decisions are taken sequentially, following the evolution of the players in time.
Initial endownment	• with complete information - each player knows the number of players, available strategies, winning functions and game rules; • with incomplete information - not all the information mentioned above are available to the players.

Figure 1

Source: by the authors

The Prisoner's Dilemma (PD)

- a strategic game that illustrates a situation involving two suspects in a crime
- the two suspects have 2 options: to confess or not to confess about the robbery and the crime, we can have 4 different results, which are presented in the figure below (the numbers represent the years in prison that they will get in each scenario)
- Various actual economic, social or political conflicts/negotiations can be modelled using the approach of Prisoner's Dilemma game

Figure 2

		Fellow 2			
		Confess the crime		Not confess the crime	
Fellow 1	Confess the crime	5	5	0	10
	Not confess the crime	10	0	1	1

Source: by the authors

Research methodology

- The research methodology of this paper consists of applying the Prisoner's Dilemma game on the negotiation between Russia and OPEC members, in order to understand the logic of the agreement that they closed in 2017 and the results of it on the international oil market.
- For a correct interpretation of the situation of the two main players on the oil market, we first conducted an in depth analysis of the specific conditions on the international oil market in the last 50 years. We studied the dynamics of prices in correlation to the main political and economic events that had an impact on the volatility of oil prices. Statistics related to average daily productions and average annual prices are presented and analysed in our study.

Application of game theory in negotiations between Russia and OPEC

- With the rise of the oil prices in 1973, numerous theoretical and empirical studies were undertaken to analyse the structure of the world oil market and the role of OPEC - Organization of Petroleum Exporting Countries
- The price of oil on the international markets is very volatile and over the years it suffered several shocks. The main peaks were reached during: Yom Kippur War (1973), Iranian Revolution (1979), Persian Gulf War (1990) and and Libyan Civil War (2011). Prices have decresed rapidly during the Asian Financial Crisis (1997), the Second Gulf War (2003) and the 2008 economic crisis.

Context analysis on the crude oil international market

- OPEC:
  - Created in the '60 by Iran, Iraq, Kuwait, Saudi Arabia and Venezuela
  - Today, OPEC has 15 member states
  - Scope: coordinating members production policies in order to maintain a convenient price of oil in the international markets and insure a stable flow of exports to the consumer countries.
- In 2016, Russia and OPEC have discussed the possibility of reaching an agreement with the scope of cutting down production of oil, with the scope of avoiding a decrease in the price on the international markets. In 2017, they agreed to cut their total oil production by 1.8 million barrels per day. The measure had helped rebalance the market and determined an increase in oil price to around $70-75 per barrel from as low as $27 in 2016

Table 1: Average production (thousand barrels per day) in OPEC countries (selection)*, non-OPEC countries (selection)** and Russia for the period 1973-2018 (selected years)

Year	OPEC producers	Russia	non-OPEC producers (including Russia)	World		Year	OPEC producers	Russia	non-OPEC producers (including Russia)	World
1973	29811	NA	25,868	55,679		2005	32526	9,043	5,184	41,325
1975	26013	NA	26,816	52,828		2006	32187	9,247	5,086	41,380
1980	25558	NA	34,000	59,558		2007	31944	9,437	5,074	41,302
1985	15539	NA	38,426	53,965		2008	33308	9,357	4,998	40,809
1990	22768	NA	37,729	60,497		2009	31609	9,495	5,349	41,321
1995	25870	5,995	6,560	36,564		2010	32500	9,694	5,475	42,177
1996	26389	5,850	6,465	37,429		2011	32672	9,774	5,643	42,056
1997	27697	5,920	6,452	38,109		2012	33859	9,922	6,497	42,278
1998	28781	5,854	6,252	38,250		2013	32890	10,054	7,466	43,393
1999	27632	6,079	5,881	38,335		2014	32935	10,107	8,753	45,235
2000	29427	6,479	5,822	39,100		2015	34190	10,253	9,408	46,364
2001	28581	6,917	5,801	39,551		2016	35170	10,551	45,195	80,563
2002	26929	7,408	5,744	40,361		2017	35306	10,580	45,615	80,820
2003	28425	8,132	5,649	41,035		2018***	34733	10,560	46,561	81,696
2004	31036	8,805	5,441	41,559						

Source: U.S. Energy Information Administration (2018). Monthly Energy Report. Available at: https://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf

Result analysis of Russia-OPEC agreement using the "Prisoner's Dilemma game"

Figure 3

		Russia	
		Low Oil Production	High Oil Production
OPEC members	Low Oil Production	3, 3 1*	1, 4 2*
	High Oil Production	4, 1 3*	2, 2 4*

Source: by the authors

Analysis of Russia and OPEC strategic options

- If we analyse Fig. 3, we can understand better which are the strategic options of each player and what are the costs of not respecting the production quotas set up after the players decide to cooperate.
- In Fig. 3, the two rows and two columns correspond to the possible actions of Russia and OPEC. They can either have a low oil production or a high oil production. The cardinal numbers listed in the cells, indicate the profit generated by the actions corresponding to OPEC (first number) and Russia (second number, after comma). The numbers are symbolic, 1 indicating the lowest profit and 4 the highest profit.

Interpretation of results

- The strategic options of the two players are: to cooperate and obtain the best result for both players simultaneously (quadrant 1) or not to cooperate, in which case the logic choice for both of them is to maintain high production, leading to moderate profit for both of them (quadrant 4).
- The interpretation of this game is crucial in understanding the reason for which Russia reached out to the OPEC representatives and convinced them to come to an agreement regarding the cutting down of oil production, which resulted in an increase of oil price (from approximately 30$ in 2016 to approximately 70$ in 2018) and higher profits for the producing countries.

Current situation of the Russia – OPEC negotiations

- In November 2017, OPEC, Russia and several other producers discussed an extension of the original agreement. The economic and political events in Venezuela, Libya and Angola have generated supply cuts of around 2.8 million barrels per day in recent months.
- In June 2018, OPEC and non-OPEC oil producers met in Vienna and agreed to raise production by pumping an extra million bdp (barrels/day) in order to meet global demand. Russia also declared that it will increase their production by 200.000 barrels/day in the second half of 2018.
- This new decision has risen some debates within the OPEC. Iran does not agree with the increase of oil supply, as it has to deal with sanctions from the U.S, which means the country will have little to gain from this agreement. Saudi Arabia on the other hand, has very much to gain, as it may fill the gaps left by countries that cannot raise their production at this time (such as Venezuela). The quota reallocations will divide OPEC members in winners and losers of the agreement to boost the oil supply [14]. Russia, on the other hand, will be a sure winner.

Conclusions

- According to the analysis conducted in this paper, Russia might have based its strategy of closing a deal with OPEC members on the logic of the PD game. The application of the approach of PD game, explains the strategic choices available to two main players on the international oil market and how the agreement reached between Russia and OPEC members in 2017 is actually the best alternative for both players in terms of profitability.
- The analysis conducted on the context of the crude oil international market, shows that the agreement between Russia and OPEC has contributed to the rise of international prices of oil.

THANK YOU FOR YOUR ATTENTION!

Any questions?

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