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An Analysis of the Intra-OPEC Bargaining Game with Emphasis on New Outlook and Sanctions (2011-2019) Using Google Trends

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Abstract
Crude oil is the most traded commodity in the world and its market has great influences on the global economy and macroeconomic activities. The present study seeks to analyze Iran's policy for oil production and export within the framework of an intra-OPEC bargaining game. This analysis helps to review Iran's oil policy and to propose an appropriate strategy in the new circumstances. The analysis of strategic relations shows that OPEC members can be divided into two groups of saver and spender countries. This categorization is due to economic, demographic, and petroleum differences among OPEC countries. OPEC members are different in terms of discount rates, impatience, and the urgent need for oil revenues too. The authors of this study have tried to model the relationship between oil quotas/production and demographic, economic, and oil variables based on the Intra-OPEC bargaining game. The model estimated for the period 2001-2019. The results indicated a strong and significant relationship between the ratio of oil production to oil reserves and demographic, economic, and oil variables. Bargaining between the two groups can largely determine the behaviors of OPEC and its members. The model estimation suggested that the oil market faces a tendency towards faster production and export in response to the shift in world oil market outlook. The results suggest that Iran's oil production capacity, the market share of Iran and recovery rates should be upgraded. Finally, the current role of Iran in OPEC does not fit into its economic needs and should be reviewed based on the above results. The study indicated that the inherent heterogeneity in OPEC still helps Iran plan to achieve its historic quota and position in OPEC.

Keywords: Google Trends, OPEC, Iran Sanctions Trend, JCPOA, Quota.
JEL Classification: C07, D74, L13, L16.

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1. Introduction

Crude oil is the most traded commodity in the world and its market has great influences on the global economy and macroeconomic activities. OPEC's role in the oil market upgraded following the quadrupling of oil prices. Great literature has been developed for modeling the OPEC behaviors and challenges. Quota allocation has been an important issue in OPEC over the past decades and the emergence of unconventional oil producers and Iran oil sanctions can complicate Intra-OPEC quota bargaining. Bargaining and game models are widely used in recent economic studies (Motamedi, Moeeni, Gharakhani and Keifarokhi, 2014; Moeeni and Moeeni, 2020). The authors of this study have provided a framework to explain this issue based on strategic interactions among OPEC members using Google Trends index. The study investigates empirical evidence about variables affecting quota allocation and its implications for Iran's oil policy.

OPEC includes relatively heterogeneous members from some aspects such as impatience, population, and public welfare. This is a key point to understand the general orientation of OPEC behavior during the last decades. On the other hand, OPEC has usually tried to restrict oil supply for supporting oil prices. In recent years, the OPEC's share of conventional oil reserves has been announced more than 73% according to the reports of IEA and the US Energy Information. By decreasing the market share, OPEC tries to increase the price. However, non-OPEC countries benefit from this policy.

All the members of OPEC do not necessarily suffer from the same restrictions on their oil production. In fact, some OPEC countries need their oil revenues more urgent and some are more patient. This may affect their behavior and how OPEC's interests are divided. Does this division affect the export behavior of members? After studying the OPEC's bargaining system, are there any suggestions or implications for Iran's policy? Is Iran's behavior or role in OPEC reasonable? What are the results and implications of the new outlook in the oil market? Should Iran revise its oil policy with regard to changing the outlook of the oil market? For these purposes, this study is organized as follows: In the second section, theoretical principles and frameworks, as well as the research background, are addressed. In the third section, the research model is specified and estimated. Finally, in section four, conclusions and policy implications will be presented.

2. Literature Review

2.1. OPEC Structure

Hnyilicza and Pindyck (1976) divided OPEC countries into two classes of saver and spender members for the first time. Spender countries were included members with the immediate need for cash revenue. They cannot postpone their oil production and sell too much. According to Hnyilicza and Pindyck, these countries included Iran, Venezuela, Indonesia, Algeria, and Ecuador which have a higher discount rate than the savers. It means that they need oil revenues immediately, underestimate the future value of oil revenue, and have a lower tendency to postpone production.

On the other hand, saver countries included Saudi Arabia, Kuwait, Libya, and the United Arab Emirates. The discount rate of these countries is lower, thus, they show less impatience in oil production and export. This categorization and bargaining system between the two groups determine the behavior in OPEC. For instance, when the oil price increases, more patient countries agree with increasing oil production because of the long-term advantages of the market. But, impatient players prefer to control the production for supporting the oil price. Therefore, there exists a game between two groups of members. The game may be effective on agreements and the bargaining system of OPEC (Alhajji and Huettner, 2000).

Danielson and Kim (1988) explained some differences between the behavior of OPEC members in a study entitled 'OPEC stability: an empirical assessment'. According to this study, empirical observations confirm that all OPEC members do not have similar production behavior; rather, wealthy members in OPEC have had both a significant and positive effect on OPEC stability by more limited production. They undertake the main role in OPEC to increase the oil price.

OPEC's role in the oil market has also been extensively studied. The oil price structure has changed from an administered-pricing system

to a more market-dependent price (Bremond, Hache and Mignon, 2012). Thus, many studies have analyzed whether OPEC is a cartel or not. This role requires coordination of production decisions of members in OPEC as well as a strong effect on prices. Some previous studies have explored this issue and showed that OPEC has not acted as a cartel in the majority of periods (Bremond et al., 2012).

Alhajji and Huettner (2000) investigated a dominant producer in the oil market based on statistical tests. The results revealed that neither the OPEC nor the OPEC core has such a role. Also, according to the results, OPEC is not considered in the framework of the competitive model or Cournot competition. Bremond et al. (2012) also explored the similarity of OPEC behavior to a cartel with coordinated decisions. They used both time series and panel data based on causality tests. The findings showed that the influence of OPEC after counter-oil shocks was important, but, it was price-taker in most periods. At last, this study showed that pseudo-cartel behavior was mainly operationalized by relying on a subgroup of the OPEC members.

Alkhathlan, Gatley, and Javid (2014) analyzed the correlation and structure of export behavior of Saudi Arabia and other OPEC members. This study entitled 'analysis of Saudi Arabia's behavior within OPEC and the world oil market'. The results indicated a strong positive correlation in ordinary periods and a negative correlation in volatile periods. This correlation structure confirmed the heterogeneity of behavior in OPEC members, especially in volatile periods.

Moeeni, et al. (2016) analyzed OPEC stability under previous sanctions of Iran. This study explored the effect of the oil and economic sanctions on the sacrifice ratio. The previous sanctions of Iran have been inserted in the model as the effective factor on sacrifice ratios and OPEC stability. The results disclosed that sanctions, either direct or indirect, have decreased the production and capability of Iran's crude oil. These sanctions have finally changed sacrifice ratios of Iran to the benefit of other members and strengthened the stability of OPEC.

Okullo and Reynes (2016) developed a model to analyze OPEC based on the degree of cooperation of each member. This criterion is used to evaluate different incentives of OPEC members for cooperation. They concluded that the heterogeneity in OPEC members, as well as non-OPEC members, created strong incentives against collusion. As a result, OPEC's supply strategy was more restrictive than a *Cournot-Nash oligopoly*. But, OPEC was not a perfect cartel. This strategy was based on the un-proportional allocation of quota in comparison to capacity and reserves. Some members received a bribe in cartel instead of stringent quotas. From the view of this study, perfect cartel behavior was more suitable for an elastic market while the oil market has an inelastic demand. These observations provided another structural explanation that explains how OPEC's behavior was different from a perfect cartel.

Van de Graaf (2017) analyzed the existing challenges in a study. He believed that OPEC has faced a storm in its history. It was due to Shale oil revolution. On the other hand, it was arising from a perspective of global peak oil demand owing to climate policies and decreasing costs of alternative energies; but this does not mean the death of OPEC. Because of the low cost of oil extraction in OPEC, this convention in a new environment was still able to compete. Anyway, OPEC needs to conform itself to a changeable environment.

2.2. The Sanction Intensity and Google Trends

Since 2008, Iran has faced many conflicts in its relations with some European and American countries which have led to the imposition of oil and banking sanctions. The most important and significant international sanctions may be the sanctions implemented in 2012 and the new sanctions that have been imposed by the United States from the beginning of 2018. Following the implementation of the 2012 sanctions against Iran and through difficult and prolonged negotiations, a comprehensive agreement was obtained in 2015. After the Joint Comprehensive Plan of Action (JCPOA), a large part of Restrictions on oil exports and some other sanctions were lifted.

However, Trump who opposed the agreement during his campaign, after being elected as the US President and several threats to exit the agreement, officially announced in

May 2018 that his government intended to withdraw from the deal. Meanwhile, the United States re-imposed the sanctions against Iran which had been previously suspended due to JCPOA. Thus, during the period 2010-2019, various sanctions have been announced and implemented against Iran (Dudlak, 2018).

However, the severity of sanctions against Iran has not been fixed during the period. In recent years, economists have widely used Google Trends to measure such trends (Campos, et al., 2017). Google Trends (www.google.com/trends/) has provided an analytic tool for measuring and monitoring public concerns based on Internet search data. Thus, Google Trends can be used to identify the magnitude and significance of events like sanctions (Ji and Guo, 2015).

Accordingly, this study attempted to analyze the impact of sanctions using Google Search Index. The Google Search Index (GSI) can be an analytical framework to identify the magnitude and significance of sanction-related events. Google search volumes about Iran's sanctions can also be an indicator of the strength and weakness of sanctions. Therefore, GSI could be a quantitative measure of the intensity of sanction. The paper measured the severity of the sanction with the intensity of the search derived from search query volumes in Google.

3. Research Model and Estimation

Previous studies have presented several models to show why the discount rate is different among OPEC members and how this difference is effective on the behavior of OPEC's countries. Instead of just presenting those models, the authors of the present study have tried to develop an innovative model that shows strategic relations and the Intra-OPEC quota bargaining through new formulations. In the next section, the behavior of OPEC and its members were estimated and analyzed in recent years. The model is developed using an innovative approach, but it is similar to the previous models in terms of the results.

First, as a simplification assumption, it is assumed that OPEC is complex for the competition and cooperation of two agents. One agent is the representative of members who have lower per capita income, lower oil reserves, and lower foreign exchange reserves per capita. They are mainly high populated too. The second agent is the representative of members who have high per capita income, higher oil reserves, and foreign exchange reserves per capita. They are less populated.

It is clear that the first agent is the representative of countries that have an immediate need for their oil revenues because of low or medium per capita income and lower foreign exchange reserves. They are highly impatient for faster extraction of their oil reserves to sell it. Also, these countries need a higher growth rate to compensate for their backwardness from rich countries. Thus, they are highly involved in supplying financial resources for development plans. They try to extract and sell more oil reserves as soon as possible.

In contrast, the second agent is representative of countries that have high per capita income and more oil reserves. Therefore, they have not an immediate need for oil revenues and the fast extraction of oil reserves. Ultimately, they are more patient in this case. Moreover, the latter group has more oil reserves and requires a market with certain demand for selling their oil through a long period (Danielson and Kim, 1988). Obviously, for the first group, impatience is high and as a result, the discount factor of future oil revenues is low. The second group is more patient with a higher discount factor. The discount factor for each OPEC member (DF_i) has a direct relationship with per capita income ($Income$), oil reserves per capita (Res), and foreign exchange reserves per capita ($ForCur$). It could be shown as follows:

$$DF_i = f(Income^+, Res^+, ForCur^+) \quad (1)$$

Given the relatively high market share of these two agents, the oil price depends on their total production. The elasticity of oil price (p) concerning the total supply of these two agents (Q) is shown with ε and is considered fixed in the short term. It can be written as below (Ahmadian, 2012):

$$p = \frac{A}{Q^{1/\varepsilon}} \quad (2)$$

$$Q = q_{Impatient} + q_{Patient} \quad (3)$$

When both agents are playing a competition game, two agents want to choose their oil

production for two periods strategically so that the present value of their oil revenue is maximized. If two agents establish a joint organization, they try to optimize their oil revenues through a combination of cooperation and competition. If it is assumed that OPEC is a perfect cartel, it means that OPEC tries to optimize the sum of revenue of all members.

$$max\ \pi_I + \pi_P = (1 + DF_I)(\frac{A}{(q_I + q_P)^{1/\varepsilon}})q_I + (1 + DF_P)(\frac{A}{(q_I + q_P)^{1/\varepsilon}})q_P \quad (4)$$

But, the literature showed that the behavior of OPEC is not like a perfect cartel (Okullo and Reynes, 2016). Moreover, empirical pieces of evidence were intuitively shown that OPEC was not a simple cartel. However, each member knows that a production plan cannot be agreed, if it is irrespective of taking into account the interests of other members. Therefore, OPEC organization is simultaneously involved in competition and cooperation. By assuming two agents, each player knows that an arrangement of production can be agreed if it simultaneously maximizes the interests of two agents. Besides, in the bargaining system of OPEC, the bargaining power of each agent is not the same.

The fundamental approach of Berhman and Craig (1987) can be used for maximizing collective welfare functions. This approach showed that if there is an exchange between the welfare of two or more agents in a group, an agreement can be made based on the maximization of the product of agents' welfare. Also, we should consider their bargaining power. According to this approach, an agreement in OPEC is possible in a way that collective income function is maximized through one of the below forms.

$$max\ {\pi_I}^{\alpha}{\pi_P}^{\beta} \quad (5)$$

$$max\ \alpha\ ln(\pi_I) + \beta\ ln(\pi_P) \quad (6)$$

where π_I and π_P are oil revenues of agents and α and β are their bargaining power. Two agents are involved in the cooperation and competition. Each of them is involved in maximizing its interests, (i.e. π_I and π_P) but, the first agent knows that self-interest maximization prevents cooperation without paying attention to interests of the second agent. Thus, it finally threatens the interests of the two agents. The second agent has the same knowledge. Thus, the agreement can occur in maximizing the product of interests of the two agents, where their interests are conjointly preserved.

Why cannot the agreement occur in the formula of maximizing the sum of interests of two agents? Berhman and Craig's response is: maximizing the sum of the interests may be accompanied by an insignificant interest for an agent and a high interest for another party. Thus, it is not a simultaneous preserving interests of both parties. The more impatient agent has a higher discount rate and highly needs its oil revenue. This player has higher bargaining power in OPEC, since inattention to its immediate needs may endanger the survival of the agent in OPEC (Abdoli, 2013). Hence, bargaining power in OPEC is conversely related to the discount factor of an agent:

$$\alpha = h(DF_I);\ h' < 0 \quad (7)$$

$$\beta = h(DF_P);\ h' < 0 \quad (8)$$

For optimization, the first agent should maximize the objective function (6) with regard to its production q_I and simultaneously, the second agent does this optimization about its production. The best response functions were obtained as follows:

$$\alpha\ {q_I}^{-1} - \frac{\alpha + \beta}{\varepsilon}(q_I + q_P)^{-1} = 0 \quad (9)$$

$$\beta\ {q_P}^{-1} - \frac{\alpha + \beta}{\varepsilon}(q_I + q_P)^{-1} = 0 \quad (10)$$

By crossing these response functions, the below equation was obtained.

$$\frac{q_I}{q_P} = \frac{\alpha}{\beta} = \frac{h(DF_I)}{h(DF_P)} \quad (11)$$

Given Equations (7), (8), and (11), it can be expected that there is a relationship between the production/quota of each OPEC member and its impatience or discount rate. Moreover, discount rates are related to their per capita income, oil reserves per capita, and foreign exchange reserves according to Eq. (1). These relationships exactly conform to the mentioned theoretical models in the literature. However, after the emergence of shale oil, the oil market has faced a new arrangement due to a heterogeneous competitor. It is expected that

this new agent and competitor leads to changes in the production behavior of OPEC countries at least in the short term. Therefore, another innovation of the model is to add variables related to recent changes in the oil market such as sanctions, trends, and shale revolution. Finally, on the basis of the models in previous studies, equation (12) was specified and estimated in the study:

$$\begin{aligned} &Ln(\text{Quota})_{it} \\ &= \alpha_1 + \alpha_2\, Ln(Income)_{it} \\ &+ \alpha_3\, Ln(Res)_{it} + \alpha_4\, Ln(ForCur)_{it} \\ &+ \alpha_5\, ShaleDum_t\, Ln(Shale)_t \\ &+ \alpha_6\, GSI_t + \alpha_7 JCPOA_t \end{aligned} \qquad (12)$$

The dependent variable is the logarithm of the ratio of oil quota to reserves for OPEC members. Independent variables are the logarithm of national income per capita, oil reserves per capita, foreign exchange reserves per capita. $ShaleDum_t\, Ln(Shale)_t$ is a variable which reflects unconventional oil production. The variable shows the growth of shale oil supply following Moeeni et al. (2016). $ShaleDum$ is a dummy variable that takes the value 1, whenever daily shale production was more than one million barrels. As explained earlier, Google Search Index could be a quantitative measure of the intensity of sanctions. Therefore, GSI_t, shows the intensity of sanctions using the google search of 'Iran oil sanction' in Google Trends.

JCPOA is a dummy variable that refers to the agreement between Iran and Western countries named Joint Comprehensive Plan of Action. It is equal to 1 from July 2015 to May 2018. JCPOA is equal to zero for other periods. The estimation period was from 2004 to 2019. The index *it* shows country *i* in period *t*. Production data of OPEC members were gathered from the OPEC statistics; income, foreign reserves, and population of OPEC countries were gathered from World Bank data; and shale oil production was obtained from the International Energy Agency (EIA). Conventional reserves of members were obtained based on the OPEC bulletin (2018).

The model was estimated using Eviews 10. Results are shown in tables 2 and 3. Given the F-Limer test statistic and its probability value and Hausman test and probability of chi-square, the model was estimated through panel data with fixed effects. The coefficient of determination (R^2) showed the good fit of the model. Durbin-Watson test implied that there exists an autocorrelation. Regarding the LR test and to eliminate autocorrelation, the GLS method was used to prevent the heterogeneity of variance.

As the results in Table 3 show, in the framework of strategic relations in OPEC, three variables including gross domestic product per capita, oil reserves per capita, and foreign exchange reserves per capita have shown a reverse relationship with the speed of production for members. This relationship is significant regarding foreign exchange and oil reserves. Furthermore, the growth of shale oil production increased the acceleration of OPEC members for extraction. In other words, the impatience rate has increased in OPEC.

The results indicated that rich members (with high oil and foreign exchange reserves) have tended to moderate oil extraction, but, middle-income and developing countries in OPEC have extracted more quickly. These results are consistent with the theoretical expectation that states OPEC's foundation is based on the lower production for a higher price, but, some members have to limit their production more than others.

Iran oil sanctions increased oil prices; therefore, the majority of OPEC members have shown more tendency and impatience for accelerated extracting. The sanctions have led to the replacement of Iran's competitors in the oil market. The competitors in OPEC have significantly increased their production in order to take advantage of this opportunity. Moreover, the agreement has led to only a slight change in the reverse direction. The coefficient of JCPOA was not significant. It can be regarded that there was a strong rigidity in competitors' new behavior. The emergence of shale oil has slightly increased the impatience for extraction in OPEC countries too. These results indicated that the outlook of the oil market has changed.

Accordingly, it can be claimed that the bargaining in OPEC is still in a way that considers the difference in countries' need for oil revenue. The effect of this factor is still strong, although some events have increased the general tendency of OPEC members to accelerate the extraction. Changing the oil

market outlook and OPEC behavior indicated that Iran should also revise its oil policy. The oil market should be seen as a shorter and riskier market. Therefore, Iran should take care to maximize the profits from the short-term oil market using an optimum and higher extraction rate. The outlook of OPEC and the oil market implicated that Iran needs to invest in more efficient, faster, and with a lower-cost extraction in the short run.

Table 1. Conventional Oil Reserves of OPEC and Non-OPEC Members

Country	Reserve (billion barrel)	Share (%)	Country	Reserve (billion barrel)	Share (%)
Venezuela	302	24.8	Qatar	25	2.1
Saudi Arabia	266	21.9	Algeria	12	1
Iran	157	12.9	Angola	9	0.8
Iraq	148	12.2	Ecuador	8	0.7
Kuwait	101	8.3	Gabon	2	0.2
UAE	97	8	The OPEC	1217	81.5
Libya	48	4	The non-OPEC	275	18.5
Nigeria	37	3.1	The world	1492	100

Source: OPEC bulletin (2018)

Table 2. Results of the Model Estimation

Variable	Coefficient	t statistic
Income per capita	-0.08	-0.87
Oil reserves per capita	-0.26	-3.83
Foreign exchange reserves per capita	-0.13	-6.11
Shale oil production	0.03	4.91
Google search on Iran Oil sanctions	0.27	1.98
JCPOA	-0.02	.079

Source: Authors

Table 3. The Model Estimation

R2	0.81
Adjusted R2	0.79
Durbin-Watson test statistic	0.18
F test statistic	32.81
Hausman test statistic	28.79
LR	47.95

Source: Authors

4. Conclusion

The theoretical literature explains that OPEC's foundation is based on lower production for a higher price. Moreover, some members have to limit their production more than others to maintain OPEC's stability. The results indicated that rich members (with high per capita oil reserves and foreign reserves) have tended to moderate oil extraction, but, middle-income and developing countries in OPEC have extracted more quickly. These results are consistent with the theoretical expectations.

There were some recent events such as oil sanctions and shale revolution that have reduced the patience among OPEC members. Iran's competitors have increased their oil exports, but, Iran has not been able to achieve optimal oil production. Iran's oil production has not been sufficient compared to its historical role in OPEC, its population, and development needs. Iran is the fourth owner of world oil reserves after Venezuela, Saudi Arabia, and Canada. Iran's share of world oil reserves is 13% and its share of total oil production is 1.5%. Iran's oil production has not been in line with its development goals. Therefore, Iran needs to produce and export more oil for its development purposes.

The importance of acquiring oil revenues is not well understood in Iran. Considering the demographic, economic, and oil components, Hnyilicza and Pindyck (1976) categorized Iran as a member with an urgent need for oil revenues. However, Iran faced a sharp decline in extraction capacity and average oil export due to political events. The sharp decline in the long-term economic growth is definitely affected by this inappropriate policy. Oil exports can play a key role in the investment, technology transfer, and the economic growth (Sultan and Haque, 2018). Moreover, the outlook of the oil market has changed. The shale revolution limits oil prices and demand for OPEC's oil. Therefore, Iran has to prioritize maximizing oil exports to improve infrastructure, increase investment, and achieve development goals.

Now, economic components show the importance of investing in oil exports. The study showed the OPEC members' typology has remained intact based on demographic, economic, and petroleum components. But, some events have changed the oil market outlook, so it has exacerbated the impatience of OPEC members in oil production. Therefore, Iran should revise its oil policy with regard to the above-mentioned factors. Finally, the market share of Iran should be increased, especially through improving the recovery rate in oil extraction. The study indicated that the

inherent heterogeneity in OPEC still helps Iran's plan to achieve its historic position in OPEC.

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