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the effect of gas pricing on the export of gas from Iran and Qatar: integration of dynamic Computable general equilibrium (CGE) approach and game theory

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Abstract

Considering the existence of oil and gas fields between Iran and Qatar and the impact on the market through a higher export share, the purpose of this research is to investigate the optimal gas price on the amount of gas exports of these countries. Therefore, in the present study the DCGE model and the 2014 social accounting matrix were used to investigate the impact of gas price shocks on the gas exports of these two countries. As Iran and Qatar are known as main competitors in the natural gas sector of world energy market, it is necessary to specify a win-win pricing strategy for both countries. Taking this into account, in the present study a model that incorporates both the dynamic computable general equilibrium and game theory is used for investigation purposes in 2022-2024. At first, in the dynamic computable general equilibrium model, price increase scenarios of 0.5, 0.7, and 1 percent were performed on Iran and Qatar's gas exports, and then using these results, the pay-off matrix was obtained for these countries.The results indicate that, 0.5% price increase would be the best strategy from among the wide range of gas price scenarios presented for 2022-2024, because a 0.5% increase in gas prices in general would further increase the exports of Iran and Qatar as two competitors. Thus, based on the equilibrium forms, stepwise price rise over a specific time interval can help these two countries maximize their interests.

Highlights

- Relationship between gas pricing and export of gas
- Integration of DCGE model with game theory
- Estimation of optimal price for gas export for Iran and Qatar

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1. Introduction

The energy role and importance with in the country's economic development is very prominent, and decisions about pricing policies, production, conversion and transmission of energy are among the other upcoming challenges. In recent years, the energy and its related topics have a special place according to environmental factors and efficiency. For Iran, which has abundant energy resources, investigating and evaluating the global energy market condition and its effective factors, as well as predict the state of the future energy market for the policy purpose is very important. (Barden et al., 2009). Iran is one of the largest in-situ gas reserve holder in the world. Out of a total of 34 trillion cubic meters of in-situ reserves, nearly 14 trillion cubic meters are located in the South Pars Dome field. At the same time, there are many obstacles in front of Iran for safe and optimal harvesting of resources and all potential unexploited capacities (Nouri et al., 2015). The existence of this number of joint oil and gas fields in the sea and on the land is a subject worthy of attention that requires its own requirements and necessities. Iran has joint oil and gas fields with its neighboring countries in four regions, which is involved in competition with these countries to extract from these fields. Irregular withdrawal from joint fields by neighbors after a while can make the oil and gas of these joint fields unexploitable and upset the balance of the fields. (Nourani, 2014)

In Iran's joint fields, each of the beneficiaries, regardless of the optimal harvesting strategy, intends to make the maximum possible harvest from his side. As a result, such a competition for acquiring a larger share does not take place in an optimal way, from the point of view of economics and engineering; Rather, each of them tries to prevent the other side harvesting, at least in the short term. As a result, it can be said that potential benefits for Iran are lost in these common fields and are harvested through the neighbors, which it caused special attention to the mentioned fields. Therefore, it can be said that the continuation of using the current method in the country joint oil and gas fields doesn't have any benefit for Iran and its neighbors and we can go for superseded strategy. Cooperation in this field will be one of the ways for creating safety for countries with joint oil and gas fields. Iran has joint oil and gas fields with two countries of Iraq and Qatar, which are very important based on the amount of reserves. According to the available statistics, the daily production rate of Qatar was 620 million cubic meters in 2019 (Zanganeh, Headquarters of Resistance Economy, 2019). Since Qatar is one of the prominent countries with huge gas reserves, and on the other hand, this huge reservoir is shared between Iran and Qatar so it has been cause serious competition in the exploitation of both countries. After meeting its limited domestic needs, Qatar has become the main exporter of this product in the world with the help of Western companies and through the implementation of numerous projects to produce liquefied natural gas. On the other hand, despite ambitious goals on the way to becoming an exporting country, Iran has failed to achieve these goals due to the postponement of projects and international sanctions (Dakhani, 2009). Regarding the decisions of each country affect the interests of the other country, about the joint fields between two countries, it is possible to obtain the optimal decision by using the theory of games. The subject matter of Game theory involves the assessment of how decisions are made by various players in such confrontations. When agents share resource systems despite having different goals, conflict may be inevitable. Companies, groups, and individuals, alone or in combination, may constitute the agents in question. The decisions and interactions among various players, leading to consequences in other players, performance, constitute a game (Bahreini, 2011).

Since one of the factors influencing the export share of each country is the gas price variable, and therefore it is important to pay attention to the optimal price to achieve an increase in the export share from the world market. Also, price determination in countries with oil and gas reserves has an important effect on other countries, and this may lead to a war over price determination and market dominance. Therefore, game theory is a well-known tool for modeling potential conflicts between factors. In this research, the conflict of interests between Iran and Qatar according to the joint South Pars Dome field with regard to the common target markets and price setting for gaining more profit is considered. Based on this, the basic question that is raised in an innovative way by combining the computable stochastic equilibrium models and game theory is how gas price determination will affect the gas exports of Iran and Qatar. To answer this question, the framework of the article is as follows: in the first part, the introduction, then the background of the research, in the third part, the theoretical foundations, in the fourth part, the estimation of the model, and in the end, the conclusion is presented.

2. A Review of the Related Literature

Since the integration of dynamic computable general equilibrium model and game theory has never been considered or used in the literature, in this section the studies conducted on natural gas and energy trade within the framework of game theory and CGE model will be reviewed. He and Lin (2017), Lin used a CGE model to investigate the effect of natural gas prices on variables in China. The results show that: an increase in natural gas price can reduce carbon emission, or tends to cause a long-term decline in the surplus profit rate of the natural gas industry. Moreover, the increase in natural gas price may raise the CPI, and reduce actual GDP and residents' welfare. Zhang and et.al (2017), investigated Natural Gas Price Effects in China Based on the CGE Model. Using the Computable General Equilibrium model and the 2012 Social Accounting Matrix, the results show increases in natural gas prices lead to an increase in the consumer price index (CPI) and lead to reductions in GDP.

Hamie and et. Al (2020), Modelled Post-Liberalized European Gas Market Concentration with a Game Theory Perspective. The results of the parametric method demonstrate that the gas suppliers' behavior in Austria and The Netherlands gas markets follows the Nash–Cournot equilibrium, where companies act rationally to maximize their payoffs. The non-parametric approach validates the fact that suppliers in both markets follow the same behavior even though one market is more liquid than the other. Chen (2023) investigated mpact of carbon border adjustment mechanism on China's manufacturing sector with a dynamic recursive CGE model based on an evolutionary game. The evolutionary game-based CGE model takes into account the dynamic strategies of both sides and is therefore less affected by carbon tariff shocks and recovers more quickly and more realistically. The results indicate that under the intra-EU competition condition, carbon tariffs will reduce the price of Chinese exports and slightly decrease China's real GDP, as well as the carbon emission intensity of 18 sectors and fossil energy.

Orlov (2016) investigated Effects of higher domestic gas prices in Russia on the European gas market with game theoretical Hotelling model. Results show that, the stock elasticity increases, so does the increase in total gas consumption. Furthermore, the results show that increasing the domestic gas price is associated with an annual average increase in the export tax revenue from gas of 38.4 billion USD and an annual average reduction in the domestic gas subsidy of 34.1 billion USD. Meng and e.t. al (2023) used A STAMP-Game model for accident analysis in oil and gas industries. The obtained results demonstrate that the proposed game model allows for identifying the effectiveness deficiency of the supervisory entity, and the safety and protection altitudes of the supervised entity. The STAMP-Game model can generate quantitative parameters for supporting the behavior and strategy selections of the supervisory and supervised entities. The quantitative data obtained can be used to guide the safety improvement, to reduce the costs of safety regulation violation and accident risk.

Esmaili et al. (2015), used the game theory approach to analyze the conflict between Iran and neighboring countries such as Qatar and Iraq over oil and gas resources. The results indicated that management of common resources and settlement of disputes between actors and adoption of reasonable policies by parties are recommended for the extraction of joint oil and gas reserves. Toufighi et al. (2022), used cooperative and non-cooperative game approaches to model production strategies for optimal production, sales price and actors' profit. The results of Nash equilibrium indicated that cooperation strategy is the best strategy and Nash equilibrium in this study.

Salimian and Shahbazi (2018) used game theory to find the best strategy for Iran against neighboring countries sharing joint gas and oil fields. The best approach for Iran and other countries, regardless of whether they adopt cooperative or non-cooperative approaches, is mutual agreement and compromise. Kheiravar et al. (2017) used the dynamic game theory to investigate oil and gas producing countries and discover investment and production decisions made in the global oil market. They showed that oil producing countries maximize their profits and consumer surplus through cooperation and a mixed oligopoly. Csercsik (2022) formalized a game theoretic model to investigate the gas supply crisis in Europe and strategies that could be used to fill this gap and promote supply security. The results showed that cooperation based on voluntary participation may contribute to the more efficient utilization of storage capacities. Hi et al. (2020) integrated cooperative and non-cooperative game theory and the Stackelberg model to investigate energy system integration in China. Chen et al. (2017) investigated the allocation mechanism of oil import/export share in China using dynamic game theory.

Roman and Stanculescu (2021), modeled the natural gas transportation system using cooperative game theory in order to determine the bargaining power of the major players (Russia, Ukraine, Germany, and Norway). Results showed that Russia dominates the market in any scenario, and by avoiding Ukraine, its position is even further strengthened. Moreover, Germany's position remains stable considering its diverse imports and large storage capabilities. Toufighi & Soltani (2022), investigated the stability of oil and gas production in common fields using static game theory. The results indicated that cooperative game is the best strategy actors can adopt. Huang et al. (2019), used the game theory to investigate the optimal scheduling method for multi-energy hub systems. They showed that the optimal scheduling method using game theory has a strong robustness in multi-energy hub systems.

Bayati et al. (2019), used a cooperative game theory to investigate Iran-Qatar extraction of joint gas reserves of South Pars field. The results showed that a non-cooperative game theory can be recognized as an optimal mechanism for both Iran and the rival countries. Hoshangi et al. (2020) investigated the conflict between OPEC and gas exporting countries within the framework of game theory. The results showed that based on the cumulative response function in the case of the formation of a gas cartel, these two cartels will choose collusion strategies. Costa & Lontelli (2018), used a 2 x 2 game strategy to investigate real-world strategies used in the oil and gas industry. They suggested that the real cases of the oil and gas industry should be examined in the form of strategic games so that the main problems ahead can be solved.

Other reserachers who have conducted studies on energy within the framework of the game theory include Chen et al. (2017), Oritz et al. (2021), Castillo & Dorao (2012), Nagayama & Horita (2014). According to the domestic and foreign literature, dynamic calculable general equilibrium model and game theory have never been interactively used in any investigation in the gas industry. Therefore, the present study is innovative as it uses the above two approaches to investigate the effects of gas pricing approaches used by Iran and Qatar, and their effects on exports and selection of the optimal strategy.

3. The Study Model

Game theory is used to investigate the problem of decision-making between several interested parties. A complete game consists of three elements: players, strategies, and interests. Players refers to the decision makers involved in the game. Strategy refers to a set of decisions available to players and the scope of their decisions in the game process. Benefit (pay-off) refers to the income that players often get in the game process to maximize their profit or benefit (Liu et al., 2018). In this research, the game is considered static in terms of simultaneity and dynamic in terms of sequence of movements; Because the movements are simultaneous. For static games, the normal or strategic form is used, which includes the number of players, who are the decision makers of the game (here are the two countries of Iran and Qatar). Thus, the set of players are: N= {I, Q}, I represents Iran and Q represents Qatar.

The guideline of the players; the strategy includes the plan of the players in the game, which consists of cooperation and non-cooperation. For each country, the strategies are: $S_Q = \{C, NC\}$ and $S_I = \{C, NC\}$. In these expressions, S represents the strategy of each country, and C contains the cooperation strategy and NC contains the non-cooperation strategy. For this game, the total combination of players' strategies is as follows, which is obtained from the Cartesian multiplication of each player's strategies, and these elements will be in the following ordered pair:

$$S = S_I \times S_Q = \{C, NC\} \times \{C, NC\} = \{(C, C), (C, NC), (NC, C), (NC, NC)\} \quad (1)$$

The outcome of the players: The outcome of each player in the game is one of the main elements and depends on the player opponent strategy. The outcome of the players in terms of strategic form will be as follows:

$$\begin{array}{ll} U_I(C, C) = \gamma & C\epsilon S_I, C\epsilon S_Q \\ U_Q(C, C) = \gamma & C\epsilon S_I, C\epsilon S_Q \\ U_I(C, NC) = \theta & C\epsilon S_I, NC\epsilon S_Q \\ U_Q(C, NC) = \alpha & C\epsilon S_I, NC\epsilon S_Q \\ U_I(NC, C) = \alpha & NC\epsilon S_I, C\epsilon S_Q \\ U_Q(NC, C) = \theta & NC\epsilon S_I, C\epsilon S_Q \\ U_I(NC, NC) = \beta & NC\epsilon S_I, NC\epsilon S_Q \\ U_Q(NC, NC) = \beta & NC\epsilon S_I, NC\epsilon S_Q \end{array} \quad (2)$$

The strategic form of the restricted game with two openers can be shown as a matrix; Because it is easy to analyze and in the real world, most of the games are played between two parties (players). The matrix form of the game, in a game where there are two players. (Abdoli, 2010).

- Rows of the matrix: each row represents one of the strategies of the first player.
- Columns of the matrix: represents one of the strategies of the second player.
- Matrix elements: each matrix element consists of two numbers, the first number (left side) shows the outcome of the first player and the second number (right side) shows the outcom of the second player.

3.1 Methods of solving the game

The purpose of finding the answer and solving the game is to predict or explain performance of the game players; This means, among the combination of strategies of the players in which the strategy determined by the player, which combination occurs in practice or should occur and this combination that occurs in practice is called equilibrium. The solution methods include the following:

3.1.1 The method of removing the beaten strategies (equilibrium in dominant strategy)

There are different methods to choose optimal or desirable strategies for a player. Eliminating beaten strategies is one of the ways to solve a game to choose the optimal strategy of the players. A beaten strategy is a strategy that worsens the situation of the target player in any condition. In this case, all the defeated strategies are removed and the solution of the game is found, which is also called the equilibrium in dominant strategy.

3.1.2 Nash equilibrium

Another method is Nash equilibrium. In game theory, it is assumed that the players are rational; That is, their chosen strategy is in line with their interests. The Nash equilibrium is achieved when each player; First according to his belief about the opponent's choice, chooses a strategy that gives him the most results; Second, the player's belief about the opponent's strategy should be correct.

3.2. GTAP data base and DCGE model

In the GTAP model, based on the production structure, the condition of zero profit is formulated for each activity. The company's production in the first layer is a combination of value-added of energy and combined Transitions, special energy inputs, internal and external transitions and foreign goods supplied from different regions. Energy goods are removed from the transitional node and added to the value-added node. This place of energy in value-added is achieved through several stages. In the first stage, the value-added of energy composition is considered as a combined capital energy product.

Therefore, this form of combination in energy is divided into electricity and non-electricity. In the next layer, non-electric energy is divided into coal and non-coal, and non-coal itself is divided into oil, gas, and oil products. For each node, the external demand for each input in each region can be considered separately. (Nejati & Bahmani 2020) In all energy levels, the demand for inputs such as transition and primary production inputs are completed using the CES function and the principle of minimization of production costs. Substitution tensions between all layers are obtained from the GTAP database (Lejour et al., 2008).

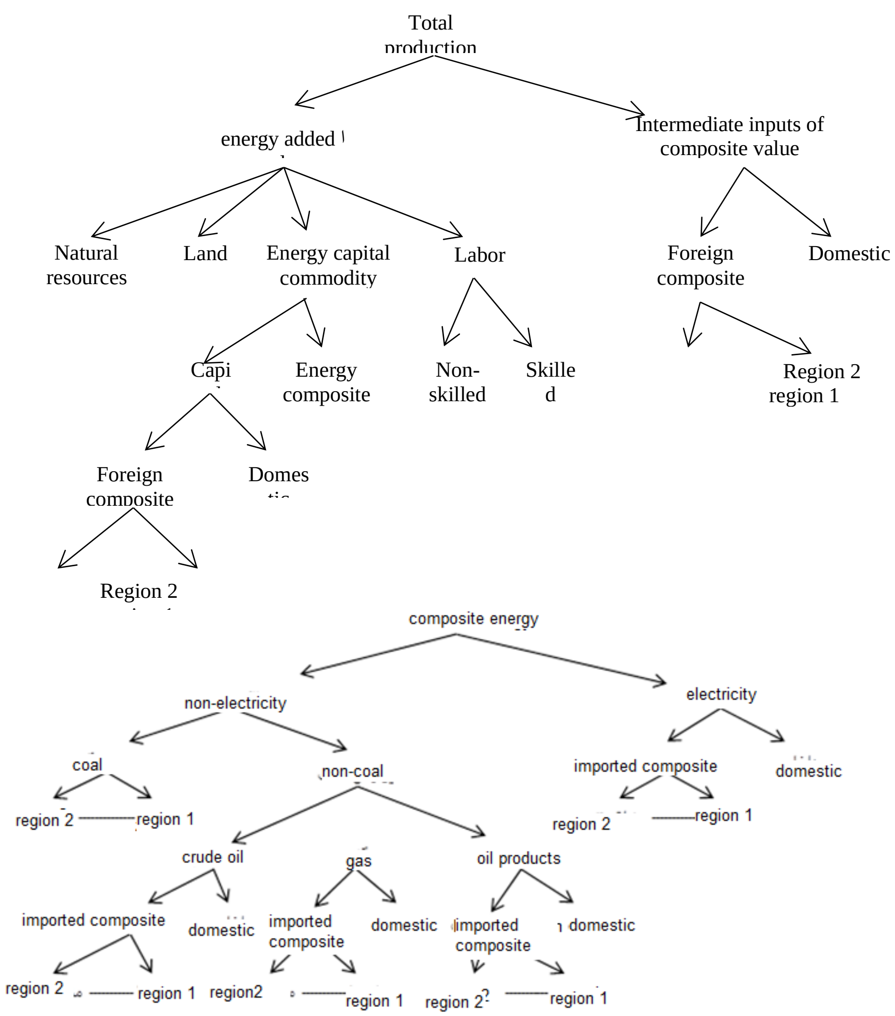

Figure 1.2. Total production node in GTAP-E model (technology tree) Buriaux and Truong (2002)

Source: *Buriaux and Truong (2002)*

Considering that the topic investigated in this research is gas price export changes in Iran and Qatar, the effect of these momentum is considered as exogenous. First of all, the momentum of gas price in this model is examined and then its effects on gas export are discussed in a chain. Since the equations in the GTAP-E model are linear, so the equations are linear and the effects of impulses are a chain of equations as follows. Here, the variable to which the momentum enters is the pm variable*:*

$$\mathrm{VXWD}(\mathrm{i},\mathrm{r},\mathrm{s}) = \mathrm{pfob}(\mathrm{i},\mathrm{r},\mathrm{s}) * \mathrm{qxs}(\mathrm{i},\mathrm{r},\mathrm{s}) \quad (3)$$

$VXWD(i,r,s)$: Export of commodity i from region r to region s at FOB price, $pfob(i,r,s)$, $qxs(i,r,s)$

$$\mathrm{VXW}(\mathrm{m},\mathrm{r}) * \mathrm{vxwfob}(\mathrm{m},\mathrm{r}) = \mathrm{sum}(\mathrm{s},\mathrm{REG},\mathrm{VXWD}(\mathrm{m},\mathrm{r},\mathrm{s}) * [\mathrm{qxs}(\mathrm{m},\mathrm{r},\mathrm{s}) + \mathrm{pfob}(\mathrm{m},\mathrm{r},\mathrm{s})] \quad (4)$$

VXW(m,r) , the export value of commodity i in region r at FOB prices, VXW(m,r)*vxwfob(m,r), change in FOB value of export commodity m from region r, VXWD(m,r, s), denotes the export value of commodity i from region r to s at global prices.

$$\mathrm{VXWREGION}(\mathrm{r}) * \mathrm{pxwreg}(\mathrm{r}) = \mathrm{sum}(\mathrm{i},\mathrm{TRAD}-\mathrm{COMM},\mathrm{VXW}(\mathrm{i},\mathrm{r}) * \mathrm{pxw}(\mathrm{i},\mathrm{r})) \quad (5)$$

VXWREGION(r), export value in region r at FOB prices, …… the price index of export commodity in region r, VXW(i,r), the export value of commodity i in region r at FOB prices and pxw(i,r) , the total export price index for product i in region r.

$$\mathrm{VIMS}(\mathrm{i},\mathrm{r},\mathrm{s}) = \mathrm{pms}(\mathrm{i},\mathrm{r},\mathrm{s}) * \mathrm{qxs}(\mathrm{i},\mathrm{r},\mathrm{s}) \quad (6)$$

VIMS(i,r,s) , the import of commodity i from region r to s at domestic market prices and pms(i,r,s), the domestic price of commodity i imported from region r to s.

$$\mathrm{qxw}(\mathrm{i},\mathrm{r}) = \mathrm{vxwfob}(\mathrm{i},\mathrm{r}) - \mathrm{pxw}(\mathrm{i},\mathrm{r}) \quad (7)$$

qxw(i,r), the total export rate of goods i from region r at FOB prices.

$$\mathrm{pfob}(\mathrm{i,r,s})=\mathrm{pm}(\mathrm{i,r,s})-\mathrm{tx}(\mathrm{i,r})-\mathrm{txs}(\mathrm{i,r,s}) \quad (8)$$

pfob(i,r,s), the FOB global price of commodity i exported from region r to s, pm(i,r,s), the market price of commodity i exported from region r to s, tx(i,r), changes in export subsidy Commodity i from region r and txs(i,r,s), the change in the export subsidy on commodity i from region r to s.

$$\mathrm{pcif}(\mathrm{i},\mathrm{r},\mathrm{s}) = \mathrm{FOBSHR}(\mathrm{i},\mathrm{r},\mathrm{s}) * \mathrm{pfob}(\mathrm{i},\mathrm{r},\mathrm{s}) + \mathrm{TRNSHR}(\mathrm{i},\mathrm{r},\mathrm{s}) * \mathrm{ptrans}(\mathrm{i},\mathrm{r},\mathrm{s}) \quad (9)$$

pcif(i,r,s) is the CIF value of commodity i exported from region r to s, FOBSHR(i,r,s), the FOB share in VIM, TRNSHR(i,r,s) is the transportation share in VIM and ptrans (i,r,s), the cost index for the international transportation of commodity i from region r to s.

$$ps(i,r)=to(i,r)+pm(i,r) \quad (10)$$

ps(i,r), the supply price of product i in region r and TO(i,r), the tax on production/income of product i in region r.

In this research, by using the dynamic computable general equilibrium (DCGE) model and GEMPACK software, the pay-off matrix were obtained which consists of gas exports from Iran and Qatar using different gas price scenarios, the matrix solution method, and the Nash equilibrium for the year 2022, 2023 and 2024.

4. Empirical Results

Modeling was conducted and existing scenarios were developed using the Dynamic computable General Equilibrium (DCGE) estimated using Social Accounting Matrix (SAM) 2014 derived from GTAP10 database. The social accounting matrix has 141 regions, 65 economic sub-regions and 8 production agents. In the present study, the number of regions was diminished to 4 regions, Iran, Qatar, common target markets such as India, Pakistan, Europe, China and other regions and 65 sectors were diminished into five sectors of oil, gas, industry, agriculture and services and eight Production agents were diminished into 5 production agents, including land, labor, natural resources, capital and energy. Energy inputs derived as production inputs from GTAP-E model were classified into coal, crude oil, gas, oil products and electricity. The sections were classified based on the standard classification model of Diao and Thurlow (2012). The significant features of the model were analyzed and simulated according to Iran-Qatar specific model within the framework of GEMPACK software, and the pay-off matrix was obtained from the estimates of general equilibrium model that can be calculated dynamically, and the optimal price strategy was discovered with respect to the quantity of Iran and Qatar's gas exports and using game theory and solving the matrix by eliminating the dominated strategy.

In order to implement different scenarios in the model, the context should be changed according to the intended goal. Using the context one can figure out which variable are exogenous and which are endogenous variable. In order to change the method used to formulate the standard model, an exogenous variable should be exchanged with an endogenous variable. This exchange doesn't cause any change in the number of endogenous variables of the model. In other words, exchange allows the modeler to shift one or more variables from an endogenous position to an exogenous one and vice versa. According to the research objective gas price for Iran and Qatar were designated as exogenous variables and the gas export from the two countries was designated as an endogenous variable. The game used in this research shares the same structure as that of prisoner's dilemma that represents denial, non-cooperation and confession and cooperation. On the one hand, Iran and Qatar both play a decisive role in the target market, and on the other hand, the quantity of imports made by the target market is fixed, the game is considered static and of complete information.

In the present study, different price scenarios were investigated. For instance, the scenarios of natural gas price increase by 0.5, 0.7. 1% has been considered for Iran and Qatar, and the pay-off matrix 2022, 2023 and 2024 was obtained as follows.

Table1. Variations in the exports of Iran and Qatar (2022)

$a_{0.5,0.5}$ (0.14,0.01)	$a_{0.5,0.7}$ (5.31,0.14)	$a_{0.5,1}$ (13.30.-0.35)
$a_{0.7,0.5}$ (-4.87,0.17)	$a_{0.7,0.7}$ (0.26,0.02)	$a_{0.7,1}$ (8.21,-0.16)
$a_{1,0.5}$ (-12.31,0.41)	$a_{1,0.7}$ (-7.24,0.25)	$a_{1,1}$ (0.67,0.16)

Source: *Research finding*

As for the price increase scenario in different situations, the Nash equilibrium 2022, 2023 and 2024 was obtained in the scenario of gas price increase of 0.5% for Iran and Qatar through the game theory matrix. When the gas price increases by 0.5%, Iran's gas exports will increase in 2022; But Qatar's gas export rises less dramatically than that of Iran.

Table2. Variations in Iran and Qatar's exports (2023)

$a_{0.5,0.5}$ (0.12,0)	$a_{0.5,0.7}$ (5.48,-0.17)	$a_{0.5,1}$ (13.87,-0.29)
$a_{0.7,0.5}$ (-5.08,0.16)	$a_{0.7,0.7}$ (0.23,0)	$a_{0.7,1}$ (8.57,0.10)
$a_{1,0.5}$ (-12.8,0.39)	$a_{1,0.7}$ (-7.55,0.23)	$a_{1,1}$ (0.69,0.19)

Source: *Research finding*

According to the matrix solution, in 2023, the best strategy for Iran and Qatar is price increase by 0.5% for both countries. With 0.5% increase in gas prices, Iran's exports will increase by 0.12 percent and Qatar's gas exports will remain intact. As Qatar has always made the most out of its gas capacities and has never sold its gas for low prices (1). In this case, a 0.5% increase in gas prices, Qatar won't increase gas exports as it holds a significant share of common target markets; Iran, on the contrary, will increase exports in this scenario as it is facing a shortage of export capacities.

Table3.Variations in the exports of Iran and Qatar (2024)

$\boldsymbol{a_{0.5,0.5}}$ (-0.09,0.04)	$a_{0.5,0.7}$ (5.7,-0.10)	$a_{0.5,1}$ (14.49,-0.32)
$a_{0.7,0.5}$ (-5.88,0.20)	$a_{0.7,0.7}$ (-0.12,0.16)	$a_{0.7,1}$ (8.59,-0.16)
$a_{1,0.5}$ (-14.49,0.16)	$a_{1,0.7}$ (-8.79,0.30)	$a_{1,1}$ (-0.17,0.09)

Source: *Research finding*

According to the matrix solution, in 2024, the best strategy for Iran and Qatar is price increase by 0.5%. With a 0.5% increase in gas prices for Iran, the country's exports will decrease by 0.09% and Qatar's exports will increase by 0.04%. Because Iran and Qatar's share of target market countries in this research is considered equal and fixed, and when gas demanding countries increase their capacity Qatar will meet their needs. For Qatar, price rise is the best strategy to gain a larger share of the market. It is appropriate; but Iran, as the country facing sanctions and shortage of available capacities in the gas sector and gas extraction, won't be able to meet the needs of the demanding countries, which will in turn lead to shrinkage of Iran's share of the common target markets. The results of Bayati et al. (2019) showed that the lack of cooperation between Iran and Qatar in harvesting from the joint fields of South Pars has more benefits for these countries. Meanwhile, the result of Naji Maidani (2015) and Rahimi (2015) indicated that cooperation will have more benefits than non-cooperation for actors.

5. Concluding Remarks

Today, oil and gas are recognized as critical leverages in international relations, and can lead to dominance of one country over others. This dominance and attempts countries make to maximize their profit, will lead to conflicts and disputes. Thus, it is of critical importance to specify the stance of the two main competitors in the natural gas market. Since the competitive structure in the natural gas market is determined with respect to the framework of game theory, and as the present study seeks to investigate the effect of the natural gas price on Iran and Qatar's gas exports, the dynamic general calculable equilibrium model and the game theory are integrated in the present study. Thus, the following question is raised here: taking into account the degree of competition between the two countries, can increase in the price of natural gas affect gas exports of these countries. In an attempt to find the answer to this question, the researchers used dynamic computable general equilibrium model and social accounting matrix 2014 to specify different gas price scenarios and used game theory to obtain the optimal strategy for Iran and Qatar. The results indicate that, with respect to gas price scenarios of 2022-2024, the best strategy for Iran and Qatar will be 0.5% price increase; as with a 0.5% increase in gas prices, the exports of Iran and Qatar, as two competitors, will increase.

Therefore, according to the equilibrium forms, by adopting an optimal strategy, both countries can maximize their benefits in the future through stepwise gas price rise. The fact that the huge South Pars reservoir is shared between Iran and Qatar has been the basis for serious competition in the exploitation of both countries. After meeting its limited domestic needs, Qatar has become the main exporter of this product in the world with the help of western companies and through the implementation of numerous projects for the production of liquefied natural gas. On the other hand, despite the ambitious goals of becoming an exporting country, Iran has failed to achieve these goals due to reasons such as the postponement of projects and international sanctions. According to the conditions of Iran and the results of this research, the best way to increase the share of exports and benefits in this field is to cooperate with Qatar. Also, Iran should seek maximum use and exploitation of the South Pars field by seeking the help of Qatar and other countries and applying the technical knowledge and capital of these countries.

Author Contributions:

Conceptualization, all authors; methodology, DCGE and Game theory.; validation, DCGE and Game theory; formal analysis, all authors; resources, DCGE and Game theory writing—original draft preparation, DCGE and Game theory; writing—review and editing, all authors; supervision, DCGE. All authors have read and agreed to the published version of the manuscript.

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