A Gas Cartels in the Market, Hype or Reality?

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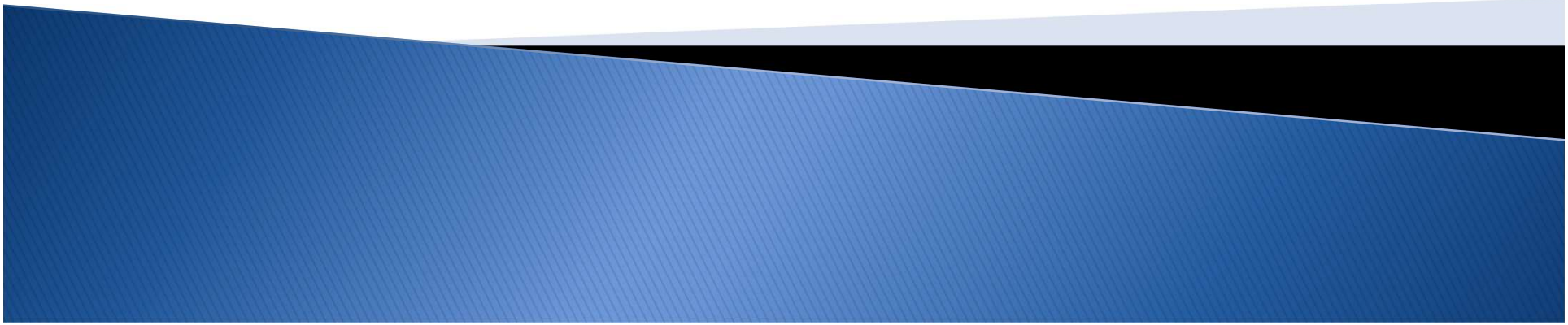


Background

- In late 2018, Qatar left the OPEC
- The announcement stressed on the Gas market
- Qatar is a key player in the GECF
- The issues of Gas cartel formation again drew attentions

Basic Questions?

- The Interaction Between Two Cartels and their members
- Which Countries Are Interested in Gas Cartel?
- Under Which Condition Gas Cartel agreement is Possible?
- The Effect of Gas Cartel Formation on P and Q of Oil and Gas

Countries Classification

- I: Export only oil, OPEC members: KSA, Kuwait, Iraq.
- II: Export only oil, not members of OPEC: UK, Syria.
- III: Export both oil and NG and OPEC members: Qatar, Iran, Algeria, Nigeria, Venezuela.
- IV: Export both oil and NG, not members of OPEC: Oman, Canada, Russia, Norway.
- V: Export only NG: Turkmenistan, Ukraine, Uzbekistan, Bahrain.

In The Model

- Group A: Export only oil, OPEC members: KSA, Kuwait, Iraq.
- Group B: Export both oil and NG, OPEC members: Qatar, Iran, Algeria, Nigeria, Venezuela.
- Group C: Export only NG: Turkmenistan, Ukraine, Uzbekistan, Bahrain.

Demand Function

$$P_i(Q_i, Q_j) = \alpha_i - \beta_i Q_i - \theta_i Q_j$$

for $i, j \in \{O, G\}$ and $i \neq j$
P_i : Price of product i
Q_i : Quantity of product i
Q_j : Quantity of product j
α_i : Maximum price of product i (intercept)
β_i : Effect of the quantity of product i (direct effect)
θ_i : Effect of the quantity of product j (indirect effect)

$$\beta_i, \beta_j \geq \theta_i, \theta_j \geq 0$$

Cost Function

- Marginal cost of production is constant and the same for all producers of a given good.

Cartel Profit Function

- When the cartel is formed, members try to maximize the sum of their profit, which includes their profit in substitute market, λ_A and λ_C show their share in each market profit.

Cartel Profit Function (Cont.)

- Scenario 1(base):

$$\pi_{OC}^{1} = \lambda_A \pi_O + (1 - \lambda_A)\pi_O + \pi_{G,B}$$

$$\pi_{B}^{1} = (1 - \lambda_A)\pi_O + \pi_{G,B}$$

$$\pi_{G,C}^{1} = q_{G,C}[(\alpha_G - \beta_G(q_{G,B} + q_{G,C}) - \theta_G Q_O - C_G)]$$

- Scenario 2:

$$\pi_{OC}^{2} = \lambda_A \pi_O + (1 - \lambda_A)\pi_O + (1 - \lambda_C)\pi_G$$

$$\pi_{GC}^{2} = \lambda_C \pi_G + (1 - \lambda_A)\pi_O + (1 - \lambda_C)\pi_G$$

Stability of the Cartel and Bargaining Factors

- They form a cartel if they are better off in the cartel compared to staying out.
- $\pi_B^1 \leq \pi_B^2$ and $\pi_C^1 \leq \pi_C^2$
- Agreement possibilities for cartel formation:
  - With money transfer
  - Without money transfer

Results– The effect of Gas Cartel Formation on P and Q

- Theorem 1: Following the formation of the gas cartel, for any sets of parameters:

i) Q_O increases

ii) Q_G decreases

iii) P_G increases

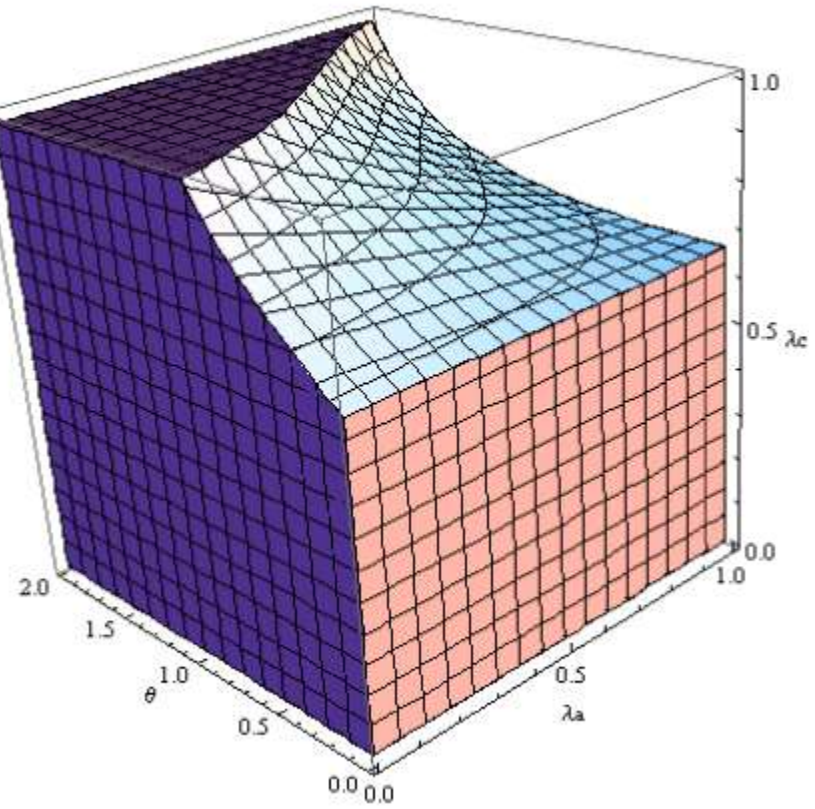
- Theorem 2:

The effects of the gas cartel formation on P_O is ambiguous.

Results (Gas Cartel Formation Feasibility)

- Theorem 3: There are some set of parameters such that there are no mutually beneficial political agreements.

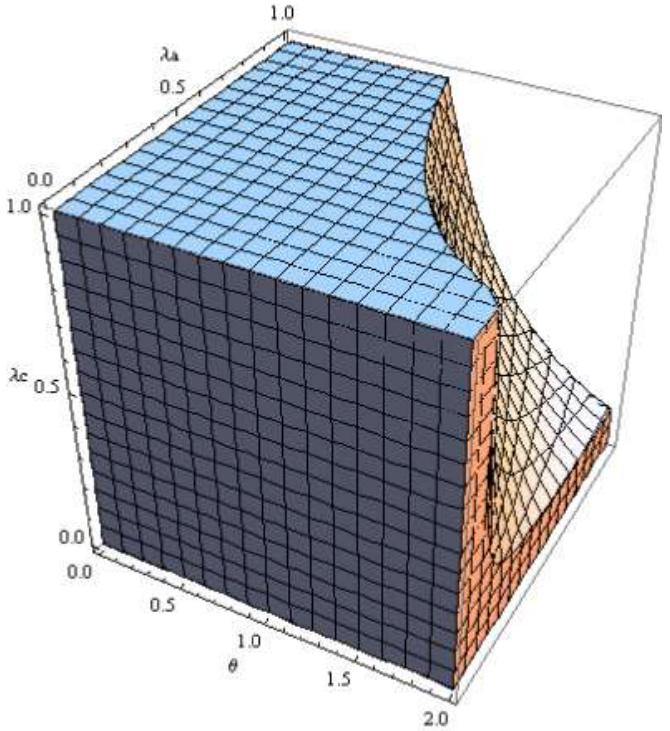
Values of θ, λ_A , and λ_C for which the oil price increases after the formation of the gas cartel with ($\alpha=1,\beta=2,C=0$)



Results (Gas Cartel Formation Feasibility)

- Theorem 4: There are some set of parameters such that there are no mutually beneficial monetary agreements

Values of θ, λ_A, and λ_C for which mutually beneficial monetary agreement is possible with ($\alpha=1, \beta=2$ and $C=0$)



Conclusion

- In reality, since no money transfer is possible, the cartel formation is feasible only in narrow region of λ_C and θ. Hence it vulnerable
- Findings implicitly indicate that λ_A is not a crucial factor impacting the formation of gas cartel.

Conclusion (Cont.)

- powerful and active members of OPEC who are also key players of gas market prefer a joint strategy for both oil and gas.
- But countries that have unbalanced portfolio of oil and gas supply may not be interested to remain in both if there is an efficient gas cartel.

Future Works

- Including all five country groups and model their willingness to join the cartel and the effects of the new gas cartel on each group's profits.

Thank you

Literature Review

- General Cartel Behavior and Its Stability

Harrington (2005), Feurestein (2005), Iwarani et al.(2007), Villar (2004), Choi et al (2009)

- Applied (Gas Cartel Formation and Its Effect)

Ehrman (2006), Egging et al.(2009), Gabriel et al. (2010)

Method of Solving

- Four Different Level of Symmetric Parameter,
- Level One: all Parameters are symmetric except λ

$$\alpha_O = \alpha_G = \alpha \ , \ \beta_O = \beta_G = \beta \ , \ \theta_O = \theta_G = \theta \text{ and } C_O = C_G = C$$

- Level Two: Only θ is Symmetric
- Level Three: θ and β are Symmetric
- Level Four: All parameters are Asymmetric

Equilibrium P, Q and Profits Scenario 1

$$Q_O^1 = \frac{(\alpha - C)\ (\beta - \theta)}{2(\beta^2 - \theta^2) + \lambda_A \theta^2}$$

$$Q_{G,B}^1 = \frac{(\alpha - C)(2\beta - \theta)(\beta + \theta(-1 + \lambda_A))}{3\beta(2(\beta^2 - \theta^2) + \lambda_A \theta^2)}$$

$$Q_{G,C}^1 = \frac{(\alpha - C)(2(\beta^2 - \theta^2) + 2\theta^2\lambda_A - \beta\theta\lambda_A)}{3\beta(2(\beta^2 - \theta^2) + \lambda_A \theta^2)}$$

$$P_O^1 = \frac{C(\beta + \theta(3\beta^2 - 2\beta\theta + \theta^2(-1 + \lambda_A))}{3\beta(2(\beta^2 - \theta^2) + \lambda_A \theta^2)} + \frac{\alpha(3\beta^3 - \beta^2\theta - \theta^3(-1 + \lambda_A) + \beta\theta^2(-3 + 2\lambda_A))}{3\beta(2(\beta^2 - \theta^2) + \lambda_A \theta^2)}$$

$$P_G^1 = \frac{C(\beta + \theta)(4\beta + \theta(-4 + \lambda_A)) + \alpha(2\beta^2 + 2\theta^2(-1 + \lambda_A) - \beta\theta\lambda_A)}{6\beta^2 + 3\theta^2(-2 + \lambda_A)}$$

Equilibrium P, Q and Profits Scenario 1(Cont.)

$$\pi_A^1 = \frac{(\alpha - C)^2(\beta - \theta)\lambda_A(3\beta^3 - \beta^2\theta - \theta^3(-1 + \lambda_A) + \beta\theta^2(-3 + 2\lambda_A))}{3\beta(2(\beta^2 - \theta^2) + \lambda_A\theta^2)^2}$$

$$\pi_B^1 = \frac{-(\alpha - C)^2(2\beta^3\theta(9 - 7\lambda_A) + 5\theta^4(-1 + \lambda_A)^2 + \beta^4(-13 + 9\lambda_A))}{9\beta(2(\beta^2 - \theta^2) + \lambda_A\theta^2)^2} +$$

$$\frac{-(\alpha - C)^2(\beta^2\theta^2(8 + \lambda_A(-17 + 8\lambda_A)) - 2\beta^3(-1 + \lambda_A)(-9 + 7\lambda_A))}{9\beta(2(\beta^2 - \theta^2) + \lambda_A\theta^2)^2}$$

$$\pi_C^1 = \frac{(\alpha - C)^2(2\beta^2 + 2\theta^2(-1 + \lambda_A) - \beta\theta\lambda_A)^2}{9\beta(2(\beta^2 - \theta^2) + \lambda_A\theta^2)^2}$$

Equilibrium P, Q and Profits Scenario 2

$$
\begin{aligned}
Q_O^2 &= \frac{(\alpha - C)(2\beta + \theta(-2 + \lambda_A))}{4\beta^2 - \theta^2(-2 + \lambda_A)(-2 + \lambda_C)} \\
Q_G^2 &= \frac{(\alpha - C)(2\beta + \theta(-2 + \lambda_C))}{4\beta^2 - \theta^2(-2 + \lambda_A)(-2 + \lambda_C)} \\
P_O^2 &= \frac{-C(2\beta^2 + \theta^2(-2 + \lambda_A) + \beta\theta\lambda_C)}{-4\beta^2 + \theta^2(-2 + \lambda_A)(-2 + \lambda_C)} + \\
&\quad \frac{\alpha(-2\beta^2 + \theta^2(-2 + \lambda_A)(-1 + \lambda_C) + \beta\theta\lambda_C)}{-4\beta^2 + \theta^2(-2 + \lambda_A)(-2 + \lambda_C)} \\
P_G^2 &= \frac{-C(2\beta^2 + \theta^2(-2 + \lambda_C) + \beta\theta\lambda_A)}{-4\beta^2 + \theta^2(-2 + \lambda_A)(-2 + \lambda_C)} + \\
&\quad \frac{\alpha(-2\beta^2 + \theta^2(-2 + \lambda_C)(-1 + \lambda_A) + \beta\theta\lambda_A)}{-4\beta^2 + \theta^2(-2 + \lambda_A)(-2 + \lambda_C)}
\end{aligned}
$$

Equilibrium P, Q and Profits Scenario 2(Cont.)

$$\pi_A^2 = \frac{\lambda_A(\alpha-C)^2(2(\beta-\theta)+\theta\lambda_C))(2\beta^2-\theta^2(-2+\lambda_A)(-1+\lambda_C)-\beta\theta\lambda_C)}{(-4\beta^2+\theta^2(-2+\lambda_A)(-2+\lambda_C))^2}$$

$$\pi_B^2 = \frac{(\alpha-C)^2(2\theta^3(-2+\lambda_A)(-1+\lambda_A)(-2+\lambda_C)(-1+\lambda_C)}{(-4\beta^2+\theta^2(-2+\lambda_A)(-2+\lambda_C))^2} -$$

$$\frac{(\alpha-C)^2(4\beta^3(-2+\lambda_A+\lambda_C)+4\beta^2\theta(-2+\lambda_A+\lambda_C))}{(-4\beta^2+\theta^2(-2+\lambda_A)(-2+\lambda_C))^2}$$

$$+\frac{(\alpha-C)^2\beta\theta^2(-8+3\lambda_A^2(-1+\lambda_C)-3(-4+\lambda_C)\lambda_C)}{(-4\beta^2+\theta^2(-2+\lambda_A)(-2+\lambda_C))^2}$$

$$\frac{(\alpha-C)^2\beta\theta^2(\lambda_A(12+\lambda_C(-16+3\lambda_C)))}{(-4\beta^2+\theta^2(-2+\lambda_A)(-2+\lambda_C))^2}$$

$$\pi_C^2 = \frac{\lambda_C(\alpha-C)^2(2(\beta-\theta)+\theta\lambda_A))(2\beta^2-\theta^2(-2+\lambda_C)(-1+\lambda_A)-\beta\theta\lambda_A)}{(-4\beta^2+\theta^2(-2+\lambda_A)(-2+\lambda_C))^2}$$

Results– The effect of Gas Cartel Formation on P and Q

- Theorem 01: Following the formation of the gas cartel, for any sets of parameters:

i) Q_o increases

ii) Q_G decreases

iii) P_G increases

- Theorem 02:

The effects of the gas cartel formation on Po is ambiguous.