COMPETITION AND COOPERATION IN THE NATURAL GAS MARKET

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Overview

Europe, as one of the major importers of natural gas, has been highly dependent on Russian exports. The practice of transporting Russian gas to Europe via transit countries has, however, been stymied by problems such as the Russia-Belarus energy dispute since 2007, the Russia gas disputes with Ukraine and similar political turmoils. As it is in Europe's interests to explore alternative gas sources, Russia too increasingly adopts a strategic position by diversifying from pipeline exports to LNG production on the Yamal Peninsula.

EU and Asia-Pacific LNG import markets have substantially boosted from 1996 to 2016 and LNG imports by OECD-Europe have increased from 21 bcm to 56.4 bcm, and that by Asia-Pacific have grown from 80.2 bcm to 241.6 bcm (BP, 2011 and 2017a). The share of gas in primary energy will grow while that of oil and coal will decrease, and LNG is expected to grow rapidly and help form a globally integrated gas market (BP, 2017b). This potential growth is largely attributed to rapidly developing Asian-Pacific economies (Komiyama, 2005), shale gas in the US (BP, 2017b) and the closure of nuclear power plants in Japan since 2013 after the Fukushima accident. Conversely, natural gas consumption in OECD-Europe has declined from 2011 to 2014 (BP, 2017a) but is expected to grow slowly in the next decade (EIA, 2016). These projections, however, are indeterminate due to the interplay of various uncertainties, such as the multiple supply options, volatile prices and volumes, and Japan's restoration of her nuclear capacity (EY, 2013). Nevertheless, the growing Asian-Pacific LNG demand has made Russia a supply competitor.

This paper explores various possibilities in the evolving global gas market. It estimates models involving the major players: Russia and Qatar exporting gas to Asia-Pacific and Europe. With a series of hypothetical scenarios such as Russia expanding her involvement in the Asia-Pacific through LNG exports and Qatar catering to the European market as an alternative supplier through pipeline gas, it derives expected prices and quantities from numerical simulations.

Methods

Russia LNG to Asia: Assume inverse demand for LNG in Asia is in the form of $P = a - bQ$ in which P and Q are the wholesale price and quantity respectively. Let l_i and c_i^e be the unit cost of liquefaction and gas extraction in exporting country i and the marginal cost of exporting gas (assume FOB terms of delivery to exclude for shipping costs) is $MC_i = m_i + (l_i + c_i^e)Q_i$ with $m_i > 0$ is the miscellaneous costs adjustments.

Scenario 1: Qatar is the market leader in LNG export, Russia is the follower.

Profit function of Russia: $\pi_R = PQ_R - \int_0^{Q_R} MC_R dQ_R = (a - b(Q_R + Q_Q))Q_R - m_R Q_R - (l_R + c_R^e)\frac{Q_R^2}{2}$

Profit function of Qatar: $\pi_Q = PQ_Q - \int_0^{Q_Q} MC_Q dQ_Q = (a - b(Q_Q + Q_R))Q_Q - m_Q Q_Q - (l_Q + c_Q^e)\frac{Q_Q^2}{2}$

Scenario 2: When Russia acquires a larger share of the Asian market, the Stackelberg game becomes the Cournot game where both Russia and Qatar choose quantity simultaneously in light of the other's best response function.

Scenario 3: When Russia and Qatar collaborate, we assume Asian importers would unite to form a monopsony. The scenarios 1 and 2 change to a bilateral monopoly game.

Qatar pipeline gas to Europe: The proposed pipeline is from South Pars gas field Saudi Arabia, via Jordon and Syria, to Turkey and Europe but Syria rejected the plan in favour of the Iran/Iraq/Syrian Islamic pipeline.
Assume there are n transit countries. Denote c_Q be the unit cost of transporting gas borne by Qatar, τ_i be the transit fee by transit country i, q_i be the own gas production of transit country, $Q_E(P_E)$ be the demand for Qatar's gas in Europe, $Q_i(P_i)$ be the gas demand function in transit country i.

Scenario 1: Qatar transports the gas up to the border between the last transit and Europe.

Profit function of Qatar is determined as: $\pi_Q = (P_E - c_Q - \sum_{i=1}^{n} \tau_i).Q_E(P_E) + \sum_{i=1}^{n} (P_i - c_Q).(Q_i(P_i) - q_i)$

Optimal transit fee is given by: $\tau_i^* = \frac{1}{2}(\frac{a_E}{b_E} - c_Q + c_{iT} - \sum_{i \neq j} \tau_j)$

Scenario 2: Qatar sells all exported gas to the last transit country (the country right next to Europe). The preceding transit countries are ignored. Qatar plays the role of a leader in the Stackelberg game with this transit country.

Results

In this simulation, demand curve in Asia-Pacific is constructed using 2 data points, one is the latest LNG price and quantity into major importers, the other is from projections of LNG price and quantity 5 years later with a growth rate based on historical trends. Demand curve in Europe is built on conjectured cases 5 and 10 years later. Qatar is supposed to fill partially the gap between growing pipeline gas demand into Europe and the amount supplied by other pipeline exporters. Competition between pipeline gas and LNG is not included for simplicity.

With the assumptions that the conventional JCC-linked LNG imported to Asia and oil-linked pipeline imported to Europe will be delinked from oil in the medium term in an effort to reduce increasing natural gas price, the hypothetical scenarios feature ideal situations where price of gas is dependent on demand and supply fundamentals (or gas-to-gas competition pricing). The optimal prices and quantities based on the above framework are calculated accordingly:

	Optimal price (US$/mmBtu)	Optimal quantity (bcm)	Optimal transit fee (US$/mmBtu)
Russia LNG to Asia			
Scenario 1	13.91	86.30 (Qatar), 2.76 (Russia)	-
Scenario 2	13.92	86.07 (Qatar), 2.76 (Russia)	-
Scenario 3	13.98 (export), 7.68 (import)*	87.69 (export), 70.59 (import)	-
Qatar pipeline gas to Europe			
Scenario 1	5.65	10 (expected)	2.3
Scenario 2	10.2	15 (expected)**	-

*In further simulations, the agreed price between importers and importers can be gauged by mininimizing the welfare possible that each party is willing to get and from there, a capped price range is estimated.

**Optimal quantity can be deduced based on price and transit results at a transportation fee of US$0.9/mmBtu and transit fee of US$0.5/mmBtu. Sensitivity analysis will be carried out to examine the impacts of these two components on the optimal price.

Conclusions

Assuming growing demand in Asia-Pacific, faltering outlook in EU, supply costs and with the confluence of supply, demand factors and price projections, competitive and cooperative outcomes for both exporters and importers of pipeline gas and LNG are studied. It appears that it is important for Russia to strike a deal with Qatar in the Asia market and accelerate their gas production in order to put them in a level ground field with the LNG market leader. Russia is likely to benefit more if it can link with Qatar to act as a monopoly on their segmental demand curve. On the other hand, Qatar's profit is expected to be higher under the scenario when Qatar sells all the gas to the last transit country as the sole demand point instead of going through the transit process to bring its gas into Europe. This originates much from the fact that Qatar's proposed pipeline has to go through several transit countries before going to Europe and thus their cost is inflated. It is then determined that an elimination of transit would be beneficial for both sides.

References

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