

The option value of Gazprom's spare capacity under the threat of US LNG on the European gas market

Extended abstract Work in progress

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Abstract

This article examines the extent to which Russia could delay a massive entry of US LNG into Europe by using its spare capacity on the European spot gas market. With a real option-game model with one-sided incomplete information and characterized by the presence of an historical gas supplier and a potential entrant, we show that the flexibility offered by the spare capacity may delay the entry of a new competitor.

JEL classification: D81, Q30, Q40.

1 Introduction

As part of its policy to establish a single, competitive market for gas, one of the priorities for the European Union is to diversify its sources of supply, in the face of the oligopoly formed by Russia, Algeria, Norway and Qatar. The structural and cyclical developments of this market - competitive market, excess supply (overcapacity of liquefaction), weak demand - have already led incumbent suppliers to adapt to maintain their market share. This is also the case of Russian gas company, Gazprom, which serves as a baseline for our analysis of the influence future competition on the behaviour of major incumbents and the strategic options open to them. For the future, the intensity of the competition will depend on several factors mainly the evolution of global LNG supply and the evolution of

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the China and India gas demand – the EU market market is increasingly positioning itself as a residual market for LNG exports – and the evolution of European demand (Corbeau and Yermakov, 2016). Particularly in one case - oversupply situation with high LNG supply, low China and India gas demand - the competition on the EU market between LNG and pipeline gaz will be strong.

With a 30% share of the EU gas market, Gazprom is a major supplier, exerting an influence on prices and enjoying several comparative advantages (Boussena and Locatelli, 2017). US LNG exports could thus compete strongly with Gazprom in the North-West Europe market, the heart of the Russian company's strategy. On the latter, Gazprom is a major player, but it is not a "price maker", especially since most of its sales (nearly 80%) are made in the form of long-term contracts (TOP), with a price indexation formula based on those of oil. Today, the major challenge for Gazprom lays not so much in current US LNG exports as in future projects because of the resulting export volumes. Given the projects already completed (operational) and under construction, the US LNG export capacity should exceed 100 Bcm by 2020 ((Dickel et al. (2014), Maugeri (2014)). But if we take into account projects whose investment decision is not yet taken, the US LNG export capacity could be more than 300 Bcm in 2030 (CRA Insights, 2018). This new conjuncture is forcing Gazprom to review its strategy. For the time being, with an over-supply market, the latter have simply adapted passively, mainly by revising some clauses of the long-term contracts which govern sales to the EU and more particularly by decreasing its prices just below the variable delivery cost of its main competitor, the US LNG. These strategies, widely analysed in the literature (Corbeau and Yermakov (2016), Benhmad and Percebois (2014)) were based on a price war. However, with the threat of growing competition, such strategies may not be enough to cope with the scale of US LNG exports.

In a context of low prices and only in this context¹, a second strategic behavior can be defined by Gazprom, in the image of Saudi Arabia in the international oil market. To this end, Gazprom has a second comparative advantage, which is that of its unused delivery capacity (in terms of production and transport). With a significant spare capacity (150 Bcm) since the beginning of 2010 and in the specific context of the European gas market - hybrid, in overcapacity and not totally globalized - , Gazprom is able to influence the evolution of prices by using it or not on the spot markets. Likewise, the spare capacity may be a strategic variable that will strengthen the context of uncertainty in which decisions concerning new LNG projects are made.

Before deploying a strategy of this sort a particular a player must check that the EU

¹In a context of high prices that reflect high demand pressure, the competition issues between US LNG and Russian gas do not really arise as all the available supply is needed to meet on demand. The strategic behavior of the actors is therefore different.

gas market fulfils certain conditions. There must be a gas-gas competition regime, making price signals more credible and feeding high price volatility, which in turn increases the price risk aversion of the potential investors. Looking specifically at the EU gas market, allowance must be made for its hybrid nature, with expanding free markets co-existing with transactions based on long-term contracts. Spot markets account for about 40% of gas transactions in the EU, the rest being covered by long-term contracts. The dominant supplier should get undeniable comparative advantages such a lower production. Moreover the incumbent should dispose of spare capacity, to flood the market at any time, as is the case with Saudi Arabia and the world oil market. Gazprom meets all these conditions. Certainly, it does not enjoy as dominant a position as Saudi Arabia for oil. But since there is not yet a global gas market, it may dominate the hybrid EU gas market at least for 10 to 15 years. Lastly, we should keep in mind that this strategy is deployed against aggressive new entrants with grassroot projects still awaiting a final investment decision. Naturally, this decision should be taken only if the return on investment is positive. Likewise, investment in natural gas field is a subject on which is grafted a plethora of questions, such as the consideration of the time, the adaptation to market conditions according to the arrival of the information, or that of the irreversibility of the investment. Complex and important, it is not surprising that the decision to invest in natural gas markets warrants special consideration on dynamics, uncertainty and risk, alternatives, etc. In this context, economic analysis based only on the cost-benefit analysis may be insufficient. In an uncertain environment, it is particularly difficult to anticipate future cash flows generated by a project.

Real options theory attempts to value the flexibility that is inherent in many investment projects. Flexibility allows investment plans to be deferred or changed as new information arrives; by responding appropriately to the arrival of such new information, investment decision-makers are thus able to take advantage of new opportunities and/or to mitigate actual or opportunity losses. For example, most investment programmes can be delayed if market drivers (price, demand) turn out to be lower than anticipated. In this case, flexibility potentially saves large amounts of unnecessary expenditure. This can be contrasted with standard NPV analysis, which ignores the ability of decision-makers to respond to new information. Real options analysis complements NPV analysis by including additional sources of value that are ignored by standard NPV calculations. Because flexibility is valuable, real options are potentially important for many types of investment decision.

In our paper, we use insights a real options approach to analyse the effectiveness of using the spare capacity to modify the investment decisions of a possible new entrant. We derive the optimal thresholds, the equilibrium strategies and the option value of Gazprom's

spare capacity. More specifically, we extend previous contributions through a dynamic framework where the main player has the option to use or not the spare capacity which comes with zero cost and by focusing on the value of this option and its determinants: scale of use, production cost advantage, price elasticity, volatility and growth rate. Under the threat of a new entrant, the incumbent may adjust its volume of sales, by injecting some part of its surplus capacity into the spot market. This unusual flexibility may alter the market conditions and thus the uncertain evolution of gas prices determined by an inverse demand function.

Our main findings show the importance of a dynamic game framework, allowing us to analyze and isolate the value of the spare capacity in a competitive environment with a significant pressure of new entry. More particularly, one of the main results of our model is that the incumbent's option to use or not the spare capacity at any time can afford protection for a while, discouraging a potential new entrant. However, the use of spare capacity to permanently prevent arrival of a new entrant is not sufficient, in the sense that it is possible to delay entry but not to forbid it. Given the greater uncertainty on market conditions, the optimal behaviour for an entrant would be to wait long enough for prices to reach a level justifying investment in the EU market. This level of prices may be altered through the incumbent's competitive advantage of holding an important amount spare capacity. If the level of prices is sufficiently high, the incumbent may inject additional capacity on the spot market in order to dissuade its competitor. Likewise, we show that the market equilibrium and trigger values change accordingly the scale of the incumbent's spare capacity used on the spot market.

To our knowledge, our paper is the first to apply the real options games approach to conceptualize and to quantify the option value and the role of the spare capacity on international gas markets. By giving a positive role to the opportunity to use the spare capacity as a strategic variable under threat of a potential competitor, our work has an important practical implication in showing the optimal strategy under simultaneous market and competition risk.

2 Related literature

Our paper uses insights from different strands of economic literature: entry deterrence strategies through excess capacity and real options games with signaling.

The former strand is that of entry barriers and preemption. Works of Bain (1956), Salop (1979), Bernheim(1984) state that entry occurs whenever there are opportunities of economic profit, conditionnal on the current strategy of the incumbent. An important review related to entry deterrence literature can be found in Wilson (1992) who separates

the entry deterrence strategies in three types: preemption, signalling and predation. Most of these entry deterrence models focused on barriers to entry and preemption. Classically, in preemption models, the incumbent can make a move in the first stage (for instance, use excess capacity, send a signal or create a reputation of a tough player) which may indicate that the entry on the market may be unprofitable. More particularly, seminal theoretical contributions (Spence (1977) and Dixit (1980)) have attempted to take into account the excess capacity and its role in competition among firms. In a deterministic framework, the authors show that the excess capacity is held by existing firms for strategic reasons to induce the potential entrant to stay out of the market.

The latter and the most recent strand concerns real options and games theory. Since the '80s, the real options theory is a modern approach used to better analyze problems of strategic decisions in domains with a high degree of uncertainty: natural resource exploration, energy industry, biodiversity, research and development, development of new technologies, etc. This theory is rooted in the decision theories and helps to explain phenomena like the dynamic nature of the decision, not addressed by the traditional method of discounted cash-flows.

The concept of *option value* was firstly developed in the work of Arrow and Fisher (1974), Henry (1974) and Myers (1976). The latter formalizes the concept under the name of *real option*. In their research, these economists show that the information available in the future is not valuable for an irreversible decision, but it is for a reversible decision. In this way the value of additional information is an important argument in favour of a reversible decision. In fact, the value of new information can be zero or positive, depending on the degree of reversibility of the decision. The difference between the value of information for a reversible decision and a irreversible one is an option value. The objective of research in these pioneering works is to show that traditional cost-benefit analysis ignores the fact that information on the consequences of the investment can be revealed in the future, the analysis being then inexact. Actually, the option value underlines this result: if we do not take into account the arrival of information during the life cycle of a project, then the analysis is biased. From an economic point of view, this statement is essential. In reality we must have indicators that can estimate the error induced when ignoring the arrival of additional information. In this sense the option value is a measure of the flexibility cost, since the choice of flexibility is never free for a firm. The price paid to benefit from this option value is the opportunity cost of non-flexibility.

However, the decision to invest is not taken in an isolated context, it involves strategic considerations in a competitive environment. An option-oriented approach focuses on maximizing the value of an option, without considering strategic interaction between market players, but game theory fills this gap. Thus, an important number of studies

come out and emphasize the complementarity between these theories and their usefulness to assess complex decision problems. The seminal contributions by Fudenberg and Tirole (1985), and Reinganum (1981), provide the basic components of game theory in a deterministic framework. Recent publications have seen contributions on using option games to allow for uncertainty. An important part of real options literature show that the decision to invest may be inhibited by different exogenous uncertainties like variable demand, fluctuating prices or production cost. Also, supplementary risk coming from the threat of rival firms may have extra impact on the optimal decision mainly in incomplete competitive markets where the decision of one firm could change the natural equilibrium between the supply and the demand and consequently, the clearing price. Smets (1991) presented a basic model, in continuous time, bearing on exercising a real option under conditions of competition in a market. He considered the decision by a firm in a duopoly situation whether or not to relocate production initially based in a developed country to an emerging economy with lower production costs. Subsequent work by Dixit and Pindyck (1994), Huisman and Kort (1999), Boyer, Lasserre, Mariotti and Moreaux (2002, 2012), Huisman and Kort (2013), Huberts et. al. (2019) has extended this strategic model and provided other applications for option games.

One of the most challenging research in this area are contexts with incomplete information or asymmetry of information between the players and presence of real options. These special category of signaling real options games involve a complex theoretical setting and they are tackled in a quite few number of scientific publications. Important contributions to the issue are brought by Grenadier (1999,2000) who introduces a real options duopoly game which is further modified through the introduction of signaling between the market players. Grenadier et Malenko (2011) provide a real options game where the decision to exercise a real option is defined as a signal of private information to competitors. They also consider that outsiders beliefs affect the profit of the decision-maker. These signals distort the timeline of the option and the direction of distortion is dependent on the increase or the decrease of the decision-maker's payoff from the exercise. In the first case, the authors observe an erosion of the option value to wait and an earlier exercise, whereas in the second case, the option is delayed. Four corporate financing situations are used to show the implications of their model: managerial myopia, cash flow diversion, product competition and venture capital. Other relevant work on real options signaling games can be found in Lambrecht and Perraudin (2003), Décamps and Mariotti (2004), Pawlina and Kort (2005), Watanabe (2016), Gryglewicz and Kolb (2018).

Similar to these papers who jointly assess the value of real options and the role of the information structure, the main theoretical contribution of our paper lies on the examination of the strategic role of the spare capacity which comes with no cost. This

increases the usual asymmetry between firms considered in previous works: the important asymmetry in terms of costs is supplemented by an information asymmetry. In fact, by holding an unusual comparative advantage, hence a real option to use or not the spare capacity, the incumbent firm may undertake aggressive defense strategy in order to deter competitor's entry on the market. Two reasons motivate our application of the aforementioned theoretical insights to the natural gas market.

On one hand, there is a lack of studies related to this subject. Indeed, when it comes to the economic literature in conjunction to the role of spare capacity in energy markets, during our survey, only very little reporting in scientific publications have been identified. The recent article of Boussena and Locatelli (2017) seems to be the starting point of emphasizing the role of Gazprom spare capacity on international gas markets. They argue without a mathematic formulation that the strategic use of surplus capacity may influence the volatility of natural-gas prices and its impact on investment decisions of a potential new entrant. Also, Corbeau and Yermakov (2016) analyze a possible « price war » between the US LNG exports and the Russia gas pipeline exports. While these authors highlight the Gazprom's comparative advantages in such a price war, they do not address the consequences of this competition on the investment strategies of the US competitor. Finally, Bros (2018) notes the new importance of the spare capacity concept for the natural gas markets. The present article follows these studies by offering a quantitative approach. On the other hand, the currentness of the subject is undeniable given that the international gas market face a new competitive environment, with changes in markets fundamentals. The issue has been tackled by Benhmad and Percebois (2014), and Yanga, Zhang and Zhang (2016) who take account of the structure of the gas market in deterministic models, which make no allowance for uncertainty, shocks or random events. Thus, integration of such approaches to assess competitive international gas markets remains a field largely open to exploration.

3 Main assumptions underpinning the model

For simplicity's sake, we treat the EU market structure as a duopoly. On the one hand, we consider Gazprom as a single incumbent, other large suppliers to the wholesale market taking their cue from its behaviour. On the other hand, we assign the role of "single entrant" to potential investors in exports of US shale gas to the EU, assuming that this role is representative of all other prospective vendors potentially interested by this market. We highlight two determinants affecting the decision to invest: real option to wait and competitive advantage of spare capacity. In our model the incumbent supplier

and potential entrant meet on free spot markets (some of which are hubs²), where prices are determined by supply and demand. Both players are confronted with market risk and strategic risk. The options of each player create negative externalities on the rival's values. We show that in the presence of spare capacity and uncertain market conditions, the strategic behaviour of players (incumbent and entrant) differ from the situation without the possibility to use the spare capacity. We use a classic model of competition with one-sided incomplete information: the stochastic evolution of the demand is supposed to be known by the two players, but the timing of use of the spare capacity is a private information for the incumbent that can be revealed through the exercise of this option. More precisely, we assume the structure of information as follows: besides the fact that at each time t the incumbent and the entrant observe the realization of the stochastic evolution of demand, there is also a Bayesian learning regarding the behaviour of the rival. In this context, the belief about the likelihood of the incumbent's action in the future allows us to obtain the optimal strategy of the competitor.

4 Preliminary results

First, we demonstrate that Gazprom is motivated to use its surplus capacity held in reserve in order to deter the entry of a potential LNG competitor and keep its market share a longer period of time. In fact, the additional uncertainty related to the strategic action increases the likelihood of the entrant subsequently learning that the value of its profits may fall quite low in the future, thus making its investment sub-optimal. So premature market entry incurs an opportunity cost for the entrant. To avoid this cost the potential competitor is prepared to wait until it can obtain more information and consequently retain the option of investing in the EU gas market a little longer. This being so, the entrant would rather keep its option, because the higher the probability of large drops in prices in the future, the greater the critical value must be to convince the player that this is the optimal moment for entry. It will enter the market later than in the case with only market uncertainty.

Second, the threshold motivating the decision to invest of the entrant is increasing with the scale of the spare capacity used by the incumbent. This result shows that not only the signal of using the spare capacity, but also the intensity of the signal have a role in inducing the competitor to delay its investment.

Third, our results show that the value of the option to use spare capacity comprises two effects: the one related to the future expected profits generated after the use of spare capacity and the one related to the effect on the decision to invest of the entrant. The

²Long-term contracts govern a large share of natural gas produced and sold by Russia.

first short-term effect may be negative given the important drop in prices, but it can be counterbalanced by the positive effect stemming from the delayed decision to invest of the competitor. Even if the reduction of current profits is significant, by sending signals that he can adopt an irrational behavior, Gazprom can deter future investments and increase the present value of future cash-flows. Likewise, detaining a very large competitive advantage may influence the prior beliefs of competitors concerning the optimal time of investment.

Fourth, we also show that the threat of a new competitor reduces the flexibility of the incumbent to keep the option alive for longer periods, for instance hold the spare capacity to serve the market when the demand naturally asks for it. More particularly, the threshold motivating its use depend on the intensity of threat.

5 Policy implications

Setting aside geopolitical constraints, our results show that, given its comparative advantages, Gazprom would gain by finding its place in the competitive market advocated by the European Commission, but at the same time the latter should make more allowance for the various consequences of a completely open market. Given its spare capacity, Gazprom may still dominate the market.

Also, in terms of energy policies, we may question on the systematic defense of high prices from 2009 to 2014. Maintaining prices at this level for so long sent an encouraging signal to potential competitors, particularly those working on LNG projects. Lastly, a spare capacity can be understood as a "strategic uncertainty" and has value for the actor who holds it. The use of spare capacity in spot markets, however, brings about a profound change in Gazprom's traditional export strategy. First, it assumes that Gazprom agrees to intervene more heavily in the spot markets and become a price taker. In addition, the question of the evolution of the price indexation formula of his long-term contracts would arise. An important debate is open on this subject. Does Gazprom have an interest in selling all its gas in free markets (Henderson, 2016; Rogers et al., 2015; Chi-Kong Chyong, 2015) or in combining two ways of sales? An extension of the present work aims to answer the question.

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