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Access to natural gas storage facilities: Strategic and regulation issues

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ABSTRACT

In this paper, we analyze the strategic function of gas storage focusing on how gas storage decisions impact competition between gas companies on both spot and downstream markets. Using a two-tier oligopolistic structure, we first show that gas storage is actually used strategically even in a symmetric oligopolistic setting along the gas value chain. Storage is then a way to intensify competition on the spot market. Second, we analyze the setting where a company has favored access to storage, for example due to a historical monopolistic position, and we analyze this as a leadership situation in the context of TPA regulation. We then show that this setting compels the leader to adopt a strategic storage decision. This strategy consists of levels of gas stored being greater than supplies available in the downstream market. Such a leader decision is part of a strategy to raise a rival's costs. Furthermore, one can think that optimal regulation of the access to storage facilities would prevent such a behavior. However, especially when storage is not too costly, we show that preventing a storage strategy for the leader is not optimal, since the strategy helps to reduce the spot market price.

1. Introduction

Faced with increasing gas demand in Europe and within the context of the gas market opening, the European Commission (EC) has underlined the need for developing gas sourcing arrangements other than long-term contracts. In addition, the slump in the indigenous gas production for the coming years puts strong pressure on Europe, which is then likely to face a substantial gap between gas supply and demand in the near future (Eurogas, 2010). Many factors can explain the increasing demand for gas such as the retail energy market opening, cost reduction in electricity generation from gas, abundant gas resources available and production expected from unconventional gas worldwide. However, this forecasted gas demand is especially related to the expected demand for renewable energy and the corresponding need for power grid balancing. Besides, European figures on gas industry show a significant increase in installed capacity of gas fired power generation in recent years.

Within such a context, and following the Energy Sector Inquiry (European Commission, 2007) that underlines the lack of liquidity in gas markets, the EU considered the need to improve gas liquidity and then to foster gas-to-gas competition to ensure supply gas flexibility mainly over the short term (e.g. Day-Ahead and Within-Day flexibility). The Energy Sector Inquiry states that "the sub-optimal levels of liquidity exist in these [European] markets. In particular, the prevalence of long-term supply contracts between gas producers and incumbent importers makes it very difficult for new entrants to access gas on the upstream markets". Hence, developing spot markets, gas hubs and Third Party Access (TPA) to storage capacities can increase liquidity on wholesale gas markets and enable gas companies to trade-off among their gas supply sources in a shorter term. More recently, the Council of European Energy Regulators (CEER, 2011) launched a consultation process to define the so-called Gas Target Model (GTM). This model is a long-term view for natural gas wholesale markets that enables European market integration by facilitating liquidity and flexibility within each entry–exit zone and by reducing cross-border congestion.

More flexibility should encourage gas companies to implement effective asset management for their supplies and trade-off between available sources in the short and long terms. Supply sources diversification is particularly useful during peak demand periods and when resources are insufficient with respect to the subscribed long-term contracts.[1] Furthermore, flexibility in wholesale markets facilitates the development of competition by new entrants in downstream gas markets.

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[1] For instance in France, long term contracts represent 80% of supply sources for Gaz de France. In the same way, long term contracts represent 90% of supply sources for the Belgian incumbent Distrigas, as mentioned in its annual report for 2005.

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Broadly, a gas company can manage its supply portfolio using several flexibility tools for obtaining the quantities which are not covered by the internal supply sources and long-term contracts: long-term flexible contracts, upstream vertical integration,[2] and short-term instruments for flexibility such as spot markets[3] and demand interruptibility. Lastly, gas companies can use natural gas storage capacities and LNG facilities to satisfy the demand increase during peak periods. In Europe, the past years have seen significant change in the attitude toward trading and this is especially the case for spot markets trading. Heather (2012) concludes that gas hubs development came from changing behavior of buyers and sellers of gas. More precisely, he explains that hub operators often adjust their storage portfolios trading gas on spot markets that become more and more mature. It is the case of some trading hubs in Europe (e.g. Dutch Title Transfer Facility or, Gaspool Balancing Services). This illustrates the existence of a growing interrelation between gas storage and spot markets. Gas storage is also becoming a significant flexibility tool when choosing a gas supply portfolio as it is observed in many American states. Following the European Union's decision, storage capacities have been transferred to third parties since August 2004 (third party access to storage).

Nowadays, storage is generally considered a natural gas flexibility tool. All gas flexibility tools can be used by downstream gas suppliers to satisfy the demand especially during peak periods. The Guidelines of Good Practice for Third-Party Access for Storage System Operators (ERGEG, 2005) clearly identified underground gas storage as a flexibility tool competing with other flexibility sources. Following Directive 2009/73/EC (European Commission, 2009), *gas flexibility tools* can be: i) storage in dedicated underground storage facilities, ii) LNG (storage) facilities, iii) interruptibility of customers, iv) flexible supply long-term contracts, v) flexible trading in gas on hubs and vi) pipeline swing gas and/or line-pack flexibility. Previously in the European Union, particularly due to limited storage capacities, flexibility tools such as the spot market were not the usual practice. Storage was traditionally considered a technical tool enabling the optimization of the gas transmission system and ensuring continuity of the service. In our model, we take into account this new flexibility role of storage and analyze how storage can influence strategic decisions made by gas competitors. This strategic dimension is reinforced by the fact that, in this case, storage concerns an intermediate good and can, therefore, influence vertical relationships between oil–gas companies and suppliers through the spot market. The main topic of this paper is the study of storage decisions from gas companies as a means for raising rivals' costs.

Our paper is organized as follows. Section 2 offers a brief literature review to contextualize the contribution of our paper. Section 3 develops the framework of the model. Section 4 considers the benchmark case of the game where gas companies are symmetric firms. Section 5 assumes that one of the gas companies is a leader in its storage strategy. For these two last sections, we proceed with a welfare analysis in order to assess the social impact from all strategic behaviors. The last section contains our conclusions. Proofs are not given in the text, but may be found in the Appendix A.

2. Related literature and motivations

Economic literature on storage activities is relatively extensive. Traditionally, storage has been considered an investment that enables firms to adjust their supply when demand is uncertain or exposed to cyclical fluctuations. This is the *traditional function* of storage. Three traditional motivations are then identified in economic literature for explaining the benefits of storage for firms: speculation, precaution and seasonal production smoothing. The storage speculative function is relatively well accepted. In this case, storage enables firms to obtain a positive income faced with an exogenous shock which, for instance, influences the market price of the stored good. Theoretically, Kirman and Sobel (1974), Philps and Richard (1989) and, Williams and Wright (1991) study storage in general contexts of intertemporal price discrimination. In these cases, storage introduces an intertemporal fixed price reliance in which decisions made during a certain period are dependent upon actions from previous periods. Concerning precautionary motives of storage, some papers analyze how stock allows firms to regulate market supply in response to an uncertain demand. In the case of natural gas storage, Chaton et al. (2008) analyze optimal depletion of gas reserves in various scenarios, and particularly, the opportunity for regulatory authorities to maintain safety stocks. Lastly, firms can choose storage in order to smooth the cyclical fluctuations of the demand. From an empirical point of view, a recent trend in literature focuses on the links between storage decisions and natural gas prices. For example, Modjtahedia and Movassagh (2005) and Xiaoyi (2007) highlight that storage has an impact on the volatility and level of natural gas prices. These analyses show that competitive natural gas storage, indeed, has a significant impact, not only on spot and future price levels for natural gas prices, but also on price volatility.

The *strategic function* of storage has initially been analyzed by Arvan (1985), Saloner (1987) and Pal (1991, 1996). Storage ensures a strategic function when it influences the future decisions of rival firms. This is due to the fact that it may be used by firms as a commitment means based on quantities. An oligopolistic firm may be induced to invest in storage capacities to preempt the future production of its competitors. In line with this perspective, Saloner (1987) and Pal (1991, 1996) consider a duopoly model in which, during the first period, firms choose their advance production (which is assimilated to their storage level) and then, over a second period, firms sell their products in the market. With a Stackelberg leadership, they show that firms may be induced to produce in advance, even if their production is more expensive during the first period. Poddar and Sasaki (2002) examine incentives for firms to produce in advance in a multiperiod competitive setting. They show that advance production can be a strategy to endogenously create a Stackelberg leadership. Storage may then be a tool to implement such a strategy.

Recently, specific literature has been developed on strategic aspects of natural gas storage decisions. Baranes et al. (2005) consider that storage facilities can be strategically used as a foreclosure tool. In order to analyze competition in gas markets, the activity of storage is included in a standard model of vertical relationship, where firms can inject or withdraw strategically natural gas resource at the intermediate level. Results show that access to a storage facility can deteriorate the welfare since it gives incentives to the vertically integrated firms to use it strategically. However, these incentives can be reduced by vertical integration between storage and distribution and thus can improve social welfare. Cavaliere et al. (2013) study storage allocation as an efficient rationing mechanism to improve competition and efficiency in gas markets. They compare market equilibrium in a dominant firm model assuming both a centralized allocation of storage by generic rationing rules and storage auctions. In an industrial context they show that storage capacity should be completely allocated to competitors, letting the leader supply gas by just resorting to the storage substitute.

Similar to our present analysis, Durand-Viel (2007) studies the effect of storage decisions on upstream resource prices. In a two-tier oligopolistic structure, it is shown that storage allows suppliers, not only to preempt future demand, but also to counter upstream producer market power. Indeed, the traditional vision of third-party access supposes that incumbents have incentives to deter entrants from storage capacities. However, when taking into account the specifics of gas market structure, it is shown that a storage facility owner does not always have incentives to foreclose on competitors in downstream markets. He might prefer to let his rival bear the costs associated with holding inventories and benefit from reductions of the spot market price. Aside from these analytical contributions, some papers have tackled these issues

[2] For instance, this has been done by merger and acquisition of holdings in oil and gas companies.

[3] Since 1998 in Europe, gas hubs have been established. For example, these spots markets are located in Bacton (UK), Zeebrugge (Belgium) and Emden (Germany).