



Efficient mechanisms for access to storage when competition in gas markets is imperfect

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ABSTRACT

Scarce storage capacity and distortions in access to storage can lead to market foreclosure in liberalized gas markets. We consider rules currently adopted in Europe for storage allocation, and discuss efficient rationing mechanisms as based on the value of storage, when other flexibility inputs are partially available. We initially analyze productive efficiency issues, without explicitly considering vertical restraints. We then assume imperfect competition in the downstream market for gas supplies, given the availability of storage capacity upstream, and analyze strategic behavior in a two-stage model. In this framework we compare regulated storage tariffs – coupled with a centralized rationing mechanism – with storage auctions. Finally, we consider the allocation of storage that arises from welfare maximization by a benevolent social planner. We find that it is usually optimal to maximize the amount of storage capacity allocated to new entrants in liberalized gas markets. Storage auctions deviate from the optimal mechanism, but still afford greater efficiency than do rules that allocate storage capacity independently of its value. Furthermore, storage allocation appears to be a powerful mechanism with which to improve competition and efficiency in gas markets.

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1. Introduction

A particular feature that differentiates natural gas from electricity is that storage enable operators to cope with demand fluctuations, whether predictable or unpredictable. Seasonal fluctuations are the most important ones,¹ but weekly and intra-day demand changes are not negligible either. Utilities need to constantly balance demand and supply (which is commonly flat). Access to storage gives suppliers the flexibility they need to face demand uncertainty. Moreover, as storage activities generally imply gas injections when prices are lower (summer) and gas withdrawal when prices are higher (winter), gas suppliers can profit from a winter–summer spread. Further spreads may be cashed by the use of storage as a financial option for short-term cycles of injection–withdrawal, and hence for speculation on the volatility of gas prices, provided spot and future markets for the commodity are liquid enough. But storage may also be useful to face gas shortages in importing countries, whose exposure to the risk of supply failures from non-EU countries is substantial. Hungary and Italy, for example, dispose of huge reserves of gas that are devoted to this purpose (strategic storage). Finally, storage

is also used by gas producers for supply optimization and by the transmission system operator to maintain physical balancing within the network.²

Before the liberalization of European gas markets, storage was used by vertically integrated utilities to optimize the size of the transmission network in the long run and to manage gas flows efficiently in the short run.³ After liberalization, new entrants should gain access to storage capacity in order to ensure the regularity of gas supplies; in fact, any supply failure would threaten their reputation as gas sellers. The lack of storage capacity can therefore be a barrier to entry (ERGE, 2010). Though storage scarcity calls for more investments in new storage fields, access rules to existing plants are also crucial to the availability of natural gas for the management of demand fluctuations. Inefficient access rules may lead to the simultaneous allocation of inadequate capacity to some suppliers and allocate excess capacity to others. If the latter behave strategically, inefficient access rules may give rise to capacity hoarding and an increase in rivals' costs. If a new entrant has no flexibility tools

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¹ Seasonal storage is also used by utilities, to satisfy public service obligations to the extent that households must be protected by supply shocks and are given priority over other types of customer.

² Individual gas suppliers, as shippers, may in turn resort to storage for commercial balancing purposes, in order to avoid penalties when unbalances arise ex-post in the transmission network.

³ The availability of storage plants circumvents the need to configure the size of the transmission network to peak demand, and hence enables big savings on investment costs for pipelines. It follows that any significant expansion in pipeline capacity should be coupled with some increase in storage capacity. In the very short term, pipeline capacity could also be used for storage purposes (linepack).

available but storage, the hoarding of storage capacity by the incumbent can prevent the new entrant from extending its market share.

According to the last enquiry carried out by the European Commission on the energy sector (CEC, 2007), distortions in access to gas storage are seen as a prominent cause of market foreclosure, one that constraints competition in the wholesale and retail markets. Accordingly, the regulation of access to storage may represent one of the key issues for the implementation of competition after liberalization across Europe. Our approach to this issue considers storage as a “flexibility” input, i.e. an additional source of gas supply that usefully balances both seasonal and unexpected demand fluctuations. As such, gas storage can – to a certain extent – be substituted by other flexibility inputs like production swing, the increase/decrease of import flows (in the case of flexible contracts) or interruptible contracts with industry. Distortions in the allocation of gas storage may result from access rules that do not account for the differences both in the availability and in the cost of storage substitutes between gas suppliers. Though our analysis considers storage capacity as being sold by independent firms to gas suppliers, we suggest that, in keeping with our assumptions, our model can also encompass the case of storage supplied by a branch of a vertically integrated incumbent in the final gas market, as still occurs in some European countries.

To the best of our knowledge, regulatory issues concerning access to gas storage have never been tackled by economic theory. The economic literature traditionally deals with speculative gas storage, and analyses the relationships between such storage and the volatility of spot and future prices. The current literature is particularly focused on the application of option pricing methodologies, and proceeds on the assumption that storage decisions have some analogies with certain derivative contracts in financial markets. Examples include Weston (2002), Thompson et al. (2003), Byers (2006) and Xiaoyi (2006). Other contributions have analyzed the economics of gas storage and the effects of liberalization policies implemented in Europe. Chaton et al. (2009) deal with seasonal gas storage in a competitive gas market, where injection and withdrawal decisions react to price fluctuations; these authors also take the depletion of exhaustible gas resources into account. Chaton et al. (2008) deal with precautionary gas storage as an instrument to face supply disruptions, and assess market failures in the light of supply security goals. More recently, Ejarque (2011) has considered the cost of blocking gas reserves for precautionary purposes in order to achieve supply security. The blocking of inventories for precautionary purposes and the limiting of access to storage through inefficient rationing rules prevent gas suppliers from fully exploiting arbitrage opportunities. The strategic nature of storage decisions in an imperfectly competitive gas market is considered by Baranes et al. (2009) and by Durand Viel (2007). According to Baranes et al. (2009), Third Party Access (TPA) to independent storage facilities can reduce welfare because it incites firms that are vertically integrated upstream to make storage decisions that increase wholesale gas prices for downstream competitors (storage may be used to raise rivals’ costs). The bundling of storage facilities with downstream suppliers is therefore considered to be a better solution than TPA. Both in Baranes et al. (2009) and in Durand Viel (2007) the alternative between carrying inventories or buying the commodity in the spot market is analyzed. However, the two models make different assumptions about market structure at the production stage. Assuming oligopoly, Durand Viel considers storage not only as an instrument to preempt future demand, but also as a strategic tool for suppliers to deter producers’ market power. Actually, storage decisions can circumvent price increases in the spot market. Strategic behavior should therefore consider this trade-off. The impact of storage capacities on market power in the European gas market has also been considered by Egging and Gabriel (2006) in the framework of a general equilibrium model of the European gas market.

This paper concentrates on the implementation of TPA regulation with regard to storage facilities. In Section 2 we consider the current regulation of access to storage in Europe; we specifically focus on the storage scarcity and rationing rules that govern storage capacity. In Section 3, we analyze the effects of rationing on the productive efficiency of gas

suppliers. As we have said above, our approach considers the opportunity of substitution between storage and alternative flexibility inputs as a key point in the evaluation of productive efficiency. We consider both a general principle (a principle that is based on the shadow price of storage) that ensures an efficient allocation of storage capacity and its application to the case of perfect substitution between flexibility inputs. In Section 4, we consider allocative efficiency in a two-stage model in which storage is initially rationed and gas suppliers subsequently compete in the downstream market. We consider market equilibrium in a dominant firm model, which compares a centralized allocation of storage and a decentralized allocation mechanism based on storage auctions. The latter, though distorted by strategic behavior, may improve efficiency to the extent that storage bids turn out to be affected by the value of storage. In Section 5, we carry out welfare analysis in which the allocation of storage resulting from welfare maximization by a benevolent dictator, is treated as a benchmark for comparison with allocations deriving from storage auctions and pro-rata mechanisms. Comparisons are completed by a numerical example, which aims to calibrate the model by making reference to what could be a real gas market. Our conclusions follow in Section 8.

2. Access to storage in Europe

The European directive 2003/55/EC requires member countries to implement non-discriminatory TPA to storage facilities. However, each country can opt between negotiated and regulated TPA, on the basis of the features of national storage markets. This option distinguishes the TPA in question from that concerning transmission and distribution networks, which are regulated by independent authorities; the distinction could derive from the features of market structure, as storage is not a natural monopoly.

Though storage costs are affected by scale economies, any storage plant can supply storage services in competition with other plants, as the minimum efficient scale is generally far below the amount of total storage demand by gas suppliers. However, the liberalization directives did not require divestiture of the existing storage assets, which were owned by former integrated utilities, as a prerequisite for the introduction of *storage-to-storage* competition.⁴ Furthermore, neither ownership nor legal unbundling was required in the case of storage. Accordingly, current storage is frequently supplied by branches of the former integrated utilities, now operating as dominant gas suppliers in the downstream market. At the moment, a free market for storage effectively exists only in the UK and in the Netherlands.

Most continental countries are characterized either by de facto monopolies or by market power in the storage sector. However, storage services are not the unique flexibility input for gas suppliers. Flexible production fields (“supply swing”) and flexible import contracts may operate as a substitute for gas storage, as might interruptible contracts with industrial customers, access to spot market liquidity and/or availability of gas fired power plants (“virtual storage”).⁵ Substitution among flexibility inputs for gas suppliers can be referred to the common concept of input substitution. But in practice, storage substitutes can hardly meet the total demand for flexible gas by any supplier. Moreover,

⁴ Before liberalization, national markets were characterized by just a single or a few companies that owned multiple storage plants. European liberalization directives did not impose any horizontal unbundling, whereby storage companies would be split by the sale of part of their plants to new entrants, as in the case of electricity generation. In the UK, divestiture of existing storage plants owned by the incumbent was requested by the Monopoly and Merger Commission, but opposed by the British Government (Yarrow, 2003). Divestiture was required only ex-post in some antitrust cases by competition authorities. An example is a Merger Case (Case No COMP/M.3868-DONG/Elsam/Energi E2) whereby the DG Competition approved a Merger by Dong, the state owned Danish gas company, but imposed the divestiture of two storage plants as a remedy to protect competition in the energy market.

⁵ Moreover, the nature of most flexibility inputs is such that a market for flexibility is hard to define. See for example Ofgem (2002) and CEC (2006).

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