Gas Contract Indexation and Market Power

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Draft: 30 August 2022

Abstract: *Recent high natural gas prices have focused attention on competition in European gas markets. In response to anti-trust pressures, many long-term pipeline gas contracts in Europe have shifted from oil-linked indexation to pricing based on traded European gas hub indices. In this short paper I show, using a simple monopoly plus fringe model, that shifting long-term gas contract indexation to prices based on short-term spot prices may have had the unintended consequence of increasing the market power of large spot market suppliers such as Gazprom, with negative consequences for European gas and power consumers.*

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Introduction

The current crisis in European gas supply, triggered in part at least by the war in Ukraine, has focused attention on competitive conditions in European gas markets. Even before the war, European gas hub prices had risen to record levels [European Commission, 2022]. Gas imports from Russia through Belarus and Ukraine significantly dropped year-on-year in the fourth quarter of 2021 [European Commission, 2022]. The large price increases and threat of supply disruptions have increased calls for market interventions and for further investigations into market competitiveness.

The recent investigations come several years after the European Commission's last major investigation into gas markets in Eastern and Central Europe. In 2015 the Commission issued a Statement of Objections related to Gazprom's behavior in regional gas markets. Gazprom agreed to a set of undertakings in 2018; one of these undertakings required Gazprom to offer supplies to customers under long-term contracts in the affected member states at pricing linked to liquid European hubs such as NCG and TTF [European Commission, 2018].

In general, pricing in long-term gas contracts increasingly appears tied to European hub prices, including pricing by major gas suppliers. Gazprom reported in 2021 that over 56% of its export portfolio was linked to daily and month-ahead contract prices. [Rene, 2022]. This in turn raises questions about the impact of such indexation on spot market competition.

Impact of forward contracting on competition

Long-term fixed price contracts serve to hedge volatile spot prices. It has long been recognized that forward contracting decisions also impact competitive decisions in commodity spot markets and hence that suppliers under imperfect competition will consider the competitive impacts of their contracting decisions. A monopolist – absent some other form of profit – will not wish to trade forward as doing so will reduce its monopoly power and lower prices [Anderson and Sundaresan, 1984]. Allaz and Vila extended the competitive framework to duopoly under Cournot competition with multiple periods and show that forward trading improves consumer welfare [Allaz and Vila, 1993]. Later authors have showed more mixed impacts on competition in various settings, demonstrating for example that the length of contracts can affect the possibility of collusion in repeated contract and spot market interactions [Green and Le Coq, 2010].

These concepts have been widely recognized as important in the energy industry, especially in relation to electricity markets. Newbery noted that the contracting positions of the generators in the England and Wales Pool would affect their bidding behavior [Newbery, 1997]. Wolak analyzed the impact of forward contracting in the National Electricity Market in Australia and found that forward hedge contracts were successful in reducing market power [Wolak, 2000]. Contracting in electricity markets and impacts of competition have also been studied in the European Union context [Glachant *et al.,* 2011].

Substantially less empirical and theoretical work has been done on contracting and competition in European natural gas markets. Neuhoff and von Hirschhausen extended the Allaz and Vila framework to

European gas markets with different long-run and short-run elasticities of demand and show that under certain circumstances gas producers may also benefit from long-term contracts. [Neuhoff and von Hirschhausen, 2006]. The impact of the 2018 Gazprom settlement on market competitiveness has also been analyzed using a computation model of Eastern and Central European gas markets. [Chyong *et al.,* 2021].

In the present paper, I use a simple monopoly plus fringe model to study the impact of gas contract indexation under imperfect competition. I demonstrate that the results depend critically on how contract pricing is set. Long-term fixed price contracts tend to reduce the monopoly power, but if such contracts are indexed to spot or near-term prices the monopolist will have a stronger incentive to restrict output to raise prices.

A simple model

To gain some simple intuition in a setting of imperfect competition, I illustrate the impact of index-linked contracts using a stylized monopoly plus competitive fringe model, with constant marginal cost *MC*, and where the level of forward hedging *L* is exogenous with price p_L. For simplicity the overall demand curve is linear and defined as $q = a - bp = q_m + q_f$ where supply is split between supply from a monopolist (q_m) with constant margin costs *MC* and from competing fringe suppliers (q_f), representing other pipeline and LNG suppliers. Fringe supply is dependent on exogenous states of the world $n = [1,....,n]$ representing different states of spot gas supply (such as shifts in the global LNG market or other pipeline imports). The fringe supply function is also linear with supply function $q_f = e_n + f_n p$. The residual demand faced by the monopolist is thus:

$$q_m = q - q_f = (a - e_n) - (b + f_n)p$$

$$p(q_m) = \left(\frac{a - e_n}{b + f_n}\right) - \frac{q_m}{(b + f_n)}$$

After applying the usual profit maximization condition, the monopolist maximizes its profits by setting

$$q_m = \frac{a - e_n - (b + f_n)MC}{2}$$

Substituting back into the demand equation above gives a price:

$$p = \frac{a - e_n}{2(b + f_n)} + \frac{MC}{2}$$

Now assume that the monopolist has sold forward and hedged a fixed quantity q_h under a long-term contract at a price p_h which is unrelated to *p.* The monopolist's revenue can be written as:

$$r = (q_m - q_h)\left[\left(\frac{a - e_n}{b + f_n}\right) - \frac{q_m}{(b + f_n)}\right] + p_h q_h$$

Solving for the usual profit maximizing condition yields:

$$q_m = \frac{a - e_n + q_h - (b + f_n)MC}{2}$$

Again, substituting back into the demand equation provides a price:

$$p = \frac{a - e_n}{2(b + f_n)} - \frac{MC}{2} - \frac{q_h}{2(b + f_n)}$$

Following the standard logic, a monopolist that sold forward a fraction of its output at a price unrelated to the spot price has a weaker incentive to withhold supply in the spot market, leading to lower prices.

Now consider the case in which the hedged output price p_h is closely linked to the spot price p. This could be the case, for example, in the current situation, where many long-term contracts have been re-indexed against short-term prices.

Assume that p_h is a linear function of the spot price p, such that $p_h = jp + k$, where j and k are again constants unrelated to p. The monopolist's revenue becomes

$$r = (q_m - q_h)\left[\left(\frac{a - e_n}{b + f_n}\right) - \frac{q_m}{(b + f_n)}\right] + jq_h\left[\left(\frac{a - e_n}{b + f_n}\right) - \frac{q_m}{(b + f_n)}\right]$$

Simplifying and differentiating with respect to q_m yields a profit maximization condition of

$$\left(\frac{a - e_n + q_h(1 - j)}{(b + f_n)}\right) - 2q_m = MC$$

The monopolist will therefore choose a level of output q_m so that:

$$q_m = \frac{a - e_n + q_h(1 - j) - (b + f_n)MC}{2}$$

Substituting back into the demand equation yields:

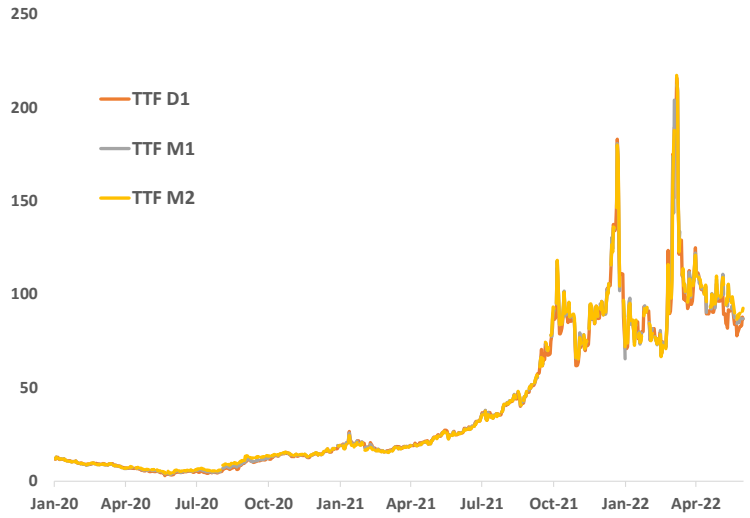
$$p = \frac{a - e_n}{2(b + f_n)} - \frac{MC}{2} - \frac{q_h(1 - j)}{2(b + f_n)}$$

By linking the hedge price p_h to the spot price p, the incentive of the monopolist to withhold in the spot market to gain higher prices on all output (spot volumes and long-term contract volumes) is restored by the ratio j. When $j = 1$, and long-term contract prices follow spot prices exactly, the monopolist has its full market power restored, with attendant consequences for market prices.

Conclusions and implications for European gas markets

Figure 1 shows recent front month (M1) and second month (M2) TTF prices, along with spot TTF daily prices (D1).

Figure 1: TTF daily, front and second month prices (Euros/MWh)



To the extent that front and second month TTF prices are used in contract indexation, for example, the potential impact on contract indexation and competitiveness is stark, with *j* likely close to 1 and substantially influenced by spot market behavior.

Shifting long-term contract indexation towards gas hub prices was advantageous to consumers when these prices were lower and European hub markets appeared reasonably competitive. Global LNG prices in the period in 2018 were moderate and supplies were increasing [Shell, 2019]. In the context of the model presented above, this represents a state of the world *n* with ample competitive fringe supplies, which helped constrain the market power of large European suppliers such as Gazprom. Even as contracts began to shift, the constraining power of fringe supply was likely important.

Currently, competitive supplies are very tight in the context of rising demand. Even before recent Gazprom restrictions on output, LNG prices had risen substantially due to high Asian demand among other factors. In a market with tight supplies, and limited scope for short-term competition from LNG and other fringe suppliers, the market power of major suppliers such as Gazprom could have been higher anyway.

The current analysis, however, suggests that changes in contract indexation may have played a major role, by greatly amplifying the market power of pipeline suppliers such as Gazprom. Having long-term contracts tied to spot market-related indices gives such a supplier further incentive to exert market power, as to achieve higher prices on all volumes, including the large volumes tied up under long-term contracts.

Further research is needed to adapt the simple monopoly plus fringe model here into a more realistic representation of European gas trading, which includes other suppliers and includes spatial and temporal characteristics not represented here. However, even a simple model of imperfect competition suggests that the competitive effects of gas contract indexation bear further examination in a period of constrained alternative supplies. The current model also suggests that a policy designed to increase competition in European gas markets may have had the unintended consequence of increasing Gazprom's market power when fringe supply conditions shifted, with potentially large impacts on European gas and power prices.

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