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## Can Liberalization Affect the Price of Gas Imports? A Theoretical Analysis of the EU Case

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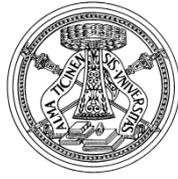
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**Quaderni di Dipartimento**

**Can Liberalization Affect the Price of Gas Imports? A Theoretical Analysis of the EU Case.**

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# Can Liberalization Affect the Price of Gas Imports? A Theoretical Analysis of the EU Case.

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## Abstract

Common wisdom about the effects of gas market liberalization in the EU claims that the fragmentation of gas supply in the downstream market can raise the price of gas imports, as the bargaining power of European firms in the upstream market would be weakened. We consider such a claim from the point of view of economic theory, by analysing the effects of downstream competition on the upstream price of gas. Though our analysis is limited by the assumption of a single gas producer upstream, we can show that the price of gas imports either is not affected by oligopolistic competition in the downstream market or it is even reduced in case of free entry and fierce competition. In this last case the incumbent is damaged by economic losses, that can explain his attempt to prevent competition by introducing vertical restraints in the supply chain. Furthermore we show that, in this last case, the introduction of pro-competitive constraints on the market share of the incumbent may damage consumers, as it raises prices in the retail market..

JEL Codes: L42, L43, L95

Keywords: liberalization, international gas markets, market structure

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## 1 Introduction

During the last fifteen years the European Union has carried out a lot of efforts to create an internal market for natural gas, by introducing liberalization in an industry that was formerly controlled by vertically integrated utilities, operating as national monopolies in each member country. The liberalization Directives aimed to separate potentially competitive activities (production, imports and supply) from natural monopolies (transmission and distribution) or de facto monopolies (gas storage). Member Countries were required to apply the

principle of unbundling in vertically integrated firms. Moreover the principle of third party access to gas networks and to storage plants was also implemented in order that new entrants could rent transmission, distribution and storage capacity to trade their gas. Legal barriers to entry and trade had been gradually eliminated, giving any customer the freedom to choose its own gas supplier.

Despite these efforts, the aims of the EU concerning the creation of an internal market for gas are far from being reached and the development of competition in natural gas markets is still unsatisfactory. In most cases a process of entry without competition has taken place, so that new gas suppliers have shared their markets with former integrated utilities, without significantly affecting price fluctuations. In its last enquiry the European Commission analyzes failures related to the creation of a truly competitive internal market for gas and finds that national markets are still dominated by incumbent gas suppliers (European Commission, 2007). By strategically restricting access to transmission networks and storage plants, former integrated utilities have created vertical restraints that prevented further developments of competition. Difficulties in creating a commodity market for wholesale exchanges are related to the persistence of long term contracts (Polo and Scarpa, 2012) with exporting countries, whose prices continue to be linked to the oil price. Therefore the European Commission further insists in removing the remaining barriers to competition by eliminating vertical restraints and promoting gas exchanges in a liquid commodity market where gas prices are expected to depend on the fluctuations of demand and supply.

Since the start of the liberalization process the gas industry has opposed to the Commission view the idea that liberalization could weaken the position of national importing companies vis a vis producing Countries like Russia and Algeria. According to this view a unique and huge national gas importer (like ENI in Italy, Gaz de France or E-ON in Germany) could obtain better contract conditions (including lower import prices) with respect to more companies involved in the same negotiation for lower gas quantities. Such a view implicitly assumes price discrimination through quantity discounts in the up-stream market and furthermore that such a discount can be passed through downstream, in the wholesale and retail market, to the benefit of final consumers ( a result that obviously may not necessarily occur) A sort of revival of these view against liberalization has been coupled with fears for supply security, especially after the conflict between Russia and Ukraina, that in the winter 2005-2006 threatened gas exports to Europe (Hubert and Ikonnikova, 2011). A more deep discussion of this issue is due to Smeers (2008) claiming that further liberalization progress due for example to the implementation of ownership unbundling of the transmission network across member Countries (as foreseen in the Third Liberalization Package<sup>1</sup>) could definitely weaken European former monopolies vis a vis gas exporting companies like Gazprom. According to Smeers (2008) "the reasoning of the (European Commission) Sector Inquiry implicitly dismisses any danger of

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<sup>1</sup>Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC.

transferring all the negotiating power to the producers"<sup>2</sup> and "It is indeed not very difficult to imagine that an un-concentrated downstream gas market would simply permit a concentrated upstream market to capture all the rent that can be made on European consumers"<sup>3</sup>.

Though common wisdom may lead to suppose that a concentrated market upstream needs a concentrated market downstream in order to balance bargaining power, to the best of our knowledge such a claim has never been carefully analysed by economic theory. The economic literature devoted to international gas exchanges in the EU mainly concerns computable equilibrium models<sup>4</sup>. The pioneering work is due to Mathiesen (1987) assuming that the European natural gas market can be modeled as a static Cournot Oligopoly. Such an assumption is maintained by Golombek, Gjelsvik and Rosenthal (1995) in their numerical model aiming to evaluate the effects of liberalization of the EU market before it was implemented. They assume that up-stream producers behave as Cournot oligopolists selling gas to multiple traders, due to the implementation of third party access to the gas network, without any bottlenecks or vertical restraints affecting the supply chain. As in the model traders can fully exploit all arbitrage possibilities, a single international price arises in the long-run equilibrium. A further contribution to this literature was given by Boots, Rijkers and Hobbs (2004) considering the EU gas market as a model of successive oligopolies: Cournot producers behave as Stackelberg leaders with respect to traders. The latter may in turn behave as Cournot oligopolists or as price-takers in the downstream market. The authors highlight that with an oligopoly both up-stream and downstream, then double marginalization arises and gas prices increase with respect to the case of a single oligopoly with vertically integrated firms. According to their results it is important to prevent concentration in the downstream market: they show that when the numbers of traders increase gas prices approach the competitive level. A dynamic version of this gas model is due to Lise, Hobbs, Oostvoorn (2006) which consider endogenously long term investments in transmission networks linking up-stream producer Countries with downstream consumer Countries. Congestion rents are then likely to affect prices and supply security issues can be considered. A further extension of the successive oligopoly approach is due to Holz, von Hirschhausen and Kemfert (2007). They eliminate some simplifying assumptions and endogenize domestic production of Western Countries (like The Netherlands and the UK) in the model (GASMOD). A dynamic version of GASMOD has been proposed by Holz (2009) not only considering pipeline investments but also introducing explicit network modelling in a graph theoretic setting. Holz (2009) can then show that not only new pipeline corridors between Russia and Europe are needed but also that the intra-european network should be expanded accordingly.

With respect to this strand of literature we exclude empirical applications and just concentrate on the relationship between up-stream producers and downstream gas supplier to analyse the impact of liberalization both on the price of

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<sup>2</sup>Smeers (2008) p.22

<sup>3</sup>Ibidem, p.49

<sup>4</sup>See Smeers (2008) and Holz (2009) for a review.

imports and on retail prices. Moreover we explicitly consider vertical restraints that prevented competition to take place in the market for gas supplies, even after liberalization implementation. For the sake of simplicity we just consider the existence of monopoly at the up-stream level, i.e. gas imports take place just from a unique exporting Country, Russia for example. In section two we consider the existence of a monopoly both at the upstream and at the downstream level in order to represent international gas exchanges before liberalization was introduced. In section three we assume that liberalization is anticipated by the incumbent who shares the market with new entrants. Due to the existence of entry barriers we assume that the downstream market is characterized by oligopolistic competition. We analyse both the case of Cournot and Stackelberg competition, in order to also consider the dominant position of the incumbent in the market for gas supplies. In section four liberalization is represented as a sudden shock, which cannot be anticipated by the incumbent. In that case new entrants are able to import gas from abroad and Cournot Competition can take place in the downstream market for gas supplies. We are then able to consider the case of perfect competition as a limit case of Cournot competition and investigate the effects of imports by new entrants on retail gas prices and on the incumbent profitability. As we find that free entry and free competition cause losses to the incumbent, we can explain his attempts to distort competition in section six. We then suppose that the incumbent not only is able to anticipate the effects of liberalization, but can also prevent competition to take place by adopting vertical restraints that make it impossible for new entrants to procure gas abroad. In that case the only option for a new entrant is to procure gas directly from the incumbent. The latter then represents both a supplier in the wholesale market and a competitor in the retail market. In this framework we then analyse the introduction of antitrust ceilings (a cap on the market share of the incumbent) whose aim is to protect new entrants by assuring them the opportunity to serve the remaining share of the downstream market for gas supplies. Considering both vertical restraint to competition pursued by the incumbent and a cap on the market share of the latter we are then able to show that antitrust ceilings -though conceived as a pro-competitive measure - cannot benefit final consumers, since they cause an increase of retail gas prices.

## 2 Bilateral monopoly

In this section we consider the relationship between an upstream gas producer and a monopolistic gas seller, before the liberalization of the EU gas market. A vertically integrated monopolistic firm existed in the supply market of each member Country. Such a firm procured gas in the upstream market by concluding long term contracts with up-stream producers.

We consider the final demand for natural gas as  $D_I(P_I) = M - aP_I$  being  $P_I$  the price fixed by the monopolist in the downstream market. The monopolist is involved in gas procurement from a producer located abroad. Such a producer may export gas to different EU Countries. Each Country represents a final

market for gas, and we suppose that gas exchanges among different Countries are not possible (destination clauses in long term contracts prevented such an exchange to take place<sup>5</sup>). Be then  $P_R$  the unit price paid by the downstream monopolist to the upstream gas producer. For the sake of simplicity we normalize to zero the unit cost of the upstream producer of gas and we neglect fixed production costs. With the former assumptions, the maximisation problem of the downstream monopolist is the following:

$$Max_{P_I} \Pi_I = D_I(P_I)(P_I - P_R) = (M - aP_I)(P_I - P_R) \quad (1)$$

Given the f.o.c.

$$\frac{d\Pi_I}{dP_I} = (M - aP_I) - (P_I - P_R) = 0 \quad (2)$$

we derive the equilibrium price in the downstream market:

$$P_I^*(P_R) = \frac{M}{2a} + \frac{P_R}{2} \quad (3)$$

and the equilibrium output:

$$D_I^*(P_I^*(P_R)) = M - \left(\frac{M}{2} + a\frac{P_R}{2}\right) = \frac{1}{2}(M - aP_R) \quad (4)$$

Therefore the maximisation problem of the up-stream firm is the following:

$$Max_{P_R} \Pi_R = D_I^*(P_I^*(P_R))P_R = \frac{1}{2}(M - aP_R)P_R \quad (5)$$

Given the f.o.c, and solving for the equilibrium price in the up-stream market, we can find the final expression of the downstream price and of the final demand for gas:

$$P_R^* = M/2a \quad (6)$$

$$P_I^* = \frac{3}{4} \frac{M}{a} \quad (7)$$

### 3 Liberalization with Duopoly in the downstream market

In this section we suppose that liberalization, though foreseen by the incumbent, is not followed by any vertical restraints by the latter and that, due to the existence of some entry barriers, the downstream market is characterized by duopolistic competition. We consider both the case of Cournot competition and Stackelberg competition to verify if different types of competition in the downstream market can affect the price of gas imports upstream.

<sup>5</sup> Destination clauses were removed by the EU after liberalization, in order to facilitate gas trade among member Countries.

### 3.1 Cournot Competition

Firstly we suppose that gas suppliers compete à la Cournot. With the same demand function as before:  $D_I(P_I) = M - aP_I$ , the profit functions of the two suppliers are the following ones:

$$\Pi_1 = q_1(p(q_1 + q_2) - P_R) \quad (8)$$

$$\Pi_2 = q_2(p(q_1 + q_2) - P_R) \quad (9)$$

given the f.o.c.

$$\left(\frac{M - q_1 - q_2}{a} - P_R\right) - \frac{q_1}{a} = 0 \quad (10)$$

$$\left(\frac{M - q_1 - q_2}{a} - P_R\right) - \frac{q_2}{a} = 0 \quad (11)$$

we find the following equilibrium values for the symmetric firms and the industry:

$$q_1^* = q_2^* = \frac{M - aP_R}{3} \quad (12)$$

$$Q^* = \frac{2}{3}(M - aP_R) \quad (13)$$

Assuming Cournot competition in the downstream market, the upstream producer maximizes the following revenue function:

$$P_R Q^* = \frac{2}{3} P_R (M - aP_R) \quad (14)$$

so that the gas price up-stream is:

$$P_R^* = \frac{M}{2a} \quad (15)$$

While the gas price downstream becomes:

$$P_I^* = \frac{2}{3} \frac{M}{a} \quad (16)$$

### 3.2 Stackelberg Competition

Despite liberalization some asymmetries may still persist in the downstream market, and we can represent them by assuming Stackelberg Competition between the incumbent (the leader) and a new entrant (the follower). Be then  $q_f$  the quantity supplied by the follower (new entrant) and  $q_l$  the quantity supplied by the leader (the incumbent in the downstream market)

$$q_f = \frac{M - aP_R}{2} - \frac{q_l}{2} \quad (17)$$

then inserting  $q_f$  in  $q_l$  we obtain the leader profit function

$$\Pi_l = q_l \left[ p\left(\frac{M - aP_R}{2} + \frac{q_l}{2}\right) - P_R \right] \quad (18)$$

and given the f.o.c. we obtain the equilibrium quantity supplied by the leader

$$q_l^* = \frac{M - aP_R}{2} \quad (19)$$

and the equilibrium quantity supplied by the follower:

$$q_f^* = \frac{M - aP_R}{4} \quad (20)$$

Given Stackelberg competition downstream, we can find the following equilibrium prices and output:

$$P_R = \frac{M}{2a} \quad (21)$$

$$q_l + q_f = 3/4(M - aP_R) = 3/8M \quad (22)$$

$$P_I = 5/8M/a \quad (23)$$

$$D^* = M/4 \quad (24)$$

One can easily check that changes concerning duopolistic competition in the downstream market have no effect on the price charged by the upstream monopolist. The price of gas imports remains the same that was charged before the market was liberalized.

## 4 Liberalization as a "shock" and the effects of free entry in the downstream market

Let us suppose that a sudden liberalization process takes place as a "shock", without the incumbent being able either to prevent or affect it. The incumbent is already bound to an existing long term contract with the up-stream producer. It has then to buy the quantity  $D^* = M/4$  at price  $P_R^* = M/2a$ . But now other firms can enter the market: the up-stream producer will sell them gas at a new price and the new entrants can contribute to supply the downstream market. Entry will then lead to a new equilibrium price in the retail market.

Formally suppose there are  $n$  firms, denoted by  $i = 1, 2, \dots, n$  each of them buying a quantity  $\epsilon_i$  of gas at the price  $P_R^n$  from the upstream producer. Once this quantities are sold on the final market, together with gas procured by the incumbent, a new price  $P_I^n$  will prevail downstream. Final demand will be  $D^n = M/4 + \sum \epsilon_i$ .

The price in the downstream market will be given by

$$P_I^n = \frac{M - D^n}{a} = \frac{M - (M/4 + \sum \epsilon_i)}{a} \quad (25)$$

Each firm  $i$  is a Cournot competitor and chooses its quantity  $\epsilon_i$  in order to maximize its profit:

$$\epsilon_i = \underset{\epsilon}{\text{Argmax}}(P_I^n - P_R^n)\epsilon_i \quad (26)$$

We will look firstly for symmetric Cournot equilibria:  $\epsilon_1 = \epsilon_2 = \dots = \epsilon_n = \epsilon^n$ . By substitution in the expression for  $P_I^n$ , we get:

$$\epsilon^n = \underset{\epsilon}{\text{Argmax}}\left(\frac{M - (M/4 + (n-1)\epsilon^n + \epsilon)}{a} - P_R^n\right)\epsilon \quad (27)$$

which gives  $\epsilon^n$  as a function of  $P_R^n$ , the price of gas imports for new entrants

$$\epsilon^n(P_R^n) = \frac{3/4M - aP_R^n}{n+1} \quad (28)$$

Now the upstream producer chooses the price  $P_R^n$  in order to maximize its profit when selling to the  $n$  new entrants the total quantity  $n\epsilon^n$

$$P_R^n = \underset{P}{\text{Argmax}} P \cdot n\epsilon^n(P) = \underset{P}{\text{Argmax}} P \cdot n \frac{3/4M - aP}{n+1} \quad (29)$$

which gives

$$P_R^n = 3/8aM \quad (30)$$

One can easily notice that in this case the upstream price of gas for the new entrants is lower. Such a lower price affects equilibrium in the downstream market, as we are going to show.

By substitution, we get the following equilibrium prices and quantities, being  $P_R^*$  the price paid by the incumbent to procure gas upstream according to its previous long term contract.

$$P_R^* = 1/2M/a \quad (31)$$

$$P_R^n = 3/8M/a \quad (32)$$

$$P_I^n = (3/4 - 3/8(1 - \frac{1}{n+1}))M/a \quad (33)$$

$$D^n = (1/4 + 3/8(1 - \frac{1}{n+1}))M \quad (34)$$

One can notice that, as soon as  $n \geq 1$ ,  $P_I^n < P_R^*$ , i.e. the incumbent after liberalization has to sell its quantity of gas at a price lower than the price of gas imports, making negative profits. So, once the incumbent has signed a long term contract up-stream, it has a very strong incentive to prevent a liberalization of the downstream market, or to affect it with vertical restraints. Moreover the up-stream price of gas for new entrants drops with respect to the previous cases.

Then the upstream producer, in order to be able to sell more gas, must offer a lower price to new entrants. Therefore more competition in the downstream market does not lead to any price increase in the the upstream market for gas, as claimed by the gas industry when liberalization was implemented in the European Union. On the contrary the upsteam price of gas may drop for new entrants in the downstream market.

As  $P_I^n > P_R^n$ , new entrants can make profits in the gas market. In particular, for any  $n$  it will be profitable for the  $n+1$  firm to enter the market. As more and more firms enter the market,  $n$  goes to infinity. In this last case  $P_I^n = 3/8M/a$ , a price that is even lower than the one that would prevail if the up-stream producer were able to sell gas directly on the downstream market, avoiding the double marginalization effect. In this last case the price would be equal to  $M/2$ . This result is due to the fact that with liberalization and free entry a part of the consumers' bill will be paid by the incumbent, as the latter makes losses by importing gas. One can also notice that the profits of new entrants, although positive, go to zero when  $n$  goes to infinity. Therefore even new entrants may be interested in stopping the entry process before their profits vanish.

## 5 Stackelberg Competition with vertical restraints and antitrust ceilings

As we have shown in last section the incumbent has a strong incentive to prevent liberalization in the downstream market or to affect it, due to the losses it may incur with free entry followed by fierce competition in the retail market. Therefore in this section, we assume Stackelberg competition in the downstream market, to account for the persisting dominant position of the incumbent, and we consider in addition strategic vertical restraints by the incumbent that can prevent the new entrants from procuring gas independently of the incumbent itself. A typical vertical restraint that has characterized the EU liberalization experience was the refuse to grant access to transit pipelines opposed by the incumbent to new entrants, claiming that capacity was fully booked. Transit pipelines connect the national transmission networks with the non-EU network (for example the network of Eastern European Countries) representing then a bottleneck for importers of gas in Europe. Actually the incumbent was the historical owner of this piece of network. Until 2004 transit pipelines were exempted from regulated third party access<sup>6</sup>. Denial of access to transit pipelines, opposed by the incumbent, means that new entrants while being able to procure gas upstream at a competitive price, cannot carry the commodity to the final market<sup>7</sup>. Therefore new entrants, in order to gain market shares in the

<sup>6</sup>But exemption has been extended to capacity concerning long term contract signed before 2004.

<sup>7</sup>Denial of access to transit pipelines owned by ENI (the Italian incumbent) in Austria has been considered by the EC Competition Authority as an abuse of its dominant position in the italian market for gas supplies. Due to the result of its enquiry the EC Competition Authority in 2010 has imposed to ENI divesture of these assets. (Case COMP/39.315-ENI,

downstream market, may be forced to procure gas from the incumbent in the wholesale market and then sell it at the retail level. Due to this kind of gas exchange the incumbent becomes both a supplier and a competitor from the point of the new entrants<sup>8</sup>.

We consider firm one, as the follower in the downstream market and firm two, as the incumbent leader. Firm one is constrained to procure its gas from firm two, at a wholesale price  $P_C$ . Such a quantity of the commodity was bought by the incumbent in the upstream market at a price  $P_R$ .

Profit functions for firm one and firm two are then respectively given by:

$$\Pi_1 = \left( \frac{M - q_1 - q_2}{a} - P_C \right) q_1 \quad (35)$$

and

$$\Pi_2 = \left( \frac{M - q_1 - q_2}{a} - P_R \right) q_2 + (P_C - P_R) q_1 \quad (36)$$

If  $P_C$  is fixed by firm 2 and there are no constraints on the quantity to be sold by the incumbent in the downstream market, then, the dominant firm remains a monopolist on the downstream market ( $q_1 = 0$ ), and the wholesale price set by the incumbent will be  $P_C = \frac{M - q_1 - q_2}{a}$ , i.e.  $\frac{M - q_2}{a}$ .

However liberalization policies implemented at a national level in order to facilitate entry of new firms introduced also asymmetric regulation either by forcing the incumbent to auction part of its gas (gas release) or by setting "antitrust ceilings", consisting in a temporary cap on the quantity of gas to be sold by the incumbent in the downstream market (Polo and Scarpa, 2012). Without these pro-competitive measures entry of new firms could only be due to the growth of total gas demand, as at the beginning of liberalization it was hard to envisage that consumers would immediately switch to another gas supplier.

We then consider the case where vertical restraints by the incumbent can be coupled with a constraint on its market share, imposed by pro-competitive regulation. Then a possible constraint is the following  $q_2 \leq (1 - \alpha)D$ ,  $D = q_1 + q_2$ , the constraint could be then written as  $q_1 \geq \frac{\alpha}{1 - \alpha} q_2$ . In that case we can find the equilibrium in the gas market by solving the following constrained optimisation problem.

Given the constraints on firm 2, then firm 1 solves the following unconstrained maximisation problem

$$\text{Argmax}_{q_1} \left( \frac{M - q_1 - q_2}{a} - P_C \right) q_1 \quad (37)$$

taking  $P_C$  and  $q_2$  as given, then the f.o.c, will be:

$$\left( \frac{M - q_1 - q_2}{a} - P_C \right) + q_1 \left( -\frac{1}{a} \right) = 0 \quad (38)$$

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[http://ec.europa.eu/competition/antitrust/cases/dec\\_docs/39315/39315\\_3019\\_9](http://ec.europa.eu/competition/antitrust/cases/dec_docs/39315/39315_3019_9)

<sup>8</sup>That was exactly what happened in the Italian natural gas market after liberalization in 2000.

and solving the f.o.c. for  $q_1$  we get:

$$q_1^* = \frac{M - q_2}{2} - \frac{a}{2}P_c \quad (39)$$

that reduces to the function  $q_1^*(q_2, P_c) = f(q_2, P_c)$

The problem of the dominant firm, given  $q_1^*$ , is to solve the following constrained maximisation problem:

$$\text{Argmax}_{q_2, P_c} \left( \frac{M - q_1^*(q_2, P_c) - q_2}{a} - P_R \right) q_2 + (P_c - P_R) q_1^*(q_2, P_c) \quad (40)$$

s.t.

$$q_1^*(q_2, P_c) = \frac{M - q_2}{2} - \frac{a}{2}P_c \quad (41)$$

with the constraint

$$q_2 \leq (1 - \alpha)D = (1 - \alpha)(q_2 + q_1) \quad (42)$$

this is equivalent to

$$q_1^*(q_2, P_c) \geq \frac{\alpha}{1 - \alpha} q_2 \quad (43)$$

then substituting  $q_1^*(q_2, P_c) = \frac{M - q_2}{2} - \frac{a}{2}P_c$  in the objective function we get:

$$\left( \frac{M - \left( \frac{M - q_2}{2} - \frac{a}{2}P_c \right) - q_2}{a} - P_R \right) q_2 + (P_c - P_R) \left( \frac{M - q_2}{2} - \frac{a}{2}P_c \right) \quad (44)$$

that simplifies to

$$\left( \frac{M}{2a} - \frac{q_2}{2a} + \frac{P_c}{2} - P_R \right) q_2 + (P_c - P_R) \left( \frac{M - q_2 - aP_c}{2} \right) \quad (45)$$

then we have to maximise the following objective function:

$$\text{Argmax}_{q_2, P_c} \left( \frac{M}{2a} - \frac{q_2}{2a} + \frac{P_c}{2} - P_R \right) q_2 + (P_c - P_R) \left( \frac{M - q_2 - aP_c}{2} \right) \quad (46)$$

with the constraint:

$$\frac{M - q_2}{2} - \frac{a}{2}P_c - \frac{\alpha}{1 - \alpha} q_2 \geq 0 \quad (47)$$

Giving the following Langragian:

$$\text{Argmax}_{q_2, P_c} L = \left[ \left( \frac{M}{2a} - \frac{q_2}{2a} + \frac{P_c}{2} - P_R \right) q_2 + (P_c - P_R) \left( \frac{M - q_2 - aP_c}{2} \right) \right] + \lambda \left( \frac{M - q_2}{2} - \frac{a}{2}P_c - \frac{\alpha}{1 - \alpha} q_2 \right) \quad (48)$$

with  $\lambda \geq 0$  and  $\lambda = 0$  if  $\frac{M-q_2}{2} - \frac{a}{2}P_c - \frac{\alpha}{1-\alpha}q_2 > 0$

The f.o.c. and the constraints give us three equations and two positivity constrains on the unknowns,  $q_2$ ,  $P_C$  and  $\lambda$ .

$$\frac{\partial L}{\partial q_2} = \left( \frac{M}{2a} - \frac{q_2}{2a} + \frac{P_c}{2} - P_R - \frac{q_2}{2a} \right) + (P_c - P_R) \left( -\frac{1}{2} \right) + \lambda \left( -\frac{1}{2} - \frac{\alpha}{1-\alpha} \right) = 0 \quad (49)$$

$$\frac{\partial L}{\partial P_c} = \frac{q_2}{2} + (P_c - P_R) \left( -\frac{a}{2} \right) + \frac{M - q_2 - aP_c}{2} + \lambda \left( -\frac{a}{2} \right) = 0 \quad (50)$$

$$\lambda \frac{M - q_2}{2} - \frac{a}{2}P_c - \frac{\alpha}{1-\alpha}q_2 = 0 \quad (51)$$

$$\lambda \geq 0 \quad (52)$$

$$\frac{M - q_2}{2} - \frac{a}{2}P_c - \frac{\alpha}{1-\alpha}q_2 \geq 0 \quad (53)$$

the first equation simplifies to

$$M/2a - q_2/a - P_R/2 - \lambda/2 \frac{1+\alpha}{1-\alpha} = 0 \quad (54)$$

or

$$q_2 = M/2 - aP_R/2 - a\lambda/2 \frac{1+\alpha}{1-\alpha} \quad (55)$$

We see easily that there are no solutions with  $\lambda = 0$ , we look then for corner solutions, with  $q_2 = M - aP_C - \frac{2\alpha}{1-\alpha}q_2$  or

$$q_2 = \frac{1-\alpha}{1+\alpha}(M - aP_C)$$

The second f.o.c. gives:

$$P_C = M/2a + P_R/2 - \lambda/2$$

putting  $P_C$  into the constraint we get

$$q_2 = \frac{1-\alpha}{1+\alpha}(M/2 - aP_R/2 + a\lambda/2)$$

we set the latter expression equal to  $q_2$  obtained from the first f.o.c.:

$$\frac{1-\alpha}{1+\alpha}(M/2 - aP_R/2 + a\lambda/2) = M/2 - aP_R/2 - a\lambda/2 \frac{1+\alpha}{1-\alpha}$$

$$\frac{2\alpha}{1-\alpha}(M/2 - aP_R/2) = a\lambda \frac{1+\alpha^2}{1-\alpha^2} \quad (56)$$

then

$$a\lambda = 2\frac{\alpha - \alpha^2}{1 + \alpha^2}(M/2 - aP_R/2) \quad (57)$$

substituting in the first f.o.c.

$$q_2 = (M/2 - aP_R/2)\left(1 - \frac{\alpha + \alpha^2}{1 + \alpha^2} = \frac{1 - \alpha}{1 + \alpha^2}(M/2 - aP_R/2)\right)$$

This gives us finally

$$D(P_R) = \frac{1}{1 + \alpha^2}(M/2 - aP_R/2)$$

Now considering profit maximisation by the upstream seller of gas

$$\text{Argmax } D(P_R)P_R$$

we get  $P_R = M/2a$ , showing once more that the upstream price of gas is the same that was charged before liberalization .

$$D = \frac{1}{1 + \alpha^2}M/4 \quad (58)$$

then with  $\alpha > 0$  the resulting gas demand is strictly lower with respect to the monopolistic demand  $M/4$ , therefore the price in the downstream market will be strictly larger:

$$P = \frac{M}{a}\left(1 - \frac{1}{4(1 + \alpha^2)}\right) \quad (59)$$

We can then conclude that asymmetric regulation constraining the incumbent market share leads to an increase of prices in the downstream market, at least when the incumbent is both able to adopt vertical restraints that prevents new entrants from procuring gas upstream and to become their supplier in the wholesale market for gas.

## 6 Conclusions

Liberalization of natural gas markets in the EU has risen the doubt that fragmentation of gas procurement following entry could weaken the position of european suppliers when contracting the price of gas upstream with producing Countries like Russia or Algeria. Due to the growing dependence on gas imports of the EU, if competition in the downstream market resulted in higher prices to procure the commodity up-stream, then the benefits of liberalization may be questioned. In this paper we have made a first attempt to analyse this issue from the theoretical point of view, by assuming the existence of a monopoly upstream

- before and after liberalization - and considering different kind of market structures downstream , in order to check if competition following liberalization may change the price of gas imports for gas suppliers. We have firstly considered the case where, due to some entry barriers, an oligopolistic market structure prevails in the downstream market, after liberalization. Comparing then the case of Cournot Competition and Stackelberg competition in the downstream market with the monopolistic market that existed before liberalization, we show that in the up-stream market the price of gas imports remain the same, though prices in the final market are obviously reduced by oligopolistic competition.

We have then considered the case of liberalization as a shock that cannot be prevented or affected by the incumbent. In that case we have also supposed that there is free entry in the downstream market. By analysing the limiting behaviour of the Cournot model with  $n$  firms, we find that gas prices not only drop in the final market but also at the upstream level, at least for what concerns new entrants, as the incumbent remains bounded to the higher prices contracted upstream before liberalization occurred. Considering this same case, one can conclude that the incumbent has an incentive to prevent liberalization and competition in the final market for gas, due to the economic losses that he must bear in the case of fierce competition following free entry. Such an incentive may explain the actual behavior of incumbent firms in the EU markets after liberalization.

In order to prevent fierce competition in the final market for gas, incumbent firms have adopted vertical restraints that prevented new entrants from procuring gas in the up-stream market. In this case the only option for new entrants has been to procure gas from the incumbent who became both their supplier in the wholesale market and their competitor in the retail market. Furthermore we have also considered the case of vertical restraints coupled with constraints on the market share of the incumbent, similar to those adopted by some European Countries to protect new entrants. Assuming then Stackelberg competition in the downstream market and a wholesale market where new entrants procure their gas from the incumbent, we show that if in addition we introduce a constraint on the incumbent market share, the only effect is to raise gas prices in the downstream market. Also in this case the price of imports is not affected by the strategic behaviour of the incumbent. Therefore, according to our analysis, there seems to be any theoretical grounds for the claim that liberalization may raise the price of gas imports. In the cases we have considered competition in the downstream market either does not affect the upstream gas prices or may induce their reduction for new entrants. In the meantime we find that incumbents may have good reasons to oppose free entry and fierce competition in the gas market, to the extent they incur economic losses when they are unable to prevent or affect the liberalization of gas markets.

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