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LONGTERM CONTRACTS AND TAKE-OR-PAY CLAUSES IN NATURAL GAS MARKETS

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ABSTRACT

This paper surveys the existing theoretical and empirical research on long term contracts inspired by the American experience. We analyze the role of take-or-pay clauses and price indexation rules, questioning whether regulation distorts optimal contract duration. The models we summarize allows us to discuss the economic fundamentals of the EU provisions on long-term contracts in the natural gas industry, pointing out that the EU position on long-term contracting seems to mix up contract duration and flexibility.

1. LONG TERM TAKE-OR-PAY CONTRACTS

According to Williamson (1979), when a transaction entails one party committing capital that has little value for other uses, the other party has a strong incentive to appropriate the rents arising from the relationship through opportunistic behavior. Anticipating this risk, also called the "hold-up" problem, buyers and sellers sign long-term contracts.

The main drawback of simplistic long-term contracting is inflexibility in the face of demand and supply fluctuations. To mitigate this problem, parties will therefore stipulate specific clauses. In practice, an initial price constitutes a floor on the value of the contract. Prices are rigid downward, but they can raise following price escalators, like predefined increases per year or petroleum price index. In addition, redetermination clauses permit renegotiation of the terms of the contract at predetermined intervals.

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The natural gas industry provides an ideal laboratory for the transaction-cost theory, because of the specific upfront capital investment required on the part of both sellers (e.g. natural gas wells) and buyers (e.g. pipeline connections).[1] The irreversibility of such infrastructures creates the potential risk of hold-up and explains that pricing in the gas market is the outcome of long-term bilateral agreements. The pipeline company and the producer negotiate a contract that specifies the price to be paid for gas delivery and the quantity to be delivered. Long-term take-or-pay contracts link sellers and buyers for a long period, generally 20-25 and even up to 30 years during which both of them have strictly defined obligations. In particular, the take-or-pay clause requires that gas has to be paid whether taken or not, and specifies an obligation for the seller to make available defined volumes of gas.

The "take" amount can be specified in two ways. The first allows the buyer to take a quantity which is a specified percentage of the production within a given lifetime. Alternatively, the take amount may be based on a percentage of the production capacity of the well (Canes and Norman, 1985). Both the reserves and the capacity are tested periodically. If these tests indicate some changes, the buyer can be asked to modify its take quantity, though the take-or-pay percentage is fixed. In order to absorb seasonal demand fluctuations, annual take requirements can be modified and complemented by monthly or daily withdrawals (Walls, 1998).

Take-or-pay provisions have received much attention in the economic literature. The next section surveys the main insights of the existing theoretical and empirical research, inspired by the American natural gas industry. We shall consider the impact of regulation on take-or-pay provisions and optimal contract duration. The models we summarize allow us to illustrate the role of take-or-pay contracts in the European gas industry and to underline its differences with respect to the American experience. A policy-oriented discussion, on the impact of long term contracts in the opening to competition of the EU gas sector, concludes the paper.

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[1] This kind of contracts is commonly used for other natural resources like coal (Joskow, 1985, 1988) or petroleum coke (Goldberg and Erickson, 1987). Masten (1988) also notes their use in ice cream sales and long distance telephone service. According to Canes and Norman (1985), even newspaper, magazine subscriptions and industrial leasing arrangements can be interpreted as take-or-pay contracts.

2. THEORETICAL FUNDAMENTALS

2.1. A simple model

To date, there are two complementary economic analyses of take-or-pay provisions or minimum bill contracts: the model of Crocker and Masten (1985, 1988, 1996) and that of Hubbard and Weiner (1986, 1991). While these latter authors interpret take-or-pay clauses as risk-sharing instruments,[2] Crocker and Masten argue that take obligations can be viewed "as a mechanism for effecting appropriate incentives for contractual performance". Crocker's and Masten's (1985) viewpoint is that a trade-off exists between the flexibility of a long term contract and the ease with which it can be implemented: the more contingent provisions are stipulated, the greater the scope for misinterpretation, and thus the greater the likelihood of a dispute and costly adjudication.

Unilateral options like take-or-pay clauses do not require court verification of exogenous events, but still preserve joint-profit maximization: the authors affirm that "take provisions can induce buyers to release investments to their alternative uses only when it is efficient to do so". In Crocker and Masten's model these alternative uses are very important. Examples of them are sale to different customers when, due to a regional decline in gas demand, the gas value decreases, or storage for future sales, if the decline in gas demand is generalized. Therefore, the most important determinant of the alternative value of gas is the number and proximity of alternative pipelines: the fewer the connections, the less likely that a producer will be able to dispose of gas at a price comparable to that in the efficient contract.

The model of Crocker and Masten points to the importance of asymmetric information between a pipeline (the buyer) and the producer (the seller) of natural gas. Typical examples are the effects on gas demand of weather, economic fluctuations or price of substitutes.

Let α represent the random factor whose realization is private information to the pipeline. The value of the well to the pipeline (net of transmission costs) is $v(\alpha)$. Prior to investing in production and transmission facilities, the parties write a contract specifying a capacity level and the terms under which the product will be exchanged in the

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[2] The Hubbard and Weiner's approach draws on the implicit-contract literature in labor economics (cf. the efficient wage bargaining model by Hall and Lilien, 1979).

subsequent periods, in particular the payment for a contractually specified quantity of gas y.

Once α is revealed (asymmetrically), if the exchange takes place, the pipeline's (henceforth, p) and the wellhead's (henceforth, w) profits are respectively:

$$\pi_p = v(\alpha) - y$$

$$\pi_w = y$$

The pipeline wishes to discontinue deliveries when $v(\alpha) < y$; in this case, the wellhead would seek the next highest value of his capacity, say s, that is the most valuable alternative uses.

Contract breach would be efficient (i.e. would maximize joint profit) if and only if alternative uses are more valuable than those contracted for:

$$s > v(\alpha)$$

If $s < v(\alpha) < y$, the decision is inefficient. If the contract imposes a penalty $\delta = y - s$ to the pipeline in case of breach, inefficient termination is discouraged. The penalty δ is simply the "expectation damages" to the producer.

Since the optimal penalty declines as a well is depleted, gas contracts usually express it as a fraction of reserves or available gas. This does not hurt the logic underlying the model, since s is observable at any time.

Written as a percentage γ of the contractually specified payment, the penalty δ becomes:

$$\gamma = 1 - \frac{s}{y} = \frac{\delta}{y}$$

Therefore, γ can be interpreted as the take-or-pay clause; it is always positive since one wants the producer to accept the contract, and can also be equal to 100% if there is no alternative value (s = 0).Note that the more valuable the alternative uses, the weaker the lock-in effect of the contractual relationship and therefore the smaller the take-or-pay provisions.

Using data on the incidence of minimum purchase requirements in natural gas contracts between well owners and pipelines signed between 1960 and 1982, Crocker and Masten find that the magnitudes of take-or-pay requirements were negatively correlated to the number of pipelines serving a field, which is consistent with the optimal breach penalty argument because more buyers increase the value of well owner's alternative sale possibilities. On the other hand, increases in the number of independent sellers located in a field, which increases the amount of drainages and reduces the value to a particular seller of storing gas in the

ground for future sale, tended to result in higher take-or-pay obligations. Similar results were obtained by Mulherin (1986) who examined the prevalence of take-or-pay requirements in natural gas contracts prior to 1954. Together, these results offer support for the contention that efficiency considerations underlie the use and magnitude of minimum purchase requirements in long term contractual agreements.

2.2. Price flexibility and renegotiation

Price adjustment mechanisms are key ingredients in contract design. While a fixed price is easy to stipulate and establishes a well-defined division of the surplus, such an approach becomes inefficient when the contract price diverges from opportunity costs. If the price turns out to be below the relevant opportunity costs, the pipeline keeps the incentive to consume when it should not.

However, introducing price flexibility in a long-term contract raises specific problems. The relation-specific investment locks in the parties away from market alternatives, so that there is no clear "market price" upon which the contract price may be conditioned. As a consequence, contracts tend to use a mix of arrangements to adjust price over time.

The factors influencing the price adjustment processes are discussed by Crocker and Masten (1991), who analyze the economic trade-off between flexibility and completeness in contractual agreements. Using the database they exploited in their 1988 paper, Crocker and Masten find that renegotiation of prices introduces important flexibility in contracts. Price escalator clauses are less likely in contracts with large take-or-pay requirements. This suggests that flexibility in pricing and in the quantity exchanged are substitutes.

Assuming away asymmetric information, Hubbard and Weiner (1986) describe the contract between a pipeline and a producer as a bilateral monopoly transaction, focusing on risk aversion and optimal risk sharing. In the empirical sequel, Hubbard and Weiner (1991) discuss the importance of price flexibility in long-term contracts. They examine the level of contract prices in a sample of natural gas supply agreements negotiated prior to 1957. They analyze whether the prices were driven by market power or transaction costs considerations, and concluded that the negative effect of producers' concentration on contract prices indicates "some" monopsony power by the pipeline purchasers. Price flexibility clauses are essentially signed to adapt to changing demand conditions, as it is hypothesized by the transaction cost theory. In particular, the role of "the most-favoured-nation" (MFN) clause is analyzed. A MFN clause,

imposed by the producer to the pipelines, raises the contract price to the level of the price agreed to by the pipeline in any contracts signed later in a nearby area. These clauses differ from what the authors call "indefinite escalator clauses", as indexation to oil prices. It is shown that, quite surprisingly, only small producers with few contracts are keen to use the MFN clause. They ensure efficient adaptation of their compensation in periods of growing demand and to mitigate ex-post pipelines opportunistic behaviour.

3. THE EFFECTS OF REGULATION AND DEREGULATION

The family of models we have summarized allows discussing additional characteristics of long-term contracts, like optimal contract duration, impact of price regulation, market power, coordination between long-term contract pricing and spot-market.

The debate on these issues parallels the evolution of natural gas regulation in the United States that we very briefly summarize. The 1938 Natural Gas Act authorized the Federal Power Commission (FPC) to regulate the tariffs of the interstate pipelines that transport natural gas produced in the Southwest to consumers in the East, Midwest, and West. In the 1954 Phillips case, the Supreme Court extended the FPC's jurisdiction to regulating wellhead (that is, producer) prices. The price ceilings led to severe supply shortages in the 1970s. The National Gas Policy Act of 1978 provided for phased deregulation. Today, no price regulation exists.

3.1. Take-or pay under price regulation

External regulatory intervention in the gas industry influences the structure of contracts. In some cases, regulation goes as far as directly delimiting contractual forms, such as mandating disclosure of some clauses to consumers. In any case, long-term contracts evolve to mitigate inefficiencies caused by external regulation. This is precisely the case in Crocker and Masten's (1985) examination of take-or-pay provisions in long-term natural gas supply contracts. They show that when these contracts were subject to wellhead price regulation, then non-price terms, such as take-or-pay provisions, increase to compensate the distortion. Moreover, Crocker and Masten estimate that the non-price competition caused by regulation increased the average size of take-or-pay provision by six percentage points.

Hubbard and Weiner (1985) also confirm that field-price regulation, in particular price-ceiling on producer's prices, will likely increase the

reliance on inframarginal compensation over marginal compensation in reaching the contract bargain. Marginal compensation (the extra payment for extra quantity) is to be simply intended as price, while inframarginal compensation refers to fixed payments. The prediction of the model is corroborated by empirical evidence from a sample of producer-pipeline contracts signed after the passage of the Natural Gas policy act in 1978.[3]

Moreover, Hubbard and Weiner also show that the type of transition to deregulation (for example, immediate total decontrol versus phased decontrol) is likely to be important, in determining both the mix between price and non-price provisions in contracts negotiated during the transition, and in distributing gains and losses due to unanticipated demand or supply fluctuations.

3.2. Contract duration

The issue of optimal contract length has been analyzed by Crocker and Masten (1988), who have generalized their previous theoretical model to introduce dynamic considerations and to derive structural equations for estimation purposes. Crocker and Masten examine the relationship between contract design (take-or-pay) and contract length. Demand of gas addressed to the pipeline is viewed as uncertain, but before exchange takes place, the producer must undertake an irreversible, relation-specific investment.

Given these assumptions, in each period under the contract, the expected profits of the pipeline and the wellhead follow the rules take-or-pay provisions imply. After the expiration of the contract, parties have to bargain each period, incurring costs that can be viewed as the time parties spend in the process, or in inquiries about the market conditions at the time of renegotiation.

The trade-off is the following: as long as the contract is more economical in terms of transaction costs, it should stay in force; else, it should be interrupted. In other terms, optimal duration of long-term take-or-pay contracts only depends on contracting and bargaining costs of the parties. If bargaining costs in the absence of a contract increase, then the contract will be of longer duration.

Given this, regulatory intervention interacts with contract duration. Crocker and Masten (1988) formulate two hypotheses:

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[3]The database consisted of a sample of 884 producer-pipeline contracts from a survey conducted in 1982 by the Energy Information administration. These contracts covered sales of natural gas in interstate commerce from 615 American producers.

1. The hazards of extending a contract to cover an additional period are likely to be larger the longer the contract and the more uncertain the transaction;

2. Contract designs that promote efficient adaptation to changing circumstances lower the cost of being bound to long-term agreements and increase contract duration.

To test these hypotheses, the authors use a database consisting of contract terms and relational characteristics for transactions between natural gas producers and interstate pipelines. The data on contract terms were obtained from a 1981 survey conducted by the Energy Information Administration. During the period covered by the sample, many of the transactions were subject to wellhead price regulation that limited the price pipelines were permitted to pay for gas purchases. To attract gas supplies, pipelines engaged in non-price competition using other contract terms.

Crocker and Masten estimate that the resulting distortions in incentive provisions induced by price regulation reduced contract length by an average of 14 years, while increased uncertainty in gas markets caused by the 1973 Arab oil embargo raised the cost of writing contracts and reduced the length of agreements by additional three years. Hence, they conclude, regulating producer's prices raises the expected cost of contracting and leads to shorter-term agreements.

3.3. Toward shorter-term contracts?

Hubbard and Weiner (1991) also express qualitative considerations on the duration of long-term contracts. In particular, the objective of their empirical work is to consider the relative effects of transaction- and market-specific variables. The paper is mainly concerned with pricing: the authors have estimated a model inspired by their previous theoretical explanation of long-term contracts with take-or-pay clauses.[4]

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[4] The database consisted of 1,804 American contracts filed between 1953 and 1957; associated with each transaction is the information about pipeline, producer, date location, term-length, price adjustment clause, initial and final price. Market-specific variables are basically concentration indices (Herfindahl indices) of buyers and sellers; transaction specific variables are buyers/sellers size and market share. Cost variables (like cost volume and gathering-cost proxies) are used as controls.

Although the analysis of contract duration is not the main focus of the paper, the authors offer an interesting discussion on contract length, and provide counterfactual arguments to those attempting to force changes in long-term contracting practices. At the beginning of the nineties, in fact, some American regulators were in favor either of abrogating long-term contracts (and direct all parties to recontract), or, more drastically, of replacing them with short-term market agreements and spot markets.

Hubbard and Weiner affirm that none of these proposals is acceptable, as their analysis confirm that long-term contracts are effective at coordinating production and exchange in presence of potential opportunistic behavior. Even if the authors find that at the end of the eighties contracts in the American gas industry are of shorter duration, they argue that this arises from contingent supply conditions:

"Low market prices have reduced new explorations, and take-or-pay provisions have made it difficult for pipelines to substitute cheaper gas from new sources for more expensive gas covered in existing contracts. Much of the contracting in recent years has been recontracting."

Said differently, short-term contracts replace long-term contract temporarily. To the extent that specific investments are the primary motive for long-term contract in these markets, long-term agreements cannot be eliminated. Even when new relationships start, producers will be reluctant to make investment in pipelines unless they are assured of long-term access to pipeline capacity. Pipelines will refuse to make these investments unless producers are willing to commit reserves on a long-term basis.

4. CONTRACTING GAS IN EUROPE

Currently, almost all European states import gas from non EU producers, like Russia, Algeria, Libya or Norway. Only The Netherlands, Denmark and UK have domestic reserves. The volume and share of long-term import contracts are quite high in the European countries, except for gas producers. See Table 1.

Table 1. Long-term contracts in the EU countries.

	Long-term import contracts*	Percentage of long-term import contracts
Austria	6.8	93
Belgium	17.8	100
Denmark	Exporter	Exporter
Finland	3.4	All under contract with Gazprom**
France	43.7	97
Germany	75.9	91
Greece	5.5	100
Italy	55.7	81
Netherlands	8.2	20
Portugal	2.5	100
Spain	20.3	100
Sweden	1.1	100
UK	1.6	2

*BCM at plateau.
** Gazprom is the largest Russian gas producer.
Source: Petroleum Economics Ltd., reported by EC (2002).

As a general trend, gas demand in Europe will rise and take-or-pay contracts are still expected to cover the largest share of gas supply for the coming 5-10 years at least, as Table 2 shows.

Table 2. EU gas supply outlook (MTOE).

	2000	2005	2010	2020
EU Gas Demand	332	392	431	471
Indigenous EU Gas Production	181	191	179	118
Net Contracted Gas Imports	159	191	198	221
Additional Supplies to be Defined	0	11	54	132
Supply Deficit % of Demand	0%	3%	13%	28%

Source: Eurogas, 2002.

As for the price mechanisms, the international contracts in force on the European continent are indexed either directly to the price of crude oil or petroleum products imported by the buyer country, or indirectly through the use of crude oil "netback" prices. The netback market value approach, which represents one specificity of the European gas market, implies that the price paid by the importing company to the producer at the border or beach is negotiated on the basis of the weighted average value of the gas in competition with other fuels (mostly, fuel oil and gas oil) on the end user market, adjusted to allow for transportation and storage costs from the beach or border and any taxes on gas (Cedigaz, 2004). This calculation yields a maximum price (netback value) and an indexing principle. The resulting margin is negotiated.[5]

As a consequence of the netback approach, gas price differentials in the different EU countries should entirely reflects transportation and storage costs at the end-user market. The existing contracts with Russia and Algeria, include a "final destination clause", which restricts the possibility of buyers to resell gas outside their respective territories.

New trends.

As it occurred in the US in the mid 1980s, short-term spot markets have emerged in Europe. Short-term trading started in the mid 1990s but developed rapidly when the UK gas market was fully deregulated in 1998. The International Petroleum Exchange (IPE) in London provides a transparent mechanism for hedging, speculation and, in some cases, physical delivery. The notional delivery point for gas is the National Balancing Point (NBP).[6] Following the UK example, other countries are now starting to catch up. Zeebrugge in Belgium is a properly established gas trading hub, and a market is starting up in Germany and in The Netherlands. A number of other locations have seen gas trade developing, although it is not yet obvious whether they will survive in the long term: Aachen-Eynatten and Lampertheim in Germany, or Zelzate, between Belgium and The Netherlands.

In addition to the new trading opportunities offered by spot markets, buyers are also changing the structure of the traditional long-term contracts. New take-or-pay agreements are characterized by shorter term

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[5] Gas price may be renegotiated every three years if market conditions are substantially modified. Both buyers and sellers may ask for the renegotiation process to start.

[6] In 2003, 50 players were active at the NBP and the traded volume was estimated to amount to 675 Bcm/year.

duration and smaller volumes, on one side, and by greater flexibility in the price indexation clauses (Cedigaz, 2002 and 2004, Finon, 2002).

Since the end of 2001, no contract of more than 20 years was signed, and 10 to 15 year contracts account for 50% of total volumes vs. 45% for 20 years contracts. The bulk of short-term deals, 1 to 5 years, represent the remaining 5%.

Indexation can include electricity prices, as it is the case for contracts between the Egyptian exporter and the Spanish companies. For example, the new contracts concluded by the largest gas company in the UK, Centrica, and both the Norwegian company Statoil and the Dutch Gasunie refer to the IPE price as a reference for sales in the British market. In the aftermath of this innovative contract, the German incumbent Ruhrgas has renegotiated its price indexation clause in some contracts with Norway because of its possibilities to re-export some quantities on the British market via the interconnector.

5. POLICY ISSUES: THE EU ON LONG-TERM CONTRACTS

The European gas sector is facing a wide regulatory reform promoted by the European Commission. The core idea of the Directive 98/30 is that for competition to work in European gas markets, it is vital that suppliers have third-party access (TPA) to pipelines. Countries are given two options to organize TPA: regulated access (article 16) is based on published tariffs; negotiated access (article 15) is based on commercial agreement between pipeline owner and user.

Under this new institutional context, what is the role of long term contracts? The first answer to this intriguing question comes from the European discipline.

The Commission's view on long term take-or-pay contracts is complex, as it is spread off in several sources and official documents.[7] In its own words, the European Commission considers that:

1. Take-or-pay contracts must not constitute a barrier to entry nor an impediment to cross-border competition: the existence of contractual

[7] Long-term contracts are mentioned: 1) in the European Directive 98/30 and in the proposals of 11/09/2002 on the reinforcement of the security of the oil and gas supplies; 2) in the proceedings of the "Meeting of Follow-Up Group on Take-or-Pay Contracts" (1999); 3) in the Green Paper "Towards a European strategy for the security of energy supply" (2001 and 2002); 4) in the proceedings of the 5th Madrid Forum on the harmonisation of the national rules governing the gas market (2002).

obligations should not undermine the main principles of European network interconnection and market liberalization;[8]

2. Large companies having a portfolio of take-or-pay contracts must not distort competition against entrants;

3. The development of gas-to-gas competition puts strong pressure on suppliers to renegotiate existing contracts to adapt to a changing regime and to organize more flexible (i.e. shorter duration) pricing provisions;

4. Take-or-pay contracts are intended to share risk between producers and buyers due to long lead times in investment planning and capital intensive operations;

5. Long-term contracts are a fundamental piece of European security of supply.

Clearly, long term contracts serve several objectives. On one hand, the EU judges unnecessary to intervene in the redefinition of take-or-pay contractual arrangements and favors market-based solutions, but on the other it stresses their importance for backing investment and long-term security of supply. Are these objectives potentially conflicting? Although the characteristics of the American gas market differ from the European ones, mainly because in the US gas is supplied by a large number of small domestic producers, the models we have analyzed constitute an interesting base to evaluate present or future European interventions in the long-term contracting discipline.

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[8] This is the most stringent view, as mentioned in the Directive 98/30, which considers that take-or-pay contracts are potential exceptions to the general principle of TPA. The article 17.1 affirms that "natural gas undertaking may refuse access to the system on the basis of [...] serious economic and financial difficulties with take-or-pay contracts". Therefore, derogation to negotiated or regulated access is only possible if alternative solutions are not reasonably available. Applications for derogation shall be presented by gas companies on a case-by-case basis either before or after refusal, according to the choice made by member states. When deciding on a possible derogation, member states and the Commission will take into account some specific criteria (cf. article 25.3), among which the objective to achieve a competitive gas market and the need to fulfil public-service obligations and to ensure security of supply. Such derogations are thus specific-that is, made on a case-by-case basis-and limited in time; moreover, they must be exceptional, as a solution of last resort, and the least restrictive possible.

5.1. Long term contracts and competition

The models surveyed are silent about the impact of long-term contracts as a barrier to entry. Indeed, in the US market structure and concentration seem not to be perceived as a major problem, given the characteristics of the gas supply. In Europe, on the contrary, competition in the gas market is still on its way, and incumbents could deter entry by using long-term agreements. One may expect that in the future long-term contracts will be signed with entrants and provide for competition across borders. However, in the short to medium term, this is unlikely to amount to much real competition. There is a relative shortage of upstream competition as the gas market is dominated by a few international oil companies. Moreover, delays in downstream gas liberalization and a prolonged transition towards a fully operational internal market could postpone the benefits consumers could expect.

On its side, the Commission stresses that long-term contracts must not "*frustrate competition either via the explicit inclusion of restrictive conditions, or by creating participants with dominant positions*". The fact that gas purchases are concluded with foreign producers explains why in Europe wellhead regulation is less material. The Commission can only ask member states to specify the conditions under which the existence of take-or-pay contracts can constitute an exception to TPA. Some countries have judged the EU Directive too weak vis-à-vis large companies having a portfolio of long-term contracts and have chosen the so-called "gas release programs" to attract entrants in the gas market. Under these programs, incumbents - either as a result of legislation or of a threat of an anti-trust investigation - are required to sell off a part of their contracted supplies. Three countries have actually implemented the gas release programs: UK, Spain and Italy.[9]

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[9] From 1992 to 1995, British Gas has been forced to release a decreasing share of the eligible market (that is customers free to choose their suppliers). From 2001 to 2004, Spain auctioned 25% of the gas she received from Algeria representing 15% of the eligible market. In Italy, from January 2003 until December 2010, no single operator can provide gas (imported or produced in Italy) to the national transmission system destined for sale in Italy in a quantity exceeding a pre-determined cap on the annual domestic gas consumption. In 2003, the cap has been fixed to 75% and will progressively decrease to reach 61%. For more details on the gas release programs, see the proceedings of the 5th Madrid Forum (2002) and Polo and Scarpa (2003).

During the last two years, the Commission has also put pressure to delete the final destination clause in the existing and new gas contracts, as it does not comply with the European competition law.[10] In fact, final destination clauses enable first-order discrimination. Even if they were formally maintained, they lose their bite: the opening of the market shall allow European companies to compete against foreign producers, other gas companies, and traders, by arbitraging between spot prices and contractual prices. Indeed, the price differential between two areas that the monopoly can impose cannot durably be larger than the transportation cost, as defined by the net-back approach.

Theoretically, it is not clear from the literature that this reduction of differences increases consumers' welfare. Why? Typically, arbitrage increases one price and decreases the other: some consumers lose and other gain. The aggregate effect on buyers is known to be ambiguous, though it is uncontroversial that the sellers profit is higher under complete discrimination.

This debate is prima facie largely orthogonal to the fact that the contracts we investigate are long-term. Overall, opening markets reduces internal inefficiency in Europe but this has to be balanced with a possible negative effect of the type described above.

5.2. FLEXIBILITY

Another interesting issue concerns the flexibility of long-term contracts. The Commission affirms that several forces "put strong pressure on suppliers to renegotiate existing contracts to adapt to a changing regime and to organize more *flexible (i.e. shorter duration)* pricing provisions" (EU, 1999, our emphasis). Those forces are the expected increase in gas demand, the need of new entrants to have access to gas, the ambition of producers to regain control over parts of their own gas under take-or-pay contracts to sell it in the emergent of spot markets, and the existence of new financial instrument to hedge risk.

The point is that it is unclear in which direction renegotiation modifies the bargaining costs of, respectively, the producer and the pipeline.

We give a simple illustration of this claim. Assume that the producer would like to subtract available capacity from existing long-term contracts to increase his supply on gas spot markets. He decides to embark on contract renegotiation. Also assume (as it is likely to be) that the infrastructure is already in place, so that the producer can costlessly

[10] For more details on this subject, see Finon (2002).

redirect his gas supply to other pipelines. Under these hypotheses, the producer expects a net gain from his outside option and his actual bargaining power increases. At the same time, the pipeline negotiation costs should increase, since if the contract is broken, the relation-specific investment loses its value. In this case the *net effect* on total bargaining cost is ambiguous. As the optimal contract duration of a long-term contract minimizes the sum of the parties' bargaining costs, there is no a priori reason to believe, as the Commission suggests, that "pressure on renegotiation" will in any case lead to shorter term contracts.

We also argue that in the Commission's view there is a slight confusion between long-term contracts and take-or-pay clauses. For example, assume that gas-to-gas competition creates new alternative uses for the resource: if a pipeline disagrees on the contractual terms with a producer, this latter might have several alternative agents to which he can supply his gas, due to the presence of entrants on the gas markets. This would imply a decrease in take-or-pay percentages, but not necessarily of contract duration.

Finally, our examples suggest that the impact of increased competition on the parties' bargaining costs, contract duration and magnitude of take-or-pay clauses is a priori unclear and deserves careful analysis. Moreover, let us underline that both Crocker and Masten's and Hubbard and Weiner's analyses, although developing different modelling perspectives, conclude that there is no reason to force long-term contracts to disappear or to be replaced by short-term agreements. In Europe, this problem is all the most important, as gas supply comes, in increasing proportion, from foreign countries.

5.3. The buyers' portfolio

The overall American experience on price regulation suggests that interventions in the structure of long-term contracts with take-or-pay provision are distorsive. This supports the optimistic view of the Commission who has preferred to leave the evolution and the characteristics of long-term contracts to be determined by market forces only: long-term contracts and spot markets would simply coexist.

The evolution of the natural gas sector in the United States has anticipated the European deregulation reform and thus offers some interesting insights on the coordination between long-term and spot market for gas transactions. Traditionally, interstate pipelines served as gas merchants, who purchased gas from independent well owners and then transported and sold the commodity under long-term contracts to local distribution companies (LDCs). In the early 80's, the Federal Energy

Regulatory administration (FERC) mandated the unbundling of gas sales and transportation, in order to transform pipelines into common carriers providing only transportation services to the end users on a non-discriminatory basis (in the same vein as the recent European Directive). The result has been the creation of a market where end users negotiate directly with well owners and then arrange transportation with a regulated interstate pipeline.

As reported by Crocker and Masten (1996), this system has advantaged the LDCs, who substituted away from their long-term contractual obligations toward less expensive spot supplies in the wellhead markets. The development of well-functioning spot markets, moreover, has altered the economics of contracting, that remains, but is now indexed to spot prices and often allows for termination on a relatively short notice. The financial impact of spot markets is generally that the degrees of contracting and price flexibility depend on the variance of the spot price and the risk aversion of the transacting parties.[11] However, the overall impact of the existence of spot and long-term transactions on the market structure of the gas industry is unclear and deserves further research.

5.4. The investment problem

The models we have surveyed do not address one important problem raised by the new organization of the European natural gas industry, namely the long-term effect of the TPA in determining the relative competitiveness of gas and the incentives to invest in a second-best-world (Joskow and Tirole, 2003). The existing theory is unclear and its conclusion depends: 1) on the nature of the market imperfection at the level of the network operator, 2) on the quality of the regulation in terms of information used or instruments available.

The typical issue is that the network operator, if not properly regulated, might use its market power to maximize profit. It might for example underinvest to create scarcity and increases equilibrium

[11]The functioning of markets in which long-term contracts and spot transaction coexist has been analyzed for several raw materials, as copper and petroleum, or, more recently, for electricity (Green, 2002). Such markets are characterized by "multiple price systems", wherein spot prices adjust supply and demand shocks, while contract prices are fixed or adjust slowly. The focus of these models (among which, Hubbard and Weiner, 1992) is to derive the equilibrium shares taken by contracts and spot trade respectively. These models stress the role of risk in determining commodity market trading arrangements when insurance and future markets are incomplete (Newbery and Stiglitz, 1981).

transportation charges largely above marginal cost. TPA, in that case, doesn't solve the bottleneck problem if it is not associated with other vigorous rules. Probably, as a consequence of the open access policy, markets interconnections will make it easier to optimize the transport of contract-based flows, especially for distant sources and destinations. In this context, spot trading and capacity swaps will complement take-or-pay contracts. Indeed, the development of spot transactions in the United States has occurred in a contingent economic situation where low oil prices and weak demand for gas obviated the need for new investments. This is not actually the case in Europe. Investment, a prerequisite to maintain long-term security of supply, will be the recurring question.

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