Pricing of Natural Gas in the West European Market

MARIAN RADETZKI

Since the mid-1970s, pricing of natural gas in western Europe, both at the import level and at the final consumer level, has been monopolistic, with virtually all the monopoly rent accruing to the producers and their governments. Since the late 1980s, the pricing modes have been experiencing strain. Producers are disillusioned by stifled market growth and unused production capacity. Simultaneously, the roles of the national transmission companies as guarantors of market stability are being questioned and diluted. This paper considers the alternative arrangements for pricing gas in western Europe that may emerge during the 1990s and explores the ensuing implications for market development.

Depuis le milieu des années 70 en Europe de l'Ouest, l'établissement des prix du gaz naturel, tant à l'importation qu'à la consommation finale, s'est fait selon un mode monopolistique, la presque totalité de la rente de monopole revenant aux producteurs et à leur gouvernements. Depuis la fin des années 80, les mécanismes d'établissement des prix sont soumis à des tensions. Les producteurs ont été déçus par la croissance anémique du marché et par la surcapacité de production. Parallèlement, les rôles des sociétés nationales de commercialisation, en tant que garantes de la stabilité du marché, sont remis en question et diminués. Cet article examine les arrangements de remplacement qui pourraient éventuellement servir à l'établissement des prix du gaz en Europe de l'Ouest au cours des années 90 et il explore les répercussions qu'ils auraient sur l'expansion du marché.

Marian Radetzki is the Director of SNS Energy, Stockholm, and Professor of Economics, University of Luleå, Sweden.

Valuable comments on earlier versions of this paper have been received from a group of advisors attached to SNS Energy, from the participants in a seminar at the Institute for International Economic Studies, University of Stockholm, and from two anonymous referees.

1. Introduction

The purpose of this paper is to scrutinize thoroughly the way natural gas is priced in western Europe and to explore the implications of pricing mechanisms for market growth. To provide a context, the following section discusses the major arrangements under which commodity trade is usually transacted. Section 3 describes the evolution of the pricing conventions in the western European gas market since its establishment in the 1960s. The implications of the prevailing pricing systems for market growth and market size are considered in section 4. Finally, section 5 discusses the emergent factors that may lead to a disintegration of the present pricing arrangement. It also considers the price system that may replace the one currently in force.

The main conclusions of the following deliberations can be bluntly stated. Stripped of various complications, including, in particular, the middleman role played by the national transmission companies which import gas and transport it through national grids, a key char-

acteristic of the pricing conventions in west European gas appears to be one of near-monopoly price levels extracted from gas users, with considerable power to discriminate between major buyer categories. The prevailing conventions also assure that the gas producers reap the major share of the rent generated by the monopolistic arrangements. The present pricing modes have led to stagnant demand, while supply has continued to expand. The ensuing market imbalance, along with the political pressures to establish more competition and more openness in price formation, make it unlikely that the arrangements will survive until the end of the century.

2. Major pricing arrangements in commodity trade

It may be instructive to discuss briefly a few of the major trading arrangements and their implications for price formation (see Radetzki 1990a for an elaboration). This discussion is intended to provide a context for the following analysis of pricing conventions in the west European gas market. I first discuss price-forming institutions, and continue with contractual forms.

The most transparent price formation process in primary commodity markets is through *commodity exchanges*. For commodity exchanges to function as pricing mechanisms, a number of preconditions have to be present. The market must have reached a considerable maturity. Exchanges presuppose a reasonable degree of competition, so there must be many buyers and sellers willing to use them. Also, the commodity must be easily standardized, or else it will be difficult to define the specifics of the contracts traded. Prices are determined both for spot transactions for immediate delivery, and for futures transactions, with delivery to take place at a particular future time. Prices are determined through a double auction in which bids are successively raised and offers successively lowered until a transaction can take place. Prices are published daily. A great advantage of commodity exchanges as mechanisms for price formation is that they allow all observers to perceive price changes when they occur.

Producer dictated prices provide an alternative, reasonably transparent mode for price formation in primary commodity markets. This mode usually occurs when there are few producers and many consumers. In such circumstances, a commodity exchange would be difficult to operate, and the producers may find individual negotiations with each consumer unpractical. In principle, prices can be known by everyone since the producers have to make them known to the public to sell their products. But since hidden rebates from the announced prices are often given to favoured customers, especially in periods of excess supply, this is somewhat illusory.

Bilateral contracts commonly occur when the number of buyers and sellers is about the same, and when the commodity is unsuited for trade on an exchange, for instance because the market is too concentrated, or because commodity standards are hard to establish. Prices will typically be determined independently in each transaction involving a seller and a buyer, so the price levels of different transactions at a particular time may differ considerably. Since the contents of bilateral contracts are not ordinarily published, prices will not be widely known. Indications of prevailing price levels or average prices are sometimes provided by journals, trade associations or government bodies, so price levels do not have to be established from scratch in each case. In some markets, for example, those for iron or manganese ore, a dominant seller and buyer take the lead in the annual contract negotiations, and their pricing agreement is published and used as a reference point in other bilateral contracts.

Related to the price-forming institutions are the contractual forms. When there are many sellers and buyers, market conditions are competitive, and access to the market is easy, there will be little need to maintain long-run contractual arrangements. When need arises, the user can always enter the market and secure his requirements. The predominant contractual form on commodity exchanges is a single transaction, without the obligation for

repeated trade.

When, in contrast, the number of agents on both sides of the market is limited and each accounts for a significant share of the total market volume, assurance of demand or supply will often require more extended contractual arrangements. Long-run contracts will be particularly common when production and/or consumption takes place in capital intensive units with a large-scale minimum size. In such circumstances, producers will hesitate to commit the funds needed to establish production unless long-run sales contracts assure them of a market. For similar reasons, users may deem it essential to reduce the uncertainty of supply by entering into long-run purchase contracts before they establish the activity that absorbs the commodity. Precisely for such reasons, long-run arrangements predominate in, for instance, iron ore or manganese ore trade.

The need for long-run contracts may be reduced as the market for a commodity grows and matures or becomes more competitive. The number of producing and consuming units will tend to increase as the market expands. Each will therefore account for a declining share of the total market volume. It will then be easier for the market to absorb the marginal quantities of an additional new producing or consuming unit. Long-run contractual arrangements become less essential in such circumstances.

3. The pricing conventions in the west European gas market[1]

The gas market in western Europe is of recent origin. It emerged on a significant scale only in the late 1960s, after the large Dutch Groningen field, discovered in 1959, went into production. For at least 10 years, until the late 1970s, when gas from Algeria, Norway, UK and USSR started to flow to western European consumers in substantial quantities, the Dutch exports constituted a major proportion of total supply, and the Dutch approaches to pricing and marketing gas were instrumental in shaping the market patterns.

Basically, the market consists of two tiers as

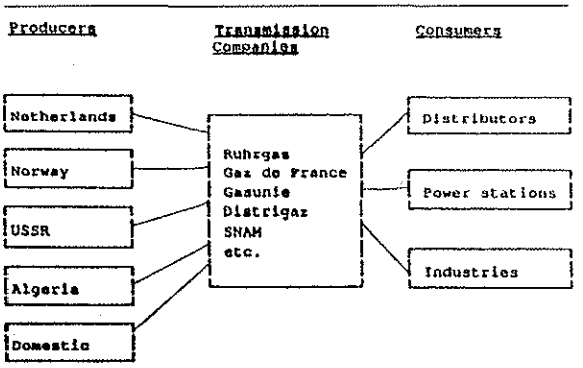

Figure 1: Main features of west European gas market structure

illustrated by Figure 1. At the first tier, producers sell gas to national transmission companies. The number of important actors involved in these deals is quite limited (Estrada, 1988). Four agencies account for an overwhelming share of total supply. In the consuming countries, one national transmission agency is either the sole or a very dominant buyer of gas. Most transactions have the form of large bilateral contracts covering very extended periods of time. Public information about price levels and price formulas in individual contracts is quite limited. The press has reported a good bit about the main pricing principles, for example, the relationship between oil and gas prices, and the value attached by both sellers and buyers to quantitative flexibility. The OECD regularly reports the average CIF price levels of national imports in individual countries and in western Europe as a whole.

At the second tier, the national transmission companies sell gas to local distributors, who are often owned and run by municipalities, or directly to large-scale consumers like industries or generating stations. With few exceptions, each buyer is connected to only one pipeline controlled by the national transmission company or the local distributor.

1/ In this paper, gas volumes are given in cubic meters with an energy content of 9000 kcal/m^3. One billion m^3 of gas corresponds to 0.9 million tons, or to 18,100 barrels, of oil. Gas prices are given in $US/million BTU. Expressed in energy equivalents, a price of $1/million BTU corresponds to $5.46/barrel of oil.

Households pay for gas in accordance with tariffs set by the sellers. In some countries these are publicly controlled. Information about charges to industries and generating stations is less complete. In several countries, the price paid by the largest consumers is determined through bilateral contracts whose content is not publicly revealed.

The near-monopoly pricing of gas was not there from the beginning. It has its origin in the oil price increases implemented by OPEC during the 1970s and the ensuing sense of crisis and the urge among energy consumers to secure their long-run energy needs.

During the 1960s, Dutch policies were based on the perception that gas resources were abundant. In consequence, pricing of gas aimed at a speedy market expansion. To ensure an increasing market share for gas in the overall energy market, the prices were consistently kept below the price of fuel oil, at that time the most important substitute for gas. In an effort to stifle the threat of potential large scale deliveries from the USSR to Germany and Italy, the Dutch exporters even implemented a price decrease during the early 1970s (Estrada, 1988). The policy was successful. Gas conquered a very substantial share of the total domestic market in the Netherlands. Exports expanded from 5 billion m^3 in 1968 to 22 billion in 1972 and 39 billion in 1974 (Gasunie, 1987).

The Dutch policy was radically changed after the first oil crisis. Gas then began to be regarded as a scarce resource, to be saved for future generations, so a conscious effort was made to reduce the export flows. Actual exports continued to expand for some years, to satisfy long-run contractual obligations. Exports reached an all-time high of 48 billion m^3 in 1976, but after that there has been a steady decline, to 44 billion m^3 in 1980 and 23 billion in 1988 (Gasunie, 1988).

The restraint on exports was a precondition for drastic changes in the Dutch pricing policy. Arguing that gas was a substitute for oil, Gasunie succeeded in renegotiating the pricing clauses in its long term export contracts. The important new principle was to establish parity between the price of gas and the price of alternative fuels available to final consumers. As a result, both the base price and the indexing clauses in the renegotiated gas contracts became closely related to the price of crude oil and oil products (Lönnroth, 1985). With the sharply augmented oil price levels, the policy became exceedingly profitable to gas producers. The emergent exporters to western Europe, i.e., Algeria, Norway and the USSR keenly adopted the new principle, and the national transmission companies, sensitized by the energy crisis and anxious to secure their long-run supply, fell into line. A tight relationship between the border prices of gas and the price of oil, and a parity of the consumer price of gas with the price of feasible substitutes have been two key characteristics of the west European gas market since the mid-1970s (Cornot, 1988).

At the second tier of the market, the exclusive position of each gas supplier vis-a-vis the final gas users, along with its control of the pipeline network has enabled the national transmission companies and/or the local distributors to set prices (producer-determined pricing) and to exercise price discrimination among the different customer categories. Even though some price difference was justified by differential costs of distribution, the guiding principle was to charge each consumer a price equivalent to the cost of available substitutes. Households usually had to pay the highest price, since the alternative to gas in their case was a combination of expensive electricity and light fuel oil. For industrial users, the tendency was to set the gas price lower, since the predominant substitute product was cheaper heavy fuel oil. Power stations were charged the lowest gas price, because their main alternative was even cheaper steam coal. However, for a variety of political and economic reasons, power generation using gas as a fuel has remained quite limited. By and large, the prices to final users were those of a price discriminating monopolist. Each user category was charged the maximum that it was prepared to pay.[2]

2/ The public control of gas tariffs in some countries does not negate this statement. See below.

An implicit consensus that the pricing principles at both the first and the second tier of the market were "equitable" to sellers as well as buyers has permeated the public opinions expressed by the gas industry since the late 1970s.

The second tier pricing arrangements should not surprise. A monopolist is normally expected to extract a monopoly price, and to exercise price discrimination when feasible, in its efforts to maximize profits.

A more surprising feature of the market is that the producers appear to have succeeded in extracting near-monopoly prices from the national transmission companies. Given that the transmission companies are few in number and can exert considerable market power, one would expect them to be able to bargain down the prices they pay to producers, substantially below the near-monopoly levels that actually occurred.

There are a number of reasons for the unaggressive, even complacent attitude of the national transmission companies in their gas price negotiations. The behaviour of the companies in this respect will be discussed below.

First, however, it is necessary to argue the claim that near-monopoly prices were extracted by the gas producers from the west European importers. This is not an easy task. Views to the contrary have been put forth. For example, Bjerkholt *et al.* (1990) contend that substantial monopoly profits are being reaped in transmission and distribution. Their comparison of actual import prices with estimated transmission/distribution costs in the residential and industrial gas markets in 1984 indicates net profits of DM 9 billion in West Germany, and FF 13 billion in France. These numbers do not appear reasonable. Ruhrgas' total sales in that year were no more than DM 15 billion, and its net revenue DM 1.1 billion (Ruhrgas, 1984). Gaz de France's turnover was about FF 50 billion, generating a loss of FF 2 billion (Gaz de France, 1984). It is hard to reconcile these two sets of figures, even after adjusting for the profits generated by other transmission agents in the two countries. The problem probably arises in the assessment by Bjerkholt *et al.* of the transmission/distribution costs.

A more indirect inference that a large part of the monopoly profits is appropriated downstream is based on comparisons of prices and transmission/distribution margins between western Europe and the US (Hopper, 1991). Such comparisons show that the transmission/distribution system accounts for some 60% of the difference between the final user prices in western Europe and the US. Though Hopper suggests that this figure is indicative of the west European transmission sector's share of the monopolistic gains reaped by the gas industry, such a conclusion does not necessarily follow from his analysis.

The most straightforward way to argue my claim that most of the monopolistic gas rent accrued to producers would be by showing that these producers had very high capital returns. This, unfortunately, is not possible. USSR profitability figures have little relevance, if they could at all be obtained. And in all the other producing countries, gas is supplied by multicommodity companies, oil being the dominant product, and with no separation of the gas profits in the published accounts. Given this difficulty, I will attempt an indirect approach to demonstrating monopoly pricing by pointing to (a) a substantial discrepancy between the marginal cost of supply and the border price, and (b) the absence of excessive profitability in the national transmission companies.

The cost of gas supply can be calculated in a number of different ways. The level of costs will depend on many factors, e.g., the chosen time horizon for a project or the discount rate used. Most gas project cost assessments are made by the gas producers or their consultants. The numbers are typically kept out of public reach. Where figures are published, one can suspect an upward bias, because producers have an interest in showing high cost levels to motivate high prices. These ambiguities create serious problems in estimating marginal cost curves.

The one comprehensive analysis of the cost of supply of natural gas to western Europe that

has been published is based on a global natural gas study undertaken at the Massachusetts Institute of Technology (MIT, 1986, chapter 3). The gist of its findings is depicted in Figure 2. Since the study was undertaken independent of the gas producers, one can assume away the common upward bias in the cost assessments. The cost levels shown reflect conditions in 1985, and are expressed in constant 1985 dollars. The cost curve comprises production and transport to the borders of west European importers. For existing production and transport capacity, only the variable costs have been included; where new facilities are required, the cost curve also comprises capital depreciation and a 12% capital return in real terms on the investments. Taxes in the exporting countries are not included. The tax take is regarded not as a cost, but as an appropriation of part of the gas rent, assumed to vary with price. This view of taxes is supported by the sharp fall of taxes in the North Sea in consequence of the oil and gas price falls of the 1980s.

The cost curve in Figure 2 depicts 255 billion m^3 annual operational capacity in Algeria, the Netherlands, Norway, UK, and USSR available for deliveries to western Europe. This curve differs from standard marginal cost schedules in that it also shows 140 billion m^3 capacity which requires some limited additional investments to become operational, and a further 100 billion m^3 of potential greenfield projects. Annual operational capacity in France, Italy and Germany, amounting to some 33 billion m^3 (BP, 1989) with low variable costs (IEA, 1986), is not included.

In summary, the existing capacity to deliver gas to western Europe in the mid-1980s was 288 billion m^3, with marginal cost levels (CIF the importing country's border) below \$1/million BTU (1985 dollars). With small additional investments, the annual capacity could be expanded to more than 400 billion m^3 at a cost, including the additional capital cost, not exceeding \$1.50/million BTU (1985 dollars) for the marginal unit.

Both cost and the ability to supply should be compared with demand and price. Consumption of natural gas in western Europe

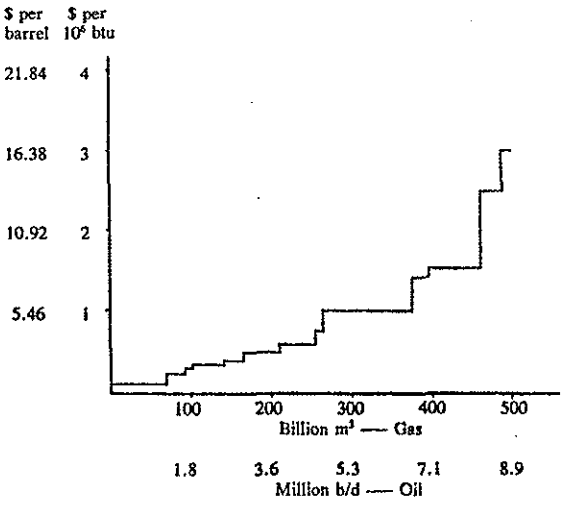

Figure 2: Cost curve for gas delivered in western Europe (CIF border of importing country)

Note: Includes 12% return on new investments. Constant 1985 dollars.

Source: MIT, 1986.

varied between 200 and 240 billion m^3 during the 1980s (BP, 1991), so it is apparent that the industry operated with a very substantial overcapacity. The evidence of overcapacity has been noted also in other studies (see e.g., Wood-Collins, 1988). In a competitive market, the gas price should settle about the level of marginal cost. In fact, as appears from Figure 3, excepting 1975 and 1988 through 1990, the constant 1985 dollar prices shown have been maintained at above \$2, i.e., more than twice as high as the marginal cost. The discrepancy between marginal costs and prices does not indicate the level of profitability, but it is a very clear indication of strong monopolistic elements in the determination of import prices.

The above still does not preclude the possibility that the gas rent was shared between the producers on the one hand and the national transmission companies and their customers on the other. Such sharing would either yield high profit levels for the national transmission companies or final user prices below the price of substitutes. The latter was clearly not the case, nor was the former true. Public sales

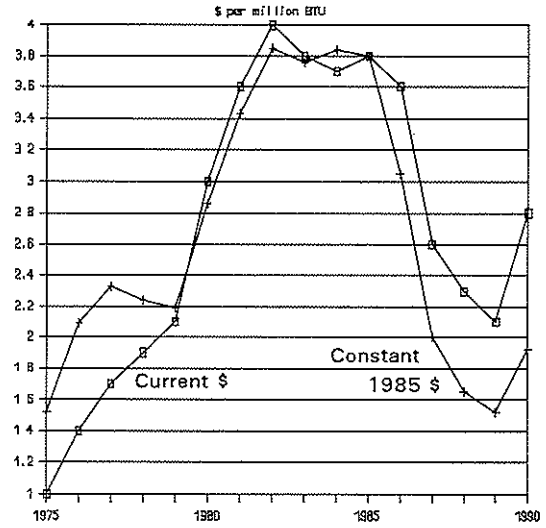

Figure 3: Prices for gas imports (CIF western Europe)

Source: BP, 1991; World Bank, 1991

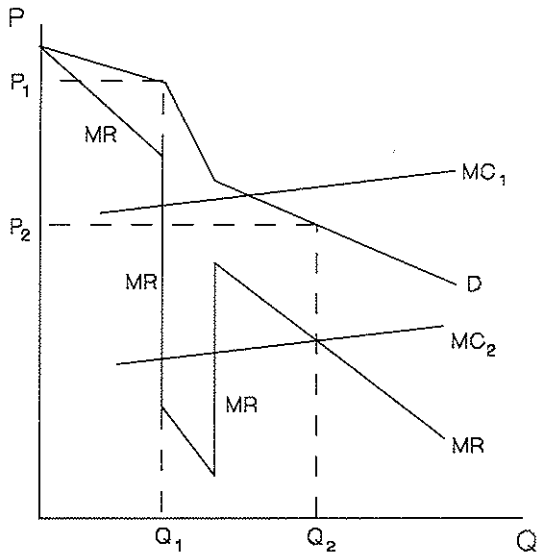

Figure 4: Profit maximization with a double-kinked demand curve

price regulation consciously limited the profitability of several of the transmission companies, notably Gaz de France in France (Gaz de France, 1986, 1987 and 1988) and Distrigaz in Belgium (private communication with Distrigaz). Ruhrgas in Germany, which had no such constraints, returned a net profit of between 16 and 19% on its own capital between 1984 and 1988, which suggests comfortable but hardly monopolistic profit levels (Ruhrgas, 1985, 1986, 1987, and 1988). These findings confirm the claim that the monopolistic gas rent was appropriated by the producing side.

An excursion into price theory explains why the price charged by the monopolistic gas producers was tied to the price of oil, and why the link has persisted despite substantial shifts in the oil price over time.

The kinked demand curve, usually encountered in textbook oligopoly theory, can provide an interesting insight on this issue. Suppose that there is a substitute (oil) for the monopoly product (gas), and that the price of the substitute is fixed. Under these conditions, the demand curve of the monopolist is likely to have two kinks, as illustrated by line D in Figure 4. The steep portion of the demand curve represents a price equivalence between the monopoly product and the substitute. Given the cost of shifting between the substitutes, there will be little incentive to change from the monopoly product to the substitute and vice versa, so long as the monopoly product price remains in the price equivalence band. Price changes within that band will therefore have a very small impact on quantity, as implied by the steepness of the demand curve. Outside the band, however, the price elasticity of demand will be much higher because substitution will then be economical. If the monopoly product price moves above the price equivalence band, markets will be speedily lost. Analogously, at prices below the price equivalence band there is the prospect of substantial market growth.

Profit maximization under monopoly requires that the quantity supplied is set at a level where marginal revenue (MR) intersects marginal cost. In the case under consideration, there will be discontinuities in the marginal revenue schedule where the kinks occur. Thus, in Figure 4, marginal revenue experiences a substantial fall at volume Q_1, and a large rise at the higher volume corresponding to the second kink. If the marginal cost curve is like MC_1, its intersection with the vertical portion of the MR

curve will determine the profit maximizing volume at Q_1, with price at P_1. It should immediately be obvious that the quantity, and hence the price, will remain the same even with very wide variations of the cost conditions. The monopolist will typically find it advantageous to assure a price at the top of the price equivalence band.

With a sufficiently low marginal cost curve, e.g., MC_2 in Figure 4, there will be two local profit maxima, one at volume Q_1, and another at volume Q_2. In practice, once operations have been established at Q_1, a move to Q_2 may be hard to bring about, even if the profit potential at Q_2 appears to be greater.

The difficulties may be due to uncertainties about the relative size of profits at the two points, or because agreement on the move is hard to reach for a group of collaborating producers.

The price equivalence band will move up if the substitute price increases and move down when it declines. Pricing at the top of the price equivalence band implies that the price is tied to the price of the substitute product.

The conclusion of this analysis is that the monopolist whose product has a close substitute will tend to have an inflexible pricing behaviour. Over a wide range of variables the price will be set at the top of the price equivalence band, and once there, it will tend to remain unchanged so long as the monopolistic elements of the market prevail.

This explains the price behaviour of the gas producers since 1975. These producers simply leaned against the high oil price maintained by the oil cartel and charged for their gas at the top of the price equivalence band. One has to add that after they adjusted to lower oil prices in the latter half of the 1980s, the monopolistic gas prices might not experience a very drastic fall to reach their **long-run** competitive level at which the full cost of new marginal projects would have to be covered.

Given the limited number of importers and the potential bargaining power of each, it remains to be explained why the producers were permitted to reap the monopolistic advantage. The answer is primarily provided by the institutional conditions under which the national transmission companies operate. These conditions have been dealt with in detail elsewhere (Radetzki, 1990b). Four factors are involved, all having to do with constrained incentives for the transmission companies to maximize profits. These factors apply selectively to the transmission companies.

The first is that a substantial proportion of the equity in a majority of the transmission companies is owned by oil producing corporations. The ownership link has tended to cement the resolve to maintain gas prices to final consumers within the price equivalence band. This is because lower relative gas prices could reduce the demand for oil to the detriment of the oil companies. The ownership link also limits the motivation to bargain hard to reduce the purchase price for gas. With tight ownership bonds, the price becomes a transfer price of little consequence to overall corporate profitability. With lesser ownership shares, rational economic behaviour suggests that the oil corporations should always use their ownership influence to make the transmission companies accept high purchase prices whenever their own gas deliveries constitute a larger proportion of total gas purchases than their ownership shares in the purchasing organizations.

The second factor is related to the regular involvement of the importing governments in the purchase contract negotiations. Such involvement is justified partly by the public ownership positions in most transmission companies, but also by energy policy, foreign policy or trade policy considerations. Some aspects of this involvement clearly reduce the transmission companies' ability to bargain down prices. Examples of government involvement include: the French and Italian governments' acceptance, on behalf of Gaz de France and SNAM, of uneconomically high import prices from Algeria; the implicit political indication to the USSR that its share of total EEC imports must not exceed 30%, making that supplier less willing to swap lower prices for higher sales volumes; and the public insistence on counter-trade which increases the cost of

gas sales to the exporter.

The third factor is the partial or complete regulation of the consumer prices for gas by the governments of several European countries. Such regulation is often based on a cost-plus formula to assure that the national transmission company can cover its costs and obtain a "normal" return on its capital. The pressure to control costs, including the costs of purchase, will be dissipated by price control measures of this kind.

The fourth factor is inherent in the monopoly position of the national transmission companies and local distributors. The monopoly guarantees that market prices will be at the top of the price equivalence band. Given the producers' willingness to grant an adequate margin to cover the cost of national transport and distribution, and to adjust the price depending on the composition of final user categories, mere acceptance of the price formula established by the producers in the mid-1970s also guarantees at least a fair level of profits for the transmission and distribution companies (private communication with Statoil).

These four factors in combination help to explain the complacent attitude of the national transmission companies vis-a-vis the gas producers with regard to prices. The price of European gas imports has varied sharply since the mid-1970s, however there is no indication of a fall in the price of gas relative to oil (BP, 1989b). The monopolistic rent generated by gas has certainly shrunk after 1985 as a result of the sharp decline in the price of oil. By and large, whatever rent remains continues to be appropriated by the gas producers.

4. Implications for market growth and market size

Between 1965 and 1975, the share of gas in total primary energy consumption in western Europe increased from 2.5 to 13.5%, or by a total of 11 percentage points. From 1975 and until 1990, the share remained virtually stagnant, with the increase limited to a mere 2.5 percentage points. These developments, depicted in Figure 5, cannot be interpreted as a sign of gas reaching its level of saturation given that the gas share in other markets, e.g., North America or the countries of the CIS, is much higher than in western Europe. Rather, the flattening of the curve that depicts the share of gas was caused by the change in the gas pricing system. Until 1975, gas at both tiers of the market was priced so as to make it competitive with energy substitutes like oil and coal. The share of gas expanded in consequence. Since 1975, gas prices were set at the top of the oil price equivalence band. Producers enjoyed high monopolistic profits at the cost of a stagnant market share.

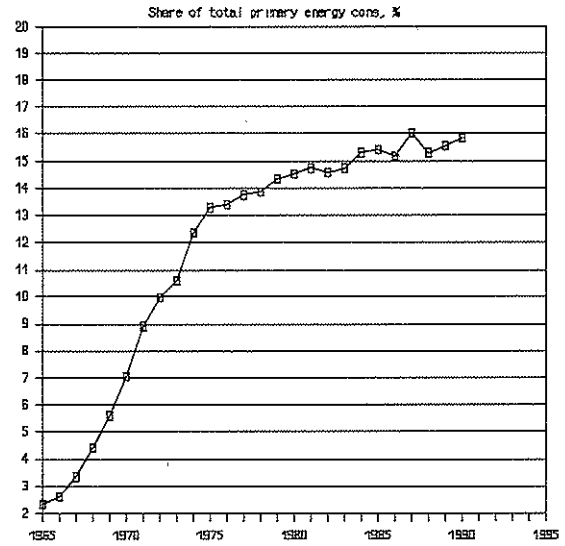

Figure 5: Gas consumption in western Europe

Source: BP, 1975, 1985 and 1991

Because total energy consumption ceased to grow after 1979, the volume of gas consumed experienced very little expansion since that time. In fact, the quantity has risen by less than 1% per year (BP, 1989a and 1991).

The producers' desire to extract monopolistic rents appears to have induced an emphasis in the marketing effort on the high-priced but stagnant segment of the energy market. Between 1978 and 1986, the share of gas in residential and commercial uses increased from 21 to 28%, but the total growth of this market was a mere 3%. In contrast, the share of gas

declined from 31 to 25% in the dynamic power generation market which expanded by almost 30% during the same period (Bergmann, 1988).

The pricing policy adopted in the mid-1970s initially brought an unambiguous advantage to the gas producers. In the shorter run, the impact on demand was small so the full capacity output could be sold at much higher prices and revenues. Over time, however, the policies resulted in a growing market imbalance.

The elevated profitability of gas production led to frantic efforts to expand the resource base and the capacity to produce and deliver gas. The efforts were quite successful. About 1980, the indigenous west European gas reserves were assessed at 3900 billion m^3 (Valais, 1988). At that time they were widely considered as inadequate for assuring long-run supply, even if supplemented by the nearby resource base outside the continent. Consumption in 1980 at 203 billion m^3 still assured reasonably full capacity utilization of the units built to supply western Europe. By 1988, however, gas reserves on the continent had risen to 5700 billion m^3, an increase of almost 50%, and reserves in Algeria and the USSR had also been expanded (BP, 1989b). More importantly, the ability to deliver gas was close to 290 billion m^3, with a further expansion to more than 400 billion m^3 requiring only marginal investment outlays (see section 3), implying a huge excess capacity over the total quantity demanded of 224 billion m^3.

The developments in the west European gas market in the 1980s have been quite akin to the tendencies in the global oil market. OPEC's monopolistic pricing had gradually led to a substantial excess capacity of oil production over consumption. Under the pressure of falling demand for its output, the OPEC cartel drastically reduced its price objective. The gas price was adjusted downwards in line with the oil price decline, but has remained steadily linked to oil at the top of the price equivalence band.

5. Prospects for gas pricing in western Europe

In my view, the gas pricing system is likely to disintegrate before the end of the century. The tensions of excess capacity, along with a number of emerging technical, political, and economic factors will bring about radical changes in the mode of gas pricing in the course of the present decade. I begin by discussing the increasing producer disillusionment with the current pricing arrangements. Thereafter, I consider the institutional changes on the importing side which also tend to undermine the present pricing policies.

When price parity with oil was first introduced, it was seen as an unambiguous advantage to the producers. With the large and growing overcapacity in the gas supply system, the constraint that the pricing arrangements impose on market growth represents a growing inconvenience and burden to the producers.

Until at least the mid-1980s there was a widespread belief among energy market analysts in a perverted version of the Hotelling rule, according to which the long-run price of exhaustible resources like oil and gas rises at the rate of interest, i.e., by 2-3% in real terms per year. Neither the true nor the perverted Hotelling rule has much relevance for actual price developments (Radetzki, 1990c), but it took the price collapse of oil in 1986 to change the perception of the energy industries in this regard. With no assurance of rising long-run prices, there is much less rationale for constraining supply today in order to benefit from higher prices in the future. In consequence, market growth assumed a greater importance in the late 1980s in the producers' long-run strategies.

At the same time, the prospects for expanded gas demand in western Europe have brightened considerably during the 1980s. This is particularly true of the power sector (Svensson, 1988). Technical developments leading to the firm establishment of combined cycle technology have greatly improved the use of gas in power generation (Shell International Gas Ltd,

1988). Implemented or planned privatizations in the power sector have further boosted the demand for gas. Since private firms tend to use higher discount rates in investment analysis than is common in publicly-owned enterprises, the less capital-intensive gas-fired generating plants are relatively attractive. Augmenting environmental concerns also promote an increased use of gas. All these developments point to a very substantial potential for expanded gas use. The attraction to producers of a policy that constrains market penetration is reduced by the knowledge that a market is readily available.

In the absence of a drastic deterioration of the exploitable resource base, technical progress typically leads to a gradual reduction in the cost of supply of exhaustible resources. The impact of technical progress is especially important for gas. If anything, the gas resource base from which western Europe can be supplied has improved over the 1980s. The youth of the industry provides ample scope for a cost-reducing buildup of knowledge and experience. Offshore gas exploitation is of recent origin, with a fast pace of technical progress. Technical improvements explain the gradual but substantial reduction of the investment costs for the Troll field in the Norwegian North Sea sector. The same is true for the transport and handling of LNG. The laying of gas pipes through the North Sea, or under Arctic conditions from the Siberian gas fields, was in large measure a pioneering effort. A doubling of these pipeline capacities would certainly cost considerably less, given the ability to avoid earlier pitfalls. Additional supply capacity needed in the future may consequently cost less than assessed in Figure 2 above. These developments provide yet another reason for the gas producers to reconsider their demand-restraining pricing policies.

The present producers have no permanent monopoly as suppliers of gas to the west European market. The growth in potential demand, described above, also makes this market of increasing interest to other suppliers, for example, Nigeria where advanced plans have been drawn up for the production of LNG, and several countries in the Middle East, notably Iran and Qatar, whose gas could be transported to Europe through the CIS pipeline system after necessary expansions. There is a growing apprehension among the current suppliers about such prospects (private communication with Statoil) and a desire to counter this threat by preempting the existing market potential in much the same way as the Dutch tried to subdue the Algerian and Russian export plans by lowering their prices in the early 1970s (see section 3).

All these factors suggest a growing preparedness among the producers to take a new look at the pricing arrangements and to make the changes needed to ensure a full realization of the **long-run** profit potential provided by the market. However, the producers' approach to this issue is very cautious. Considerable uncertainty remains about the true dimensions of demand and about the reactions of other producers if one of them decided to implement a change. For the reasons explored in the discussion of Figure 4 above, it may seem safer to do nothing and to remain at P_1Q_1 rather than making a move through unmapped territory in an attempt to reap the potentially higher profit at P_2Q_2.

A change in the pricing system is also impeded by the national transmission companies. Initially, these companies were greatly valued counterparts to the producers in assuring long-run absorption of supply from new outlets and in providing stability to the market and pricing arrangements. Over time, however, these roles have lost some of their earlier importance. In the more mature gas market of the late 1980s, where a new project adds only marginally to supply, the guarantees provided through long-term contracts are becoming less essential. At the same time, it is far from clear that the transmission companies would be prepared to pass on any producer price reductions to the final users in an effort to expand the market share of gas. To reap the full advantage of more aggressive pricing, the producers would need more of a direct contact with users. From their point of view, the transmission companies' tight control of the final gas

market emerges as an increasingly dispensable feature and at the same time as an impediment to change.

At least two factors suggest that the role of the transmission companies is being diluted. The first is the further development of the pipeline network, which tends to reduce the exclusive role of each company. One example is the Norwegian decision to draw the second pipeline from its North Sea fields (Zeepipe) to Belgium rather than to Germany, despite the fact that drawing a parallel pipeline would have been a cheaper solution. The additional expenditure is motivated by a desire to avoid the wholesale dependence on Ruhrgas, the strongest of the transmission companies. Another example is the decision of Wintershall, a subsidiary of German chemical giant BASF, to build its own pipelines, which would permit imports of Norwegian and CIS gas independent of Ruhrgas (*Financial Times*, 1989; *World Gas Intelligence*, 1991). A third example is the SEP contract whereby Norwegian gas would be landed onshore quite close to a group of planned power stations in the Netherlands, obviating the need to use the German or Dutch transmission companies' pipelines altogether.

The second factor diluting the transmission companies' market position is the increasingly energetic effort by the European Commission to increase competition and price transparence in the gas market.

One attempted measure in this effort is to reduce the exclusivity of the transmission companies as suppliers of gas by inducing or coercing them to transport gas for others. The issue of "open access" or "common carriage" has been subject to lively debate in western Europe since the late 1980s. Critics of the present system in which pipelines are exclusively used by their owners claim that this arrangement suppresses competition and breeds inefficiency, thereby raising final user prices. In the US, where open access is widely practised, pipe capacity utilization is persistently much higher than in western Europe. Also, competition has induced the US gas suppliers and users to install much more storage and dual fuel capacity. The fuller capacity use and the greater flexibility afforded by the US arrangements leads to higher efficiency that lowers costs and suppresses prices. It is alleged that similar benefits will be realized in western Europe once open access has been introduced (Hopper, 1991). Furthermore, the diversified contacts between producers and users in an open access system are likely to lead to more gas-to-gas competition reducing the producers' monopoly power.

The European Commission's desire to increase competition in the gas market presumably also comprises an effort to subdue political actions by individual governments that have reduced competition in the past, e.g., the decision to import high-priced Algerian gas, or the implicit restriction on the imports of gas from the CIS. The latter producers may be particularly desirous to penetrate the west European market more profoundly when allowed to do so, given the declining eastern European demand after the introduction of world market prices in Comecon trade.

The emergent attitudes among producers, along with the changes in the importing countries described above, provide the basis for my claim that the longer-term viability of the current monopolistic pricing arrangements is in doubt.

What will replace the present system once it has disintegrated? Given a reduced role for the transmission intermediaries, the limited number of current and potential producers, and the great number of consumers, some kind of producer pricing is likely. But also given excess supply capacity, the fast growth of the supply potential, and the threat posed by potential supply to the present producers, the price is likely to settle near the competitive level, with the average over longer periods close to the total cost of marginal supply. With such pricing arrangements, the marginal producer will obtain no more than a "normal" return on capital; other producers will reap intramarginal gas rents from their lower-cost supply.

The cost levels depicted in Figure 2 suggest that the competitive producer price could

settle substantially below the price equivalence band with oil, given the long-run forecasts for oil prices at between $15 and $20/b (constant 1985 dollars) at the turn of the century (Energy Information Administration, 1989; World Bank, 1989). At the forecast oil prices, the gas producers would be able to price their supply below the price equivalence band with oil even if the gas supply costs proved to be markedly higher than Figure 2 indicates. With gas prices set below the price equivalence band, the growth of the gas market would be speeded up, and substitution would increase the share of gas in total energy consumption.

The prospective mode of gas pricing just described is in no way unique. In fact, it would be quite akin to the way oil was priced in the 1930-1972 period. Then the oligopoly of multinational oil corporations consciously set oil prices below the price equivalence band with coal, forgoing short-run monopolistic gains in favour of a phenomenal demand growth as oil took over increasing shares of the total energy market from coal.

References

Bergmann, B. (1988) 'Gas Market Structures in Western Europe,' paper presented at the Offshore Northern Seas Conference, Stavanger, Norway, 24 August.

Bjerkholt, O., E. Gjelsvik and O. Olsen (1990) 'The Western European gas market: Deregulation and supply competition,' in O. Bjerkholt *et al.* (eds.) *Recent Modelling Approaches in Applied Energy Economics* (London: Chapman and Hall).

BP (1975) *BP Statistical Review of the World Oil Industry* (London: The British Petroleum Company p.l.c.).

——(1985) *BP Review of World Energy* (London: The British Petroleum Company p.l.c.).

——(1989a) *BP Review of World Energy* (London: The British Petroleum Company p.l.c.).

——(1989b) *BP Review of World Gas* (London: The British Petroleum Company p.l.c.).

——(1991) *BP Review of World Energy* (London: The British Petroleum Company p.l.c.).

Cornot, S. (1988) *Le gaz naturel dans le monde en 1987* (Paris: CEDIGAZ).

Energy Information Administration (1989) *International Energy Outlook 1989* (Washington).

Estrada, J. *et al.* (1988) *Natural Gas in Europe, Markets, Organization and Politics* (London: Pinter).

Financial Times (1989) 28 November.

Gasunie (1987) *Annual Report.*

——(1988) *Annual Report.*

Gaz de France (1984) *Annual Report.*

——(1986) *Annual Report.*

——(1987) *Annual Report.*

——(1988) *Annual Report.*

Hopper, R.J. (1991) 'Natural Gas: Open Access: The Potential Economic Benefits to Consumers in EC Markets,' *CEFIC* (Brussels: European Chemical Industry Council) February, Issue No 1.

IEA (1986) *Prospects for Natural Gas* (Paris: OECD).

Lönnroth, M. (1985) *Troll Dance, The Next Act on the West European Gas Scene* (Laxenburg, Austria: IIASA).

MIT (1986) *Western Europe Natural Gas Trade, Final Report* (Cambridge, Mass.: Center for Energy Policy Research) MIT EL 86-010, December.

Radetzki, M. (1990a) *A Guide to Primary Commodities in the World Economy* (Oxford: Blackwell).

——(1990b) 'Major Actors in the West European Gas Market,' *OPEC Review*, Summer.

——(1990c) 'Long Run Factors in Oil Price Formation,' in L.A. Winters and D. Sapsford (eds.) *Primary Commodity Prices: Economic Models and Policy* (London: Cambridge University Press).

Ruhrgaz (1984) *Annual Report.*

——(1985) *Annual Report.*

——(1986) *Annual Report.*

——(1987) *Annual Report.*

——(1988) *Annual Report.*

Shell International Gas Ltd. (1988) *Natural Gas Combined Fuel Cycle Power Generation,* Report No. Sig 88/1 (the Hague) August.

Svensson, B. (1988) *Use of Natural Gas in Power*

Generation in IEA Countries, presented at European Gas Seminar, Milan, November.
Valais, M. (1988) *Natural Gas in Western Europe: A Market in Transition*, presented at International Seminar on Energy Policy, Rio de Janeiro, June.
Wood-Collins, J. (1988), Arthur D. Little Inc., *An Overview of Europe's Gas Supply Options*, presented at European Gas Seminar, Milan, November.
World Bank (1989) *Revision of Commodity Price Forecasts* (Washington: World Bank) October.
——(1991) *Revision of Primary Commodity Forecasts* (Washington: World Bank) August.
World Gas Intelligence (1991) July.