IMF PAPER ON POLICY ANALYSIS AND ASSESSMENT

PPAA/93/15

INTERNATIONAL MONETARY FUND

The World Market for Natural Gas: Macroeconomic and Financial Implications

by

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October 1993

Abstract

While the world petroleum market has been intensively analyzed, the economic and financial implications of the international market for natural gas have received less attention. However, the role of gas is rising rapidly. The volume of gas reserves now rivals that of oil, and gas supplies are increasing at a faster rate than oil discoveries. World consumption of natural gas is growing because of concern about the environment, technological change in the electric power industry, and government energy policies. This paper analyzes developments in supply, demand, and prices in the world natural gas market in a medium-term framework, and assesses the longer term macroeconomic and financial implications of this market.

JEL Classification Numbers:

F49

1/ The author is grateful to Malcolm Knight and Zubair Iqbal for helpful comments and discussions. The views expressed are those of the author and do not necessarily represent those of the International Monetary Fund.

Contents

I. Introduction

Over the past two decades a great deal of attention has been paid to developments in the world petroleum market and their impact upon macroeconomic events. Changes in the supply of and demand for petroleum and the variations in oil prices have been studied intensively to determine their effects on international trade, payments balances, output, employment, and inflation in both the industrial and developing countries.

In sharp contrast to the case of petroleum, until recently relatively scant attention has been devoted to the world market for natural gas and the ways in which it might influence international macroeconomic and financial developments. This lack of interest is partly attributable to the fact that during the late 1970s to the late 1980s government regulations in the industrial countries tended to depress the demand for gas and favor the use of coal and nuclear power. For example, until the late 1980s government policies in the industrial countries either restrained or forbid the use of natural gas by the electrical utilities. As a result, as recently as 1982 it was common for analysts of the market to forecast a decline in the use of gas in the power industry. 1/ Since then, however, important changes have taken place in the international economy that promise to augment strongly the use of gas over the medium term. 2/ Among the most important changes are concern about the quality of the environment, safety problems with nuclear power, government energy diversification policies, the evolution of the Eastern European economies, and technological changes in the electric

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1/ International Energy Agency, Natural Gas: Prospects to 2000, 1982.
2/ International Energy Agency, Natural Gas: Prospects and Policies, 1991.

power industry. Because of these changes, natural gas is likely to gain a place alongside petroleum as a major internationally traded source of energy in coming years. Since the development of major gas fields is highly capital intensive, it is likely to exert profound effects on the international pattern of fixed capital formation and financing flows. As such in future years, developments in the international market for natural gas are likely to have important effects on the evolution of world commodity trade and capital movements, thereby exerting an impact on broader macroeconomic and financial behavior.

This paper reviews the salient features of the international gas market, its potential development, interactions with the world petroleum market, and some possible macroeconomic implications. Section II examines the size and scope of the world gas and oil markets and presents some comparisons of reserves, production, and international trade. Section III discusses the prospects for the world gas market--the projected supply and demand for gas and the pricing of gas--with the aim of offering a broad view of the likely evolution of the world gas market and its macroeconomic implications from now to the end of the decade.

II. Natural Gas and Petroleum

As a result of intensive exploration over the past decade, proven world reserves of natural gas are now at a level similar to those of crude oil. Global oil reserves have risen from 90.7 billion tons (bt) in 1973 to 136 billion tons by 1993, while reserves of natural gas increased from 49

billion tons oil equivalent to 132 billion (btoe). 1/ At 1991 rates of production, the ratio of proven reserves to production for oil was about 43 years while that for gas was 59 years. It is also important to note that the average growth rate of proven gas reserves in recent years has been more than double that of oil reserves and it is likely that this trend will continue as the demand for gas continues its trend growth.

The geographical distribution of the gas reserves is quite different than that for petroleum reserves (Table 1), a fact that will have major implications for the future evolution of the patterns of international trade in the two markets. About 65 percent of world oil reserves are in the Middle East, mainly in the Gulf countries. In contrast, natural gas supplies are considerably more geographically dispersed. About 39 percent of global gas reserves are found in the Russian Federation, mostly in the Tyumen Region, while only about 30 percent is located in the Middle East. North America has about 5 percent of the world's proven gas reserves. The remaining 16 percent is widely distributed. The members of the Organization of Petroleum Exporting Countries have about 77 percent of the world's crude oil reserves but only 40 percent of its gas reserves.

There have also been very marked differences in the growth of consumption of oil and gas over time. Although the cumulative increase in total energy consumption was less than 20 percent from 1980 to 1990, gas consumption rose by 39 percent compared with an increase of only 3.8 percent for petroleum. 2/ Although the consumption of oil and that of coal are

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1/ Cedigaz, Natural Gas in the World, 1992 Survey; Cedigaz, News Report, March 2, 1993 and May 1993.

2/ United Nations, Energy Statistics Yearbook 1990.

both still greater than that of gas, the gas consumption has been rising rapidly since 1973 whereas that for oil has been slower (Table 2). By 1991 the share accounted for by gas in the primary energy market was 23 percent, up from 18 percent in 1973 and for several reasons it is expected that the role of gas will continue to rise in the future. First, safety problems with nuclear reactors have meant that gas has been replacing nuclear energy in the power industry. Second, new electricity generator technology has stimulated the substitution of gas for oil and coal in the power industry. 1/

International trade in natural gas increased by 39 percent in volume terms from 1985 to 1991 (Table 3), reaching 319 billion cubic meters (bcm) in the latter year. Most of the international trade in gas was by pipeline, but about 24 percent was by sea in the form of liquid natural gas (LNG). 2/ Regarding the pattern of gas trade, the Russian Federation was the largest gas exporter, while Western Europe was the largest importer. Regarding the regional export patterns, the data show that gas exports from Latin America and western Europe stagnated, while gas exports from other regions experienced double digit growth (Table 3). Africa was second to Eastern Europe as a gas exporter. North American gas import trade was about 9 percent of consumption in 1990.

By comparison, international trade in petroleum products increased at the slower pace of 29 percent from 1985 to 1991. Export trade in petroleum

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1/ G. Sommers, LNG - The Challenge of Growth, 1992.

2/ Liquefying natural gas is an efficient means of transporting it over long distances because its volume is compressed to 1/600th. However, the technology is essentially hampered by high start up costs and concerns about safety.

products was about 14.4 billion barrels in 1991. Crude oil exports registered about 10.1 billion barrels in 1991, while exports of refined petroleum products reached about 4.3 billion barrels. A notable feature of the regional composition of petroleum export trade was the 37 percent decline in exports from the former Soviet Union in 1991 that was more than offset by sharp increases in exports from other regions.

International export trade in oil and refined products remained much greater than that for gas in 1991. World gas export trade in 1991 was about 2.9 billion barrels of oil equivalent (boe), compared with trade in petroleum products of 14.4 billion barrels. The estimated value of gas trade in 1991 was about $34.9 billion while that for crude oil trade was about $216.1 billion. 1/

III. The Global Market for Gas

1. Gas supply

New reserves of natural gas are presently being discovered at a rate of about four times the current growth in consumption. Consequently, supplies of gas to the market have been constantly rising. The production of gas takes place in two different forms: associated gas and non-associated gas. Associated gas or "wet gas" is produced jointly with the extraction of crude oil and contains methane and from 20 to 50 percent of other gases such as butane and ethane. Oil production must, of course, increase to produce more associated gas. Nonassociated gas or "dry gas" is produced directly from

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1/ The value of oil trade was estimated using the average petroleum spot price (APSP) for 1991. The value of gas trade was estimated using gas import prices for North America, Europe, and Asia.

geological gas dome formations and is predominantly methane. If oil production is restrained by OPEC producers to achieve a target price, the expectation is for the supply of associated gas to decline in the OPEC region. The offset to such a decline in associated gas might be expected to come from reserves of non-associated gas in Central Asia, North America, and the Far East. 1/

Gas is transported by pipeline or by specially designed LNG carrier ships; in 1990 exports by pipeline accounted for 76 percent of total gas trade. The high cost of transporting gas via pipelines or as LNG has been an important factor in the development of gas exports. 2/

In addition to high capital intensity, the inability to use gas liquification facilities for other purposes and scale economy factors have resulted in a conservative approach by resource owners and investors to the development of gas supplies and international trade in gas. Typically, contracts for the sale of gas and the financing of the capital investments are arranged before any newly developed gas comes out of the wells. Qatar's experience in the development of LNG exports that will use the gas from the

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1/ Not all of the production of natural gas is marketed: some gas is reinjected into oil wells to maintain oil flow pressures; some gas is flared or burned; and, some shrinkage results from the processing of natural gas. For example, in 1990 gas production totaled 2530 bcm, of that amount 100 bcm was flared, shrinkage accounted for 109.6 bcm, and 2075.7 bcm were marketed. The gas flaring process has environmental emission effects, such as carbon dioxide creation, because combustion takes place in the air. The loss from flaring gas has fallen steadily over time, from 6.7 percent of production in 1980 to 4.4 percent in 1990. See Cedigaz, Natural Gas in the World: 1992 Survey.

2/ In the case of LNG, the liquification process reduces the gas volume to about 1/600 for sea transport with cryogenic tankers. LNG trade requires special infrastructure such as loading, unloading, and re-gasification facilities. The temperature of LNG is super cold and significantly below the level of freezing.

massive North Field in the Gulf illustrates the long lead time necessary to bring a project to completion. The gestation period for the development of Qatar's LNG exports is estimated at 6 to 7 years.

The total amount of natural gas sent to market increased by 3 percent per year from 1980 to 1990 when 2,075.7 bcm were marketed. This rate of increase is consistent with approximately a doubling time of gas production every 24 years. Eastern Europe, mainly the Russian Federation, had the largest share of marketed gas in 1990 of 41 percent. The second largest share in marketed gas was that of North America which registered 29 percent.

2. Gas demand

Gas is used in four major ways in the world economy. 1/ First, there is the public distribution of gas for space and water heating, and for cooking in residential and commercial locations. Second, industry uses gas for direct heating and firing boilers for steam. Third, electrical utilities use natural gas as a fuel for base-load power plants and in combined cycle/co-generation power plants; LNG is re-gassified and used by utility firms to generate electricity. Fourth, the petrochemical industry uses gas as a feedstock to manufacture various chemicals including alcohols, urea, plastics, and glycols.

The consumption of natural gas increased from 1,041 bcm in 1970 to 2,119 bcm in 1991, an average growth rate of about 1.4 percent per

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1/ Industry (including petrochemicals) has used the greatest share of gas (31 percent) as feedstock followed by electrical utilities (26 percent) and residential users (24 percent). These shares have been stable since 1989.

year. 1/ The main regions of consumption are the United States, Western Europe, and the industrial countries along the Pacific Rim. On a global basis, between 1985 and 1991 the consumption of natural gas grew about twice as fast as petroleum consumption.

Gas demand is dependent upon prices, tastes, and trends in national income. In particular, the demand for gas responds to changes in its price relative to competing fuels such as fuel oil, to changes in the rate of economic growth, and to government energy and environmental policies. World demand for gas has had a variable growth rate since 1970. Although economic growth has been an important determinant of natural gas demand, the other factors have also been important. For example, the data for the first half of the 1980s reflect the collapse of oil prices that slowed the growth of gas demand. From the mid 1970s to the late 1980s, government energy policies discouraged the use of gas to generate electricity because the alternative uses of gas, particularly for heating and petrochemical feedstock, were favored.

There are several other factors that help to explain the rapid growth of demand for gas in recent years. One of the most important is that the falling rate of growth of demand for two competing fuels, particularly coal and nuclear energy, has been to the advantage of gas. Regarding coal, concern about acid rain from emissions of coal-fired electric power stations has moderated demand. On a per btu basis, the emissions from burning gas are smaller than those from burning either coal or oil: gas produces about one half the carbon dioxide emissions of coal and about two thirds the

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1/ Cedigaz, op. cit.

emissions of fuel oil. 1/ If governments impose taxes on carbon dioxide emissions, the expectation is that the growth of gas demand will be augmented although the total demand for energy is likely to decline. Nuclear reactor accidents in the United States and the Soviet Union put nuclear energy into a decline in the electric power industry. Should existing nuclear energy programs falter, the growth in demand for gas would further accelerate. 2/

3. Gas and oil prices

The natural gas market, and hence gas prices, are closely interrelated with developments in the oil market because oil is the dominant competing fuel and has a well-organized international market (Chart 1). Of course, changes in the supply and demand for gas also feed back on to the prices of petroleum and other energy products. Nevertheless, because of the size of the oil market and because oil has also many non-energy uses (plastics, fertilizers, lubrication, solvents) the dominant causal linkages doubtless run from oil to gas.

Over the last two decades, gas prices have experienced a downward trend in response to increased supplies (Table 4). Gas prices tracked oil prices from 1975 to their peak in the early 1980s. In this period, LNG prices followed oil prices closely but European and American gas import prices peaked a year later. LNG prices and oil prices declined after 1985, but LNG prices exceeded gas prices. There is a possibility that gas prices will be

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1/ IEA (1991), op. cit.

2/ G. Summers, LNG - The Challenge of Growth, Shell International Gas, May 1992.

somewhat more independent of oil prices in the future. 1/ Two factors are likely to be particularly important. First, environmental taxes might bear more heavily upon petroleum products than natural gas. Second, energy security policies tend to place a premium upon the use of natural gas. These policies diversify energy use by type of fuel and geographic source. Under such conditions, the size of the gas market relative to that of the petroleum may well grow, increasing the feed-back effects of the developments in the gas market onto that for petroleum.

4. Global market for gas

There are two regional components in the international gas market, the Atlantic and Pacific. In the Atlantic market most of the trade is by pipeline, while LNG trade dominates the Pacific market. Japan is the largest importer of LNG. The consumption of gas reflects economic and regional differences. Gas consumption has been concentrated in North America and Europe, with 80 percent of the gas consumed in these two regions. The industrial countries consumed 48 percent of the gas in 1991 compared to 15 percent for the developing countries and OPEC.

To a much greater extent than oil prices, gas prices also vary widely across regions at a given time because the potential for arbitrage between regions is limited. In 1992 and early 1993 European gas prices were in the range of $2.40 to $2.80 per million btu (mmbtu) for gas flowing from eastern Europe and North Africa. Prices for LNG in Japan imported from the Gulf, Brunei, and Indonesia were in the range of $3.60/mmbtu. 2/ The pipeline

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1/ Gas prices increased while oil prices declined in several countries in 1992 and 1993. See World Gas Intelligence.

2/ World Gas Intelligence, Various issues.

gas prices for United States and Canadian gas have been in the $1.90/mmbtu range while imported LNG from Africa has sold in the range of $2.50/mmbtu.

5. Gas prices in relation to oil prices

As a consequence of the factors discussed above, the price of gas has changed significantly relative to that of oil over time. Relative to crude oil, natural gas prices in three major international markets have had a rising trend since 1975 (Chart 2). The prices of LNG relative to oil have risen also over time (Chart 3).

The rationale for the behavior of the relative price of gas involves several different factors. First, the oil price shock in the 1970s stimulated a quest for energy security that resulted in substantial diversification of energy sources into gas, particularly in western Europe and Japan. Improving energy security has favored the use of gas because gas reserves have a different geographic dispersion from those of crude oil. As already noted, oil reserves are mainly located in the Middle East while gas reserves are found in Europe, North America, and Asia. Thus at the margin, the substitution of gas for oil helps to diminish oil imports, and to reduce the dependence of consuming nations on imports of energy from any single region. A second factor, until the late 1980s there was pervasive government regulation of the natural gas industry that artificially restrained the use of gas and controlled gas prices. In the United States the regulation covered not only gas prices but also pipeline transportation charges and access. The reform of energy policies in the main importing countries included the relaxation of government regulation. Therefore, deregulation permitted the integration of the gas production and gas

pipeline transportation. A third factor has been the change in electricity generator technology. For example, a gas-fired generator plant is more efficient than coal at delivered gas prices up to $4.30 per million btu (mmbtu). Thus, gas priced at $3.00/mmbtu will produce a kilowatt hour (KWH) of electricity at 20 percent less cost than coal, and gas at $2.50/mmbtu will produce a KWH of electricity at 26 percent less cost. 1/ A fourth factor stimulating the use of gas over the past ten years has been rising public concern about the environment. Nuclear reactor accidents, at Three Mile Island in 1979 and Chernobyl in 1986, as well as the complex technical and political problems involved in disposing of nuclear waste products have demonstrated the difficulties of using this fuel intensively without adding to environmental risks. 2/ On a related issue, there has been concern about the effects of acid rain from sulphur and nitrogen emissions produced from burning coal and oil. The main advantage of gas is that on a per btu basis it produces less sulphur and nitrogen emissions than either coal or oil. Therefore, gas has become particularly important in controlling costs in the electrical utility industry.

6. World macroeconomic and trade implications

a. Scenarios for future market growth

The above discussion suggests that over the medium term the need for environmentally clean fuel in conjunction with plentiful reserves of natural gas will be among the main determinants of its role in primary energy

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1/ Energy Economist, March 1993, p. 12.

2/ Among the industrial countries only Japan has plans to construct more nuclear power generation facilities. See International Energy Agency, World Energy Outlook, 1993.

consumption, and will exert pervasive macroeconomic effects on patterns of economic activity and trade among countries. In particular, the desire to use clean fuels will likely become an objective in national energy policies. Although technological changes favoring a higher quality environment are expected in the use of all fuels, gas has a head start in electric power and transportation.

In order to consider the macroeconomic implications of the world gas market, it is useful to review some projections of the evolution of global supply and demand for natural gas. Regarding gas demand, two alternative scenarios are worth considering, based on differing assumptions about the extent to which environmentalism--particularly reducing carbon dioxide emissions-- will become a dominant factor in the consumption of energy over the next twenty years. The 'high-growth' scenario implies that gas may account for as much as 30 percent of world primary energy demand by the year 2010. The 'low-growth' scenario has gas being subjected to intense competition from alternative fuels and, although it includes the environmental objective, it assumes that environmental concerns exert less influence; hence it envisions that gas might only have a constant share of world primary energy demand. These two extremes bracket an intermediate scenario that has world economic growth as the primary stimulus for growth in gas demand. 1/

The projection of world gas demand for 1995 is in the range of 2.3 trillion cubic meters (tcm) (low case) - 2.5 tcm (high) with the base case

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1/ Cedigaz, op. cit., Drewry, Trading in LNG and Natural Gas: Global Patterns and Prospects, 1992; British Petroleum, Review of World Gas, 1992; British Petroleum, Statistical Review of World Energy, 1992; Petroleum Economist, April and May 1993; International Energy Agency, Natural Gas:Prospects to 2000, 1982.

of 2,4 tcm and 2.6 tcm - 3,1 tcm for the year 2000. 1/ Pipeline movement of gas is projected to rise by 25-50 percent by the end of the decade. These projections suggest that the global natural gas market will be adequately supplied over the medium term and there is little likelihood of a sharp escalation of international gas prices. 2/ In other words, given the medium term supply and demand conditions in the gas market. gas prices are not likely to be an important short-run influence on inflation rates as was the case for the episode of sharply rising oil prices. Conversely, there are substantial downside price risks because the Russian far east, Qatar, and Iran may become major gas exporters by the end of the decade, and there is a significant possibility that gas prices could tend to decline secularly relative to oil prices as these large fields come on stream.

b. Macroeconomic and financial implications

This anticipated growth of the world natural gas market has a number of important macroeconomic and financial implications for the world economy. Natural gas projects are highly capital intensive, even when compared to petroleum projects. Several of the countries that have large gas reserves

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1/ Drewry, op. cit., British Petroleum, Review of World Gas, 1992; British Petroleum, Statistical Review of World Energy, 1992; Petroleum Economist, April and May 1993.

2/ A forecast of European gas prices, U. S. natural gas import prices, and Japanese LNG import prices was done. The forecast is for natural gas prices in Europe to range from $2.30/mmbtu in 1993 to $2.60/mmbtu in 1998. The projection for United States gas import prices ranged from $1.70/mmbtu in 1993 to $2.00/mmbtu in 1998. The projection for Japanese LNG import prices ranged from $3.20/mmbtu in 1993 to $3.50/mmbtu in 1998. Accordingly, the expectation is for real gas prices to be relatively unchanged in the medium term. This reflects the excess gas supply situation that is likely to prevail and is also plausible because of the substitution effect between oil and gas.

are unlikely to be able to finance such investments entirely from domestically generated savings. Therefore, large foreign investment flows are likely to be a major factor in the future development of the market's export capacity.

As illustrated by Qatar's experience, the construction of the gas infrastructure not only has large capital requirements but also entails large risks. The long gestation period in the development of Qatar's natural gas resources for export of LNG illustrates the importance of securing financing. Qatar is attempting to deliver LNG to a Japanese electrical utility customer by 1997. Although upstream and downstream equity arrangements have been negotiated for the first phase of well development, $800 million is required for the second phase, an estimated $2.5 billion will be needed for the construction of the LNG plant, and the estimated cost of LNG tanker ships is $2.0 billion. The $3.0 billion sum for offshore and onshore LNG infrastructure is a massive financial undertaking for a single project.

The expansion in the role of gas in the world economy, especially if the high growth scenario prevails, will require a very large investment in fixed capital stock. Taking the needs of the Far East, North America, and Western Europe together, it has been estimated that at least 10 to 15 potentially viable gas projects exist that would require a total investment in the range of $80 to $100 billion (current dollars) by the year 2010. 1/ This amount compares for example, to about $10 billion of bonds issued in the world capital market by developing countries in 1991. Therefore, it

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1/ Summers, op. cit., p. 9.

seems likely that regions and countries with exploitable gas reserves would become very large importers of capital goods of associated financing flows for a sustained period.

Investment in the development of natural gas will be concentrated in certain geographic regions. The fixed investment required for gas development and infrastructure will be concentrated in those regions that own the largest reserves, mainly the Eastern Europe (including the Russian Federation) and the Middle East (Qatar, Iran). It is also likely that gas reserves will be developed in Asia (Indonesia, Malaysia, Oceania) and Africa (Algeria, Nigeria). Accordingly, in countries that possess major gas reserves, the establishment of a regulatory environment conducive to large and sustained inflows of foreign investment will be of major importance in order to obtain both financing and technological expertise. Several factors merit attention in this context. First, attracting the skills and investment of experienced international business firms will require a balancing of adequate rewards for taking large risks. In this context, contracts for service in the construction of 'turnkey' projects are no longer sufficient. The experience of Algeria and Qatar suggests that equity participation is desirable to attract the technological expertise and financial interest of the international gas and oil firms.

Second, there has to be assurance that foreign investors and creditors will be able to receive their returns, including assurances about the fiscal regime. Full backing of gas projects by host governments is necessary to provide credible guarantees to risk takers. Third, since an equitable system of taxation on income earned from foreign investments is closely

related to the opportunity to earn an acceptable return tax regimes in producing countries will need to be carefully planned and should generally be announced in advance: arbitrary fiscal treatment of foreign investment would only lead to delays or cancellation of projects.

As the international natural gas industry develops and becomes larger, its structure will also evolve. As the world gas industry undergoes development and growth in the years ahead, it is likely there will be more international integration of the industry. One aspect is the vertical integration of the gas business. The experience of the state-owned firms in the oil industry shows an interest in downstream marketing and distribution activities on a multinational basis. It is plausible for the state-owned gas companies to behave in a similar manner. Already there are some signs this is happening within the LNG market when the transportation of LNG is viewed as an integral part of the business. Regarding the gas trade by pipeline, the vertical integration beginning in the United States and Canada illustrates there is potential for more international integration in Europe and Asia.

Second, the growth of the world gas industry over the next decade is likely to result in the "de-regionalization" of international trade in gas. This has potential to form a single global market with, like oil, a single price with only small regional differences owing to transport and related costs. Although rising trade in gas is expected, LNG trade is expected to grow faster than pipeline trade. 1/ This has ramifications for some

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1/ LNG trade is a means to avoid the medium-term political risks associated with gas transportation problems by pipeline.

changes in the pattern of international trade. For example, more robust LNG import trade for North America and Europe can alter the pattern of global gas trade in the future.

A third aspect of integration in the world gas industry relates to gas pricing. At present the unit price for gas is different in each major market area. Such price differences in principle create an incentive for arbitrage, which is presently limited by the high cost of moving gas between certain areas. Some price differentials will always exist because transportation cost is a factor as distant reserves are marketed. All in all, the expectation is that capital investment to connect the regional distribution systems and associated exploitation of arbitrage opportunities may act strongly to reduce international price differences in the medium term. Rising LNG trade will also help to moderate price differentials when re-gasification facilities become more available. Nevertheless, evolution of the presently small gas futures market should also be expected. Although the arrival of an organized global gas market might be well into the future, growth in the size of the gas market is likely to precipitate innovations in gas trading arrangements, particularly in its pricing. There are constraints on the development of arbitrage in the gas industry--the very large size of gas contracts and the number of substitutes. Gas trade contracts are not only large, ranging in several bcm, but also they are concluded between a large seller and a large buyer. Moreover, the use of the combined cycle turbo generator technology signifies a lack of substitutes for gas in the power industry. Accordingly, there is potential

for the development of an arbitrage market, but it will likely be some time before it takes place.

As already noted, growth of the world gas industry can dramatically improve the export prospects of those countries with high proven reserves over the longer term. These developments promise to have a major impact upon the pattern of world trade. The Russian Federation, which has the largest proven reserves of gas, can therefore benefit from the development of the industry. This region, which exported 120 bcm of natural gas in 1991, is expected to become a significant gas exporter in the medium term. There is potential for CIS gas exports to rise by as much as 50 bcm by 2000. In addition, countries in the Middle East that have gas reserves, including Qatar, Iran, and Oman, have potential to become significant gas exporters. In Africa, Algeria is already a major player in the gas market and Nigerian LNG export trade is a possibility in the medium term. There are also studies underway on the potential for pipeline links from gas reserves located in Qatar and Iran to Dubai, Pakistan, and India. These projects have estimated costs of about $2.0 billion each. In this connection, the World Bank has promoted a regional pipeline in the Gulf that would operate as a common carrier for gas. The services of this pipeline would be available to all the gas producing and consuming countries. 1/ There are also prospects for greater gas trade in Asia, particularly from Indonesia and Oceania.

As already noted, another issue that may be expected to have a bearing on energy security concerns of governments has focused upon diversification

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1/ Middle East Economic Digest, June 12, 1993.

of energy supplies. The growth and development of gas exports from the Russian Republic and other countries in Central Asia, North and West Africa, and in Asia will reduce dependence upon any one region. Japanese energy companies, already participating in the gas sector investments in the Gulf, are also reviewing prospects in Africa and Asia. European and American energy firms are considering gas export projects in the Russian Federation and Central Asia.

This paper has traced the growing importance of world gas market and offered some thoughts about its general development in the future. One conclusion is that in general, the market for natural gas is very likely to become more integrated and therefore exert a major influence on world trade and finance. In this sense its importance may come to be equal to that of the world oil market. Another conclusion is, however, that unlike the world oil market, the developments in natural gas are likely to exert impacts upon the world economy not through effects of short term price shocks on income and employment but rather on the level and geographic pattern of international trade, investment, and financial flows. Accordingly, economic policies dedicated to ensuring that these flows take place in a well-defined international regulatory setting and tax environment will be important elements to underpin the smooth evolution of the world economy in the longer term.

Table 1. Location of World Reserves in 1991

(In percent)

	Gas Reserves	Oil Reserves
N. America	5.20	3.20
S. America	5.50	12.20
E. Europe	39.30	5.80
W. Europe	4.20	2.30
Mid. East	30.10	65.30
Africa	6.90	6.30
Asia	8.80	4.90
Total	100.00	100.00

Sources: OPEC and Cedigaz

Table 2. Primary Energy Consumption*

(Billion tons of oil equivalent)

	1950	1973	1986	1991
Crude oil	531.93	2,796.85	2,881.00	3,141.40
Gas	174.90	1,064.34	1,507.00	1,769.70
Coal	1,049.60	1,667.47	2,309.10	2,186.20
Nuclear	0.00	53.22	372.70	514.40
Hydro Electric	28.56	331.13	519.40	195.90
Total	1,784.99	5,913.00	7,589.30	7,807.00
		Composition (In percent)		
Crude oil	29.8	47.3	38.0	40.2
Gas	9.8	18.0	19.9	22.7
Coal	58.8	28.2	30.4	28.0
Nuclear	0.0	0.9	4.9	6.6
Hydro Electric	1.6	5.6	6.8	2.5
Total	100.0	100.0	100.0	100.0
		Consumption Growth (over each period, in percent)		
		1950–1973	1973–1985	1985–1991
Crude oil		425.8	3.0	9.0
Gas		508.5	41.6	17.4
Coal		58.9	38.5	-5.3
Nuclear		0.0	600.3	38.0
Hydro Electric		1059.4	56.9	-62.3
Total		231.3	28.3	2.9

*Includes only commercially traded fuels.

Source: BP, World Review of Gas, 1991.

Table 3. Gas Trade by Region in 1991

(In billion cubic meters)

	Exports	Imports	Balance
N. America	50.68	49.59	1.09
L. America	2.20	3.89	−1.69
W. Europe	66.09	163.36	−97.27
E. Europe	105.20	39.76	65.44
Africa	35.48	0.70	34.78
Middle East	9.46	7.03	2.43
Asia	51.47	56.25	−4.78
Total	320.58	320.58	

World Exports of Gas
(Growth rates in percent)

	1985	1991	Growth
N. America	27,662	50,680	83.2
L. America	2,210	2,200	−0.5
W. Europe	68,135	65,670	−3.6
E. Europe	69,250	107,200	54.8
Africa	22,870	35,480	55.1
Middle East	3,036	5,950	96.0
Asia	35,509	51,470	44.9
Total	228,672	318,650	39.3

Source: Cedigaz, Petroleum Intelligence Weekly, Oil and Gas Journal.

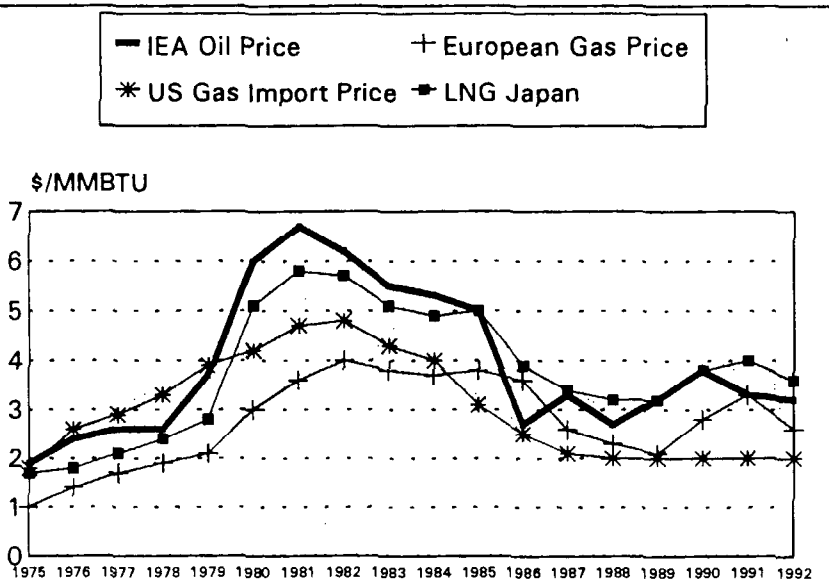
Table 4. Oil and Gas Prices

(In dollars per million British thermal units)

Year	Crude Oil APSP	Gas IEA Cif	Gas OECD Europe	Gas USA Inp.	Gas USA Well	LNG Japan
1975		1.9	1.0	1.8	0.4	1.7
1976		2.4	1.4	2.6	0.6	1.8
1977		2.6	1.7	2.9	0.8	2.1
1978		2.6	1.9	3.3	0.9	2.4
1979		3.7	2.1	3.9	1.2	2.8
1980		6.0	3.0	4.2	1.6	5.1
1981		6.7	3.6	4.7	2.0	5.8
1982		6.2	4.0	4.8	2.5	5.7
1983		5.5	3.8	4.3	2.6	5.1
1984	4.9	5.3	3.7	4.0	2.7	4.9
1985	4.7	5.0	3.8	3.1	2.6	5.0
1986	2.4	2.7	3.6	2.5	2.0	3.9
1987	3.1	3.3	2.6	2.1	2.7	3.4
1988	2.4	2.7	2.3	2.0	1.7	3.2
1989	3.0	3.2	2.1	2.0	1.8	3.2
1990	3.8	3.8	2.8	2.0	1.7	3.8
1991	3.2	3.3	3.3	2.0	1.6	4.0
1992	3.1	3.2	2.6	1.96		3.6

Source: BP Review of World Gas; and Cedigaz.

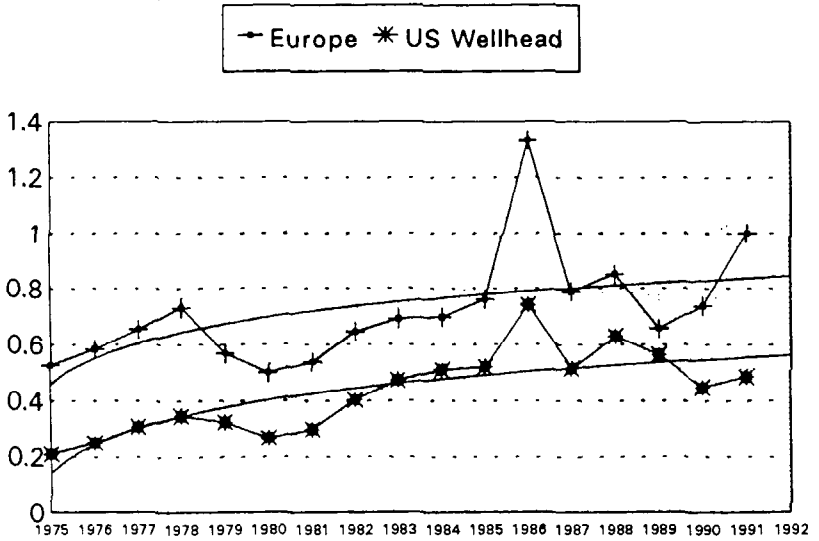
Chart 1: Gas and Oil Prices



Source: BP

Chart 2: Relative Price of Gas

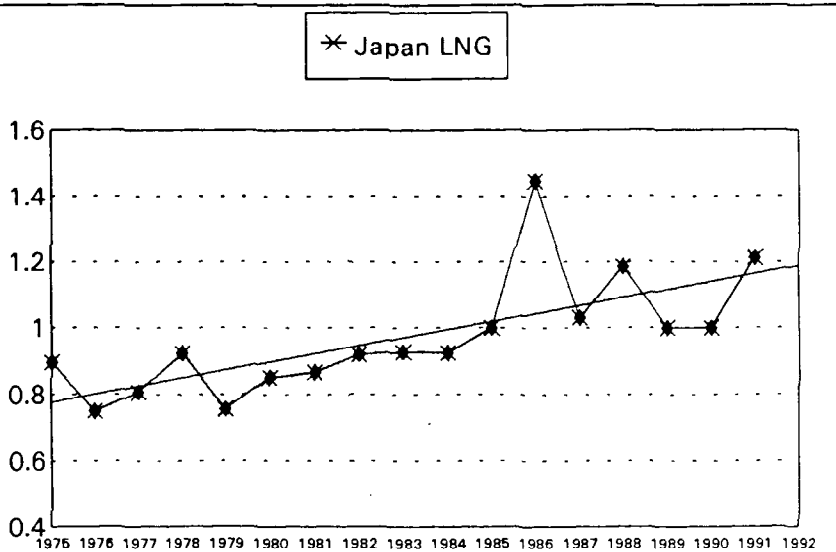
Ratio of Gas to Oil Prices



Trends are log regressions.

Chart 3: Relative Price of LNG

Ratio of LNG to Oil Prices



Trend is a log regression.

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