

the price elasticity of production equals the price elasticity of discovery (Erickson and Waverman, 1974). Assuming that the elasticity of discovery for the U.S. applies to other major producers, the Middle East can be expected to increase its current reserves to 1,600 billion barrels of oil. The U.S. and Canada can increase to 200 billion barrels, Latin America to 1,300 billion barrels, U.S.S.R. and China to 350 billion barrels and Africa to about 200 billion barrels (reserves data from Steele, 1974) -- assuming the current level of price is maintained in the long-term and a supply of unit elasticity.

Even if errors and differences in elasticities among producers maybe committed, the fourfold increase in oil prices can indeed coax tremendous oil reserves from the ground in the long-term. Such a situation can exert a downward pressure upon prices that may be difficult to contain. The condition happening in the long-term maybe observed even in the short-term, as the following paragraphs suggest:

Erickson and Waverman (1974) estimate that if current world prices persist and are allowed to operate in the U.S. and Canada, conventional crude and natural

gas output in 1980-1985 can be 50-100 per cent higher than present levels. Major finds in the Northern slope of Alaska and the Arctic of Canada are early indications of things to come. So is the major find in the Gulf of Mexico reported to rival the huge deposits of Saudi Arabia (Bulletin Today, February 7, 1977, p. 7). Both oil and natural gas deposits are also expected in the Gulf of Alaska, and the Atlantic and Pacific shelves of North America.

Another important development is taking place in sub-Saharan Africa, particularly Nigeria. In 1969-1973 known oil reserves increased from 5.0 to 22.8 billion barrels while known natural gas reserves increased from 10.0 to 48.0 trillion cubic feet -- a growth of about 400 per cent in four years. Over three-fourths of these belong to Nigeria. Angola, Gabon and the Congo can be expected to attain substantial growth in future reserves.

In Europe, the discovery of oil and gas deposits in the North Sea can make Britain and Norway self-sufficient by the 1980s. (Posner, 1974).

South American, Trinidad and Tobago, Ecuador, and Colombia also made important discoveries in recent years. Encouraging news about a major discovery in Peru has

circulated although no official estimates of reserves was released yet (Steele, 1974). The continental shelves of Venezuela, Brazil, Argentina, Chile, Ecuador and Peru are also very promising.

Development of another sort is shaping up in another area. Russia and lately China, are showing more interest and willingness to participate in the oil trade. Large resource base of these countries can contribute considerably to available supply in the world market. Japanese, Germans and Americans flock to Moscow to negotiate for Russian oil and gas while Japanese firm woo Peking to deal in oil or natural gas (Wright, 1974). Vast oil reserves are expected in China (Rawski, 1974).

Coal, which can substitute for oil and natural gas in power generation and other uses are abundant in several countries. Russia, China and the U.S. have trillion tons of coal reserves. Australia, South Africa, Chile, Argentina, Brazil and Europe have very substantial reserves, too.

The above discussions show the various factors that can shift the supply curve of oil to the right. However, balancing forces also exist. Strict environmental control policies can prevent the development and

utilization of certain resources. Such happened to the Alaskan oil pipeline. Again, government policies and unstable social and political conditions can render alternative resources uneconomic.

3.c Non-Conventional Sources of Oil

Tar sands and oil shale are rocks in which solid hydrocarbons are impregnated. They can be used as raw materials to produce oil or gas. Similarly, both liquid and gaseous hydrocarbons can be produced from coal. Huge deposits of these materials are known, like those in Russia, China, the U.S. and a few other countries. Tar sands of Alberta, Canada and the oil shales of Colorado, Utah and Wyoming can yield 300 and 1,000 billion barrels of crude oil respectively (Quirin, 1974). Venezuela has 700 billion barrels of oil recoverable from shale while Brazil has vast but undetermined oil in shale (Steele, 1974). China presumably has about 136 billion barrels of potential synthetic oil from shale (Rawski, 1974). Clearly, just the known deposits of oil shale and tar sand substantially exceed all known natural oil deposits.

Although the technology for extracting liquid or gaseous products from the above materials has passed the

pilot and early commercial stages, many uncertainties and problems remain. Nevertheless, estimates of costs and availability have been made. Quirin (1974), based on a set of "reasonable" assumptions, estimate that at \$5.00 per barrel of oil, 20 billion barrels from shale can be available. At \$7.00 per barrel, 150 billion barrels can be procured; and at \$9.00 per barrel, 900 billion barrels from oil shale and 300 billion barrels from tar sand can be available, all at constant 1973 prices. Erickson and Waverman (1974) estimated the cost of producing oil from tar sand and oil shale at \$8-9 per barrel (based on 1973 prices). These cost estimates are tentative and dependent over time on the learning curve of experience, technological development, environmental considerations and the oil content and homogeneity of the deposits. At any rate, the costs of extracting oil and related products from tar sand, shale oil and coal imposes a limit to the long run price of conventional oil. This is so because a vast supply of oil will become economical the moment long-term price equals production costs.

3.d Alternative Energy Sources

Other energy sources, besides oil, exist. But the most important are the breeder and fusion reactors. The former can stretch the life span of the limited nuclear fuel supply. Fusion, along with solar energy, can provide almost inexhaustible raw material supplies for producing usable energy at almost constant, probably even decreasing costs. But the necessary technology for these processes are not yet clearly conceived (Barnett, 1974). Perhaps the 1980s can see a significant breakthrough in nuclear technology development.

Ordinary nuclear reaction is being harnessed to provide energy especially for electrical generation. The U.S., Japan and Western Europe are heavily investing in it. This energy source obviously appears to have become economical under prevailing conditions.

3.e Long Run Stability of OPEC

Since the OPEC cartel is instrumental for raising the oil price up to 3-130 times the cost of production, it is the cartel's stability that holds the key to the problem of escalating oil prices. Should it persist indefinitely, the price of oil may inevitably soar. If the cartel breaks up, the oil price may be determined

by forces operating in the market again so the current prices may decline to a level comparable to prices before the oil embargo of 1973. Therefore, analysis of OPEC's long-term stability can project the future prices of oil.

OPEC's stability highlights a number of factors. First, the OPEC being composed of developing countries find strong moral and political support from Third World countries. Second, OPEC derives strong political support from big powers such as the United States, Russia and China. Third, consuming countries, find it difficult to unite to countervail OPEC's monopoly power. Fourth, multinational oil companies are efficient means to implement price decisions of the cartel preventing the proliferation of cheating (that can undermine the cartel among members. Fifth, no close substitutes comparable in price to OPEC oil are available.

On the other hand, crucial to the control of price is the control of production. Factors leading to expansion of production beyond the monopoly level can undermine the cartel's stability. But what motivates the support or undermining of the cartel? A cartel is organized by producers to maximize the profits of the

industry by controlling price through restricted production. A member having the larger share of the market gains more. Because the cartel price is way above the production costs, the profits and market share of some members can be increased by selling below the cartel price. This leads to cheating, that can break up the cartel if not checked.

It is interesting to ask: what factors can force OPEC to lose control of the world supply, hence of prices?

A member country depending heavily on oil revenue for its domestic programs may refuse to cut back its production especially in the face of decreasing demand (as during recession) as it has bills that need to be paid. Such reluctance may be minimized if it has other revenue sources like Iran, Indonesia, Nigeria and Algeria. In fact, Iran refused to cut down production during the 1973 embargo and sold to every one paying the right price. Another difficulty arises from volatile freight cost. For instance, Iraq used to get considerable premium for its crude because of its direct access to the Mediterranean through pipe lines. When freight cost dropped low in 1971 the premium priced Iraq out of the market.

"It is not clear ... what kind of mechanism OPEC can develop to adjust export prices to changing tanker rates" (Houthakker, 1974).

Another difficult problem for OPEC is the entry of new producers in the world market. Russia and China are coming in a big way as noted earlier. Britain and Norway are soon becoming self-sufficient in oil and gas and will soon become exporters. Nigeria, Indonesia, Ecuador and Mexico made recent major discoveries. It will be unlikely that they will settle for their small market shares. In addition, the high oil price will coax out bigger production from say Canada and the U.S. This can further eat up the market share of OPEC countries. Finally, substitute energy coming from nuclear plants, coal, tar sand, oil shale and others can cut down further the OPEC countries' share of the world market.

If OPEC countries will accommodate new oil producers and its substitutes by reducing their output to control prices, their share of the market can likely shrink to the point that gains from keeping the cartel outweigh losses. A recent development shows another dimension of the OPEC stability.

Since January 1, 1977 a two-tier price system for OPEC oil has prevailed resulting from the decision of Saudi Arabia (which produces about one third of OPEC's oil) and the United Arab Emirates to raise the price by

only 5.0 per cent. This is contrary to the decision of other members to raise by 10 per cent (Bild, 1976). Saudi Arabia argued that the economy of the oil importing countries will be unable to recover from recession if burdened with the 10 per cent price. Such concern reflects the view that failure of the economies of importing countries to grow, or the reduction in the level of industrial activity and output, can shrink effective demand thus reducing sales and revenues. Increase in price can also induce more production from non-OPEC producers. Intensive search for more oil deposits can even trigger substitution of coal, nuclear fuel, and other energy materials for oil. This can undermine even more the level of OPEC's oil revenues. Some may consider Saudi Arabia's desire to foster an image of moderation and statesmanship evident in its decision to impose lower price hike. In any event, Saudi Arabia will no doubt discover that its lower price conduces to higher revenues, larger market share and more power and prestige for leading OPEC.

As a result of the two-tier oil price, Saudi Arabia considers increasing its production from 8.5 million barrels per day to 12.0 million. The United Arab Emirates on the other hand, plans a 60 per cent increase

from 1.6 to 2.6 million barrels per day (Bulletin Today, January 15, 1977, p. 1). "Iran, whose crude oil price is the highest in the Middle East, recorded a 35 per cent drop in oil exports for the first nine days of the new year." This means a loss of \$20 million per day (Bulletin Today, January 15, 1977, p. 17). In addition, "Kuwait's oil production in January fell by one third to 1.2 million barrels a day because buyers sought cheaper crude oils" (Bulletin Today, February 6, 1977, p. 3). These events exemplify the kinds of pressures that tend to erode the market power of the OPEC cartel, or any cartel, for that matter.

This analysis only shows that OPEC has strong and weak points. Although the natural forces tending to erode its stability appear formidable, such forces do not necessarily neutralize the political and other factors supporting OPEC.

4. Summary and Conclusions

This inquiry examined the probable limits to the seemingly endless escalation of oil prices. It was investigated whether the high prices resulted from the depletion of oil resources or from the exercise of monopoly power by the OPEC cartel. Evidence points to the existence

of supply growing faster than demand and to high prices above production costs contrived by the OPEC cartel. In the long-term the limits to the price of oil will come from the (1) contraction of demand resulting from high prices and deliberate government policies; (2) expansion of supply due to high prices, discovery and development of new deposits and development of substitute resources; and (3) operation of forces--economic, political, and social--tending to undermine the stability of the OPEC cartel.

Based on known elasticities of demand, substantial contraction in oil consumption can be expected in response to the fourfold increase in oil prices in 1973-1974. Such price hike can decrease consumption by about 40 per cent in the short-term and 30 per cent in the long-term. Empirical evidence in the Philippines, U.S., and Western Europe points to the operation of processes that tend to decrease demand.

On the supply side, long-term price elasticity of reserves (equals price elasticity of production) equal or greater than unity implies a fourfold expansion of known reserves of oil and natural gas resulting from the

400 per cent oil price hike. Increase in reserves can come from secondary and tertiary recovery of existing deposits and from new discoveries.

Development of oil shale, tar sand and coal as sources of synthetic oil and gas is in order considering the current prices. These vast energy resources can become economical if the price of oil stays at \$6-9 per barrel (based on 1973 prices). Development of these resources is, however, stalled by the expectation that oil will cost about \$3-4 per barrel when the oil cartel breaks up.

Breeder and fusion reactors and solar energy can provide a broad base of energy sources. Although, the natural resource input for these energy sources may be low cost, huge capital, skilled manpower and research efforts may be necessary. These will make them more expensive than oil shale.

OPEC's ability to control price hinges on its control of the supply level in the world market. This is hampered by the reluctance of some members to reduce their output; China and Russia's entry and the influx of new producers resulting from new discoveries. Further pressure can come from the curtailment of demand resulting

from more economical uses of oil and from substitution.

The limits to oil price as expounded in this paper probably explains why Japan and Western Europe opted for a policy of energy interdependence and why the U.S. is reluctant to implement a policy of energy independence. Any revision of domestic energy policies should perhaps carefully consider the limits to the price of oil.

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