THE EFFECT OF INCREASED NATIONAL OIL COMPANY SALES ON OPEC AND THE LONG RUN STRUCTURE OF THE INTERNATIONAL PETROLEUM MARKET

by

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ABSTRACT

This thesis examines the effect of increased national oil company sales on the world petroleum system. These sales cut into the volume of crude handled by the major international companies and will impact upon OPEC's pricing ability.

The growth of these sales is measured using annual reports and other industry statistics. Their effects on oil company behavior are examined from both a theoretical and an empirical standpoint. The analysis shows that the firms' behavior patterns are indeed changing, as predicted.

These changes will create pressure on the OPEC producers to restrict production. Using supply/demand models developed by the M.I.T. World Oil Project, the output levels of major cartel members are simulated. These results are compared with the countries' economic needs into the late 1980's.

The simulations indicate that the OPEC core will encounter financial difficulties if current programs are continued. Alternate strategies for the cartel are

discussed.

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CHAPTER I

INTRODUCTION

Summary

The growth of nationalized oil sales within the next few years will test OPEC's ability to act as a cohesive cartel. By relegating the companies to a lesser role, the producing states may inadvertently force the creation of a more competitive market. If OPEC is not able to adjust to the additional economic pressures, it may have to forego its plans to increase nationalized sales further.

These growing volumes of sale crude cut directly to the heart of the pricing issue. The cartel's ability to set prices and to hold them rests upon the balance between the oil demanded and that offerred at a given time. If more petroleum is on the market than is needed, individual sellers will place downward pressure on prices.

In the past, the cartel has used the behavioral and structural characteristics of the international petroleum market to inhibit these price shadings. The international majors have been co-opted through very profitable "participation schemes," which have allowed them to purchase a fraction of their offtakes below the official sale prices. This has given them a large advantage vis-a-vis

the "independents," who have had to purchase all their crude at sale prices.

The participation arrangements have retarded the majors' response to short-term crude surpluses and have given the cartel a buffer from market forces. When excess crude enters world systems, the sellers must offer it at a discount. In a completely competitive environment, buyers would rush to offtake all they could. The majors, however, are reluctant to jeopardize their profitable participation deals, so the quantities they take from the fringe producers have been rather limited.

Other companies--the independents--would naturally be attracted by this bargain crude. Because many of these firms lack the downstream outlets to dispose of large volumes, however, they may be unable to lift as much as they might desire. This combination of participation incentives and structural peculiarities has given OPEC the ability to maintain price levels even through persistent periods of "glut."

Instead of having to maintain a tight supply situation, the producing states have been relying on the majors to allocate offtakes so that excess crude would not find its way to product markets. Without these companies, OPEC may be forced to monitor the members' production so

that supply can be constrained. This would place Saudi Arabia and other "saver" nations in the uncomfortable position of "residual producers."

The structure is already changing. The decreased volume of "participation" crude is sending majors to third party markets more frequently to meet their own system requirements. Because they must obtain these volumes at official sale prices, these companies are becoming more sensitive to the price/value differentials offerred by the governments. The relatively large quantities that will move at these "arm's length" prices in the future threaten to create dramatic swings in country-by-country liftings.

Nationalized oil sales will reduce the buffer that the majors have used to stabilize markets when crude costs and values are out of line. The countries, themselves, therefore, will have to insure that the market realizations are commensurate with the price they charge. OPEC must be able to maintain a continuous tight supply situation--a feat which they have been able to accomplish only for limited periods of time. The key questions to be answered are: what will be the role of the cartel "core"; and what dangers are likely to upset the stragegic moves necessary to enforce the pricing maneuvers?

During the next few years, the cartel will be threatened from the outside. Large increases in output are expected from areas such as Mexico, China, the North Sea, and other non-OPEC countries. This supply situation could be exacerbated by "flat out" production by Algeria, Indonesia, and the rest of the "spender" nations. Because of price increases and conservation consciousness, demand growth for crude is expected to abate somewhat over the next decade and will add further to the possibilities of a glut.

In view of this environment, the cartel core will have to slash output in order to keep unneeded oil off world markets. The revolution in Iran has lessened the producers' difficulties for the moment by taking three million barrels per day out of supply markets. The long term outlook, however, is still uncertain. The core's ability to curtail output for an extended period of time is limited by the need to generate revenues necessary for internal economic development.

If the cartel cannot maintain the tight supply needed to support a nationalized sales program, OPEC will have to find another way to maintain price levels and give the residual producers the necessary income. Among the better alternatives open to OPEC is the old system in

which the major international companies acted as the countries' agents and performed the cartel's allocation duties. This would imply a decline in the relative importance of nationalized sales and a resurgence of some of the majors' former power. Unless the cartel can adjust to the strains brought on by the nationalized sales, therefore, the recent trend may be simply a passing phenomenon.

Background

Up until the 1960's, the international majors controlled the production and marketing phases of world oil. Their presence promoted the stability of prices and volumes on which both consuming and producing nations learned to depend. Their fundamental strengths were derived from access to low cost crude and the downstream networks necessary to move the output.

When other companies, known as "independents," acquired cheap Libyan crude during the Sixties, the majors began to lose their control on world markets.[1] The extremely profitable concession agreements gave the independents the ability to establish downstream market positions. Since these volumes passed outside of the majors' systems, their ability to allocate global production was inhibited.

The excess crude situation, of course, caused prices to decline. This environment led to the well-known Teheran and Tripoli agreements in which the OPEC states began to assert their power.

OPEC raised crude prices in 1973/74 and assumed responsibility for most production decisions, but did not attempt to remove the majors from their favorable economic arrangements. The cartel recognized the need for these companies to have strong downstream positions so that they could help control problems encountered with excess crude.

It was no accident that most of the incentives that originally drew the newcomers were smothered. The attractive concession agreements that brought companies such as Occidental into Libya and other producing states are now gone.[2] During many of the past few years, it has been uneconomic to run incremental purchase crude in refineries.[3] This entire price structure has been designed by the OPEC nations so that the prime participants in downstream activities will be the international majors.

The cartel has harnessed their downstream strengths through the participation agreements. The majors match the volumes demanded in product markets with available crude supplies. The participation deals insure that these

crude volumes will not be sourced from countries attempting to boost sales by shading prices. The companies would be reluctant to lose their favored status by pursuing the most profitable short-term purchases which would increase the volatility of offtakes and antagonize their producer partners.[4]

Because of changes in the structure of the market, however, the system may lose some of its former stability. The percentage of equity crude for the majors has been dropping steadily as nationalized oil sales have grown. At a given price differential between "equity" and "sale" crude, the heavier bias toward sale volumes will force the majors' average acquisition costs toward the third party price. Due to this divorce from the producing states, these firms will have less to lose by reacting sooner to changes in operating economics than ever before.

By disfranchising these companies from participation arrangements, the producing states may force the majors into becoming merely large independents. The structural and behavioral characteristics of the market would be changed so that all companies will react quickly to changes in incremental economics. Their role would be to match the price/realization relationships in product markets with the cost/value relationships in supply markets.

If the cartel is to maintain its economic power in this environment, it will have to find alternative methods of enforcing price hikes or give up its attempt to increase nationalized oil sales. The development of any new system will be heavily influenced by the future sources of crude supply and by the degree of competition OPEC encourages by its sales actions.

Analysis

The thesis will evaluate the eventual impact of nationalized oil sales on OPEC's pricing ability. Chapters II and III will analyze the historic relationships of companies and producing states as they pertain to the changing pattern of crude distribution. Chapters IV and V project the impact OPEC's policies will have on the international petroleum system if current trends continue.

Chapter II focuses on the development of the National Oil Companies (NOC's) and the underlying relation to the new demands placed on OPEC's pricing structure. The increased dependence on "sale crude" will force the producing states to become more aware of the value of their oil relative to its price. If it is to maintain a NOC sales program, OPEC must insure that the "net-back" values remain above the contract sales price.

The analysis begins with a quantitative look at the growth of international crude sold outside the channels of the majors. These NOC sales have reduced the volume of participation crude available to the majors under preferential terms. The economic effects of these actions are illustrated by examining European market trends since the early 1970's.

Chapter III examines the motives that drive the firms to make certain allocation and procurement decisions. The majors make profits on their liftings of equity crude, and thus can be expected to move slowly in response to changes in spot value. Nevertheless, these firms will eventually adjust their programs to accommodate the most "economic" crude slate. The majors' exposure to third party markets for system needs will reinforce the motivation to modify lifting schedules.

In view of these companies' expected behavior, it is unrealistic to assume that they will be able to assist the cartel in maintaining price levels or in controlling production levels. OPEC's problems will be amplified by the possible return of the independents with access to profitable crude. The advent of these competitive markets would necessarily imply that the producing states would have to hold prices high entirely through their own actions

and without any help from the companies.

Proof that the different companies actually affect markets as hypothesized would substantiate the argument that OPEC has been placed in a tenuous position with increased NOC sales. In order to show that these economic relationships hold, two tests were devised: one for the majors and one for the independents. Liftings from several countries are examined for any evidence of variance that could be explained by the companies' behavior.

Chapter IV addresses the issue of how far the cartel core must cut output to maintain a tight supply. The key parameters are: (1) the demand expected from consuming nations; (2) the additional output coming from non-cartel sources (i.e. Mexico); and (3) the actions of the cartel core members. Any drop in demand relative to non-core supply must be met by production cuts by the core.

The simulations will be based on a supply/demand model currently being developed by the World Oil Project at M.I.T. The residual demand to be met by the core can be viewed against several different supply scenarios.

Chapter V assesses the problems inherent in pursuing this "residual producer" strategy. Financial constraints determined by internal development needs will interfere with the curtailment of production. The simulation model

of Chapter IV will be used in tandem with projections of the core's current account balances to examine how severe the problems will be.

Chapter VI is an analysis of the options open to the cartel. The conclusions are based upon the trends and forecasts developed in earlier chapters.

Chapter I Footnotes

1. Sampson, Anthony, The Seven Sisters, Bantam Books, 1976, p. 185.

2. Petroleum Economics, Limited, Technical Analysis of the International Oil Market, June 1978, p. 14.

3. Department of Energy, An Analysis of Current Trends in United States Access to World Oil, July 1, 1978, p. 15.

4. Ibid, Tab 4, p.2.

CHAPTER II

RISE OF THE NATIONAL OIL COMPANIES

The advent of the national oil companies (NOC's) is changing the structure and economics of the entire industry. In the past, the international majors controlled most of the allocation and distribution of the world's petroleum so that it passed through to markets within secure networks.[1] In selling its own crude, OPEC has restricted the powers of the majors and has forced a change in the manner in which oil gets to markets.

OPEC created these national outlets when the countries moved to assume control over their petroleum industries. As a matter of long-term policy, most of these producer-based NOC's seek increases in their direct foreign sales as well as an expansion of their role in ancillary marketing activities.[2] The direct results of this trend are twofold: (1) more crude will reach third parties outside of the established channels of the majors; and (2) this oil will reach markets at official "sale" prices rather than at the reduced levels available to former concessionaires.

The increase of open market purchases will engender heightened sensitivity to the price/value relationship

of each country's crude. Over the long term, the "netted-back" value of a composite barrel of products must remain above the cost of the oil if the NOC's expect to maintain a direct sale system. In recent years, this has not been the case, as the average costs of incremental purchase, shipping, and refining have exceeded the product realizations.

In order to maintain high market values, OPEC will have to control output now that NOC sales constitute most of the trade in world oil. The decline in relative importance of the majors signals that they will no longer be able to insulate the cartel from product markets as they once did. Key to OPEC's future will be the competitive economics that will develop among the firms and the policies the cartel will pursue to compensate for the changes in market structure.

Types of NOC's

As a result of local expertise, nationalistic fervor, or a myriad of other factors, NOC's have developed along several different lines. The degree to which increases in direct sales will affect world markets will depend largely upon the historical relationships that have existed between the majors and the individual countries.

A Type I NOC can be thought of as handling its own sales of crude and of products from domestic refineries.[3] These companies are usually found in the more "radical" states which nationalized their industries sometime in the past. Examples of this genre are: Iraq National Oil Company (INOC); Sonatrach (Algeria); Pemex (Mexico); and Petroleos de Venezuela.

As may be expected, the relationships of Type I NOC's with the world oil community are predominantly on an arm's length basis. All sales are made at a fixed price (more or less), and so far as is publicly known, the majors are not given any relative advantages. Increases in volume will not dramatically impact the majors and their market structure unless the additional production represents a large absolute quantity vis-a-vis world supply.

Countries whose NOC's handle a substantial volume themselves but still use the former concessionaires to a considerable extent would be classified as Type II.[4] The state firms maintain strict control over most production and investment decisions, but maintain close ties with the majors through "advisory contracts" or participation agreements. These companies include: National Iranian Oil Company (NIOC, pre-1979); Libyan National Oil

Company (Linoco); Pertamina (Indonesia); CEPE (Ecuador); and others.

The Type III NOC's operate largely through management of the majors, who receive special participation incentives vis-a-vis the independent purchasers. This type of arrangement helps to bind the interest of the NOC and major together. Examples of Type III are: Saudi Arabia; the Persian Gulf Sheikdoms; and Gabon.

The key structural relationships lie between the majors and the Type II and III NOC's. Since the companies have been allowed to lift crude at an average cost that is lower than the sale price, they have had incentives to lend stability to the system. The extra profit margin shielded them from the vagaries of product prices, so that they were not forced to alter their sources of supply. The countries, in return, were given a fairly dependable outlet for their crude. As long as the participation percentage of total world oil supply remains at "high" levels, the system can maintain its strength.

Even Type III NOC's, however, have begun to change their policies recently. Although they use the former concessionaires as their main offtakers for security of outlet, countries such as Abu Dhabi have been generally increasing their direct sales to all comers. Further,

Saudi Arabia and Qatar have stepped up sales to other governments such as Brazil and France.[5] These deals necessarily imply that the majors' relative importance is waning and that they are losing their aggregate incentives to cooperate with the NOC's.

NOC's and Crude Disposal

NOC crude has been on world markets for over forty years. Yet the volumes of this trade have been insignificant relative to those moving within the majors' system. The new wave of NOC sales, however, does appear to have the potential to alter the means of disposal drastically.

NOC disposal can be defined within the framework of the international oil market. The world oil trade is a system linking the product markets of North America, Western Europe, and Asia with the producing states of the world. Volumes produced in North America are not included, since the region is a net consumer and few barrels leave the continent.

The products traded internationally are generally: (1) channeled through the majors' systems (including crude for the U.S. market); (2) sold to independents and other companies; or (3) consumed locally by the producing states. The key parameter on the sales side is the quan-

tity of products sold by the major companies. This serves as an indicator of these firms' relative strength when compared with their volume of crude available.

The crude reaching the markets is usually: (1) owned (equity) by the oil companies; (2) sold under special "buy-back" or participation arrangements; or (3) sold in spot or long-term contracts by NOC's. The first two sources have historically provided the majority of oil to the product markets and have been controlled by the majors. They distributed the crude in excess of their product selling capabilities under long-term contract to independent refineries. The shift toward NOC sources will alter these relationships and place added burdens upon the producing states to constrain supplies.

NOC sales have been increasing for several years (Figure 2.1). These volumes, which are the difference between international demand and majors' sources, are reaching record levels and represent about half of the entire free world trade. Since the oil markets have remained intact, one may conclude that the eventual impact of the upward trend in nationalized sales is marginal.

The growth in sales alone, however, is not the only key factor in the expected change. The act of increasing state sales automatically cuts into the crude available

to the majors under preferential terms. To the extent that the "participation" crude is in excess of product marketing requirements, these companies have a buffer against changes in operating policies. Over time, they will merely reduce the crude to third parties under long-term contracts. As the situation worsens and the majors become "crude short," however, their operating decisions will be more oriented towards meeting system requirements.

The crude sold outside the channels of the majors has grown in recent years (Table 2.1). The net figures are calculated by subtracting the companies' equity and participation production per country (Tables 2.2 A-E) from the total production of each country (BP Statistical Review). Much of the recent growth in NOC sales has come from Abu Dhabi, Kuwait, Iran, Nigeria, and Saudi Arabia. These countries have provided the majors with a large proportion of their crude requirements in the past. By selling more crude on the open market, these states have cut directly into the excess supply of the majors.

The extent of these changes on the crude surplus varies from company to company (Tables 2.2 A-E).* Over

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*Sohio is included as a result of its recent acquisition by BP. Occidental, Continental, ARCO, and Marathon are included because of their long-term arrangements with some proucer states.

the five year period, the crude available to virtually every one of these companies has decreased, as indicated by the trend in total company crude production. The impacts were most pronounced for BP, Gulf, and Royal Dutch, which had relied on countries bent on increasing their marketing abilities--Kuwait and Iran.

During this period when the majors' crude sources were drying up, their marketing requirements were not reduced nearly as far (Table 2.3). The difference between the crude production figures and product sales represents the net crude surplus for each of the companies (Table 2.4). The majors as a group fell from a net surplus of four to five million barrels per day to almost nothing over the period of study. It is this result which is important for world oil, as the allocation powers are passing from the major internationals to the producer states.

The NOC's will replace the international companies as marketers of the "marginal crude" on world systems. The disposal of these last barrels is key to the pricing ability of OPEC. Because the supply/demand balance on the margin determines the spot crude price, the producing states must be able to restrict production so that the value remains above the official price.

Some analysts have attempted to show that NOC increases have had no significant effects on world markets, as the volumes have had to be distributed in much the same manner as they always have. Through a series of approximations, the Petroleum Economics study "proved" that the overall volume of crude moving through integrated channels has not changed since 1970:[6]

	Net Volume of Crude Moving to:	
	Integrated Operations	Third Parties
1970	79%	21%
1975	78%	22%

This analysis paints a different picture than that suggested in Tables 2.2 (A-E). Petroleum Economics did not remove the crude purchased in open markets by some of the Integrated Operators. Their results are more appropriate as a description of the extent of downstream control of the majors, since the basis of analysis is really the crude passing through integrated channels to marketing outlets.

The report, therefore, does not evaluate the declining percentage of marketing requirements filled by "owned" crude. The percentage of crude moving to integrated operations is artificially high and masks the potential loss

of stability in the marketplace.

The study makes a more fundamental error in overlooking the key factors of value and relative economics and how they mesh with the disposal of crude. They did correctly assess the ownership of production and refining capacity and incorporate deals such as "participation/ buy back," "long-term sales," and "royalty," but omitted the impact these arrangements have on the companies' decision processes and incentives. In order to understand the importance of the recent changes in the oil industry, it is essential to examine what the cost of crude really means to a company.

Value vs. Cost

The increased volumes of NOC sales has created system crude shortages for the majors. As a result, more companies have become exposed to third party crude markets in which they must buy directly from the producer states at official sale prices. Purchases of this oil, therefore, will be largely a function of the market prices of the products vis-a-vis the company costs of acquiring the crude.

The value ex-refinery is the sum of the realizations on a composite barrel of the products the oil will

yield. A typical yield structure for an average crude in a European refinery is shown in Table 2.5. This barrel of crude will become 20% gasoline, 10% kerosene, and so on. By multiplying the 20% gasoline fraction by the product price, we can estimate the realization on that part of the barrel. Summing these realizations for a three week period in Rotterdam gives the "value" of that crude.

Before the oil gets to the product markets, however, the companies incur costs of refining and transportation. The value of the composite barrel of products must be reduced by a representative refining margin and the spot freight from the point of origin to the refinery.[7] The result is the F.O.B. value of the crude on an absolute scale and represents what an average company can afford to pay.

This value can then be compared with the actual costs of acquiring the crude. Purchases in third party markets from the NOC's will usually be made at the official sale price. Although there may be discounts or premia attached to long-term contracts, the list price usually gives a reasonable objective approximation of the terms of the transaction.

Participation agreements have given the majors official discounts off the sale price on a certain percentage

of their offtakes. Petroleum Intelligence Weekly has calculated the average acquisition costs for several key crudes based on the percentage of production at the official sale price and that at the participation price. The difference between this figure and the official sale price gives an indication of the majors' incentives vis-a-vis independents (Table 2.6).

These low average acquisition prices result in fundamentally different profit opportunities for the majors than for the independents. Decisions based on the costs of supply, therefore, will necessarily be colored by the extra margins. The growth of NOC sales, however, has created a situation in which the companies are exposed to third party prices on the last barrels into their systems.[8] The effects on their behavior will be almost as if the firms had to buy all their crude on the open market.

Operating economics in the oil industry center around running an "incremental barrel" through the system. The companies use this evaluation tool to decide whether or not to expand volume or to trade one crude off against another. Because the last barrels into the system will be NOC sale crude, the companies will balk if the oil's value were significantly less than the official price.

The large volumes which will be involved in these margin transactions have the potential to upset market equilibria. In periods of poor product realizations, many cartel members may find their output reduced involuntarily. By placing these majors in a position where they will be sensitive to the tight margins between value and official price, the OPEC states have weakened the companies' abilities to withstand market fluctuations. This, in turn, will place added strain on OPEC's pricing ability.

Relation to Markets

The source of OPEC's mystique is its ability to raise the price of oil. Its original success was due largely to the participation arrangements with the majors. The lowered cost of crude gave these companies the ability to withstand periods of poor market conditions without putting pressure on the cartel members. The large quantities of NOC crude on world markets, however, may hinder the cartel's ability to maintain increases. The companies' increased sensitivity to incremental economics will force OPEC to sustain price hikes entirely through its own actions.

OPEC's price increases have been achieved by restricting output so that excess demand bids up product prices to record levels. The embargo in late 1973 created shortages that sent spot prices in Rotterdam through the roof (Figure 2.2). OPEC then raised its crude prices in order to capture most of the gain in realizations. It appears as if the cartel is allowing the Iranian crisis to boost spot prices again so that they can follow with a substantial increase in the crude price.

During periods in which prices increase this drastically, markets reflect the instability caused by incorrect "valuing" of relative crude prices. Figure 2.3 shows the realization/average cost pattern over a ten year period spanning the embargo. For most of the period after the supply shortages, realizations appear to have fallen below the average costs of acquisition, transport, and refining.[9] The data is not sufficiently precise to ascertain the exact levels of loss, but the consistently negative margins would indicate that companies at best made very low profits on NOC sale crude.

Incremental economics would suggest that this should never occur. Companies would cut back on the most unprofitable liftings until the reduced supply

raised prices to levels commensurate with the cost of crude. Some of this equalization never occurred in product markets, however.

These companies were given enough of a margin to have the flexibility to wait until product realizations eventually returned to profitable levels for incremental crude. They were not forced to drop liftings or pressure the producers into backing down off their price demands. The majors' loss of excess crude, however, changes the economics of the international oil market and reduces the likelihood of the companies' continued ability to "ride through" turbulent markets.

If the companies are no longer able to insulate the majors from market forces, liftings may be reduced for the most uneconomic crudes to the extent possible. This automatic market equilibration may increase product realizations at the expense of market share, but it also may reduce the sales of countries badly in need of revenues. The result could be a series of price shadings through which the original price increase would be lost.

The next chapter will examine the means by which the companies react to market stimuli and measure the magnitude of the effects. Because these firms do adjust

to changes in relative economics, OPEC will have to control its output and pricing policies to accommodate the competitive environment NOC sales have created.

Chapter II Footnotes

1. Sampson, op.cit., p. 70

2. Analysis of Current Trends, op.cit., Tab 1, p. 4.

3. Petroleum Economics, op.cit., p. 21.

4. Ibid

5. Ibid

6. Ibid, p. 36.

7. Petroleum Intelligence Weekly, March 7, 1979, p. 4.

8. Petroleum Economics, op.cit., p. 6.

9. Analysis of Current Trends, op.cit., Tab 3, pp. 8,9.

CHAPTER III

OIL COMPANIES AND THEIR INCENTIVES

The oil companies have historically been the bond between the owners of reserves and the ultimate consumers. They have provided the vehicle by which the OPEC states can be assured of a steady revenue flow and have shielded the countries from the vagaries of the market. The companies have had incentives thus far to act in the best interests of the producing states and have indirectly helped the OPEC countries exert market influence.

In Chapter II, we showed that the structure of this industry is changing in response to new demands by some OPEC members. The effects of these changes should be reflected in the motivations which drive the oil companies and in their subsequent behavior. These new actions will foster a more competitive, dynamic environment with which OPEC will have to deal if it is to maintain its dominant position.

The firms have always reacted to changes in competitive economics. The growth in NOC sales, however, has altered the fundamental environment for these firms. The majors have become exposed to third party markets for the first time. Independents may be able to re-

establish downstream marketing positions and increase product sales due to the return of low cost crude. These factors will increase the magnitude and quickness of reaction to changes in relative incentives.

In order to assess these potential effects, it will be necessary to examine the past relationship of company offtakes to the spread between value and cost. Because of the differences in opportunities for the majors and independents, we have devised tests that illustrate the companies' behavior. We attempted to show that the majors respond to relative incentives over a long period of time and that the independents react more quickly to similar opportunities. Furthermore, we tried to prove that the reactions themselves have become more "competitive" since the NOC sales began to edge out the majors' excess crude.

The strength of the results indicates that increased NOC sales will create a situation in which a relatively large percentage of world production will be subject to rapid fluctuations in offtake. If OPEC is to avoid this problem, the cartel must reduce NOC sales or hold production levels down so that the value will remain above the incremental sale price.

The Role of the Companies

The international majors and the independents move oil from far-off fields to consumer markets. Their long-term behavior is governed by the economic incentives each is given to produce, transport, refine, and sell petroleum. Collectively, these participants and their actions comprise the "structure" of the international petroleum market.

Each group, however, acts in its own peculiar manner and is guided by different environmental considerations. An understanding of the factors which influence the behavior patterns will make it possible to monitor performance in the marketplace.

The International Majors may have fallen from power, but continue to have an important role as purveyors of oil. These companies--Exxon, Royal Dutch/Shell, Mobil, Standard Oil of California, Texaco, Gulf, BP, and CFP--provide both the physical ability to refine, transport, and distribute the mainstream volumes of oil flowing in international trade and the operational expertise to handle such trade.[1] They are differentiated from the second tier of companies such as Continental and Marathon by their downstream sales strength in virtually all product markets. The associated ability to move

crude within totally integrated systems all the way to the ultimate consumer gives these majors the wherewithal to provide a stabilizing influence for the market.

The majors will continue to lift crude, even if the offtakes are uneconomic in the short term. Because they are given special participation privileges by the OPEC states, the companies will be reticent to sacrifice long-term strengths for relatively small present profits. These firms have adequate cash flow from other activities, such as North Sea production, so that they can cover their marginal operations by "averaging" out between markets.[2] This gives them the flexibility to take a strategic perspective on country-by-country liftings.

Over time, the majors will adjust their crude slates to obtain more favorable economics. They will examine the relative incentives of one source over another to find the most profitable crude mix that satisfies their marketing requirements. At first, the companies will overlift or underlift their allotted volumes by shifting the offtake schedules. If the differentials persist over a longer period (more than a year or two), these firms may slash the actual magnitudes of nominated volumes.

The adjustments made in the liftings, however, will only be directional. Contract provisions require the companies to maintain a certain base offtake program over a period of time. If the firms allowed their liftings to drop below this minimum level, they would risk alienating the producing state. A strategic perspective would demand that the company pursue a policy that maintains good rapport with the OPEC members, even though short-term profits may be sacrificed.

The trade-offs between long- and short-term returns will become more pronounced as the OPEC states move toward increasing NOC sales to third parties. Since the majors' systems will become more exposed to open market purchases, these firms may be less reluctant to curtail entire offtake programs in the future. Over time, the companies should become more responsive to changes in incentives and should alter their crude slates more frequently.

The majors are evolving toward positions where they will rely solely on their strengths as masters of logistical networks and as refiners and marketers. The pace at which they move will be dictated by the decisions the OPEC nations make on "acquisition cost" and NOC sales. If the evolution is allowed to continue, OPEC will lose the majors as buffer agents to shield the cartel from

external market pressures.

Independents are companies whose size and scope of operations do not compare with those of the major firms. These companies, such as Atlantic Richfield and Continental, have recently been relegated to one or two of the three main phases of the international industry. Unlike the fully integrated and balanced majors, they either have to buy crude and/or products, sell crude to refiners at arm's length prices, or sell products to bulk operators.[3] These companies, however, have the flexibility to return to more integrated operations if they are given more favorable incentives by the producer states.

The independents derive their strength from greater maneuverability and speed of decision-making than the majors. Their presence can be evidenced by periods of heightened market activity whenever incremental crude became profitable, such as in the European markets of the 1960's. Until recently, OPEC effectively impeded these companies' operations by pricing sale crude over its value. It appears, however, as if there is a general trend in worldwide crude prices that will make operations profitable for the independents once more.

The potential return of the independents and the changed role of the majors may create an environment

inimical to the best interests of OPEC. The emphasis in the industry will shift from a strategic perspective centered on perceived commonality of economic goals between the majors and the cartel to one of short-term response to changes in relative incentives. This will place added pressure on OPEC to maintain profitable price/value relationships in order to avoid possible volatility in off-take volumes.

Incentives and the Majors

In Chapter II, we discussed the concept "value vs. cost" that dominates the supply side economics. Decisions in the industry are based upon the "incremental barrel," which will be purchased at the official sale price. The correct notion of incentive for both majors and independents, therefore, is the difference between the net-back value and the sale price.

The presence of a positive incentive for purchasing a crude type should be correlated with an increase in that country's NOC sales, and vice versa. In reality, the companies are tied to volumes under long-term contracts, so that the liftings should never actually go to zero. If there is a persistent disincentive, however, we can expect production levels to fall as companies

postpone their liftings.

This framework is useful in evaluating the effects of growing NOC sales on the actions of the majors. If it can be shown that these companies adjusted offtake volumes in response to relative incentives during periods of excess system crude, it follows that the reactions will be more severe in the upcoming years of shortage since larger volumes will be purchased from the NOC's than ever before.

In order to assess these responses, it is necessary to devise a test that incorporates criteria relevant to the majors. The concept of value, however is difficult to quantify. The majors do not respond to absolute netbacks, but rather to "alternate," or relative value. Most non-U.S. refineries have been designed around a set percentage of Arab Light. Any changes in economics are usually measured against this basic crude (or equivalent) and other oils are run or backed-out accordingly. A concept of value that measures the worth of crudes vis-a-vis Arab Light would go a long way toward capturing an important aspect of the major's decision-making process.

Petroleum Intelligence Weekly has calculated this value since the beginning of 1975. Except for Venezuelan crudes, the values have been measured in Rotterdam prices

(Table 3.1). Because Rotterdam is considered to be the most efficient, competitive market in the world, the numbers are probably more reliable than those obtained from the Caribbean or Singapore. The "value" of Saudi Light is defined as its official price and all other values are slated in reference to it. These figures may be compared with the official prices for the same crudes (Table 3.2).

The difference between these two numbers will be the majors' incentive to run a crude instead of Arab Light (Table 3.3). Given that the supply of each crude type is limited, it is of little importance that most of these oils bear disincentives against Arab Light per se. What is important is the relative incentive of a crude compared with the other opportunities at hand. For an individual firm, the opportunities would be the selection of one of a few other crudes available. On a worldwide scale, however, we need an index that represents the average value of all the crudes moving in international trade.

We can approximate this index--the "trade weighted incentive"--by multiplying the percentage of world volume supplied by each country by the incentive of a representative crude of that nation (Table 3.4). The difference

between the country incentive (Table 3.3) and the trade weighted one is the relative incentive for that crude in Rotterdam (Table 3.5).

This relative incentive gives the most accurate indication of the profitability of crudes we can obtain. Not only does the measure conform to the alternate value decision process of the majors, but it escapes the data problems inherent in the absolute incentives. The inaccuracies in data reported on product values and the inconsistencies in methods of calculation may bias a single value. Because the relative incentive is the difference of two such values, these inaccuracies would tend to "wash out."

The international majors' reactions to these relative economics, however, is not usually immediate. Since they set their crude slates six months in advance, the most common short-term response is to move up or postpone offtakes. If any discernable patterns are to be observed, therefore, the majors must be given time to respond.

Relative incentives should persist as positive or negative for at least two quarters in order to have substantial effects. For this reason, it is probably best to use a two quarter moving average for the relative incentives of the crudes. Similarly, it takes time for the majors to significantly adjust their liftings. A

three quarter moving average, centered on the second value, would be the most appropriate measure. This permits examination of the current and past quarters--the period concurrent with that of the value measurement--as well as the effects of present values on future liftings. These time lags were used to make comparison tests for three OPEC nations: Iraq, Libya, and Nigeria.

Iraq has nationalized virtually all of its production under the auspices of INOC. Crude sales, therefore, should be expected to carry a positive incentive over most periods since majors are given no equity percentage. Kirkuk, Iraq's "representative crude," however, has been carrying a disincentive for almost the entire period of study.

This apparent anomaly is merely a misrepresentation caused by political pressure. As an OPEC "hawk," Iraq has kept its "official" government take up with the other Arab nations. OPEC members have expressed suspicion of Iraq's sales deals which have permitted it to increase offtakes in the face of limited total demand growth. The general consensus is that INOC gives discounts and extra credit to big, steady buyers.[4]

Most discounts are in the form of "cents off" purchases or credit terms, so that the apparent disincentives

would actually disappear. These discounts should not bias the Iraqi analysis, however, as most additional offtakes are probably purchased at the official price. Since these marginal liftings may be added or postponed, the relative incentive captures the relevant decision criteria of the majors when they examine Iraq vis-a-vis other producers.

Table 3.6 shows the calculation of the moving averages for both production and relative incentives. Almost without exception, liftings increased in periods when the relative incentive was positive and decreased when it was negative (Figure 3.1). This implies that the majors were responding to relative economics by increasing offtakes over those taken in the previous quarter when the incentive was positive and vice versa. In a purely competitive environment, all points should lie in quadrants I and III since positive (negative) relative incentives should be correlated with increased (decreased) liftings. The "outlier," which represents a small volume decrease with a positive incentive, occurred chronologically after two very large consecutive increases (Table 3.6). This is a normal phenomenon and may reflect some readjustings of liftings as well as minor errors in data.

Iraq is as clear-cut a case as we have. Although INOC probably cuts prices, the majors are not given equity

participation and are not bound to long-term commitments. The companies have been responsive to changes in economics over time and have adjusted their liftings accordingly. As NOC sales increase, the incentive/production relationships for other nations will approach the Iraqi example.

Libya represents a Type II country in which the former concessionaires are still present and receive a percentage of equity crude. There is no penalty on the companies for underlifting slated volumes, so the government has reserved the right to sell to non-concessionaires any oil not taken under the entitlements. As a consequence of this relatively flexible concessionary system, Linoco production is intimately related to fluctuations in the world oil market. Over the years, in fact, Libya's prices have responded to market trends faster and with more precision than those of most other governments.[5]

In view of these policies, we would expect Libyan production to be responsive to changes in its market value. The relation of Linoco sales to these incentives since 1975 has been strong (Table 3.7 and Figure 3.2). As with the Iraqi relationships, the data points fall primarily in quadrants I and III. There are, however, three periods in which production increased while relative incentives were negative. When the economics

started to deteriorate in 1977, the companies still increased their offtakes and did not let them decline until the incentives had remained negative for some time.

Even though there was a disincentive to lift Libyan crudes instead of other types, some companies probably believed that it would be corrected in short order. Discounts off list price and fear of losing participation privileges delayed the response time almost a year. It was not until the situation persisted that the majors realized that they were in a losing position and began to cut offtakes.

If the companies had been required to purchase crude from Linoco at official sale prices, the liftings would probably not have run counter to the relative incentives. Libya would have been forced to back down off its price demands sooner or face a serious decline in output. The excess system crude that damped the response is disappearing as NOC sales continue to increase. Without this buffer, Libyan offtakes will be kept in line with the relative incentives.

Nigeria provides an interesting example of a Type IIIcountry. The companies have been retained to market virtually all the crude, and have been given fairly large incentives vis-a-vis the independents (Table 2.6).

Nigerian production, however, has recently had a very stormy history due to government policies aimed at raising revenues by increasing the official price postings.

The relationship between output and value is slightly out of line (Table 3.8 and Figure 3.3). During 1976, the country raised company costs three times via the price posting and higher buy-back mechanism. Even after this occurred, however, sales continued to climb. It was not until 1977 that the companies cut back on liftings in response to competitive economics.[6] The delay is reflected in Figure 3.3 as the two outliers in the second quadrant.

The majors' eventual actions were drastic enough to reduce Nigerian output to 75% of its previous high. NNOC was then forced to back off on its aggressive pricing policies and to reinstate favorable economics. As with Libya, the companies' reactions would have probably come sooner if they had been in third party crude markets at the time.

The Libyan and Nigerian examples demonstrate that participation agreements and excess supply crude have blunted competitive responses over the past few years. Because the majors purchased incremental barrels from these countries at the comparatively low acquisition

cost, they were not compelled to change their offtake programs immediately. The slow reactions gave the OPEC states time to adjust their pricing structure and helped insulate the cartel from the rapid fluctuations in market value.

Acceleration of Majors' Response

The majors have been insulated from poor market realizations by participation crude. The loss of this oil forces them to enter third party markets in order to cover their system requirements. This need to purchase incremental sale crude should create an environment in which the majors change lifting programs as incentives change. If we can show that the majors have begun to change their programs sooner, we can infer that the cartel has lost the luxury of delays in response time it once enjoyed.

We would like to create an index that measures the degree of response (change in liftings) relative to the inducement (relative incentive). This can then be plotted against time to capture any recent trends. From the earlier analysis in this chapter, we have the data plotted on Figures 3.1, 3.2, and 3.3. If we divide the "Δ" by the relative incentive, we have created an index that

captures the relevant criteria.

The trend in Iraq, for example, definitely shows that the response has become more dramatic (Figure 3.4 and Table 3.9). Before 1977, there was no discernable pattern in the plot. After the majors as a group began to be crude short, however, the response in Iraq has grown greater over time. This is demonstrated by the monotonically increasing function since 1977 (dotted line).

The pattern is repeated for both Libya (Figure 3.5 and Table 3.10) and Nigeria (Figure 3.6 and Table 3.11). The indices have become progressively larger over the period since 1977 and are no longer negative. The negative values are from an era in which the majors still had the strength, given by excess system crude, to ignore incremental economics. The trend away from this non-competitive behavior confirms the hypothesis that the majors are being forced to react sooner.

We may infer, therefore, that the companies will no longer buffer the producing states from market forces by avoiding the concept "value vs. cost." The cartel will have to insure that prices are consistently in line with market realizations. OPEC's pricing problems will be exacerbated by the entrance of other competitive firms onto the world oil scene.

Independents and Purchase Crude

Until recently, it has not been profitable for independents to refine and sell incremental purchase crude from many of the producing states (Figure 2.3). Their absence from these supply markets has reduced the necessity for OPEC to maintain crude prices at the levels of the corresponding market values. This has given the cartel a degree of pricing flexibility it would otherwise not enjoy since it has been protected from short-term fluctuations in product markets.

As NOC's continue to increase their sales on third party markets, they raise the incentives in order to attract customers. The producers which have been moving toward this more "competitive" stance include Libya, Algeria, Nigeria, and the U.A.E. (Table 3.3). If more nations follow suit, as trends suggest, and Type I NOC's such as Pemex increase production dramatically, the stage may be set for a resurgence of the independents.

These companies' chief strength is their speed of decision-making. Their presence in supply markets would create problems for OPEC's pricing ministers if product prices started to get out of line with crude costs. The resultant volatilities in offtake and subsequent price shadings may make it difficult to hold a significant price increase,

Proof that the independents do react this quickly to changes in incentives would reinforce the idea that increased NOC sales are inherently dangerous for the cartel. Since independents are active in trading markets, their actions can be monitored by examining the differential between "spot" and "official" F.O.B. prices. If the differential is positive, the volume of crude sold should increase over the quarter as traders rush to arbitrage the markets. Eventually, as markets are brought back in line, the differentials grow smaller and the cycle begins anew. Evidence of this relationship would demonstrate that the independents are a real market force.

In Libya, the changes in offtakes are closely linked with the absolute incentives (Table 3.12 and Figure 3.7). Some of the measured effects are undoubtedly due to the majors' programs, but the close correspondence between arbitrage opportunities and output variances suggests that the independents clearly are a viable market force. Similar results can be seen in Tables 3.13 and 3.14 and Figures 3.8 and 3.9 for Nigeria and Iraq.

At present, the volumes moving in response to these spot incentives are relatively small. Many of the inde-

pendents simply do not have established outlets for the crude, and so the trading markets have remained "thin." As more crudes become "economic" for long periods of time, the independents may be able to re-enter markets as fully integrated firms. Their renewed presence downstream will give these companies the wherewithal to move enough crude to significantly affect the lifting programs of the producer states. If these independents are as efficient as the above analysis suggests, they may indeed be a problem for OPEC.

Implications

The increase in NOC sales has resulted in a system where: (1) majors have become exposed to "incremental economics" on their third party purchases; and (2) independents will be able to re-integrate and be able to control more crude. Because the firms are responding more quickly to changes in relative incentives than before, OPEC will have to design a more robust pricing mechanism. The objective of the producer states will be to maintain crude values at least at the level of their sale prices.

The only method by which the cartel can hold market realizations at high levels and prevent volatilities in

offtake is to restrict output. The difficulty, of course, is that the entire environment is constantly changing. Increased production is expected from the Type I NOC's and from the "fringes" of the cartel. OPEC's relative power and its ability to keep the market structure under its wing rests on the decisions made by key producers and the extent to which they dominate world production.

The next chapter will analyze the supply/demand balance over the next decade. The central question to be answered is: "How far must the OPEC core cut output to maintain desired price/value relationships?"

Chapter III Footnotes

1. Petroleum Economics, op.cit., p. 7.

2. Analysis of Current Trends, op.cit., Tab 2, p. 5.

3. Petroleum Economics, op.cit., p. 12.

4. Analysis of Current Trends, op.cit., Tab 4, p. 11.

5. Ibid, Tab 4, p. 16.

6. Ibid, Tab 4, p. 14.

CHAPTER IV

OPEC AS "RESIDUAL PRODUCER"

Ever-growing volumes of oil are being sold on the market by the NOC's of the OPEC countries. These sales have crowded out crude from the majors' own systems and have forced them to seek incremental purchase crude. Past trends indicate that these companies react to relative incentives of one oil type vis-a-vis other alternatives by increasing or decreasing offtake volumes. The larger quantities that must be bought from the NOC's in the future suggest that these effects will become more pronounced and will ultimately lead to a more competitive market system.

OPEC can adjust to this new world by controlling either: (1) the sale prices of its crudes, both on an absolute scale and relative to each other; or (2) the market prices of the products. Either of these mechanisms, if effective, would embrace the concept "value vs. cost" and would reduce the dangers inherent in the increased NOC sales.

The first alternative is a more elaborate extension of the existing pricing formula. OPEC has a computer model that suggests appropriate prices for member crudes

based on location, quality, "market price," and other factors. The producing states use this as a guide, but there seems to be some latitude for individual pricing discretion. Furthermore, the simulation is not updated frequently enough to account for random swings in product prices.

In order to provide a method for the members to adhere to an "objective" pricing scheme that would eliminate the incentives to lift one crude over another, OPEC would have to monitor all phases of the market and revise the sale prices frequently.[1] Because of the impracticalities of constant price revisions and the vast arrays of up-to-the-minute data needed for this task, an attempt to create an accurate framework that would maintain sale prices at the level of their product values and against other crudes would be doomed from its inception. Models may only provide general indications of directionality and magnitude; markets are so complex that central price-setting is infeasible.

The cartel, therefore, will have to control product market prices so that net-backs will at least equal the sale prices of its crudes. This action will dampen the potential swings occurring from value/cost differentials among several crudes.[2] In order to keep market realiza-

tions at high levels, OPEC will have to cut output so that excess capacity in the "wrong hands" will not create downward pressure on prices.

The OPEC members--particularly the cartel "core"--increasingly will be made to bear the brunt of supply fluctuations in their role as residual suppliers. They must balance the net demand of the consuming countries with their total capacity after all other producers have sold their desired quantities.[3] This prevents excess volumes of oil from coming onto world markets at discounts off list price. The core itself, however, must have the strength to reduce its output at the appropriate moments regardless of how severe these cutbacks may be.

Role of the Residual Producer

The best method of raising petroleum prices is to restrict production. OPEC proved that marginal cost and competitive theories of exhaustible resources have little to do with the price of petroleum.[4] By curtailing output, they quadrupled the crude price within a few short months. Users of energy, motivated by fear or necessity, bid up the last barrels on the spot market to a level that again equilibrated supply with demand.

The cartel optimization strategy suggested here could be undermined if a few producers supplied extra quantities onto world markets. Countries badly in need of additional revenues would be tempted to throw these incremental barrels into the system. In order to avoid this danger of excess capacity, OPEC must allow its higher spenders to produce as much as they want.

The responsibility for residual production has fallen upon the cartel "core": Saudi Arabia, Kuwait, the United Arab Emirates (U.A.E.), and Libya.[5] Whenever the net demand on OPEC fell substantially below capacity, these four nations cut back output and gave the other members an opportunity to produce (Table 4.1). There was, of course, excess capacity among the non-core countries, but it was kept low through the concerted action of the core. During the period of the embargo and subsequent price increase, excess capacity in "weak hands" was kept under 15%. The stronger producers absorbed the demand decrease in 1974 and allowed the other members to enjoy comfortable export levels. Based on this observation, we may assume that 10 to 15% non-core excess capacity is a "safe" level for periods of price increases. Greater slack may encourage excess production during these violent periods of adjustment.

After the price hike had become firmly established and worldwide demand slowed, OPEC excess capacity rose to high levels. Although the core members absorbed a large part of the cutback, the other producers suffered excess capacity of 20%. During this period, the cartel did not raise the real price of oil, possibly as a result of this surplus capacity problem. It was not until late 1978 when Iran cut exports that the non-core excess dropped to levels where OPEC could again raise prices.

In order to keep prices firm and rising in the future, therefore, the cartel will have to maintain a tight supply situation. The responsibility for this control falls upon the "residual producers" within the organization. They must make certain that their "firm hands" sell the last barrels moving through the international petroleum system. Their presence as last sellers will reduce the downward pressure on prices that would exist if a revenue-hungry nation needed to increase its output by shading its postings.

These core producers have a very delicate balancing act indeed. They must first decide the level of demand sustainable in the world at a given oil price. The calculation is complicated by the price/growth/energy relationships which adjust economies to energy costs over

time. OPEC must be wary of choking off too much consumption with too steep a price trajectory.

Residual Demand

When OPEC raised the price of oil in 1973/74, it changed many of the established relationships between GNP growth and energy consumption. The extent of the structural change is unclear and no economic forecaster can predict what the future relationships will be. Nevertheless, it is possible to approximate near-term effects with basic assumptions about price and demand. This demand framework can then be used to the extent to which the cartel core will have to reduce production levels in the future.

The most fundamental relationship deals with the cost of energy and the quantity of its use. As the price increases, other inputs such as labor become relatively more economic. Over time, as machines wear out, they will be replaced with more energy-efficient ones. Because some of the capital stock using energy is fixed in the short term, it will take some years for the price increase to affect demand completely.

If we assume that half of the ultimate demand decrease net of substitution from other energy forms will

take place over the first five years, and that half of the remaining decrease will occur over the next five, we can approximate the time lags in the world economy. This assumption will allow us to measure the price elasticity of energy demand.

In 1973/74, there was a real price increase in oil of 300%. Over the same period, net demand dropped 3.3%. Given the "half life" assumption that this first year decrease represents approximately 10% of the eventual drop, we can calculate the long-run price elasticity to be about -0.1 (Table 4.2). This implies that a 10% real increase in price will ultimately result in a demand level 1% lower than if there had been no price hike.

Before the embargo and new price levels, oil demand had increased regularly at 7 to 8% per year. Since this was about the same growth rate as that of GNP, economists have linked the two by saying that energy had an income elasticity of one. In the last few years, however, it is unclear as to whether or not the relationship has changed.

Oil consumption has been growing at a rate of about three percent per year for the period since 1974. If we assume that this underlying growth path will remain at or under 3%, we can begin to construct a price-demand model.

This necessarily begs the question of income elasticities, but allows us to approximate the annual increase in demand for oil.

The price effect captured in the half-life formula represents the relation between energy and other inputs in society and does not include the "shocks" caused in consumer markets. These "blips" are short-term events that we assume will last for one year and then disappear. To account for these hypothesized changes, we may assume that as price increases by 10%, demand growth will fall by 0.5%, from 3% to 2.5%.

This rather arbitrary decision is an attempt to account for one-time shocks introduced into the system by an oil price rise. The effect is really to depress the long-term growth rate slightly below 3%. Together with the price effects, the model gives a conservative estimate of annual petroleum demand. This lower estimate is preferable since it gives a lower net residual demand on the cartel core. If the core can keep supply tight with this particular scenario, it can adjust with relatively more ease to a world with higher levels of demand.

The model does give, therefore, a price/volume relationship that will allow us to calculate the revenues of the OPEC core producers under relatively "tough"

environmental conditions. By varying the price trajectory, we can simulate the effects on world demand for the next few years.

If OPEC pushes through real price increases of $1/Barrel each year, demand will grow at slightly over 2% annually. The effects on consumption are shown in Case A of Table 4.3. Similarly, the demand forecasts for a high price trajectory and constant real price can be constructed from the model (Table 4.3 B and C). The simulations are compared with other estimates in Table 4.4.

These scenarios can be used to check the degree to which the cartel core must restrict output in order to maintain a tight supply situation where no cargoes are offered in excess of world demand. Non-core production must be subtracted from total consumption to yield net demand on the core. The difference between this and the existing capacity is the extent to which these four producers must slash output.

Integrated Supply and Demand

World demand will grow at varying rates predicated upon the price path OPEC takes. The cartel core in large part controls this price trajectory, but must trade off

higher receipts per barrel with lower residual demand. This demand will depend on total non-core production levels.

The supply projections were derived from the M.I.T. World Oil Project (W.O.P.) model. Because of difficulties inherent in modelling core behavior, it predicts capacities in lieu of actual production levels. In order to convert to production figures, we can multiply total capacity by set percentages based on a priori assumptions about non-core behavior. The objective of the simulation is to determine how far the cartel core must cut back to accommodate the other producers' desires.

Most "free world" producers will produce at or near capacity. These "price taker" countries maximize their net revenues by producing as much oil as they can economically extract at one time. This output will be accompanied by the net Communist exports projected by the W.O.P. model.

During 1973/74, non-core members of OPEC were able to absorb about 10-15% excess capacity. A production level of 90% of expected capacity, therefore, would be in line with past experience for these countries. More surplus may engender a situation where the nations are tempted to increase NOC sales by reducing the effective price.

These conditions would create an environment in which the cartel core would have to operate under some duress. The model will give a conservative estimate of residual demand, so that the strains may be slightly amplified. It will thus help to illustrate the hard choices faced by OPEC planners.

The first case was run under assumptions of constant real prices and pre-revolution Iranian production trends (Table 4.5). The relatively large percentage of capacity that would have to be shut in makes this extremely unattractive in view of the core's development plans and revenue needs. In all probability, non-core cartel members would be required to "share" some of the excess capacity.

This simulation of the world, with a full stream Iran, casts doubt upon OPEC's ability to boost prices or to support a large scale NOC sales program. The surplus capacity in the weak hands of non-core members would create some downward pressure on prices. Core ability to cut production levels may be limited beyond some limit due to internal development needs for revenue. The recent situation in Iran, however, has changed the assumptions behind the above simulation.

If we constrain Iran to four million barrels per day in the future, the residual demand is, of course, much greater (Table 4.6). Iran's restriction of output has given the cartel the ability to raise prices more than anticipated even at the December 1978 meeting. Its future production levels will determine much of OPEC's ability to increase prices by curtailing output.

If the core does manage to keep output low enough to maintain steadily increasing prices, it will ultimately decrease the annual growth in world demand. The resulting loss in the residual to the core (Tables 4.7 and 4.8) must be weighed against the greater per-barrel revenues from a high-price strategy.

Implications

The role of residual supplier is inherently undesirable, as it inevitably leads to fluctuations in revenues. In the past, the system worked fairly well because Saudi Arabia, Kuwait, the U.A.E., and Libya were satisfied to absorb the bulk of production cutbacks. The situation is changing, however, as government expenditure commitments are increasing and production levels are approaching the desired minimum for those countries.[6] OPEC must be able to sustain tight produc-

tion in the face of its increased revenue needs and non-cartel increases if it is to maintain control over the market prices of its products.

The question of revenue needs will probably provide the key to OPEC's future. NOC sales will give the countries more control of and direct access to the actual revenue flows. If the rent received proves to be sufficient, OPEC will grow in strength as a cartel. If it does not, and nations such as Iran increase production to meet greater than anticipated revenue needs, control may become more difficult and OPEC may have to return to a world in which the companies act as the cartel's agents.

Chapter IV Footnotes

1. Jaidah, Ali M., "The Pricing of Petroleum," Petroleum Intelligence Weekly, Oct. 2, 1978, Supplement, p. 3.

2. Ibid, p. 2.

3. Ibid

4. Jaidah, Ali M., "Pricing of Oil: Role of the Controlling Power," Petroleum Intelligence Weekly, May 16, 1977, Supplement, p. 1.

5. Sampson, op.cit., p. 360.

6. "The Pricing of Petroleum," op.cit., p. 3.

CHAPTER V

OPEC AND ITS DEVELOPMENT NEEDS

The OPEC "core"--Saudi Arabia, Kuwait, the U.A.E. and Libya--must assume the role of residual producers in order to ensure that world supply remains tight. Because increased NOC sales threaten to remove the international majors from their roles as "buffers" for the producing states, output must be curtailed to maintain crude values above the official sale prices.

The question remains, however, as to whether these four producers can balance the residual demand with their growing revenue needs. The current account surpluses of these countries have been decreasing over the past few years as internal development needs have increased at a rapid pace. Any future cutbacks in output will be achieved at the expense of lost development programs and internal growth. The core, therefore, seeks enough income to finance the industrialization of their economies, a massive project that will last at least through the 1980's.

Revenue Needs

The OPEC nations need the foreign exchange received for their oil in order to import enough goods and services to build an industrial base. Without such an infrastructure, their economies would return to primitive levels after the oil began to run out. These countries, therefore, are in a race with the clock to develop the physical and technical capabilities necessary to rival Western societies.

The ability to develop can be measured with the current account from the Balance of Payments. This is simply the net exports of goods and services, after subtracting "official transfers," or Grants-in-Aid. It represents the "hard currency" accumulated that can be used to finance imports of industrial goods in the future. The sum of these current account flows over time represents the "stock" of foreign assets owned by a nation, exclusive of financings by international institutions.

Theoretically, this stock of financial assets gives the oil exporting country the wherewithal to become a developed nation. As the domestic economy heats up and absorbs more imports, the country loses the ability to pay for these with current revenues. It then draws down the stock of assets to finance the current account defi-

cit. This continues until the country is "developed," or is at least strong enough to borrow externally to complete the process.

The current accounts for the four core members demonstrate this stock surplus/high import growth pattern (Tables 5.1 A-D). They have accumulated large external asset positions and have increased imports at a rapid pace. Eventually the current account surplus will disappear as imports grow larger than oil revenues, and the countries will have to finance part of their needs from their stock of assets. The uncertainty for these nations is whether or not the stock will be depleted before their development programs have become more or less self-sufficient.

The core's ability to finance these internal growth needs is dependent upon future current account balances. If we make the assumption that imports and miscellaneous exports grow at historic nominal rates, we can approximate the revenue needs for the cartel core at different points in the future. The difficulty in measuring "real" imports necessitates the use of nominal values. This implies that the real oil prices from Chapter IV will have to be converted into nominal ones. By assuming an implicit rate of inflation of 10%, we can accomplish

this so that the current account will be completely in nominal dollars.

If we net the current account balance to zero each year, we can calculate the oil revenues necessary to finance development (Table 5.2). Actual revenues, of course, will be greater or less than this "residual" figure. The difference is the amount by which the stock of external assets is built up or drawn down.

The Cartel Core--Development vs. Cumulative Surplus

In order to promote internal development of their economies, the cartel core will have to import vast quantities of goods and services. This creates an enormous need for foreign exchange, most of which must be generated by petroleum revenues (Table 5.2). These financial constraints must be balanced against alternate price/output strategies, which will result in different levels of revenue for the producers (Table 4.3).

If we lump the requirements for the four core members together, we can simplify the integration of revenues and expenses. The total core revenue needs can then be compared with the total receipts from residual production. This avoids the problems encountered in allocating output levels within the core itself and allows us to

consider the four as one cohesive unit.

The receipts and expenses are compared for each of the three cases of price/demand projections (Table 5.3). The net surplus or deficit on current account is added to the existing stock of external assets to determine the cumulative surplus. As long as this figure is positive, the countries can finance their development needs from their own sources.

In each case, the accumulated earnings are insufficient to cover the projected levels of imports by the mid-1980's. The countries, therefore, have two basic options. They can either slash the development programs or go to international capital markets to cover the deficit on current account.

If the core reduces its demand for imports, the financial squeeze can be eased at the expense of lost improvements in domestic quality of life. To be sure, the Islamic Revolution would suggest some deceleration of the industrialization trend as militant groups demand a return to the "old ways." The ruling classes in monarchies such as Saudi Arabia and the U.A.E. would be particularly sensitive to these potential pressures. It appears, however, that the need for internal development programs will remain strong in any case, as evi-

denced by the relatively high (4000-4700 TBD) production of Iran in recent weeks.[1] This output will pay for a new budget designed to return the local economy to former levels of prosperity.

The option of borrowing on international markets, therefore, seems to be the more reasonable choice. In order to acquire these loans, the core will have to keep production levels up to satisfy the financial community and will have to invest the funds in projects that promise good returns. This implies that the infrastructure needs will have to be largely satisfied and that the countries should be relatively close to industrialization.

In view of the sadly deficient levels of education and skills in the OPEC world, it is unlikely that any of the core members will be near this modernized state by the mid-to-late 1980's. They will have to stretch their day of borrowing out further by decreasing the rate of import absorption and hope that the domestic product will pick up the slack. Similarly, they will have to find ways to maximize the incoming revenue stream.

Implications

In view of OPEC's financial crunch illustrated in Table 5.3, the cartel will probably begin to raise the

real price of oil as soon as possible. Given the arbitrary nature of the model used to obtain the results, the focus should not be on the exact optimum price path, but on the fact that a very high pricing strategy seems to be better for the core. If this is an accurate representation of reality, we can expect a rapid price escalation over the next few years.

In any case, it appears as if the cartel core will experience financial difficulties sometime in the mid-1980's. After that period, these countries will have to juggle their own development and revenue needs with the task of controlling output to maintain the cartel. As residual producers, they cannot reallocate production to ease their situation.

This is precisely the role the major international companies could play in world oil markets. Over the years, these "impartial" participants have been able to allocate production globally so that individual countries could meet acute revenue needs for a period of time.[2] The four core members could still keep the supply semi-tight, but produce more than the simple "residual."

The problem is that NOC sales have grown to the point where the majors are losing the discretion over whether or not they lift crudes from some nations at a

given time. They are being forced to purchase the "last barrels" at official sale prices and must seek the most profitable deals. This is counter to behavior which would help the core occasionally expand output by cutting into rivals' production.

The question for OPEC is whether or not they can maintain cartel stability if the core producers are forced to restrict output so that value is almost always above sale price. Given their financial constraints, this may be extremely difficult in the mid-to-late 1980's.

If this is found to be untenable, there are few other options open to the cartel. They can work toward a complex pricing scheme by which all sales are updated at least monthly. Not only is this choice infeasible, however, but is almost impossible to enforce. Similarly, they could encounter equivalent problems in designing some "equitable" allocation formula.

Finally, they could choose a pricing path so high that non-core members could be on the "backward-bending" part of the supply curve, as they would not have to produce that much to receive "enough" revenues. OPEC would probably be reluctant to pursue this policy in view of the potential disastrous effects on world economies (and their sales) and because of the ever-

increasing appetites of most countries who would simply maintain historic production levels and generate even more rent.

None of these alternatives is as attractive as the participation system in which the majors were given incentives to buffer the producers from market forces. This gave each country the opportunity to produce relatively more in times of financial need. The companies thus served as OPEC's unofficial allocation system.[3]

In place of this allocation flexibility, the OPEC states are resigning themselves to mandatory output restriction. The loss of freedom for the four core states may eventually prove too great because of their revenue needs and we may witness the eventual decline of NOC sales.

Chapter V Footnotes

1. Petroleum Intelligence Weekly, April 16, 1979

2. Blair, John M., The Control of Oil, Pantheon, 1976, p. 362.

3. Ibid

CHAPTER VI

CONCLUSIONS

The rise in NOC sales is an important phase in the cartel's development. It represents the beginning of an era in which the OPEC states can effect control over more than just the upstream ends of the industry. Yet the problems these sales have engendered may cause the producer nations to limit NOC sales growth and reinstate part of the old system in which the majors controlled world oil.

Summary of Results

As NOC sales have increased, they have cut into the excess crude supplies of the majors. Many of the firms have been forced to purchase incremental sale crude on third party markets in order to meet marketing requirements. In theory, this exposure should cause these firms to react more quickly to changes in crude values and create some allocation problems for the countries.

In Chapter III, we proved that the competitive system is indeed changing. Companies--both majors and independents--react to relative incentives by changing the volume of offtakes from one source vis-a-vis the

other alternatives. Since 1977, when the firms as a group began to be crude short, these reactions to changes in value have become more pronounced. Because the companies will not give OPEC the buffer they once did, the cartel will have to maintain crude values above their sale prices at all times.

The most effective way for OPEC to control these realizations is to hold back supply so that demand will place upward pressure on prices. Unfortunately for OPEC, production increases are expected from outside the cartel as well as from "non-core" members. In order to maintain a tight supply situation, the cartel core will have to perform the role of residual producer. The environment of the 1980's will probably force these countries to keep output well below capacity.

The core nations, however, have financial needs that may make this mandatory restriction difficult. Their internal development programs will probably not be completed by the end of the 1980's, so much of the annual growth will undoubtedly come from imports. Payment for these imports will require vast amounts of petroleum revenues. Based upon simulated supply/demand/price scenarios, it appears as if the core will experience some financial strains toward the end of the decade.

These constraints may impede the pursuit of a "residual producer" strategy.

Dangers for the Cartel

The cartel core has been resigned to this residual producer strategy because one of OPEC's prime objectives has been the institution of NOC sales programs. The wisdom of this decision is questionable in view of the analysis in earlier chapters. Environmental considerations not included in these results add further to the dangers inherent in OPEC's moves.

The demand model constructed in Chapter IV gave a fairly conservative estimate of price elasticities. If the "true" elasticity is in fact higher, as some economists have suggested,[1] the total world demand would be even lower than the model indicates. Although the model's predictions are in line with other forecasts (Table 4.4), the long-term effects of the recent price rise are far from clear.

The other recent phenomenon that could create planning uncertainties for OPEC is the possible resurgence of Iranian production. The revolution created a shutdown situation in which excess capacity disappeared and the cartel was able to boost prices. Iran is already

back to over 4000 TBD and probably could go higher if economic pressures warranted.[2] The supply side problem is further confused by the omnipresent, if somewhat unlikely possibility that major new discoveries will be made in non-OPEC lands.

The combined effects of the supply and demand problems could create a situation in which the residual to the core is much less than that suggested in the thesis simulations. This implies that the financial problems could become much more severe for these nations. The only solution for the core, therefore, is to find a means of allocation that will allow them to maintain the price level while producing enough to meet their revenue needs.

Implications

The cartel decision makers face tough choices in the future. The fundamental trade-off is over the problem of allocation: how to keep world oil supply tight if the core produces as much as it might like. Because this issue has never been resolved, the core has had to assume the role of residual producer.

If OPEC maintains this "residual" structure, it appears as if the core nations will experience financial difficulties in the late 1980's. Even if they signifi-

cantly raise the price of oil, their problems will be only slightly ameliorated. The only manner in which these countries will be able to generate enough revenues to save necessary development programs is to sell more crude.

The rise of NOC sales, however, prohibits such action. The competitive markets fostered by the change in industry structure necessitate the tight control of supply. Otherwise, the values of given crudes may fall below the official sale prices, causing fluctuations in output volume and revenues. The price shading resulting from these countries' attempting to regain market share would be exacerbated by additional downward pressure from excess supply crude.

Tight control of production is mandatory for the existence of a NOC sales system. Yet the mechanism by which it is achieved--residual control--seems unstable in the long run. OPEC must find an alternate method of achieving cartel control.

NOC sales are the manifestation of an attempt to increase influence in international markets at the expense of the major companies. The countries wish to gain "prestige" and to improve their knowledge and expertise in downstream operations. Most of the benefits which

accrue from such a strategy do not appear to be altogether economic in nature. To be sure, the cartel will be able to operate more efficiently if they gain greater understanding of markets. The direct rewards, however, are more elusive.

The gains made in this area must be traded off against the loss of revenues for the core producers. Because the international majors had performed the cartel's allocation duties, the core had been able to produce more than the simple residual, as evidenced by non-core excess capacity (Table 4.1). The participation arrangements gave the majors the ability and incentive to lend stability to the offtake programs. Occasionally, these companies kept one or more countries "down" in an attempt to prevent excess crude from entering world markets.

In periods when the majors have been in control of world petroleum markets, prices have eroded only very slowly. Given that these companies were faced with perennial glut, they did a remarkable job of keeping price levels up by holding production down. Furthermore, they were able to allocate offtakes so that the revenue needs of individual countries could be satisfied.

These companies' strength was derived from the excess

equity and participation crude in their systems. OPEC can regain the use of the majors as agents by returning these firms to their former "crude long" status. Given the "correct" incentive schemes, the majors can buffer the cartel from swings in product prices and can allocate production so that the core need no longer act as residual producer.

The key lies in the actions of Saudi Arabia, Kuwait, and Abu Dhabi, three of the countries which rapidly increased NOC sales (Table 2.1). In the long term, these core states must increase offtake volumes in order to generate additional revenues. Yet their increases of state sales have created an environment in which they must keep potential production in the ground. If they cut back on NOC sales and let the majors buy more crude at discount prices, their roles will be changed.

By allowing the majors to be "crude long" again, the core can shrug off the burden of being a residual producer. The improved position of the companies will allow them to be more "discriminating" in designing lifting programs. Because the participation volumes eliminate the high-cost incremental barrel, the majors will no longer be required to shop around among sellers. Even if non-core producers shade prices, there is no guarantee that they can sell all they want.

The surplus participation crude gives the companies both the ability and the motivation to allocate worldwide production. They have relatively large margins on this crude and would prefer to produce as much as they can. The majors balance this desire against the oil pushed onto markets by the Type I NOC's. They use their downstream strengths to maximize the volumes of participation crude and minimize those of sale crude, within limits. If the majors allocated offtakes, therefore, they would lift more than the simple residual from the core by cutting back on offtakes from other sources.

The increased revenues for the cartel core will be achieved at the direct expense of the NOC sales programs. In view of the financial rewards possible with the majors' control over allocation, the more esoteric benefits of NOC sales may pale in comparison. The core, therefore, may be expected to cut back on their programs in order to give the companies increased leverage.

The majors, however, no longer enjoy the same control over downstream channels that they once did. The rise of consumer NOC's is an example of this erosion of market power. These companies, such as ENI, buy directly from the producer NOC's and circumvent the channels of the majors. Since there is no reason to believe that

this trend in state-to-state deals will be stopped, NOC sales will continue to have outlets out of the control of the international majors.

What may dry up, however, is the increase in NOC sales from the core and a few other OPEC states. Countries which recognize the need for cartel control and their own inability to allocate production will be less reluctant to forego their sales programs in favor of modified concessionary agreements. The "sacrifice" of total control over production is offset by the gains to be made in long-run cartel stability.

The increased volumes of system crude will allow the majors to reinstate long term contracts with third party customers. This will give them effective control over marketing outlets, even if they do not "own" them. The resulting power over the independents will offset some of the effects of NOC sales sourced from "spender" nations.

If the majors' return to a crude long state does reduce the pressure on the cartel core, the growth in NOC sales will be damped. These sales do provide an opportunity for the cartel to learn more about downstream operations and give OPEC the flexibility to use its own outlets rather than rely on the Western companies. Unfortunately, these sales create an environment in which

the cartel core is forced to pursue a residual strategy which may lead to financial difficulties.

The core, therefore, may reduce its emphasis on promoting these sales programs and focus on an allocation system based on the majors. This will permit them to earn more revenues than they otherwise would. The increased reliance on the majors, however, does not signal the end of NOC sales. Although the growth may die down, these sales will remain as a valuable outlet for the cartel's crude.

Chapter VI Footnotes

1. Pindyck, Robert S., "Interfuel Substitution and the Industrial Demand for Energy: An International Comparison. M.I.T. Energy Laboratory Working Paper no. MIT-EL 77-026 WP.

2. Petroleum Intelligence Weekly, April 16, 1979.

APPENDICES

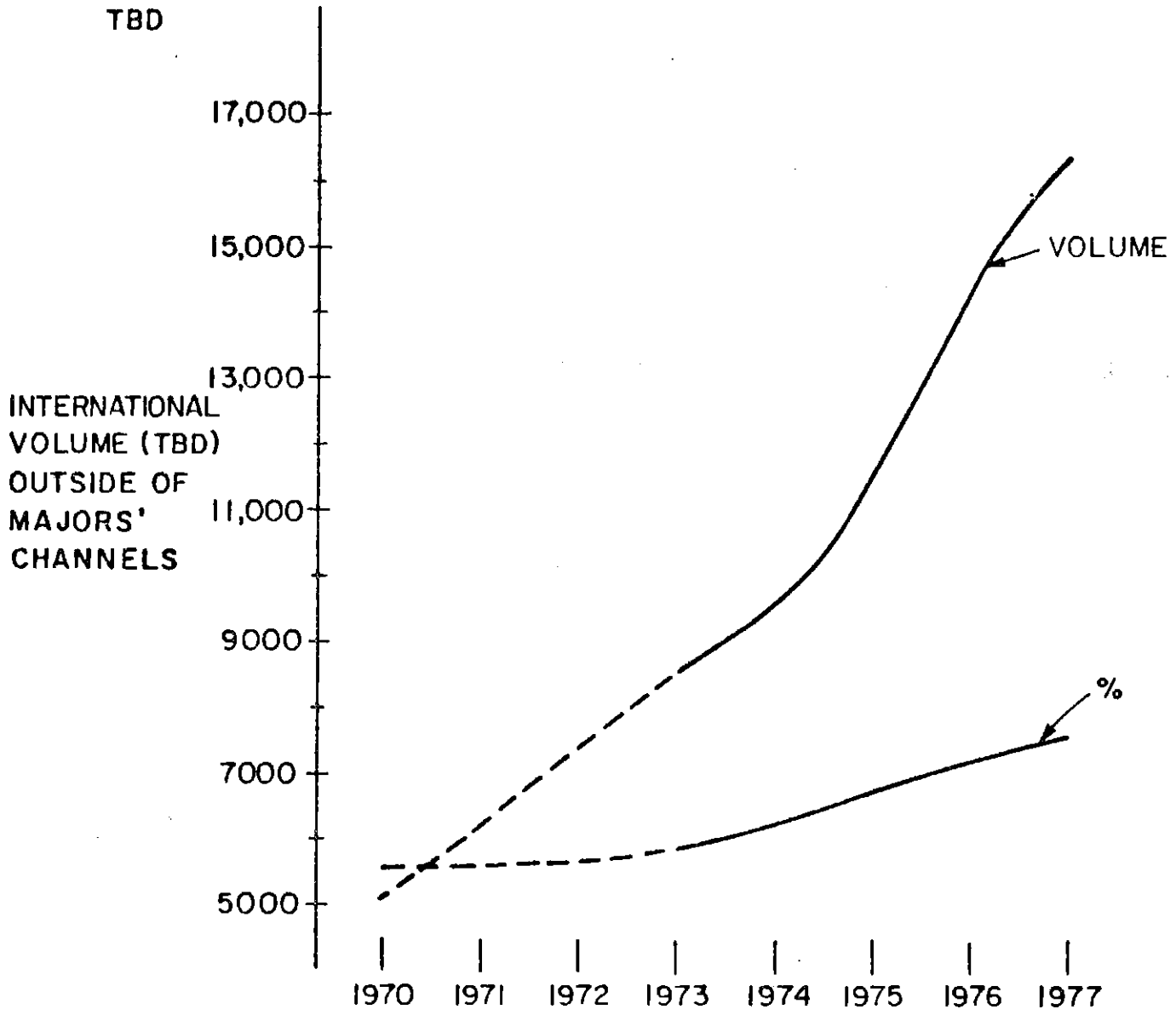


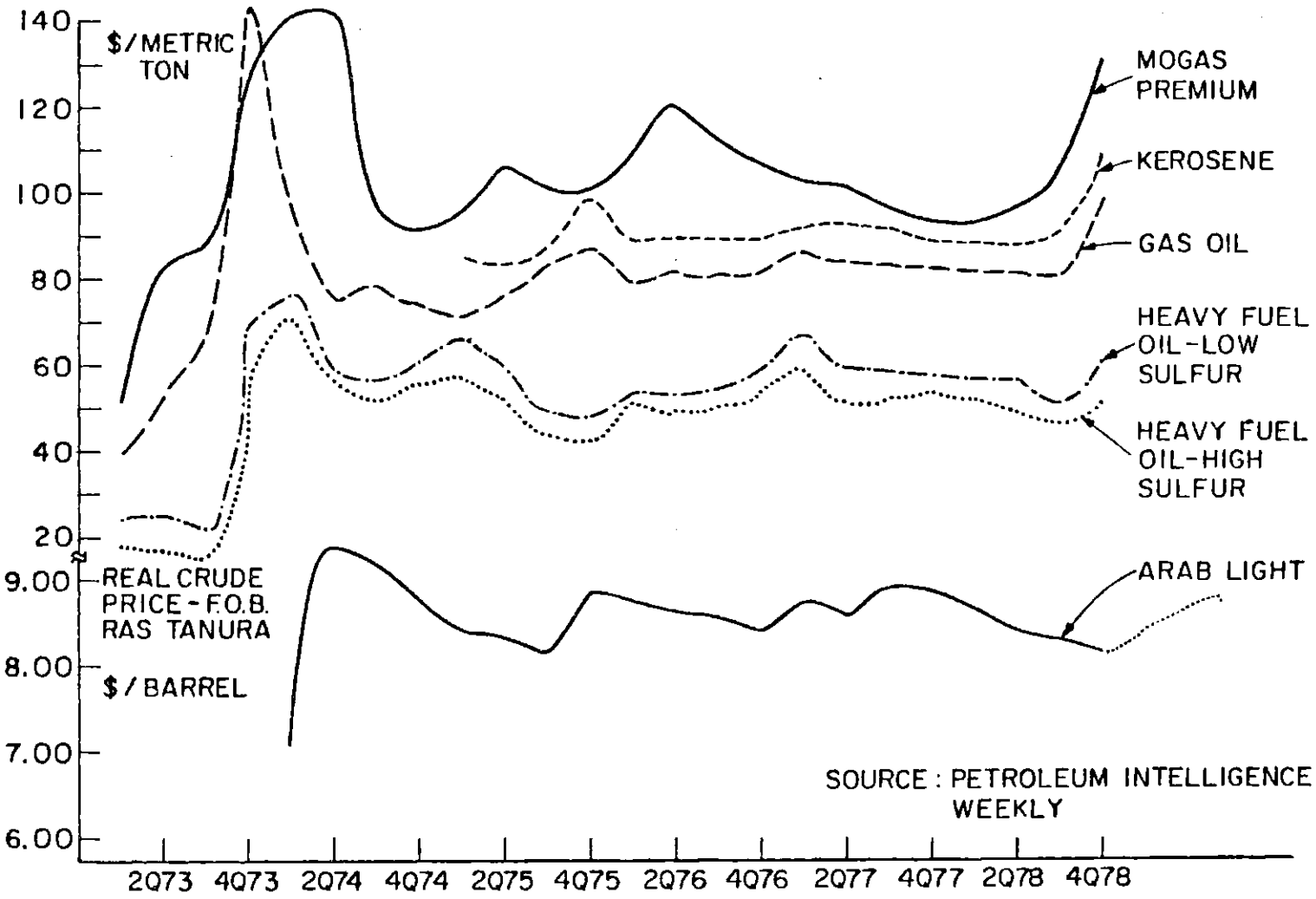
FIGURE 2.1

GROWTH OF INTERNATIONAL CRUDE SOLD OUTSIDE THE CHANNELS OF MAJORS

SOURCE: ANNUAL REPORTS, BP STATISTICAL REVIEW

REAL PRICE LEVELS - ROTTERDAM

FIGURE 2.2



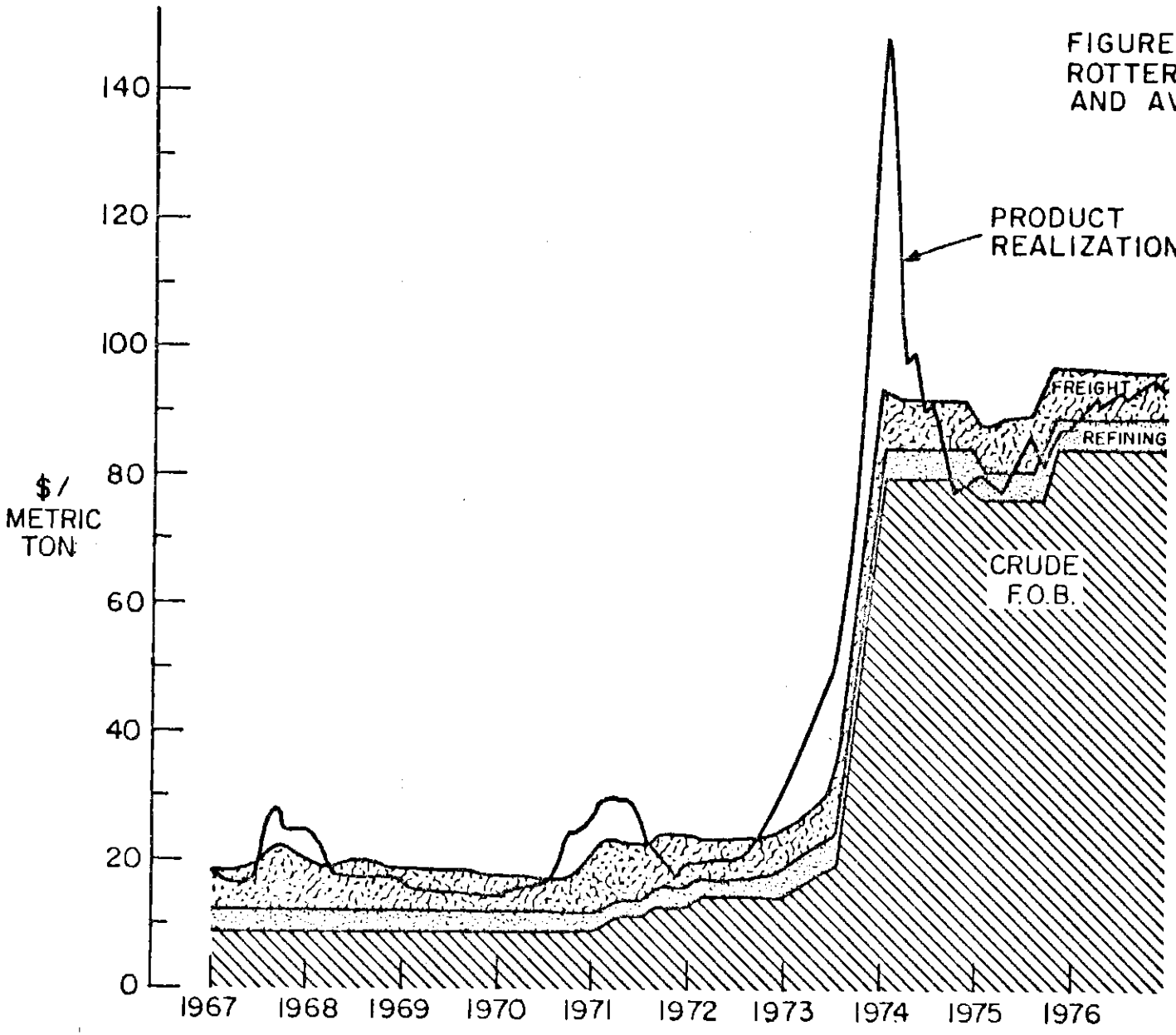
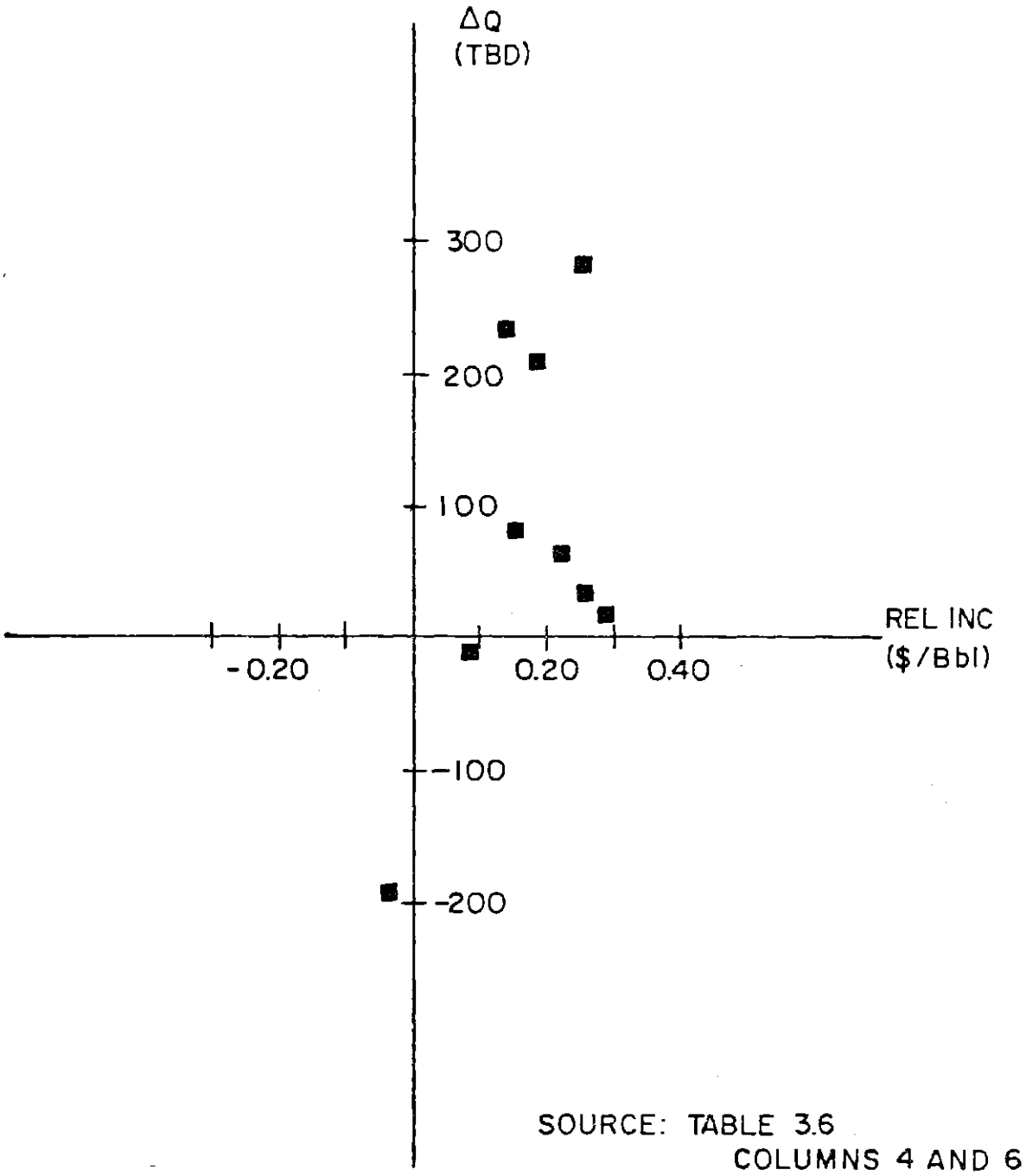


FIGURE 2.3
ROTTERDAM REALIZATIONS
AND AVERAGE COSTS

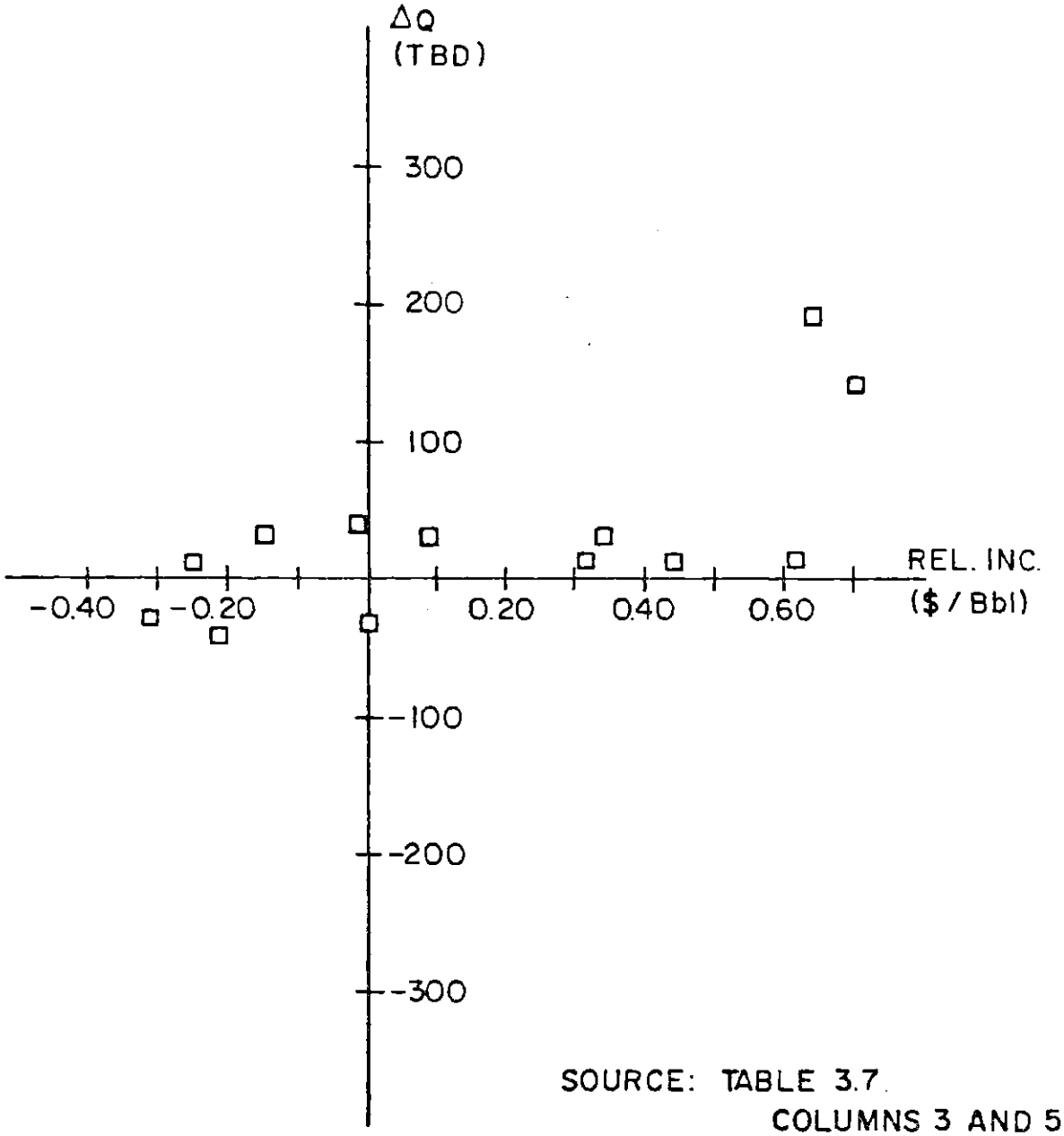
SOURCE:
PETROLEUM
ECONOMICS

CHANGE IN OFFTAKE (ΔQ)
vs. RELATIVE INCENTIVE



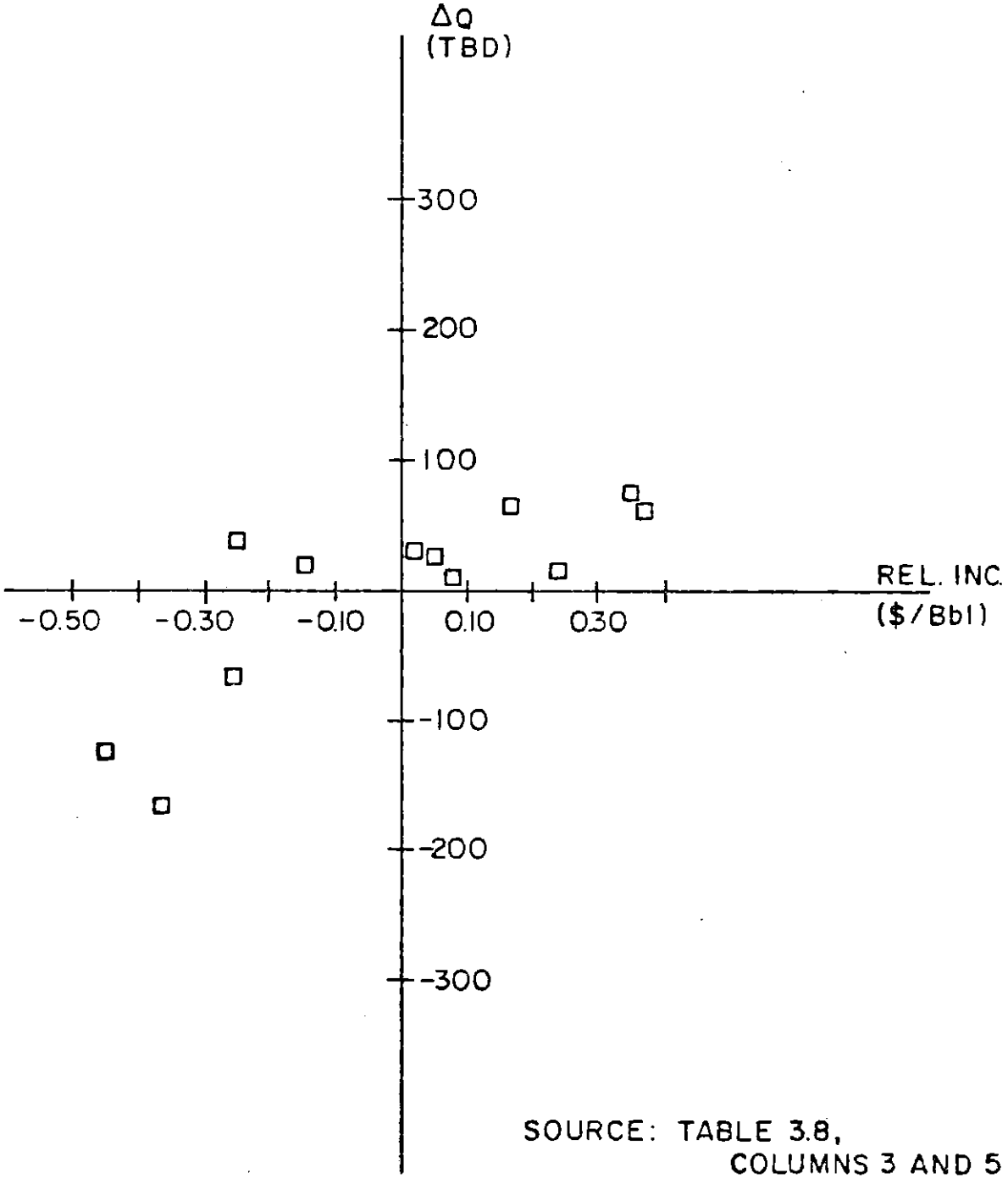
SOURCE: TABLE 3.6
COLUMNS 4 AND 6

CHANGE IN OFFTAKE (ΔQ)
vs. RELATIVE INCENTIVE

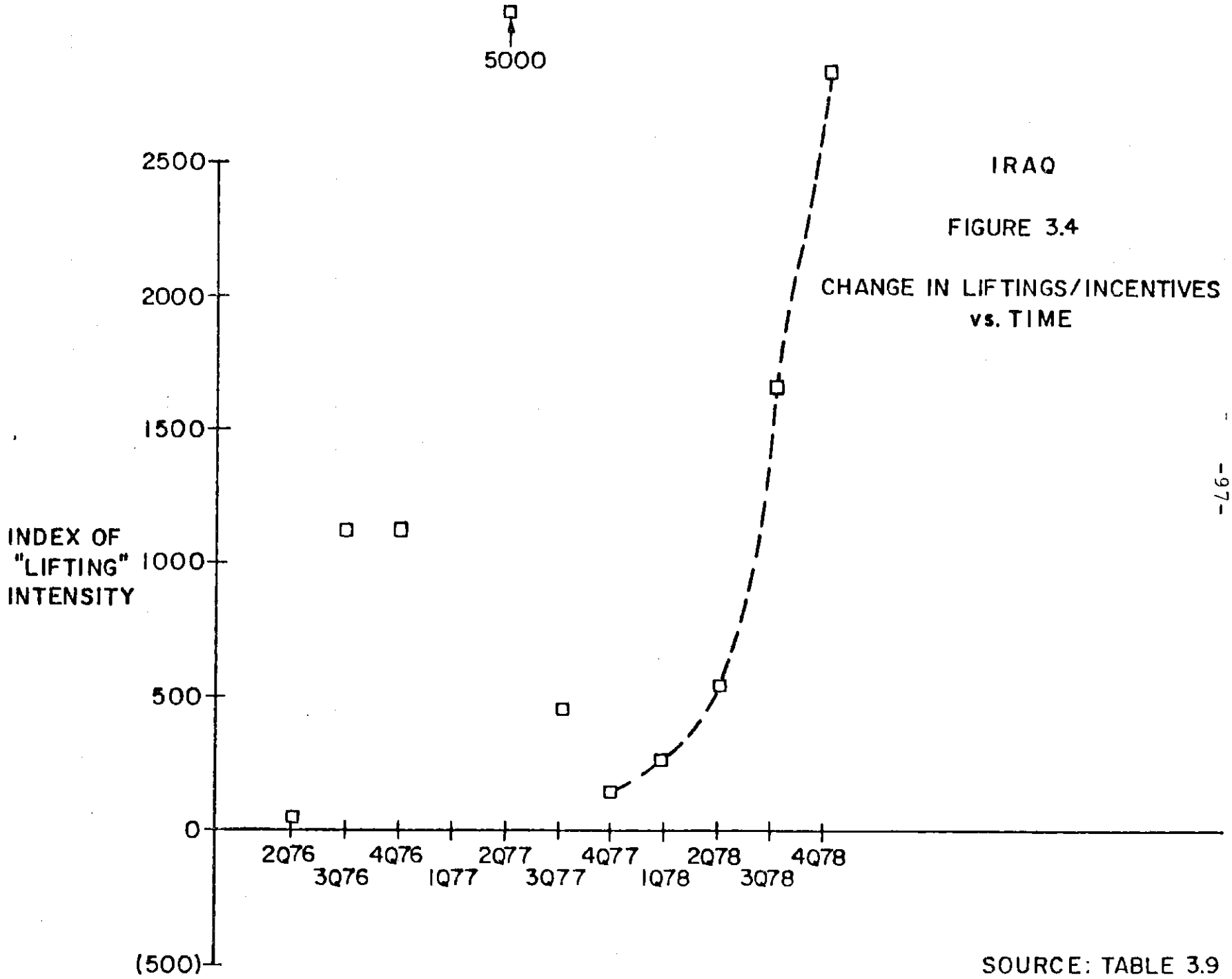


SOURCE: TABLE 3.7
COLUMNS 3 AND 5

CHANGE IN OFFTAKE (ΔQ)
vs. RELATIVE INCENTIVE



SOURCE: TABLE 3.8,
COLUMNS 3 AND 5



IRAQ

FIGURE 3.4

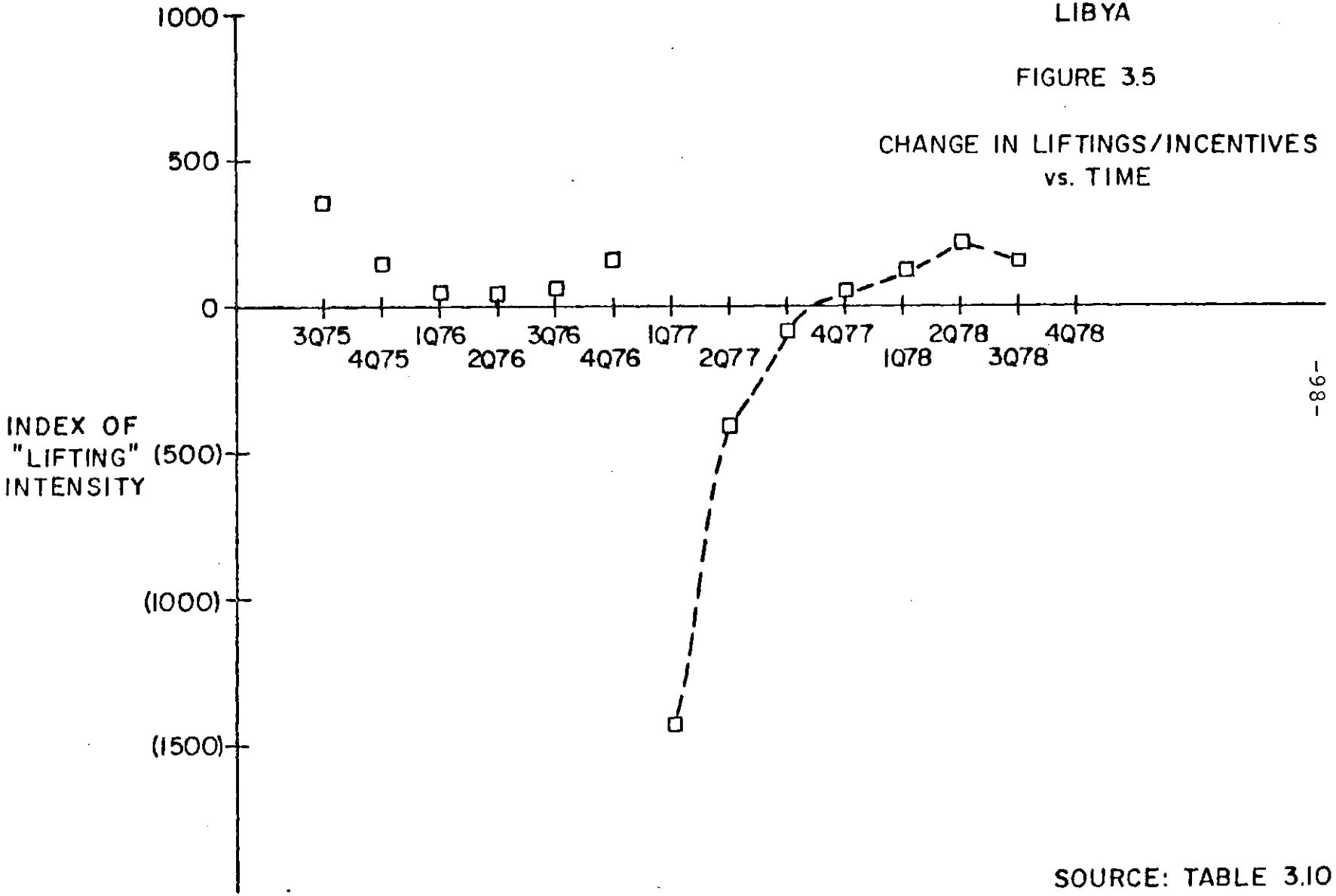
CHANGE IN LIFTINGS/INCENTIVES vs. TIME

SOURCE: TABLE 3.9

LIBYA

FIGURE 3.5

CHANGE IN LIFTINGS/INCENTIVES
vs. TIME

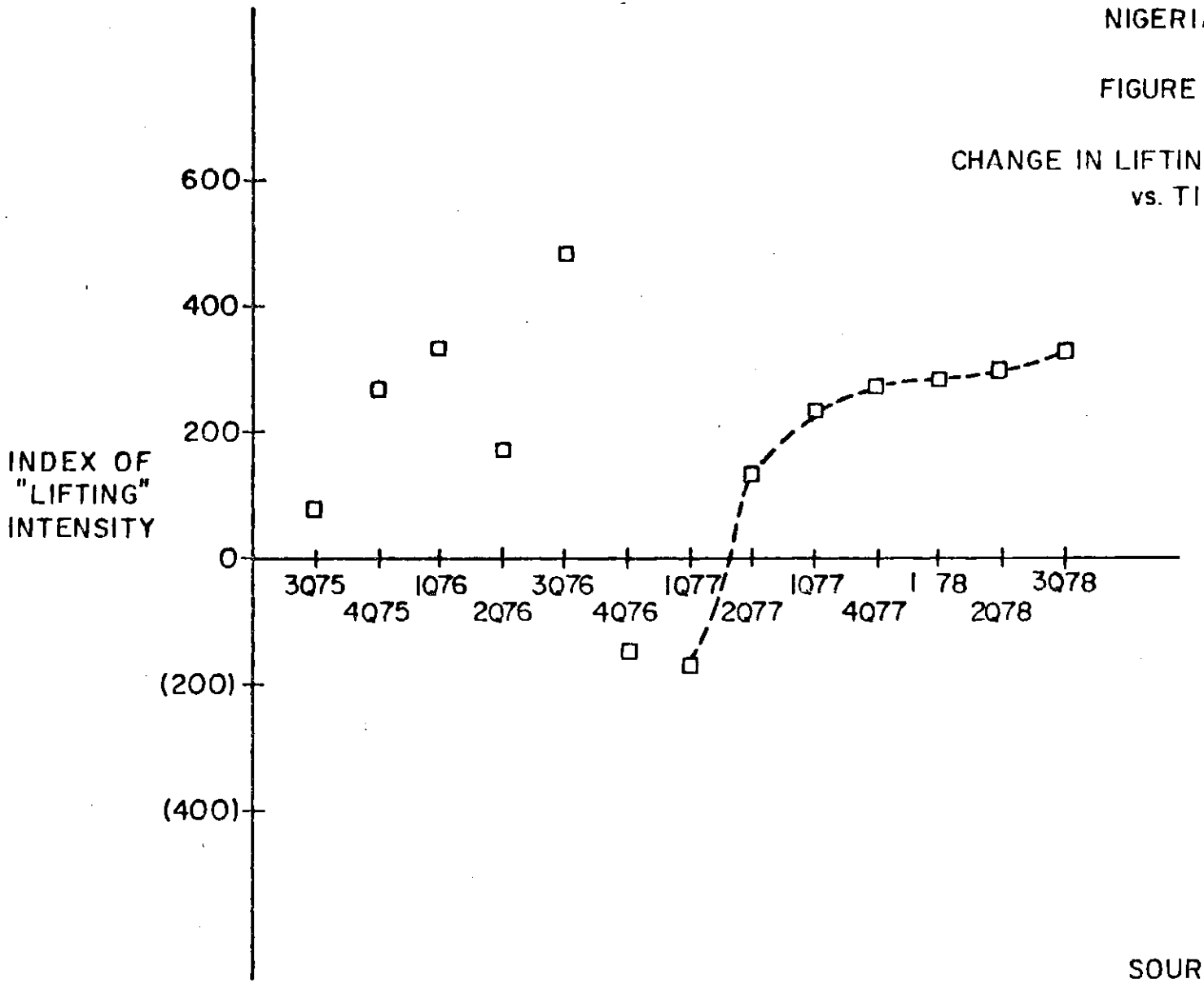


SOURCE: TABLE 3.10

NIGERIA

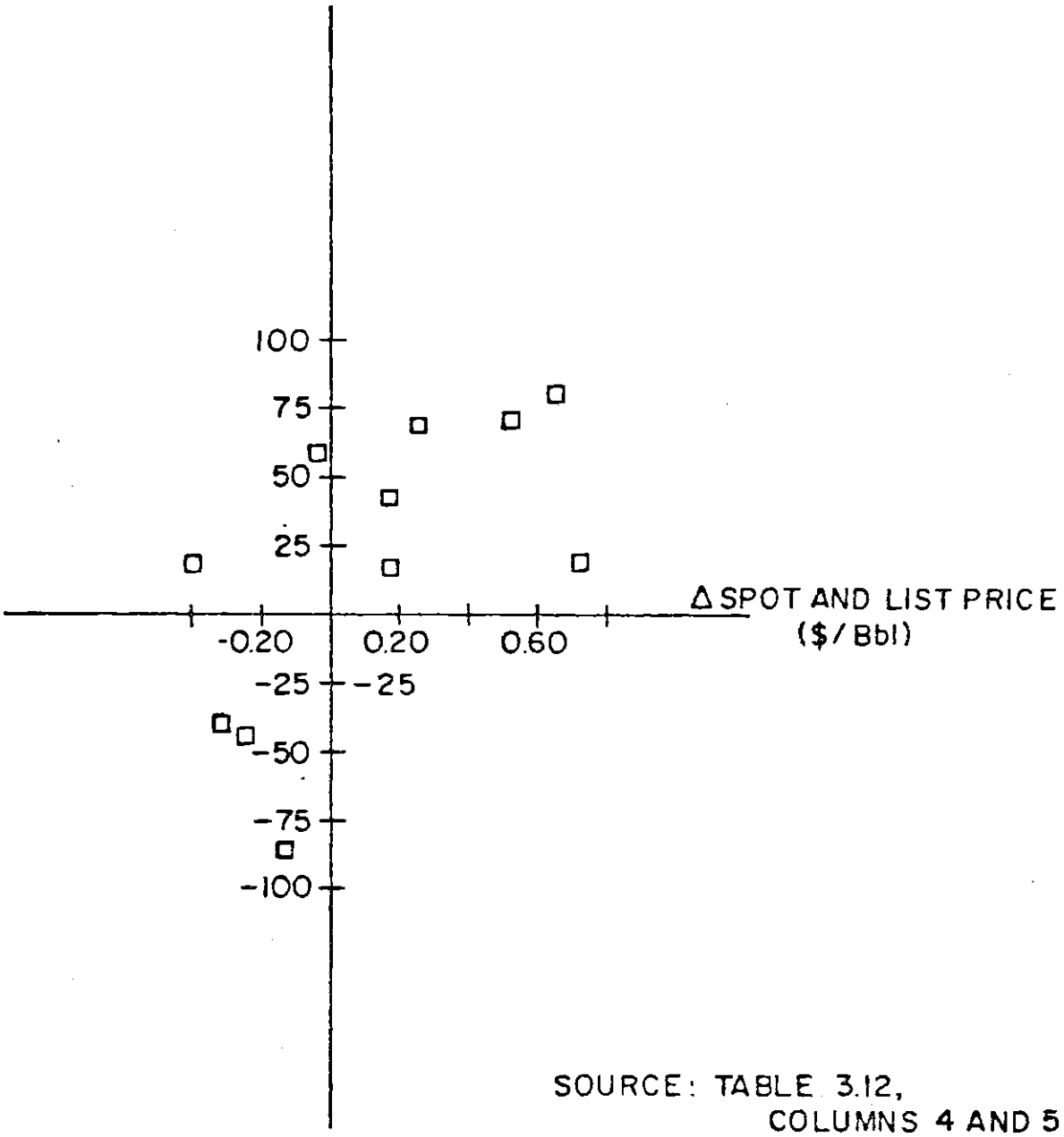
FIGURE 3.6

CHANGE IN LIFTINGS/INCENTIVES
vs. TIME



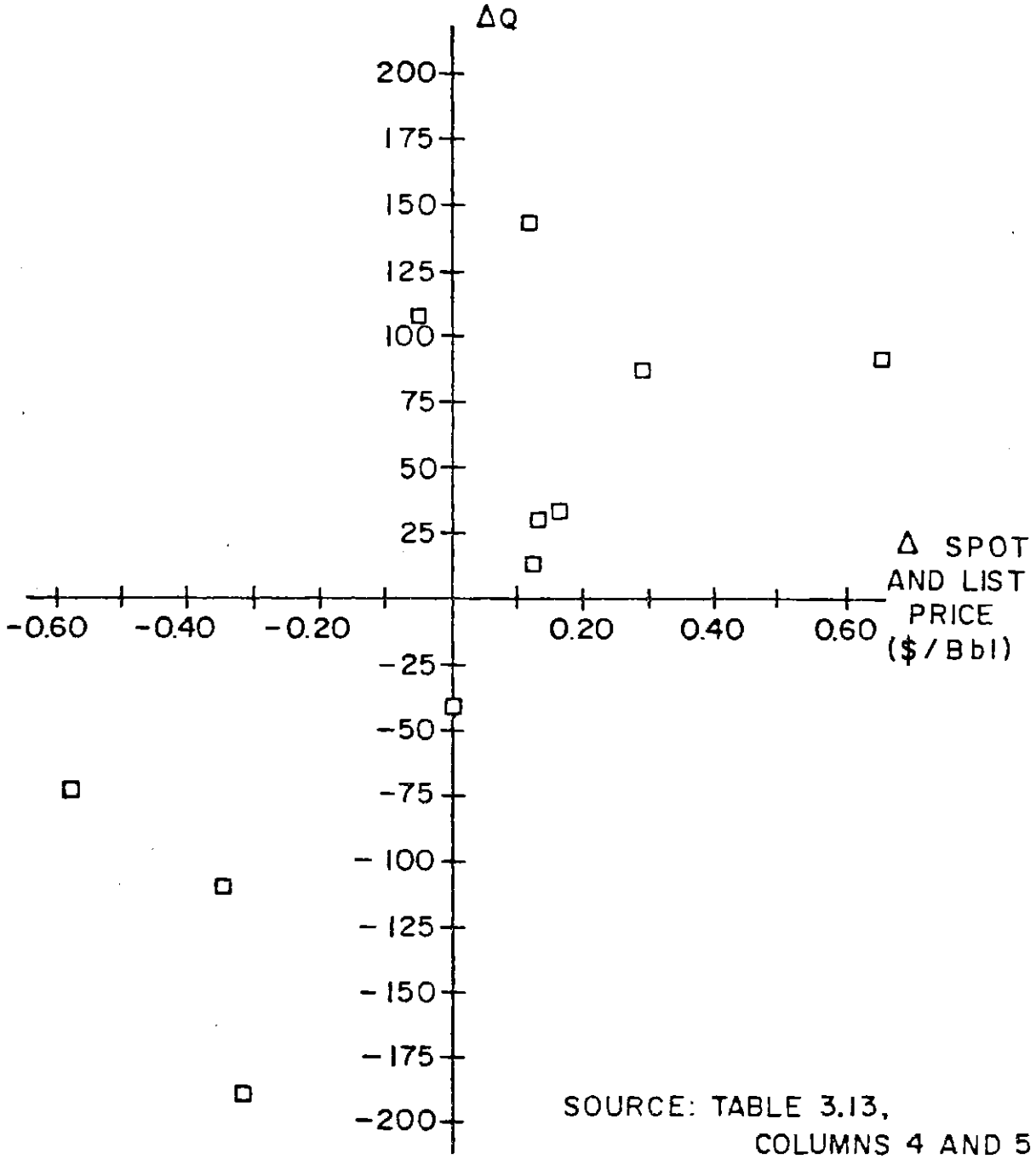
SOURCE: TABLE 3.11

LINOCO OUTPUT CHANGES (ΔQ)
vs. SPOT PRICE DIFFERENTIAL



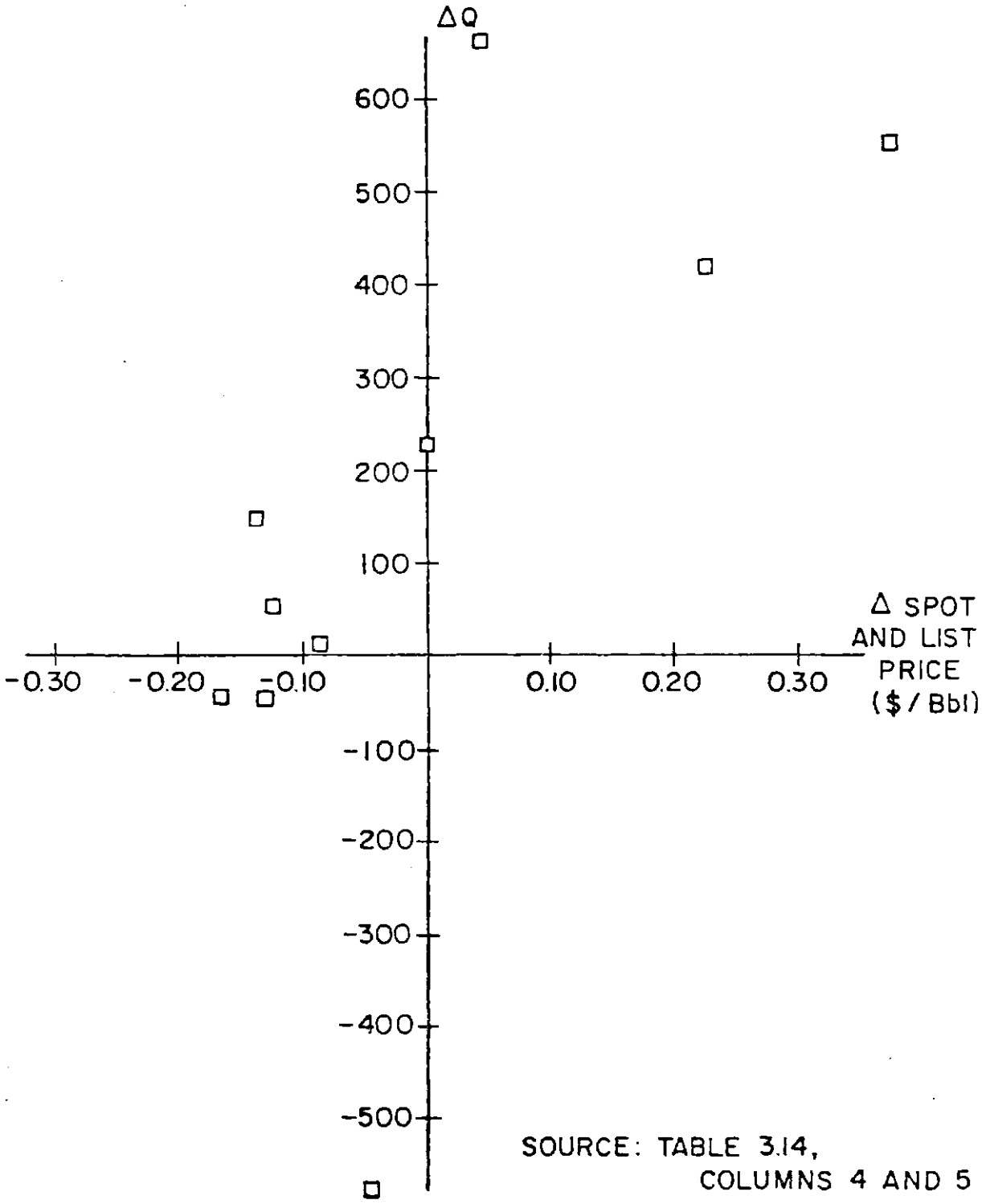
SOURCE: TABLE 3.12,
COLUMNS 4 AND 5

NNOC OUTPUT CHANGES (ΔQ)
vs. SPOT PRICE DIFFERENTIAL



SOURCE: TABLE 3.13, COLUMNS 4 AND 5

OUTPUT CHANGES (ΔQ)
vs. SPOT PRICE DIFFERENTIAL



SOURCE: TABLE 3.14, COLUMNS 4 AND 5

TABLE 2.1

NET CRUDE SOLD OUTSIDE

CHANNELS OF MAJORS (TBD)

	1973	1974	1975	1976	1977
Selected Middle East					
Abu Dhabi	198	450	457	700	826
Iran	982	1111	1272	1711	2326
Kuwait	0	124	608	949	946
Qatar	15	97	217	207	240
Saudi	166	501	604	592	946
Dubai	75	82	87	108	110
Oman	17	18	16	23	25
Iraq	1205	1031	1541	1856	1771
Total Middle East	3280	4098	5516	6830	7748
Selected Africa					
Libya	786	588	694	1013	1125
Nigeria	166	243	464	787	757
Gabon	160	200	201	212	223
Algeria	958	908	838	877	934
Total Africa	2449	2326	2653	3347	3628
Total World (Excl. NA & Communist Bloc)	8544	9532	11,612	14,415	16,474

NOTE: Derived From Tables 2.2(A-E)

Net Crude = Total Country -Majors' Production in Country

Source: Annual Reports, BP Statistical Review

TABLE 2.2(A)

1973 CRUDE PRODUCTION (TBD)

	Exxon	Mobil	Socal	Texaco	Gulf	Royal Dutch	BP	CFP	Occidental	Continental	Marathon	ARCO	SOHIO	Total Country
U.S.	983	380	446	762	440	718	-	-	10	219	175	391	29	
Canada	275	126	105	154	113	94	-	7	2	50	9	42	-	
Latin America	1395	120	56	282	253	948	-	-	-	4	-	92	-	
Europe	51	-	-	-	-	27	-	39	-	1	-	-	-	
Middle East	2624	1444	2452	2519	1693	1821	3980	1187	-	88	-	-	22	
Africa	132	268	87	100	509	804	620	139	376	255	257	19	-	
Other East	219	85	495	491	4	336	180	-	-	-	-	112	-	
	5679	2423	3641	4335	3012	4760	4780	1334	388	616	441	656	51	
Middle East														
Abu Dhabi	71	99	-	-	-	189	400	348	-	-	-	-	-	1305
Iran	356	427	345	343	307	823	1980	288	-	22	-	-	22	5895
Kuwait	-	64	-	-	1386	-	1320	-	-	-	-	-	-	2770
Qatar	29	36	-	-	-	376	60	54	-	-	-	-	-	570
Saudi	2168	818	2073	2120	-	-	-	-	-	-	-	-	-	7345
Bahrain	-	-	34	34	-	-	-	-	-	-	-	-	-	68
Dubai	-	-	-	22	-	-	-	57	-	66	-	-	-	220
Oman	-	-	-	-	-	249	-	29	-	-	-	-	-	295
Neutral Zone	-	-	-	-	-	-	-	-	-	-	-	-	-	535
Iraq	-	-	-	-	-	184	220	411	-	-	-	-	-	2020
Africa														
Libya	132	46	83	96	-	130	-	-	376	255	257	19	-	2180
Nigeria	-	222	4	4	365	674	620	-	-	-	-	-	-	2055
Angola	-	-	-	-	144	-	-	-	-	-	-	-	-	161
Gabon	-	-	-	-	-	-	-	-	-	-	-	-	-	160
Zaire	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Algeria	-	-	-	-	-	-	-	137	-	-	-	-	-	1095
Tunisia	-	-	-	-	-	-	-	2	-	-	-	-	-	82

Source: Annual Reports

TABLE 2.2(B)

1974 CRUDE PRODUCTION (TBD)

	Exxon	Mobil	Socal	Texaco	Gulf	Royal Dutch	BP	CFP	Occidental	Continental	Marathon	ARCO	SOHIO	Total Country
U.S.	925	363	413	705	401	654	-	-	8	218	174	383	30	
Canada	224	86	87	126	89	92	-	6	2	47	7	28	-	
Latin America	1243	88	54	235	227	807	-	-	-	2	-	62	-	
Europe	47	-	-	25	-	51	-	1	-	-	-	-	-	
Middle East	2753	1475	2685	2755	1345	1684	3660	1308	-	95	-	-	22	
Africa	89	280	4	4	520	832	660	134	331	189	196	-	-	
Other East	212	65	466	457	3	290	120	-	-	-	-	122	-	
	5493	2357	3709	4307	2585	4410	4440	1449	341	551	377	595	52	
Middle East														
Abu Dhabi	44	96	-	-	-	145	340	335	-	-	-	-	-	1410
Iran	344	448	341	343	293	830	2000	306	-	22	-	-	22	6060
Kuwait	-	59	-	-	1052	-	1040	-	-	-	-	-	-	2275
Qatar	21	32	-	-	-	286	40	44	-	-	-	-	-	520
Saudi	2344	840	2310	2355	-	-	-	-	-	-	-	-	-	8350
Bahrain	-	-	34	33	-	-	-	-	-	-	-	-	-	65
Dubai	-	-	-	24	-	-	-	61	-	73	-	-	-	240
Oman	-	-	-	-	-	247	-	25	-	-	-	-	-	290
Neutral Zone	-	-	-	-	-	-	-	-	-	-	-	-	-	540
Iraq	-	-	-	-	-	176	240	528	-	-	-	-	-	1975
Africa														
Libya	89	33	3	3	-	93	-	-	331	189	196	-	-	1525
Nigeria	-	247	1	1	369	739	660	-	-	-	-	-	-	2260
Angola	-	-	-	-	151	-	-	-	-	-	-	-	-	173
Gabon	-	-	-	-	-	-	-	-	-	-	-	-	-	200
Zaire	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Algeria	-	-	-	-	-	-	-	132	-	-	-	-	-	1040
Tonisia	-	-	-	-	-	-	-	2	-	-	-	-	-	86

Source: Annual Reports

TABLE 2.2(C)

1975 CRUDE PRODUCTION (TBD)

	Exxon	Mobil	Socal	Texaco	Gulf	Royal Dutch	BP	CFP	Occidental	Continental	Marathon	ARCO	Sohio	Total Country
U.S.	879	342	383	665	361	619	-	-	7	206	175	370	28	
Canada	174	72	76	96	80	82	-	6	2	41	5	23	-	
Latin America	947	79	42	193	196	633	-	-	2	2	-	55	-	
Europe	46	-	-	25	-	49	-	7	-	-	-	-	-	
Middle East	2089	1408	1999	2217	993	1479	2740	1101	-	96	-	-	22	
Africa	87	204	2	6	320	553	480	143	261	165	171	-	-	
Other East	227	39	425	398	3	129	220	5	-	-	-	145	-	
	4449	2144	2927	3600	1953	3544	3440	1262	272	510	351	593	50	
Middle East														
Abu Dhabi	43	96	-	-	-	142	320	342	-	-	-	-	-	1400
Iran	260	287	259	275	332	725	1700	234	-	19	-	-	22	5385
Kuwait	-	11	-	-	661	-	560	-	-	-	-	-	-	1840
Qatar	11	19	-	-	-	146	20	22	-	-	-	-	-	435
Saudi	1775	995	1710	1886	-	-	-	-	-	-	-	-	-	6970
Bahrain	-	-	30	31	-	-	-	-	-	-	-	-	-	61
Dubai	-	-	-	25	-	-	-	66	-	77	-	-	-	255
Oman	-	-	-	-	-	291	-	33	-	-	-	-	-	340
Neutral Zone	-	-	-	-	-	-	-	-	-	-	-	-	-	500
Iraq	-	-	-	-	-	175	140	404	-	-	-	-	-	2260
Africa														
Libya	87	29	-	-	-	73	-	-	261	165	171	-	-	1480
Nigeria	-	175	2	2	182	480	480	-	-	-	-	-	-	1785
Angola	-	-	-	4	134	-	-	-	-	-	-	-	-	158
Gabon	-	-	-	-	4	-	-	-	-	-	-	-	-	205
Zaire	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Algeria	-	-	-	-	-	-	-	142	-	-	-	-	-	980
Tonisia	-	-	-	-	-		-	1	-	-	-	-	-	95

Source: Annual Reports

TABLE 2.2(D)

1976 CRUDE PRODUCTION (TBD)

	Exxon	Mobil	Socal	Texaco	Gulf	Royal Dutch	BP	CFP	Occidental	Continental	Marathon	ARCO	Sohio	Total Country
U.S.	842	323	370	611	338	606	-	-	7	197	179	363	25	
Canada	154	68	63	86	71	74	-	9	2	37	6	11	-	
Latin America	1013	-	11	156	165	256	-	1	4	-	-	1	-	
Europe	57	-	-	25	-	76	180	10	-	-	-	-	-	
Middle East	2631	1397	2580	2582	831	1601	2520	972	-	109	-	106	16	
Africa	106	192	8	12	325	541	420	199	260	218	212	-	-	
Other East	233	74	429	396	-	192	420	28	-	-	-	30	-	
	5036	2054	3461	3868	1730	3346	3540	1219	273	561	397	511	41	
Middle East														
Abu Dhabi	49	85	-	-	-	166	280	315	-	-	-	-	-	1595
Iran	264	271	240	232	311	749	1760	245	-	15	-	106	16	5920
Kuwait	-	-	-	-	521	-	480	-	-	-	-	-	-	1950
Qatar	6	22	-	-	-	208	-	42	-	-	-	-	-	485
Saudi	2312	1019	2312	2290	-	-	-	-	-	-	-	-	-	8525
Bahrain	-	-	28	29	-	-	-	-	-	-	-	-	-	58
Dubai	-	-	-	31	-	-	-	82	-	94	-	-	-	315
Oman	-	-	-	-	-	312	-	30	-	-	-	-	-	365
Neutral Zone	-	-	-	-	-	-	-	-	-	-	-	-	-	465
Iraq	-	-	-	-	-	166	-	258	-	-	-	-	-	2280
Africa														
Libya	106	28	-	-	-	104	-	-	260	218	201	-	-	1930
Nigeria	-	164	8	8	230	437	420	-	-	-	11	-	-	2065
Angola	-	-	-	4	78	-	-	-	-	-	-	-	-	101
Gabon	-	-	-	-	3	-	-	-	-	-	-	-	-	215
Zaire	-	-	-	-	12	-	-	-	-	-	-	-	-	25
Algeria	-	-	-	-	-	-	-	198	-	-	-	-	-	1075
Tunisia	-	-	-	-	-	-	-	1	-	-	-	-	-	76

Source: Annual Reports

TABLE 2.2(E)

1977 CRUDE PRODUCTION (TBD)

	Exxon	Mobil	Socal	Texaco	Gulf	Royal Dutch.	BP	CFP	Occidental	Continental	Marathon	ARCO	SOHIO	Total Country
U.S.	823	314	362	564	336	572	-	-	8	187	181	408	167	
Canada	148	68	64	83	66	70	-	10	1	46	6	-	-	
Latin America	841	-	10	154	96	210	-	-	5	-	-	1	-	
Europe	80	-	-	25	-	129	410	9	59	-	-	1	-	
Middle East	2529	1621	2447	2528	744	1584	2060	831	-	123	-	119	16	
Africa	104	198	12	22	366	601	440	217	303	194	205	-	-	
Other East	239	77	428	422	2	125	480	68	-	1	-	35	-	
	4764	2278	3323	3792	1611	3291	3390	1135	376	551	392	564	183	
Middle East														
Abu Dhabi	46	71	-	-	-	174	260	288	-	-	-	-	-	
Iran	233	222	165	194	305	596	1320	182	-	27	-	119	16	
Kuwait	-	-	-	-	439	-	400	-	-	-	-	-	-	
Qatar	-	16	-	-	-	150	-	29	-	-	-	-	-	
Saudi	2250	1312	2254	2273	-	200	-	-	-	-	-	-	-	
Bahrain	-	-	28	29	-	-	-	-	-	-	-	-	-	
Dubai	-	-	-	32	-	-	-	82	-	96	-	-	-	
Oman	-	-	-	-	-	289	-	26	-	-	-	-	-	
Neutral Zone	-	-	-	-	-	-	-	-	-	-	-	-	-	
Iraq	-	-	-	-	-	175	80	224	-	-	-	-	-	
Africa														
Libya	104	30	-	-	-	125	-	-	303	194	194	-	-	
Nigeria	-	168	12	12	230	476	440	-	-	-	11	-	-	
Angola	-	-	-	10	123	-	-	-	-	-	-	-	-	
Gabon	-	-	-	-	3	-	-	-	-	-	-	-	-	
Zaire	-	-	-	-	11	-	-	-	-	-	-	-	-	
Algeria	-	-	-	-	-	-	-	216	-	-	-	-	-	
Tonisia	-	-	-	-	-	-	-	1	-	-	-	-	-	

Source: Annual Reports

TABLE 2.3

MAJORS' PRODUCT SALES (TBD)

	1973	1974	1975	1976	1977
Exxon	6178	5505	4990	5353	5266
Mobil	2451	2227	2211	2264	2299
Socal	2259	2184	2116	2339	2455
Texaco	3472	3446	3241	3277	3227
Gulf	1791	1673	1610	1609	1669
Royal Dutch	5809	5042	4610	4642	4676
BP	2200	1920	1760	1920	1933
CFP	1172	1174	1132	1187	1184
Occidental	160	93	48	42	0
Continental	654	611	594	592	601
Marathon	261	280	307	368	488
ARCO	896	802	761	811	829
Sohio	385	333	351	403	407

Source: Annual Reports

TABLE 2.4

NET CRUDE SALES OF MAJORS (TBD)

(CRUDE - PRODUCT SALES)

	1973	1974	1975	1976	1977
Exxon	(499)	(12)	(541)	(317)	(502)
Mobil	(28)	130	(67)	(210)	(21)
Socal	1382	1525	811	1122	868
Texaco	863	861	359	591	565
Gulf	1221	912	343	121	(58)
Royal Dutch	(1049)	(632)	(1066)	(1296)	(1385)
BP	2580	2520	1680	1620	1457
CFP	162	275	130	32	(49)
Occidental	228	248	224	231	376
Continental	(38)	(60)	(84)	(31)	(50)
Marathon	180	97	44	29	(96)
ARCO	(240)	(207)	(168)	(300)	(265)
Sohio	(334)	(281)	(301)	(362)	(224)
NET	4428	5376	1364	1239	616

Source: Annual Reports
Tables 2.2(A-E), 2.3

TABLE 2.5

EUROPEAN YIELD

STRUCTURE & ASSOCIATED REVENUES

Product	Yield(%)	$/Bbl 1Q77	1Q77
Mogas	20	16.79	3.36
DP KERO	10	16.31	1.63
ADO	25	15.97	3.99
HFO-LS	20	13.73	2.75
HFO-HS	25	11.91	2.98

Source: Petroleum Intelligence Weekly

TABLE 2.6

MAJORS' INCENTIVES

VIS-A-VIS INDEPENDENTS ($/Bbl)

	Saudi Light	UAE Murban	Libya Zuetina	Indonesia Minas	Nigeria Bonny	Iran Light
6/75	0.22	0.32	0.20	0.15	0.47	0.22
10/75	0.25	0.29	0.27	0.15	0.50	0.22
1/76	0.25	0.29	0.27	0.15	0.36	0.22
4/76	0.25	0.24	0.27	1.25	0.30	0.22
7/76	0.25	0.24	0.32	1.25	0.32	0.22
10/76	0.20	0.24	0.27	1.25	0.42	0.22
1/77	0.20	0.42	0.31	1.30	0.44	0.22
7/77	0.20	0.44	0.23	1.30	0.51	0.15
1/78	0.20	0.53	0.30	1.30	0.60	0.15
7/78	0.20	0.53	0.40	1.30	0.39	0.15
12/78	0.20	0.55	0.40	1.30	0.48	-

Source: Petroluem Intelligence Weekly

TABLE 3.1

"VALUES" OF CRUDES

($/Bbl)

	4Q78	3Q78	2Q78	1Q78	4Q77	3Q77	2Q77	1Q77	4Q76	3Q76	2Q76	1Q76	4Q75	3Q75	2Q75	1Q75
Arab Light	12.70	12.70	12.70	12.70	12.70	12.70	12.09	12.09	11.51	11.51	11.51	11.51	11.51	10.46	10.46	10.46
Arab Heavy	10.78	11.33	11.44	11.67	-	-	-	-	-	-	-	-	-	-	-	-
Iran Light	12.63	12.65	12.71	12.66	12.63	12.69	12.10	12.09	11.49	11.43	11.44	11.45	11.19	10.04	10.35	10.48
Iran Heavy	12.07	12.24	12.34	12.38	12.39	12.39	11.77	11.85	11.25	11.10	11.05	11.14	-	-	-	-
Kuwait	11.56	11.97	12.02	12.13	12.19	12.12	11.42	11.50	11.01	10.95	10.91	11.00	10.76	9.80	10.11	10.36
Iraq Basrah	12.40	12.49	12.50	12.55	12.56	12.53	11.90	11.91	11.32	11.35	11.33	11.36	-	-	-	-
Iraq Kirkuk	12.85	12.84	12.71	12.71	12.71	12.71	12.12	12.06	11.56	11.66	11.70	11.65	-	-	-	-
UAE Murban	13.54	13.29	13.22	13.09	13.03	13.21	12.76	12.49	11.91	11.94	12.00	11.92	11.79	10.65	10.69	10.60
Nigerian Light	15.11	14.17	14.02	13.77	13.70	13.83	13.49	13.33	12.69	12.83	12.84	12.64	12.69	11.45	11.30	11.39
Algerian Saharan	14.73	14.12	13.68	13.50	13.43	13.53	13.22	13.06	12.51	12.78	12.88	12.64	12.81	11.41	11.30	11.61
Libya Zuetina	14.53	13.98	13.75	13.46	13.41	13.59	13.24	13.08	12.41	12.72	12.70	12.52	12.85	11.70	11.18	10.95
N. Sea Ekofish	14.19	13.56	13.54	13.43	13.43	13.48	13.07	13.21	12.39	12.29	12.13	12.09	-	-	-	-
Venezuela:																
Tia Juana-24	11.29	11.73	11.85	12.00	12.37	12.34	11.51	11.81	11.27	11.09	10.91	10.79	11.23	-	-	-
Tia Juana-31	12.98	12.78	12.84	12.83	12.95	12.97	12.31	12.56	11.88	11.78	11.68	11.56	10.53	-	-	-
Oficina-34	14.05	13.45	13.37	13.30	13.30	13.27	12.77	12.93	12.25	12.43	12.61	12.61	11.83	-	-	-
Indonesia Minas	13.60	13.18	13.10	13.23	13.22	13.19	12.47	12.59	11.89	12.12	12.28	12.41	-	-	-	-

Source: Petroleum Intelligence Weekly

TABLE 3.2

OFFICIAL SALE PRICES OF CRUDES

$/Bbl

	4Q78	3Q78	2Q78	1Q78	4Q77	3Q77	2Q77	1Q77	4Q76	3Q76	2Q76	1Q76	4Q75	3Q75	2Q75	1Q75
Arab Light	12.70	12.70	12.70	12.70	12.70	12.70	12.09	12.09	11.51	11.51	11.51	11.51	11.51	10.46	10.46	10.46
Iran Light	12.81	12.81	12.81	12.81	12.81	12.81	12.81	12.81	11.62	11.62	11.62	11.62	11.62	10.67	10.67	10.67
Kuwait	12.22	12.22	12.22	12.22	12.27	12.37	12.37	12.37	11.23	11.23	11.30	11.30	11.40	10.36	10.36	10.36
UAE Murban	13.26	13.26	13.26	13.26	13.26	13.26	12.50	12.50	11.92	11.92	11.92	11.92	11.92	10.87	10.87	10.87
Nigerian Light	13.97	13.87	13.95	14.33	14.63	14.63	14.33	14.33	13.27	13.10	12.89	12.84	12.80	11.43	11.43	11.43
Algerian Saharan	14.10	14.10	14.10	14.25	14.45	14.45	14.30	14.30	13.10	13.07	13.00	12.85	12.75	11.75	11.75	11.75
Libya Zubtina	13.90	13.90	13.90	14.05	14.25	14.25	14.00	14.00	12.62	12.62	12.32	12.32	12.32	11.20	11.20	11.20
N. Sea Ekofish	14.20	13.82	13.70	13.75	14.30	14.30	-	-	-	-	-	-	-	-	-	-
Iraq Basrah	12.66	12.60	12.60	12.60	12.60	12.60	12.65	12.65	11.46	11.45	11.45	11.45	11.53	10.48	10.48	10.48
Iraq Kirkuk	12.88	12.82	12.82	12.85	13.85	12.85	12.89	12.89	11.70	11.67	11.60	11.59	11.74	10.67	10.67	10.67
Ven. Tia Juana	12.72	12.72	12.72	12.82	12.72	12.72	12.72	12.72	11.65	12.30	12.30	12.30	12.06	11.05	11.05	11.05
Indonesia Minas	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	12.80	12.80	12.80	12.80	12.80	12.60	12.60	12.60

Source: Petroleum Intelligence Weekly

TABLE 3.3

INCENTIVES VIS-A-VIS ARAB LIGHT

($/Bbl)	4Q78	3Q78	2Q78	1Q78	4Q77	3Q77	2Q77	1Q77	4Q76	3Q76	2Q76	1Q76	4Q75	3Q75	2Q75	1Q75
Iran Light	(0.18)	(0.16)	(0.10)	(0.15)	(0.18)	(0.12)	(0.71)	(0.72)	(0.13)	(0.19)	(0.18)	(0.17)	(0.43)	(0.63)	(0.32)	(0.19)
Kuwait	(0.66)	(0.25)	(0.10)	(0.09)	(0.08)	(0.15)	(0.95)	(0.87)	(0.22)	(0.28)	(0.39)	(0.30)	(0.64)	(0.56)	(0.25)	0.00
UAE Murban	0.28	(0.03)	(0.04)	(0.17)	(0.23)	(0.05)	0.26	(0.01)	(0.01)	0.02	0.08	0.00	(0.13)	(0.22)	(0.18)	(0.27)
Nigerian Light	1.14	(0.30)	0.07	(0.56)	(0.93)	(0.80)	(0.84)	(1.00)	(0.58)	(0.77)	(0.05)	(0.20)	(0.01)	0.02	(0.15)	(0.04)
Algerian Saharan	0.63	0.02	(0.42)	(0.75)	(1.02)	(0.92)	(1.08)	(1.24)	(0.59)	(0.27)	(0.07)	(0.21)	0.06	(0.34)	(0.45)	(0.14)
Libya Zuetina	0.63	(0.08)	(0.15)	(0.59)	(0.84)	(0.66)	(0.76)	(0.92)	(0.21)	0.10	0.38	0.20	0.53	0.50	(0.22)	(0.25)
N. Sea Ekofisk	(0.01)	(0.26)	(0.16)	(0.32)	(0.87)	(0.82)	-	-	-	-	-	-	-	-	-	-
Iraq Basrah	(0.26)	(0.11)	(0.10)	(0.05)	(0.04)	(0.07)	(0.75)	(0.74)	(0.14)	(0.10)	(0.12)	(0.09)	-	-	-	-
Iraq Kirkuk	(0.03)	0.02	(0.11)	(0.14)	(0.14)	(0.14)	(0.77)	(0.83)	(0.14)	(0.01)	0.10	0.06	-	-	-	-
Ven. Tia Juana	(0.56)	(0.76)	(0.70)	(0.71)	(0.59)	(0157)	(1.23)	(0.98)	(0.47)	(0.52)	(0.62)	(0.74)	-	-	-	-
Indonesia Minas	0.05	(0.37)	(0.45)	(0.32)	(0.33)	(0.36)	(1.08)	(0.96)	(0.91)	(0.68)	(0.52)	(0.39)	-	-	-	-

Source: Petroleum Intelligence Weekly
Table 3.1 and 3.2

TABLE 3.4

CALCULATION OF THE "TRADE-WEIGHTED" INCENTIVE

$/Bbl for 1Q78

	ColA	ColB	ColC		ColD
Country/Crude	Incentive[1]	Volumes of Crude(TBD)[2]	Pct of Column B	A*C	Relative Incentive (A+0.321)
Iran Light	(0.15)	5197	23.5	(0.0353)	0.17
Kuwait	(0.09)	2096	9.5	(0.0086)	0.23
U.A.E. Murban	(0.17)	1832	8.3	(0.0141)	0.15
Nigerian Light	(0.56)	1911	8.7	(0.0487)	(0.24)
Algerian Saharan	(0.75)	1225	5.5	(0.0413)	(0.43)
Libya Zuetina	(0.59)	1990	9.0	(0.0531)	(0.27)
N. Sea Ekofisk	(0.32)	1410	6.4	(0.0205)	0.00
Iraq Basrah	(0.05)	2629	11.9	(0.0060)	0.27
Ven. Tia Juana	(0.71)	2163	9.8	(0.0696)	(0.39)
Indonesia Minas	(0.32)	1635	7.4	(0.0237)	0.00
		22,088	100.0	(0.321) [Trade-Weighted Incentive]	

[1] From Table 3.3

[2] Volume Produced by Country (1978) from Petroleum Intelligence Weekly

TABLE 3.5

RELATIVE INCENTIVES

($/Bbl)	4Q78	3Q78	2Q78	1Q78	4Q77	3Q77	2Q77	1Q77	4Q76	3Q76	2Q76	1Q76	4Q75	3Q75	2Q75	1Q75
Trade-Weighted*	0.02	(0.15)	(0.21)	(0.32)	(0.42)	(0.37)	(0.75)	(0.78)	(0.30)	(0.23)	(0.18)	(0.21)	(0.34)	(0.33)	(0.25)	(0.16)
Iran Light	(0.20)	(0.01)	0.11	0.17	0.24	0.25	0.04	0.06	0.17	0.04	0.00	0.04	(0.09)	(0.30)	(0.07)	(0.03)
Kuwait	(0.68)	(0.10)	0.01	0.23	0.34	0.22	(0.20)	(0.09)	0.08	(0.05)	(0.21)	(0.09)	(0.30)	(0.23)	0.00	0.16
UAE Murban	0.26	0.18	0.17	0.15	0.19	0.32	1.01	0.77	0.29	0.25	0.26	0.21	0.47	0.11	0.07	(0.11)
Nigerian Light	1.12	0.45	0.28	(0.24)	(0.51)	(0.43)	(0.09)	(0.22)	(0.28)	(0.04)	0.13	0.01	0.33	0.35	0.10	0.12
Algerian Saharan	0.61	0.17	(0.21)	(0.43)	(0.60)	(0.55)	(0.33)	(0.46)	(0.29)	(0.04)	0.11	0.00	0.40	(0.01)	(0.20)	0.02
Libya Zuetina	0.61	0.23	0.06	(0.27)	(0.42)	(0.29)	(0.01)	(.14)	0.09	0.33	0.56	0.41	0.87	0.83	0.03	(0.09)
N. Sea Ekokisk	(0.03)	(0.11)	0.05	0.00	(0.45)	(0.45)	-	-	-	-	-	-	-	-	-	-
Iraq Kirkuk	(0.05)	0.17	0.10	0.19	0.28	0.23	(0.02)	(0.05)	0.16	0.22	0.28	0.27	-	-	-	-
Ven. Tia Juana	(0.58)	(0.61)	(0.49)	(0.39)	(0.17)	(0.20)	(0.48)	(0.20)	(0.17)	(0.29)	(0.44)	(0.53)	-	-	-	-
Indonesia Minas	0.03	(0.22)	(0.24)	0.00	0.09	0.01	(0.33)	(0.18)	(0.61)	(0.45)	(0.16)	(0.18)	-	-	-	-

*For Explanation, See Table 3.4

Source: Petroleum Intelligence Weekly
Table 3.3

TABLE 3.6

CHANGE IN OFFTAKE VS. RELATIVE INCENTIVE

IRAQ

	(Col.1) Total Production (Q)	(Col.2) Moving Average (MA): $\frac{Q_{t-1}+Q_t+Q_{t+1}}{3}$	(Col.3) Change in Moving Average (ΔQ): $MA_t - MA_{t-1}$	(Col.4) Relative[1] Incentive (RI)	(Col.5) Moving Average (Rel. Inc.) $\frac{RI_t + RI_{t-1}}{2}$
4Q75	2231	-	-	-	-
1Q76	2000	1948	-	0.27	-
2Q76	1613	1965	17	0.28	0.28
3Q76	2283	2243	278	0.22	0.25
4Q76	2833	2455	212	0.16	0.19
1Q77	2250	2450	(5)	(0.05)	0.11
2Q77	2267	2250	(200)	(0.02)	(0.04)
3Q77	2233	2300	50	0.23	0.11
4Q77	2400	2333	33	0.28	0.26
1Q78	2367	2400	67	0.19	0.23
2Q78	2433	2483	83	0.10	0.15
3Q78	2650	2717	234	0.17	0.14
4Q78	3067	-	-	0.00	0.09

[1] From Table 3.5

Source: Petroleum Intelligence Weekly

TABLE 3.7

CHANGE IN OFFTAKE VS. RELATIVE INCENTIVE

LIBYA

	(Col1)	(Col2)	(Col3)	(Col4)	(Col5)
	Total[1] Production(Q)	Moving Average (MA): $\frac{Q_{t-1}+Q_t+Q_{t+1}}{3}$	Change in Moving Average (ΔQ) $MA_t - MA_{t-1}$	Relative[2] Incentive (RI)	Moving Average (Rel. Inc.) $\frac{RI_t + RI_{t-1}}{2}$
1Q75	584	-	-	(0.09)	-
2Q75	786	880	-	0.23	0.07
3Q75	1269	1072	192	0.83	0.53
4Q75	1161	1200	128	0.87	0.85
1Q76	1170	1212	12	0.41	0.64
2Q76	1243	1224	12	0.56	0.49
3Q76	1259	1259	35	0.33	0.45
4Q76	1276	1294	35	0.09	0.21
1Q77	1346	1337	43	(0.14)	(0.03)
2Q77	1390	1365	28	(0.01)	(0.07)
3Q77	1358	1376	11	(0.29)	(0.15)
4Q77	1380	1359	(17)	(0.42)	(0.36)
1Q78	1338	1324	(35)	(0.26)	(0.34)
2Q78	1255	1303	(21)	0.06	(0.10)
3Q78	1315	1321	18	0.23	0.15
4Q78	1393	-	-	0.66	0.45

[1] Linoco Production Only

[2] From Table 3.5

Source: Petroleum Intelligence Weekly

TABLE 3.8

CHANGE IN OFFTAKE VS. RELATIVE INCENTIVE

NIGERIA

	(Col1) Total[1] Production(Q)	(Col2) Moving Average(MA): $\frac{Q_{t-1}+Q_t+Q_{t+1}}{3}$	(Col3) Change in Moving Average (ΔQ) $MA_t - MA_{t-1}$	(Col4) Relative[2] Incentive (RI)	(Col5) Moving Average (Rel. Inc.) $\frac{RI_{t-1}+RI_t}{2}$
1Q75	1007	-	-	0.12	-
2Q75	876	950	-	0.10	0.11
3Q75	968	969	19	0.35	0.23
4Q75	1064	1048	79	0.33	0.34
1Q76	1111	1106	58	0.01	0.17
2Q76	1142	1118	12	0.13	0.07
3Q76	1101	1142	24	(0.04)	0.05
4Q76	1184	1166	24	(0.28)	(0.16)
1Q77	1213	1207	41	(0.22)	(0.25)
2Q77	1224	1184	(23)	(0.09)	(0.16)
3Q77	1115	1127	(57)	(0.43)	(0.26)
4Q77	1043	1006	(121)	(0.51)	(0.47)
1Q78	860	957	(49)	(0.23)	(0.37)
2Q78	967	647	(310)	0.28	0.03
3Q78	1115	1094	447	0.45	0.37
4Q78	1200	-		1.17	0.81

[1] NNOC Production Only

[2] From Table 3.5

Source: Petroleum Intelligence Weekly

TABLE 3.9

INDEX OF "LIFTING INTENSITY"

IRAQ

	(Col.1) ΔQ	(Col.2) $\frac{RI + RI_{-1}}{2}$	(Col3) Lifting Intensity Col(1)/Col(2)
2Q76	17	0.28	60.71
3Q76	278	0.25	1112.00
4Q76	212	0.19	1115.79
1Q77	(5)	0.11	-45.45
2Q77	(200)	(0.04)	5000.00
3Q77	50	0.11	454.55
4Q77	33	0.26	126.92
1Q78	67	0.23	291.3
2Q78	83	0.15	553.33
3Q78	234	0.14	1671.43
4Q78	255	0.09	2837.04

Source: Table 3.6, Columns 3 and 5

TABLE 3.10

INDEX OF "LIFTING INTENSITY"

LIBYA

	(Col1)	(Col2)	(Col3)
	ΔQ	$\frac{RI + RI_{-1}}{2}$	Lifting Intensity Col(1)/Col(2)
3Q75	192	0.53	362.26
4Q75	128	0.85	150.59
1Q76	12	0.64	18.75
2Q76	12	0.49	24.49
3Q76	35	0.45	77.78
4Q76	35	0.21	166.67
1Q77	43	(0.03)	(1433.33)
2Q77	28	(0.07)	(400.00)
3Q77	11	(0.15)	(73.33)
4Q77	(17)	(0.36)	47.22
1Q78	(35)	(0.34)	102.94
2Q78	(21)	(0.10)	210.00
3Q78	18	0.15	120.00

Source: Table 3.7, Columns 3 and 5

TABLE 3.11

INDEX OF "LIFTING INTENSITY"

NIGERIA

	(Col.1)	(Col.2)	(Col.3)
	ΔQ	$\frac{RI + RI_{-1}}{2}$	Lifting Intensity Col(1)/Col(2)
3Q75	19	0.23	82.61
4Q75	79	0.34	232.35
1Q76	58	0.17	341.18
2Q76	12	0.07	171.43
3Q76	24	0.05	480.00
4Q76	24	(0.16)	(150.00)
1Q77	41	(0.25)	(164.00)
2Q77	(23)	(0.16)	143.75
3Q77	(57)	(0.26)	219.23
4Q77	(121)	(0.47)	257.45
1Q78	(102)	(0.37)	275.45
2Q78	9	0.03	300.00
3Q78	113	0.37	305.41

Source: Table 3.8, Columns 3 and 5

TABLE 3.12

OUTPUT CHANGES VS. SPOT PRICE DIFFERENTIAL

LIBYA

	(Col.1)	(Col.2)	(Col.3)	(Col.4)	(Col.5)
	Linoco Production(Q)	Spot Price F.O.B.	Official Sale Price F.O.B.	Spot Price Differential Col2 - Col3	Output Changes(ΔQ) $Q_t - Q_{t-1}$
1Q75	584	11.98	11.20	0.78	-
2Q75	786	11.58	11.20	0.38	-
3Q75	1269	-	11.20	-	-
4Q75	1161	-	12.32	-	-
1Q76	1170	-	12.32	-	-
2Q76	1243	12.83	12.32	0.51	73
3Q76	1259	12.80	12.62	0.18	16
4Q76	1276	13.35	12.62	0.73	17
1Q77	1346	14.25	14.00	0.25	70
2Q77	1390	14.17	14.00	0.17	44
3Q77	1358	13.93	14.25	(0.32)	(32)
4Q77	1380	13.85	14.25	(0.40)	22
1Q78	1338	13.80	14.05	(0.25)	(42)
2Q78	1255	13.77	13.90	(0.13)	(83)
3Q78	1315	13.85	13.90	(0.05)	60
4Q78	1393	14.53	13.90	(0.63)	78

Source: Petroleum Intelligence Weekly

TABLE 3.13

OUTPUT CHANGES VS. SPOT PRICE DIFFERENTIAL

NIGERIA

	(Col.1)	(Col.2)	(Col.3)	(Col.4)	(Col.5)
	NNOC Production(Q)	Spot Price F.O.B.	Official Sale Price F.O.B.	Spot Price Differential Col2 - Col3	Output Changes(ΔQ) $Q_t - Q_{t-1}$
1Q75	1007	11.81	11.40	0.41	-
2Q75	876	11.60	11.40	0.20	-
3Q75	968	-	11.40	-	-
4Q75	1064	-	12.60	-	-
1Q76	1111	-	12.84	-	-
2Q76	1142	13.05	12.89	0.16	31
3Q76	1101	13.11	13.10	0.01	(41)
4Q76	1184	13.27	13.27	0.29	83
1Q77	1213	14.45	14.33	0.12	29
2Q77	1224	14.45	14.33	0.12	11
3Q77	1115	14.28	14.63	(0.35)	(109)
4Q77	1043	14.05	14.63	(0.58)	(72)
1Q78	860	14.00	14.33	(0.33)	(183)
2Q78	967	13.89	13.95	(0.06)	107
3Q78	1115	13.98	13.87	0.11	148
4Q78	1200	14.63	13.97	0.66	85

Source: Petroleum Intelligence Weekly

TABLE 3.14

OUTPUT CHANGES VS. SPOT PRICE DIFFERENTIAL

IRAQ

	(Col.1)	(Col.2)	(Col.3)	(Col.4)	(Col.5)
	Production(Q)	Spot Price F.O.B.	Official Sale Price F.O.B.	Spot Price Differential Col2 - Col3	Output Changes(Q) $Q_t - Q_{t-1}$
1Q75	-	-	-	-	-
2Q75	-	-	-	-	-
3Q75	-	-	-	-	-
4Q75	2231	-	11.74	-	-
1Q76	2000	-	11.95	-	-
2Q76	1613	11.65	11.60	0.05	-
3Q76	2283	11.69	11.65	0.04	670
4Q76	2833	12.05	11.70	0.35	550
1Q77	2250	12.85	12.89	(0.04)	(583)
2Q77	2267	12.80	12.89	(0.09)	17
3Q77	2233	12.73	12.85	(0.12)	(34)
4Q77	2400	12.72	12.85	(0.13)	167
1Q78	2367	12.68	12.85	(0.17)	(33)
2Q78	2433	12.70	12.82	(0.12)	66
3Q78	2650	12.81	12.82	(0.01)	217
4Q78	2067	13.10	12.88	0.22	417

Source: Petroleum Intelligence Weekly

TABLE 4.1

OPEC PRODUCTION AND CAPACITY (TBD)

	1973	1974	1975	1976	1977	1978	1978*
Net OPEC Production	31,140	30,645	27,083	30,001	30,948	29,813	29,813
OPEC Capacity	37,000+	37,950	37,540	38,890	39,300	40,095	37,125
OPEC Surplus	5860	7305	10,457	8889	8352	10,282	7312
% of Capacity	(16%)	(19%)	(28%)	(23%)	(21%)	(26%)	(20%)
Member Surplus							
Saudi (TBD, % of Capacity)		1821/18%	3760/35%	3277/28%	2676/23%	3717/31%	3717/31%
Iran		479/ 7%	1204/18%	786/12%	1254/18%	1519/22%	0/ 0%
Kuwait		1253/33%	1207/37%	1260/38%	1476/44%	1253/38%	1253/38%
Iraq		730/28%	336/13%	892/30%	861/28%	1414/35%	332/ 8%
Abu Dhai		506/26%	583/30%	44/22%	387/19%	629/30%	629/30%
Dubai		28/10%	48/16%	23/ 7%	22/ 6%	4/ 1%	4/ 1%
Sharjah		22/49%	6/13%	13/26%	27/49%	32/58%	32/58%
Qatar		131/20%	227/35%	165/25%	218/34%	177/27%	58/ 9%
Venezuela		324/10%	604/20%	316/12%	440/16%	251/10%	251/10%
Nigeria		362/14%	862/33%	652/24%	279/12%	535/22%	216/ 9%
Indonesia		107/ 7%	396/23%	253/14%	116/ 6%	161/ 9%	161/ 9%
Libya		1479/49%	1025/41%	599/24%	438/18%	538/22%	538/22%
Algeria		95/ 9%	91/ 9%	140/13%	88/ 7%	0/ 0%	0/ 0%
Gabon		8/ 4%	11/ 5%	31/12%	24/10%	25/10%	25/10%
Ecuador		78/31%	97/38%	40/18%	46/20%	26/12%	26/12%
Saudi, Kuwait, UAE, Libya	3303/17%	5109/26%	6629/35%	5616/28%	5026/25%	6172/31%	6172/31%
Others	2557/14%	2196/12%	3828/21%	3273/17%	3326/17%	4110/21%	1140/ 7%

*Adjustments Made: Iran (production & Capacity) 4000; Production Revised

+Estimated

Source: Petroleum Intelligence Weekly

TABLE 4.2

PRICE ELASTICITY CALCULATIONS

1. Real price increase of 300% in 1973/74.
2. Consumption drops from 47,845 (1973) to 46,250 (1974) TBD, or a decrease of 3.33%.
3. Assumption: A price increase will cause a long-term demand decrease, 50% of which will occur in the first five years.
4. Since a decrease of 3.33% occurred in the first year, 16.67% will occur in five years, and 33.33% will take place eventually.
5. This implies a price elasticity of:

$$\frac{-33.33\%}{300\%} = -0.11$$

6. The price effect, therefore, will be slightly more than one percent decrease in demand for every ten percent real increase in price.

TABLE 4.3

DEMAND SIMULATION: THREE PRICE ASSUMPTIONS

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
CASE A:												
Real Price Increase of $1/Bbl Per Year												
World Demand (TBD)	49,430	50,983	52,201	53,430	54,578	55,604	56,460	57,133	57,604	57,857	57,873	57,633
Price ($/Bbl)	11.08	10.82	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00
CASE B:												
Steep Real Price Trajectory; "Backstop Technology" at $25/Bbl												
World Demand (TBD)	49,430	50,983	51,896	52,768	53,249	53,452	53,485	53,124	52,607	51,750	50,587	49,132
Price ($/Bbl)	11.08	10.82	13.00	15.00	18.00	21.00	23.00	25.00	25.00	25.00	25.00	25.00
CASE C:												
Constant Real Price												
World Demand	49,430	50,983	52,201	53,691	55,181	56,672	58,158	59,667	61,199	63,315	64,912	66,533
Price ($/Bbl)	11.08	10.82	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00

TABLE 4.4

COMPARISON OF MODEL RESULTS

	1980								1985							
	Case A	Case B	Case C	Oil Companies' Spread	ITC	CRS	CIA	EPRI/ PIRINC	Case A	Case B	Case C	Oil Companies' Spread	ITC	CRS	CIA	EPRI/ PIRINC
World Consumption (Excl. Communist Areas)	53	53	54	52-58	54	57	56	53-56	58	53	61	60-68	65	69	70	57-66
Non-OPEC Free World Supply	21	21	21	20-24	23	21	22	21	22	22	22	25-31	32	25	25	24-25
Communist Bloc Supply	2	2	2	0-1	1	1	0	1	2	2	2	0-1	1	1	(4)	0-1
Net Demand on OPEC	30	29	30	32-38	30	35	34	31-34	34	29	37	34-42	32	43	49	33-41
OPEC Capacity	40	40	40	40-43	43+	44	42	-	39	39	39	34-45	49	48	38	-

TABLE 4.5

RESIDUAL DEMAND ON OPEC (TBD):

DEMAND GROWTH WITH CONSTANT REAL PRICE;

IRAN "UNCONSTRAINED" AT 7200 TBD

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
World Demand (Constant Real Price)	49,430	50,983	52,201	53,691	55,181	56,672	58,158	59,667	61,199	63,315	64,912	66,533
Supply: Free World	17,851	19,778	20,493	20,936	21,270	21,539	21,768	21,975	22,161	22,332	22,491	22,630
Communist Bloc	1,892	2,105	2,319	2,484	2,399	2,314	2,030	1,847	1,564	1,382	1,200	1,019
Net OPEC	29,687	29,100	29,389	30,271	31,512	32,819	34,360	35,845	37,474	39,601	41,221	42,884
OPEC Capacity	41,237	42,258	42,956	43,300	43,466	43,215	42,902	42,464	41,943	41,360	39,942	42,057
Capacity of 9 "Non-Core"	18,411	18,528	18,639	18,693	18,707	18,683	18,629	18,547	18,442	18,318	17,383	19,988
Output at 90%	16,570	16,675	16,776	16,824	16,836	16,815	16,766	16,692	16,598	16,486	15,645	17,989
Residual on 4 "Core"	13,117	12,425	12,614	13,447	14,676	16,004	17,594	19,153	20,876	23,115	25,576	24,895
Capacity	22,826	23,730	24,317	24,607	24,659	24,532	24,273	23,917	23,501	24,874	24,297	22,069
% of Capacity	57	52	52	55	60	65	72	80	89	93	105	113

TABLE 4.6

RESIDUAL DEMAND ON OPEC (TBD):

DEMAND GROWTH WITH CONSTANT REAL PRICE;

IRAN "CONSTRAINTED" AT 4000 TBD

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
World Demand (Constant Real Price)	49,430	50,983	52,201	53,691	55,181	56,672	58,158	59,667	61,199	63,315	64,912	66,533
Supply: Free World	17,851	19,778	20,493	20,936	21,270	21,529	21,768	21,975	22,161	22,332	22,491	22,630
Communist Bloc	1892	2105	2319	2484	2399	2314	2030	1847	1564	1382	1200	1019
Net OPEC	29,687	29,100	29,389	30,271	31,512	32,819	34,360	35,845	37,471	39,601	41,221	42,884
OPEC Capacity	41,237	42,258	39,756	40,100	40,166	40,015	39,702	39,264	38,743	38,160	36,742	38,857
Capacity of 9 "Non-Core"	18,411	18,528	15,439	15,493	15,507	15,483	15,429	15,347	15,242	15,118	14,183	16,788
Output at 90%	16,570	16,675	13,895	13,943	13,956	13,934	13,886	13,812	13,718	13,606	12,765	15,109
Residual on 4 "Core"	13,117	12,435	15,514	16,328	17,556	17,885	20,474	22,033	23,756	25,995	28,456	27,775
Capacity	22,826	23,730	24,317	24,607	24,659	24,532	24,273	23,917	23,501	24,874	24,297	22,069
% of Capacity	57	52	64	66	71	77	84	92	-	-	-	-

TABLE 4.7

RESIDUAL DEMAND ON OPEC (TBD)

DEMAND GROWTH WITH MODERATE REAL PRICE RISE;

IRAN "CONSTRAINED" AT 4000 TBD

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
World Demand	49,430	50,983	52,201	53,430	54,578	55,604	56,460	57,133	57,604	57,857	57,873	57,633
Supply: Free World	17,851	19,778	20,473	20,936	21,270	21,539	21,768	21,975	22,161	22,332	22,491	22,630
Communist Bloc	1892	2105	2319	2484	2399	2314	2030	1847	1564	1382	1200	1019
Net OPEC	29,687	29,100	29,409	30,010	30,909	31,751	32,662	33,311	33,879	34,143	34,182	33,984
Non-Core Production (% of Capacity)	16,570	16,675	13,895	13,943	13,956	13,934	13,886	13,812	13,718	13,606	12,765	15,109
Residual on 4 "Core"	13,117	12,425	15,514	16,067	16,953	17,817	18,776	19,499	20,161	20,537	21,417	18,875

TABLE 4.8

RESIDUAL DEMAND ON OPEC (TBD):

DEMAND GROWTH WITH STEEP REAL PRICE RISE;

IRAN "CONSTRAINED" AT 4000 TBD

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
World Demand	49,430	50,983	51,896	52,768	53,249	53,452	53,485	53,124	52,607	51,750	50,587	49,132
Supply: Free World	17,851	19,778	20,473	20,936	21,270	21,539	21,768	21,975	22,161	22,332	22,491	22,630
Communist Bloc	1892	2105	2319	2484	2399	2314	2030	1847	1564	1382	1200	1019
Net OPEC	29,687	29,100	29,104	29,348	29,580	29,599	29,687	29,302	28,882	28,036	26,896	25,483
Non-Core Production (90% of Capacity)	16,570	16,675	13,895	13,943	13,956	13,934	13,886	13,812	13,718	13,606	12,765	15,109
Residual on 4 "Core"	13,117	12,425	15,209	15,405	15,624	15,665	15,801	15,490	15,164	15,430	114,131	10,374

TABLE 5.1(A)

CURRENT ACCOUNT: SAUDI ARABIA

($BILLION)

	1972	1973	1974	1975	1976	1977
Petroleum Revenues	4.33	7.53	30.09	27.15	35.37	39.98
Other Merch. Exports	-	-	-	-	0.10	0.10
Service & Other Income	0.46	0.76	2.56	3.30	4.65	6.13
Merchandise Imports, F.O.B.	(1.28)	(2.10)	(3.71)	(5.99)	(10.39)	(14.36)
Service Imports	(1.62)	(3.10)	(4.39)	(6.54)	(11.12)	(13.67)
Current Account	1.89	3.01	24.55	17.92	18.61	18.18
Official Transfers	(0.16)	(0.50)	(1.02)	(3.13)	(3.33)	(3.89)
Change in External Position	1.73	2.59	23.53	14.79	15.28	14.29
Net External Assets (Year End)	3.37	5.10	26.63	43.42	58.70	72.99
Real Imports	4.81	7.39	9.06	12.53	20.76	26.03
			[40% Growth]			
Nominal Imports	Assume 35% Growth					

Source: International Financial Statistics

TABLE 5.1(B)

CURRENT ACCOUNT: KUWAIT

($BILLION)

	1975	1976	1977
Petroleum Revenues	7.89	8.95	8.82
Other Merch. Exports	0.60	0.73	0.90
Service & Other Income	1.77	2.23	2.58
Merchandise Imports, F.O.B.	(2.40)	(3.30)	(3.93)
Service Imports	(0.89)	(1.10)	(1.74)
Current Account	6.97	7.51	6.63
Official Transfers	(0.79)	(0.22)	(0.81)
Change in External Position	6.18	7.29	5.82
Net External Assets (Year End)	8.95	16.24	22.06
Real Imports	3.29	4.25	5.26
		[Growth of 26%]	
Nominal Imports:	Assume 30% Growth		

Source: International Financial Statistics

TABLE 5.1(C)

CURRENT ACCOUNT: LIBYA

($BILLION)

	1972	1973	1974	1975	1976	1977
Petroleum Revenues	2.47	3.49	7.13	6.09	8.43	9.97
Other Merch. Exports	0.00	0.04	0.09	0.33	0.31	0.41
Service & Other Income	0.23	0.22	0.43	0.38	0.35	0.42
Merchandise Imports, F.O.B.	(1.29)	(2.01)	(3.75)	(4.42)	(4.28)	(5.21)
Service Imports	(1.01)	(1.47)	(1.86)	(2.24)	(2.20)	(2.49)
Current Account	0.40	0.27	2.04	0.14	2.61	3.10
Official Transfers	(0.10)	(0.16)	(0.07)	(0.16)	(0.14)	(0.15)
Change in External Position	0.30	0.11	1.97	(0.02)	2.47	2.95
Net External Assets (Year End)	2.95	3.06	5.03	5.01	7.48	10.43
Real Imports	3.81	4.94	6.28	6.66	6.48	7.70

[19% Growth w/o 1976]

Nominal Imports: Assume 20% Growth

Source: International Financial Statistics

TABLE 5.1(D)

CURRENT ACCOUNT: UAE

($BILLION)

	1972	1973	1974	1975	1976	1977
Petroleum Revenues	1.04	1.73	6.27	6.67	8.19	9.13
Other Merch. Exports	0.21	0.62	1.12	0.42	0.69	1.03
Service & Other Imcone	0.00	0.04	0.12	0.43	0.67	0.98
Merchandise Imports, F.O.B.	(0.44)	(0.74)	(1.54)	(2.41)	(3.01)	(4.10)
Service Imports	(0.13)	(0.18)	(0.47)	(0.62)	(0.76)	(0.83)
Current Account	0.68	(1.47)	(5.50)	(4.49)	(5.78)	(6.21)
Official Transfers	0.00	(0.20)	(0.35)	(0.50)	(0.60)	(0.60)
Change in External Position	0.68	1.27	5.15	3.99	5.18	5.61
Net External Assets	0.68	1.95	7.10	11.09	16.27	21.88
Real Imports	0.95	1.31	2.25	3.03	3.64	4.58
			[37% Real Growth)			
Nominal Imports:	Assume 30% Growth					

Source: International Financial Statistics

TABLE 5.2

CURRENT ACCOUNT PROJECTIONS ($BILLIONS)

SAUDI ARABIA

	1977	1978	1979	1980	1981	1982
Petroleum Revenues[1.]	21.80	30.67	42.84	59.49	82.21	113.16
Other Merch. Exports[2.]	0.10	0.12	0.13	0.15	0.17	0.20
Service & Other Income[3.]	6.13	7.05	8.11	9.32	10.72	12.33
Imports[4.]	(28.03)	(37.84)	(51.08)	(68.96)	(93.10)	(125.69)
Net Zero Current Account	0.00	0.00	0.00	0.00	0.00	0.00

1. Residual
2. Growth at 15% Per Year
3. Growth at 15% Per Year
4. Growth at 35% Per Year

LIBYA

	1977	1978	1979	1980	1981	1982
1.	6.87	8.25	9.89	11.87	14.24	17.07
2.	0.41	0.51	0.64	0.80	1.00	1.25
3.	0.42	0.48	0.56	0.64	0.73	0.84
4.	(7.70)	(9.24)	(11.09)	(13.13)	(15.97)	(19.16)
	0.00	0.00	0.00	0.00	0.00	0.00

1. Residual
2. Growth at 25% Per Year
3. Growth at 15% Per Year
4. Growth at 20% Per Year

KUWAIT

	1977	1978	1979	1980	1981	1982
Petroleum Revenues[1.]	2.19	3.19	4.56	6.44	8.97	12.39
Other Merch. Exports[2.]	0.90	1.08	1.30	1.56	1.87	2.24
Service & Other Income[3.]	2.58	3.10	3.72	4.46	5.35	6.42
Imports[4.]	(5.67)	(7.37)	(9.58)	(12.46)	(16.19)	(21.05)
Net Zero Current Account	0.00	0.00	0.00	0.00	0.00	0.00

1. Residual
2. Growth at 20% Per Year
3. Growth at 20% Per Year
4. Growth at 30% Per Year

UAE

	1977	1978	1979	1980	1981	1982
	2.92	4.04	5.55	7.56	10.23	13.77
	1.03	1.24	1.48	1.78	2.14	2.56
	0.98	1.13	1.30	1.49	1.71	1.97
	(4.93)	(6.41)	(8.33)	(10.83)	(14.08)	(18.03)
	0.00	0.00	0.00	0.00	0.00	0.00

1. Residual
2. Growth at 20% Per Year
3. Growth at 15% Per Year
4. Growth at 30% Per Year

TABLE 5.3

FINANCIAL PROJECTIONS OF OPEC CORE

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	
Total Core Revenue Needs (From Table 5-2)	33.78	46.15	62.84	85.36	115.65	156.39	212.69	289.26	393.39	535.01	727.62	989.56	(Nominal Growth of @ 36% Per Year)
CASE 1. (Demand from Table 4.7)	13,117	12,425	15,514	16,067	16,953	17,817	18,776	19,499	20,161	20,537	21,417	18,875	(Production in TBD)
Nom. Price Trajectory ($/Bbl)	12.70	12.70	15.00	17.88	21.18	24.96	29.29	34.23	39.87	46.29	53.60	61.91	(Assumes 10% Inflation)
Receipts ($Billion)	60.80	57.60	84.94	104.86	131.06	162.32	200.73	243.62	292.39	346.99	419.00	426.52	
Cumulative Surplus	83.68	95.13	117.23	136.73	152.14	158.07	146.11	100.47	0.47	(188.02)	(496.64)	(1059.68)	
CASE 2. (Demand from Table 4.8)	13,117	12,425	15,209	15,405	15,624	15,665	15,801	15,490	15,164	14,430	14,131	10,374	
Nom. Price Trajectory ($/Bbl)	12.70	12.70	16.25	20.63	27.23	34.94	42.09	50.33	55.36	60.90	66.99	73.69	
Receipts ($Billion)	60.80	57.60	90.21	116.00	155.29	199.78	242.75	284.56	306.41	320.76	345.52	279.03	
Cumulative Suplus	83.68	95.13	122.60	153.14	192.78	236.17	266.23	261.53	174.55	(39.70)	(421.80)	(1132.33)	
CASE 3. (Demand from Table 4.6)	13,117	12,425	15,514	16,328	17,556	18,885	20,474	22,033	23,756	25,995	28,456	27,775	
Nom. Price Trajectory ($/Bbl)	12.70	12.70	15.00	16.50	18.15	19.97	21.97	24.16	26.58	29.24	32.16	35.38	
Receipts ($Billion)	60.80	57.60	84.94	98.34	116.30	137.65	164.18	194.30	230.47	277.43	334.03	358.68	
Cumulative Surplus	83.86	95.13	117.23	130.21	130.86	112.12	63.21	(31.35)	(194.27)	(451.85)	(845.44)	(1476.32)	

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