A PROPOSED CURRENCY COMPOSITE APPROACH TO PRICING OPEC OIL: PROBLEMS AND POSSIBILITIES

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CHAPTER I

INTRODUCTION

Nature of Problem

The pricing policies of OPEC, as a monopoly cartel, have three major dimensions. First, they involve finding and maintaining a pricing structure which increases the probability of OPEC being able to act as a viable cartel. Second, they involve the efficacy of oil availability and price as a political tool. Finally, they involve the adjustment of the nominal price of oil for inflation and the fluctuation of the dollar for the purpose of maintaining the real price of oil in international markets.

World inflation has resulted in the loss of purchasing power of OPEC oil revenues denominated in dollars. The fluctuation of the value of the dollar vis-a-vis other currencies in a world of floating exchange rates has brought about an instability in the price of OPEC oil in terms of other currencies. This instability accelerates during periods when the rate of change in exchange rate is faster or slower than the rate of change in the relative prices between countries.

The instability of the dollar generates instability in the terms of trade[1] for OPEC members. This instability represents a real economic cost that cannot be avoided, especially for OPEC members which are heavily dependent on imports. For example, depreciation of the dollar versus the German mark makes the terms of trade worse for OPEC

members which are Germany's trade partners. Thus, those OPEC members which are Germany's trade partners suffer an increase in import prices relative to the price of oil.

This turmoil is not unique to OPEC countries. However, in order to diminish the impact, some government officials, as well as private enterprises, have arranged some type of currency basket as a substitute for single currencies in their international transactions. Also, many countries have sought to peg their currencies to a weighted currency basket (57).

There are various reasons why a country might wish to peg the value of its currency in terms of a currency basket. Exchange rates are determined in a market which is based on the demand for and the supply of different currencies. Consequently, even in a relatively stable world, the price of one currency vis-a-vis another tends to fluctuate, and pegging to a currency basket instead of a single currency diminishes the exchange rate variation impact on the economy.

The composition and the weight of the basket are generally based on the objective of minimizing the effects of exchange rate fluctuation on the economy. In other words, an optimal basket could be designed so that it minimizes the exchange rate changes among trading partners. The basket is optimal only in the sense of the specific objective and is assumed to be appropriate to the objectives of the authorities who select the composition and the weights of the basket (57).

To protect the real price of oil in terms of other currencies, at least partially, OPEC has two choices:

(1) Adjusting the price of oil for the fluctuation of the dollar, but payments stay in terms of the dollar. Yet, the question is, what

index measure to be used. A currency basket can be used, as a unit of account, to measure the magnitude of the dollar fluctuation for the adjustment.

(2) The second choice is a currency basket, as a unit of account and also as a medium of exchange. That is, OPEC receives its oil revenues in the form and proportional to the weights of the currencies of a selected basket.

If a currency basket is used as a medium of payment, the problem would be even more complicated than the present dollar pricing system in terms of its feasibility in the existing international monetary system (26). Furthermore, for the determination of the weights of the basket, each OPEC member would prefer to be more closely aligned with its own trade and investment pattern (26). However, the currency basket issue is crucial and important, whether OPEC uses it as a unit of account and/or as a medium of exchange.

The thought of any currency basket pricing of OPEC oil should be in the light of the future share, pattern, and structure of the trade of OPEC members, individually and as a whole, with the industrial nations and specifically with the United States. The value of the dollar versus other currencies in the international market is not the only determinant of the degree of competitiveness of the United States versus other countries. Thus, for the adoption of any currency basket the consideration of the other determinants, the rate of inflation in the United State compared with other industrial nations and OPEC trade elasticity of substitution, must also be taken into account (26). For instance, if the dollar depreciates against another currency,

but the rate of inflation in the United States is substantially lower, the American products might still be cheaper than the products of another country whose currency appreciated, and the trade share of OPEC with the United States could even increase rather than decrease. Still, changes in the United States' share of trade with OPEC, as a result of the depreciation of the dollar, depend on other non-price related determinants of OPEC's trade structure, such as military cooperation and commitments.

Different OPEC members have different shares, patterns, and structures of trade with the industrial nations. Furthermore, OPEC members have different amounts and currency denominations of investments and debts in the industrial nations. These differences among the OPEC members can prevent an agreement on the weights and currencies of the basket for the price of oil. One way of solving some of these issues related to the differences among the OPEC members is to apply the principle of compensation. Accordingly, if a change from state A to state B, which is preferable from the viewpoint of the group as a whole, benefits some member countries at the cost of others, the countries which benefit from the change should compensate the losers in a mutually agreeable manner (26). Under such an agreement two problems must be solved: (1) base the optimum basket on the assumption that OPEC is a homogeneous entity, and (2) try to identify the losers and gainers (26).

Another purpose of a currency basket for the price of OPEC oil might be the stability of the real price of oil in terms of other currencies. Overall, the purpose of the currency basket might be to prevent worsening terms of trade between OPEC members and industrialized

nations--that is, to protect the real price of oil from the fluctuations of the dollar and inflation in the United States and elsewhere. For this purpose, the basket might be designed to be related to some inflationary index.

At the same time, there are objections and problems with any currency basket, especially for the major surplus members of OPEC. The major opposition stems from the expected and sharper depreciation of the dollar caused by switching to a basket of currencies for the price of oil, which will result in capital losses of financial assets denominated in dollars. In addition, if the dollar appreciates, any currency basket would do worse in terms of other currencies.

Whether or not OPEC will use any basket of currencies for the price of oil in the future is not known. What is known is that the staff of OPEC has examined and is still considering the currency baskets for the price of oil.[2] Also, officials of OPEC and member countries remarked on the possible use of it in the future.[3] The recent glut in the oil market and the loss of unity among OPEC members can bring a new era for OPEC which may weaken the prospect of the use of a currency basket.

Justification and Objectives of the Study

While studies supporting the view of OPEC as a monopoly cartel (2, 3, 4) still continue, the debate, issues and difficulties of the basket of currencies or indexing as a substitute for the dollar and as the medium for pricing of oil have not been extensively examined. This is due to the fact that the basket currency argument is still in the discussion phase and has been supported by only a few members of OPEC. But the prospect of a currency basket in the future is likely.[4]

Use of the currency basket depends, among other things, on the stability of the dollar in the future and the political stability and cohesiveness of OPEC members.

The purpose of this study is to attempt to assess the establishment of a currency basket for OPEC as an alternative to the use of the dollar in international trade in oil. Specifically, the objectives are as follows:

1. To explore the nature, purposes, benefits and barriers of establishing a currency basket in international trade of oil.
2. Given the OPEC pricing of oil, the study includes the construction and evaluation of three alternative currency baskets and the evaluation of two others for the measurement and protection of the real price of OPEC oil.
3. To measure the impact of inflation on OPEC oil prices between 1971 to 1980.
4. Combining the impact of changes in the exchange rates and inflation, the study attempts to assess the terms of trade between OPEC and the major industrial nations.
5. To assess the impact of adjustments in a currency basket and inflation on the changes in the terms of trade for each OPEC country, individually.

Two of these baskets, the Geneva I and the Geneva II, were agreed to between OPEC officials and the oil companies in the early seventies. The Geneva I basket consists of nine currencies of the following countries: Germany, Japan, Belgium, France, Italy, Netherlands,

Switzerland, Sweden, and Great Britain. Geneva II includes the currencies of Geneva I plus those of Canada and Australia. The agreement was to adjust the price of oil by the average changes of the exchange rates of these currencies against the United States dollar. The Geneva I basket was only used for a short period of time, and was replaced with Geneva II. In late 1973 when OPEC, for the first time, unilaterally set the price of oil, the basket issue was dismissed. In this study, we will measure the impact of the dollar fluctuation on the price of oil based on these two baskets as compared to actual prices.

The third currency basket under study is the Special Drawing Right (SDR) of the International Monetary Fund (IMF), which was mentioned by OPEC officials as a possible future standard for the price of oil.[5] The SDR, as a composite of currencies, was established in 1974 with currencies from the United States, Germany, United Kingdom, France, Japan, Canada, Italy, Netherlands, Belgium, Sweden, Australia, Spain, Norway, Denmark, Austria, and South Africa (71). In 1978, the currencies of Denmark and South Africa were replaced with the currencies of Saudi Arabia and Iran (71). In 1981, the currency basket was reduced to five currencies, of the United States, West Germany, United Kingdom, Japan, and France. The dollar fluctuation impact is also measured and compared by the SDR basket.

Fourth, the trade basket which is developed in this study, and which is based on the trade relationships of OPEC members with the major industrial countries, has been designed and used to measure the price of oil. The purpose of this basket is to tie the price of oil to OPEC

imports from industrial nations, which would allow OPEC members to protect and diminish the fluctuation of the real price of oil.

Finally, a basket of nine currencies of the major industrial nations, which are not exactly the same as those of the trade basket, will be examined. This basket, which was suggested and examined for the price of OPEC oil for the period 1971 to 1977 by Mansor Dialami (26), will be updated for 1971 to 1980 and compared with the other four baskets.

The number of currencies in the trade basket is the same as in Dailami's (nine). But, in the trade basket, the Swiss franc is replaced by the Denmark kroner. The size of trade of these two countries with OPEC is roughly the same. But Switzerland is not a member of the European Economic Community, whereas Denmark is. It is believed that this community's currencies should be included in the basket because they have similar and coordinated standards for their trade with other countries, including OPEC members. Furthermore, and even more important since the Swiss franc is more volatile, it is believed that its inclusion in the basket makes the basket less stable. Thus, it is hypothesized that the trade basket is more stable than Dailami's. This hypothesis will be tested by the comparison of the variance of the basket indices.

Past data have been used to evaluate the performance of each of the five currency baskets. The results of the evaluations of these baskets depend on the composition, weight and relative weakness or strength of the currencies against the dollar. In addition, important potential changes in trade volumes, income and export prices have been abstracted from the evaluation exercise for all five baskets. How successful these

currency baskets can be in future pricing, in terms of protecting the real price of oil, depends on the relative weakness or strength and weights of the currencies of the basket in the future. Obviously, if the past performance of the exchange rates continues in the future, the basket which most protects the real price for OPEC will be the best for the future.

The United States' Producers Price Index and the export price index from industrial nations (the import price index to OPEC countries), weighted for OPEC's imports from each industrial country, will be used to measure the impact of inflation on the price of OPEC oil.

The overall fluctuations of the dollar against other currencies and worldwide inflation in the seventies have resulted in a loss of purchasing power of OPEC. How severe these losses are depends on standard devices for measurement. We will adapt five currency baskets for the calculations of the impact of dollar fluctuation and employ two different inflationary indices for the measurement of inflationary impact on the OPEC oil prices.

The joint adjustment of the changes in the nominal price of oil by foreign exchange rates and inflation allows a rough assessment of changes in the terms of trade of OPEC during 1971-1980.

Overall, the results suggested:

1. Some loss in real price of oil due to the relative weakness of the dollar. This loss was about three percent per year.
2. Greater loss in real price of oil due to inflation in the industrialized countries. The loss due to inflation was about six percent per year.

3. Nevertheless, OPEC's terms of trade improved considerably over the period, regardless of basket choice or inflation index, suggesting OPEC pricing policies have more than compensated for the fluctuation of the dollar or inflation.

Approach and Shortcomings

The desirability of OPEC "currency basket" pricing for wealth maximization depends on its impact on OPEC members' future income from oil and consequently on their domestic economies, on the economies of the oil importing countries and their feedback to OPEC. However, this study is abstracting important variables, if the currency basket had been used for the price of OPEC oil. Furthermore, because of the following reasons, the study can be regarded as a "partial" rather than a "general" equilibrium analysis. First, though we review the literature on price policy models of OPEC in Chapter III, the study is not concerned with the price-path policies of OPEC. Given the price of oil, it attempts to construct measures to reduce the adverse monetary effect of exchange rate changes (by currency baskets) and inflation.

Second, the study is also not concerned with the impact of currency basket pricing of oil on OPEC investment and surplus assets (wealth and income effect), retaliation or the consumers' reactions in the oil importing countries to higher oil prices, and the transfer of wealth from oil importing countries to OPEC. Specifically, the impact of currency basket pricing of oil may weaken the dollar and result in a loss to those OPEC members which heavily invested their surplus funds in the denomination of the dollar. Retaliation to higher oil prices by the oil

importing countries can be expressed in different ways, including military action and (sur)taxes on oil imports from OPEC and commodity exports to OPEC members. The magnitude of the impact on OPEC of taxes on OPEC oil imports and commodity exports to OPEC depends on the price and income elasticity of demand for oil and price elasticity of commodity exports to OPEC.

Third, the study abstracts out any effects of changes in the trade elasticity of substitution between OPEC members and the industrial nations due to the currency basket pricing of oil. Also, it is abstracting out the effects of changes in exchange rates on export prices, stated in domestic currency terms, of goods imported by OPEC.

Fourth, the purpose is to examine currency baskets and inflationary measures for the purpose of protecting the real price of oil and not necessarily oil revenues. However, as long as the price elasticity of demand for oil is less than one, the protection of oil revenue can also be achieved. Obviously, if the price elasticity of demand for oil in the oil importing countries rises in the future and relative to the 1970s, oil price increase cannot guarantee revenue increase to OPEC. Furthermore, if higher prices of oil result in a higher general "price" level and reduction of the growth of the real "income" in the oil importing countries, the feedback effect on the reduction of the demand for OPEC oil is obvious. But the issues related to elasticities, price and income effects exist even under the present pricing system. Based on the experience of the successful price increases of the "OPEC cartel" in the seventies, the overall feedback of these factors most of the time seems not to be significant. This suggests that OPEC price increases, based on a

currency basket adjustment, can be achieved without a significant negative feedback compared to the gains of the higher prices to OPEC. Yet, as a part of its fundamental price policies, with which this dissertation is not concerned, OPEC must take these factors into account.

Fifth, different currency baskets are distinguished by the composition and weights of the currencies, which are constructed based on past data and only for the period between 1971 and 1980. Although past data cannot necessarily be used as a guide for the future, it can give an idea about the problems and prospects of using a currency basket pricing approach for oil. However, the results of these measures most likely would be different for any other time period, including the future.

The Organization

Chapter II outlines the foundation of OPEC in a historical context, including a brief overview of the oil embargo of 1973. The organization, resolutions, prices, production, reserves and solidarity of OPEC are also presented. OPEC price policies, as a major part of wealth maximization, are discussed in Chapter III. In this regard, two price policy models have been examined, and the issues of price and income elasticity of oil, which are important for the price policies, are discussed. In Chapter IV, the problems of the current international pricing system of oil are discussed, and the currency basket alternative pricing of oil is examined. The empirical research concerning currency baskets is also reviewed in this chapter.

In Chapter V, four alternative currency baskets for the price of OPEC oil are constructed, evaluated and compared with one another.

Also included is the evaluation of the SDR basket prices of OPEC oil. The inflationary impact on the real price of oil is also measured, and will be combined with the impacts of exchange rate change in each of the five currency baskets to measure their impact on the terms of trade of OPEC. Finally, the 1971-80 average impact of inflation by the weighted export price index and dollar fluctuation, measured by the trade basket, will be calculated and compared for each of the OPEC members, individually. The summary and conclusions are presented in Chapter VI.

CHAPTER II

OPEC: ESTABLISHMENT, CONTROL AND SOLIDARITY

The development of OPEC was a lengthy process and even after it was founded, it took more than a decade for it to gain full control of setting its members' oil prices and attaining its market power.

The main goals of this chapter are: (1) to review the conditions and circumstances under which OPEC was established and under which it subsequently attained its market power; (2) to discuss the evolutionary process of the shift of power from oil companies to OPEC, with reference to OPEC resolutions, agreements, and the oil embargo; (3) to explain the structure, organization, and objectives of OPEC; (4) to provide a brief economic overview of the production, reserves, and impact of OPEC members in petroleum and natural gas markets; and (5) to review some of the major conflicting forces among OPEC members and the possibility of a breakdown of OPEC.

OPEC: Foundation

In the early exploration and production of oil, the Middle Eastern oil producing nations were not profit maximizers, nor were they in the position to apply marginal cost-marginal revenue tools in their oil production.

First, they did not have much control over any aspect of production and marketing of oil due to a lack of technical expertise and managerial manpower; second, they did not have the financial ability necessary to develop their oil fields independently; third,

the oil money was the major source of revenue for their governments so they could not face loss of revenue due to challenging oil companies; fourth, they did not have any surplus funds; and, lastly, none of the individual oil producers could act as independently of others as they can today (35).

These limitations placed the oil exporting countries in a weak position vis-a-vis multinational oil companies. The weak position of oil producing countries of the Middle East resulted in long leases with the oil companies.

As the first step in correcting this situation, OPEC was formed in 1949, when Venezuela joined Kuwait, Saudi Arabia, Iran, and Iraq for the purpose of cooperation and communication among the oil exporting countries (32). But, at that time, nothing happened because those countries had no treaty agreement and could not face the oil companies.

In 1959, the multinational oil companies, as a powerful monopsony cartel, unilaterally reduced the posted price for Venezuelan crude oil by $0.05 and $0.25 per barrel for two different qualities of crude oil (32). In 1960, the same occurrence took place regarding Middle East crude oil prices. The reduction was between $0.10 and $0.14 per barrel for two different qualities of crude oil (32). In the same year, high level delegations from Venezuela, Kuwait, Saudi Arabia, Iran, and Iraq met in Baghdad to consider collective action against unilateral price reductions by the oil companies.

At the Baghdad conference on September 10-14, 1960, OPEC was officially established as a permanent intergovernmental organization.

The treaty establishing OPEC was registered in November, 1962, at the United Nations Secretariat.

OPEC consists of Asian, African, and Latin American states of different socio-economic backgrounds which are linked by matters concerning energy. Chief among these concerns is a simultaneous striving toward independent production of the level of oil, participation with regard to the decisions about the price of oil, and modernization of their countries (54). To answer these concerns, OPEC tried to control their own oil resources, refinery operations, and the transportation and distribution of oil. The achievement of these goals was a tedious process.

For instance, between 1951 and 1953, Iran attempted to take unilateral action against the then concession holder, the Anglo-Iranian Oil Company, by announcing the nationalization of the oil industry. Iran was faced with resistance from the major oil companies which, in a show of unity, initiated a virtual boycott of Iranian oil. This boycott and other actions led to political changes in Iran, which eventually ended the conflict. Iran obtained formal recognition of the nationalization of the oil industry without substantial changes in the basic pattern of control and profit-sharing compared with the neighboring countries (54).

As another example, in 1961, when Iraq announced the nationalization of most of Iraq Petroleum Company's concession area and, subsequently, rejected offers of settlement, the international oil companies penalized it by restricting production and increasing the level of output in other producing states of the Persian Gulf (54).

The emphasis at the early stage of the establishment of OPEC was for defense, under special circumstances, and only gradually did it take on a more militant flavor. The situation of demand for and supply of oil, as it evolved in the decades after World War II, did contribute to a special circumstance. During this period, the rate of energy consumption growth appeared to be accelerating, and the gap between the world supply and demand had been getting smaller.

The increasing dependence on oil as the "balancing" element in meeting United States' energy demand was reflected in substantially expanded American oil imports during the sixties (28). Between 1962 and 1973, the United States' imports of oil increased from two million barrels a day to almost five million barrels a day, at a growth rate of 8½ percent each year (28). Early in 1972, United States government officials reported that the United States crude oil output was expected to fall for the third consecutive year by over two percent and that imports would rise rapidly to meet the consequent abnormally high demand (83).

The import share of United States oil consumption rose from twenty percent in 1962 to thirty percent in early 1973, and, just before the October, 1973, Arab-Israeli War, was running close to thirty-five percent (28). Today, it is nearly forty-four percent.[6]

High growth in the demand for crude oil also appeared during the same period in Western Europe. Between 1962 and 1973, oil imports

TABLE 2.1

UNITED STATES PETROLEUM IMPORTS

Year	Volume of Imports (million barrels per day)			Imports (percent of supply)	OPEC Imports[2] (percent of total imports)		Value of Imports[3] (million dollars)
	Crude Oil[1]	Refined Products	Total		Total OPEC	Arab OPEC	
1949	0.42	0.22	0.65	11	NA*	NA*	0.45
1950	0.49	0.36	0.85	12	NA	NA	0.59
1955	0.78	0.47	1.25	14	NA	NA	1.10
1960	1.02	0.80	1.81	18	72	8	1.66
1965	1.24	1.23	2.47	21	59	8	2.04
1970	1.32	2.10	3.42	23	39	8	2.74
1971	1.68	2.25	3.93	25	42	8	3.35
1972	2.22	2.53	4.74	29	43	11	4.36
1973	3.24	3.01	6.26	36	47	14	7.74
1974	3.48	2.64	6.11	36	53	12	26.26
1975	4.10	1.95	6.06	37	59	22	25.06
1976	5.29	2.03	7.31	41	69	32	32.11
1977	6.61	2.19	8.81	47	70	36	42.01
1978	6.36	2.01	8.36	43	68	35	39.60
1979[4]	6.39	1.89	8.28	44	66	36	56.51

[1]Includes imports for the Strategic Petroleum Reserve which began in 1977.

[2]Excludes indirect imports from OPEC countries (imports of refined petroleum products, primarily from Caribbean and West European areas, which were refined from crude oil produced in OPEC countries).

[3]Includes value of imports into Puerto Rico from foreign countries; excludes receipts from the Virgin Islands.

[4]Preliminary

*NA: not announced.

NOTE: Sum of components may not equal total due to independent roundings.

Source: Energy Information Administration, Annual Report to Congress, 1979, Volume Two: Synopsis, October, 1980, U. S. Department of Energy, p. 8.

in Western Europe increased from thirty-seven percent of total energy consumption to nearly sixty percent; in Japan, the increase was from forty-four percent to seventy-three percent; the United States' increase was from nine percent to thirteen percent (28).

Because the costs of producing coal in Europe and discovering oil in the United States increased during the fifties and sixties, the attraction of cheap Middle East oil developed as a viable alternative (83). During the 1958 Suez crisis and 1967 Arab-Israeli War, excess unused capacity still existed in the United States and elsewhere to absorb the short term shock of the shortage of oil (83). However, by the late sixties, the sharp increase in the demand for energy, in general, and for oil, in particular, by Europe, Japan, and the United States absorbed the unused capacity (83). This sharp increase in the demand for oil was partly due to delays in bringing nuclear power plants into operation, and because of various anti-pollution controls (83).

The Evolutionary Process: 1970-73

Even though OPEC was officially founded in 1960, the multinational oil companies were still in control until the early seventies (35, 60).

Politics and the economy were the two major reasons why a ten year period elapsed between the formation of OPEC and any serious attempt to utilize its cartel power. One of the major economic reasons which was mentioned earlier in this chapter was the sharp demand for oil relative to its supply. The principal political factors were mistrust among OPEC members and international opposition (35).

There were four additional major economic reasons. First, there was not sufficient information about the extent of oil reserves and the nature of the world demand for oil; this was intentionally encouraged by Western oil interests in order to maintain the status quo relations to OPEC members on the individual bilateral basis (35). Second, there were other attempts by multinational oil companies and their customers to prevent collective action among the producing nations (35). Third, since oil revenue for OPEC members had become the principal source of their development, they were hesitant to risk losing that as a result of any change (35). Finally, in some cases, there were instances of collusion between producing countries and oil company officials (35).

But this situation slowly changed and finally was reversed. Some of the activities and counter-activities since 1970 by OPEC are most evident from a review of resolutions, actions and reactions adopted at OPEC conferences (66).

June 24-26, 1970, Algiers:

> The XX OPEC Conference resolved to adopt the recommendation of the Economic Commission Board of a five-year production plan (1971-75) intended to apply rational increases in OPEC production to meet estimated increases in world demand. It also instructed the said Commission to carry out a study on the integration of the petroleum industry in the national economies of Member Countries; reaffirmed its total solidarity with Algeria in its negotiations with the French oil companies; supported Iraq's position with respect to the production policy pursued by the concessionary oil companies and implementation of the royalty expensing formula. . . .

December 9-12, 1970, Caracas:

> The XXI OPEC Conference resolved that all Member Countries were to adopt a set of objectives, namely, to establish 55% as the minimum rate of taxation on the net income of oil companies; to eliminate disparities in posted or tax reference

prices of crude oils on the basis of the highest posted price applicable in Member Countries, taking into consideration differences in gravity and geographic location; to establish a uniform general increase in the posted or tax reference prices in all Member Countries to reflect general improvement in the conditions of international petroleum market; to adopt a new system for the adjustment of gravity differential of posted or tax reference prices; and to eliminate completely the allowances granted to oil companies as from the beginning of 1971. It also approved the establishment of a committee comprising Iran, Iraq and Saudi Arabia to negotiate on behalf of Member Countries . . . with the oil companies, with a view to achieving the above objectives. . . . The principle that price adjustment should be made in the light of changes in the parity of moneys of major industrialized countries was also adopted. . . .

February 3-4, 1971, Tehran:

The XXII OPEC (Extraordinary) Conference resolved that each Member Country exporting oil from Gulf terminals would introduce, effective February 15, the necessary legal and/or legislative measures for the implementation of the objectives embodied in Resolution XXI. 120, if the oil companies did not express their willingness to comply with the minimum requirements agreed upon regarding the implementation of these objectives. . . .

February 14, 1971, Tehran:

A five-year agreement (The Tehran Agreement) was signed between six Member Countries in the Gulf and 23 international oil companies whereby the posted price of the Arabian Light was adjusted to $2.18/bbl. The agreement included a flat increase across-the-board of 33¢ bbl. in the posted prices, a flat increase of 5¢ annually in lieu of claims relating to adjustments in products prices, an increase of 2.5% annually for inflation, full expensing of royalties, elimination of the marketing allowances, an increase in the tax rate to 55%, and the realignment of all posted prices in the Gulf using the price of Arabian Light as a reference, taking into account a freight differential based on a rate of World scale 72.

September 22, 1971, Beirut:

The XXV OPEC Conference decided that all Member Countries concerned would establish negotiations, either individually or in groups, with the oil companies regarding state participation in oil concessions and adopt ways and means to offset any adverse effect on the per barrel real income of Member Countries resulting from the U. S. dollar's de facto devaluation.

December 7, 1971, Abu Dhabi:

> The XXVI OPEC Conference decided that the OPEC Secretariat should invite fully authorized representatives of the oil companies to meet the Ministers of Member Countries in Geneva on January 10, 1972, to finalize the issue of the loss in value of the U. S. dollar vis-a-vis the currencies of major industrialized countries and, on January 20, to negotiate on the issue of participation.

January 20, 1972, Geneva:

> . . . Agreement was reached between OPEC Countries and the oil companies, . . . whereby oil revenues of Member Countries were increased by the provision of an immediate price adjustment in the Arabian Light posted prices of 8.49%. The settlement also included provisions for further adjustment in oil revenues between 1972 and 1975 based on an index measuring changes between the exchange rates of the U. S. dollar and nine other key currencies.

June 9, 1972, Beirut:

> The XXVIII OPEC (Extraordinary) Conference supported the Government of Iraq's nationalization of IPC's operations as a lawful act of sovereignty to safeguard its legitimate interests.

March 16-17, 1973, Vienna:

> . . . The change in the value of the U. S. dollar and its adverse effect on the purchasing power of oil revenues of Member Countries was also reviewed, and a Ministerial Committee set up to discuss the matter.

March 22, 1973, Beirut:

> An OPEC Ministerial Committee Meeting, attended by all Member Countries, decided to establish a negotiating team comprising Iraq, Kuwait and the Libyan Arab Republic to negotiate with the oil companies with a view to amending the Geneva I Agreement to offset the devaluation of the U. S. dollar and avoid further loopholes.

April 12, 1973, Beirut:

> A second round of negotiations between the OPEC Ministerial Committee and the oil companies on the amendment of Geneva I Agreement.

April 13-14, 1973, Cairo:

A third round of negotiations between the two parties on the amendment of Geneva I Agreement.

April 23, 1973, Vienna:

Negotiations with the oil companies reached an impasse, and the OPEC Negotiating Team decided to call for an Extraordinary Conference, which was postponed on 4th May, negotiations resuming in Tripoli on 7th May, 1973.

May 7, 1973, Tripoli:

Breakdown of negotiations with the oil companies' representatives and the decision to call for an Extraordinary Meeting of the Conference in Vienna.

May 26, 1973, Vienna:

The XXXIII OPEC (Extraordinary) Conference took note of the outcome of negotiations and of the oil companies' readiness to reach a negotiated settlement, and decided to resume negotiations with a view to arriving at a positive result.

June 1, 1973, Geneva:

Agreement (Geneva II) with international oil companies to amend Geneva I and relating agreements. Using the arithmetical average of eleven currencies against the exchange rate of the dollar, the agreement adjusted the posted price of the Arabian Light by 5.7% to $2.898/bbl. Under this mechanism, prices were recalculated on a monthly basis.

September 15-16, 1973, Vienna:

The XXXV OPEC (Extraordinary) Conference decided that Member Countries should negotiate individually, or collectively, with the oil companies with a view to amending the terms of Tehran, Tripoli and Lagos Agreements. A Ministerial Committee comprising six Member Countries bordering the Gulf . . . was set up to negotiate collectively the revision of the terms of the Tehran Agreement. Full support for the decision of the Libyan Government to nationalize 51% of the operations of oil companies operating in Libya.

October 16, 1973, Kuwait:

The Ministerial Committee decided to recommend to the XXXVI OPEC Conference that the posted prices of all crudes be adjusted to a level 70% above the prevailing one, and that the adjustment

> apply generally to all OPEC Member Countries. In consequence, the price of the Marker Crude would rise from $3.02 to $5.11 per barrel.

December 22-23, 1973, Tehran:

> The Ministerial Committee of the six Gulf Member Countries, set up in accordance with a Resolution of the XXXV OPEC Conference, decided to set government-take of $7 a barrel for the Marker Crude, and consequently, the relevant posted price of the Marker Crude rose to $11.651 a barrel. . . .

A few days after the Arab-Israeli War in October, 1973, a conference of Arab oil ministers in Kuwait decided to use oil as an economic/political weapon. In that conference, they decided to reduce their export of oil to unfriendly nations and to place an embargo on exports to the United States (53). Despite this apparent solidarity, however, the Arab oil ministers' underlying attitudes were not identical (53).

The Oil Embargo and Boycott

As a recommendation by Saudi Arabia, the oil embargo became a stated collective policy of the oil-producing Arab countries of OPEC. On October 19 and 20, 1973, Saudi Arabia formally announced a whole range of restrictive measures and an export embargo to specified countries including the United States (53). Although it was assumed to be a collective Arab action, the impact and the effects of the boycott were not identical for each Arab oil-producing country. The impact on each country was directly related to that country's volume of oil previously exported to the United States (53).

On November 4, 1973, another conference of Arab oil ministers was held in Kuwait. The major decisions of that conference were as follows: (1) to reduce the November production to a uniform

twenty-five percent of the September level, with an additional further five percent reduction planned for December; (2) oil consumer nations were to be warned that a more positive attitude toward the Arab cause would have to be taken before they could receive oil; (3) a high level delegation from Saudi Arabia and Algeria would tour major consumer nations to explain these Arab restrictive measures (27, 53).

Until the end of November, 1973, the Arab mood was still one of defiance. In response to the United States' Secretary of State's reference to possible American counter-measures, the Saudi Arabian oil minister declared in Copenhagen on November 22 that any military intervention would simply induce the Arabs to destroy their oil facilities (53).

However, in early December, 1973, Arab oil producers, with Saudi Arabia as the leader and spokesman, began to give signs of relaxing their conditions and, on March 18, 1974, the Arab oil ministers decided to provisionally remove the embargo against the United States.

Even though OPEC members were not responsible for the Arab-Israeli War, they made use of its impact. When the war broke out in October, 1973, the OPEC delegations were in Vienna, negotiating with the international oil companies for higher export prices, demanding increases of up to $5.6 per barrel for Arabian crude oil (60).

The oil companies did not respond to the higher oil price request. Consequently, OPEC set the price unilaterally for the first time without prior agreement of the oil companies. Finally, the

oil companies accepted the price and the October and December, 1973, price increase was fourfold (41).

The creation and survival of OPEC can best be interpreted as a reaction to a perceived collective threat. The creation of a powerful OPEC occurred when the multinational oil companies threatened the prosperity of the developing oil exporting countries with unilateral cuts in oil export prices and other acts regarded as actual or potential threats to OPEC members' welfare (60).

OPEC: Structure and Organization

The structure of OPEC has three distinct organs: the Conference, the Board of Governors and the Secretariat.

The Conference, the highest authority of OPEC, consists of delegations representing the member countries. Each full member country has one vote in most decisions of the Conference, including price and output. Decisions require a unanimous vote (67).

The Board of Governors consists of governors nominated by member countries and approved, for two year terms, by the Conference, to supervise the administration of OPEC. More specifically, its functions are: (1) the implementation of the resolutions of the Conference; (2) the preparation of OPEC's annual budget and submission of the budget to the Conference for approval; and, (3) the submission of reports and recommendations to the Conference on the affairs of OPEC (66, 67).

The Secretariat is the executive body of OPEC under the direction of the Board of Governors. It is headed by the Secretary General,

who is appointed, for three years, by the Conference. His term may be renewed once for the same period of time (66, 67).

The Secretary General is assisted by the Deputy Secretary General and the staffs of the Departments of Research, Public Relations, Personnel, Administration and Legal Affairs.

In 1964, under the supervision of the Secretariat, the Economic Commission was founded. This Commission consists of a body of experts as the Commission's board and staff and national representatives to recommend policies for the promotion of the stability of oil prices in the world. The Commission Board meets a minimum of four times each year (66).

OPEC: The Objectives

According to OPEC documents, the main purpose of the organization is the coordination and unification of the petroleum policies of member countries and the determination of the best means for safeguarding their interests, individually and collectively (67).

In addition, the organization should arrange all possible ways and instruments to prevent any harmful and sharp fluctuations in the international prices of oil markets, with due concern for the interest of the members. The security of a steady flow of income to the members, a regular supply of petroleum to the consuming countries, and a fair return on OPEC's capital investment in the petroleum industry are other aims of the organization (66).

Libya described OPEC in 1972 as a countervailing force along the lines of a cartel to counter both the transnational companies themselves and other cooperating groups in industrial countries (51).

However, because of the price agreement among the members, OPEC can be regarded as a "loose" but not a "formal" cartel.

If one applies the definition of formal export cartel used by Western countries, output and price allocations and agreement and arrangement among the producers for only exporting goods, OPEC does not pass the test to be an export cartel. Zuhayr Mikdashi elaborated on this point. In "The OPEC Process" in The Oil Crisis, he said:

> An export cartel not only must include rigid agreements on prices, but also related agreements in such key areas as production control and market sharing. The export cartel must also be responsible for monitoring the activities of its constituent members with a view to policing violations and penalizing violators. The OPEC member governments do not perform any of these cartel functions. Their agreement on oil export prices is strictly voluntary, and does not carry with it sanctions or rewards. Moreover, the agreements leave to the discretion of each member government the setting and changing of prices within a range considered reasonable by OPEC members. Member countries do not delegate to any central body their policy or decision-making powers. Indeed, they jealously guard their sovereignty, and consider their freedom of action to be paramount. This relatively low level of authority that member countries provide the OPEC organization has so far not proven a source of weakness. On the contrary, it has enabled the organization to weather dramatic changes in world oil conditions and in its members' policies. It has enabled OPEC to survive periods of political division, of economic rivalry, and of mutations in international relations. Flexibility and responsiveness to changing circumstances have throughout characterized the OPEC organization . . .: its capacity for maintaining itself without the constant support of individual governments is limited, as is its ability to take initiatives. . . . In periods of a buyers' market (as in the sixties), OPEC was primarily a clearing house and a relatively weak negotiator vis-a-vis transnational companies. In periods of a sellers' market (as in the seventies), OPEC has been able to exercise greater authority (60).

The "optimum" size and timing of price changes have often been a source of controversy among OPEC members. There are important socio-political differences as well since the OPEC countries encompass a wide range of cultural, religious, and racial differences.

But, in spite of their significant differences, OPEC member governments are aware that unless they remain together on the oil pricing issue they may well fail separately.

OPEC members' inability or unwillingness to develop a close cooperative relationship has prevented the organization from achieving some of its objectives. On this issue, Mikdashi wrote:

> Specifically, attempts to establish common institutions and projects approved in conference resolutions have often subsequently bogged down in the unwillingness of members to delegate national authority to a central body. Among these projects have been: (1) a high court of justice to arbitrate in oil and related affairs among members; (2) an OPEC-wide production prorationing system; (3) a mutual-aid fund to support member countries should their observance of OPEC resolutions lead them to suffer punitive action by major companies; (4) an OPEC developmental bank to help oil-importing developing countries; and (5) a code of uniform petroleum laws (60).

OPEC's Production of Crude Oil

The level of production of crude oil of OPEC members, individually and as a whole, and of other countries and the world for the years 1960, 1970, 1973, 1978, 1979, and 1980 are shown in Table 2.2. For most of the members of OPEC, the trend is upward. OPEC's production reached its peak in 1973 when OPEC itself did not determine the price of its oil and the price of wholesale crude oil was less than $2.00.

The year 1973 was the production peak for Iran, Kuwait, and Libya. The United States, in 1970, was producing the highest level--9.64 million barrels per day (mbd). For other countries, including China, Mexico, the United Kingdom, and USSR, the level of production of crude oil was steadily increasing. Total world production peaked

at 62.40 mbd in 1979 and in 1980 dropped to 59.65 mbd. This was a decrease of more than four percent. Total OPEC production/total world production ratio in 1960 was 0.4150. This ratio was .5169, .5545, .4950, .4956, and 0.4548 for the years 1970, 1973, 1978, 1979, and 1980, respectively. It should be noted that this ratio had a downward trend during these periods. Accordingly, in 1970 and 1973, OPEC members were supplying more than half of the world demand. In 1973, OPEC supplied a record of more than 55.83 percent of the world demand for oil. Also, in 1973, the revolutionary price of OPEC started, and OPEC gained power in terms of unilaterally setting the price of its own oil.

Since 1970, Saudi Arabia and Iran have been the major producers of crude oil, but since the revolution, Iranian production has been substantially reduced.

OPEC Crude Oil and Natural Gas Proved Reserves

Table 2.3 shows proved reserves of crude oil and natural gas by OPEC members, individually and as a whole, and the world total by the end of 1980. OPEC, with 434.4 billion barrels of proved reserves of crude oil and 1,006 trillion cubic feet of natural gas, holds 66.99 percent of the world total proved reserves of natural gas. These figures, especially the crude oil reserves, are good indicators of the role of OPEC as the major world energy and crude oil supplier in the future.

Among the OPEC members, Saudi Arabia, with 168.0 billion barrels of proven reserves of crude oil (38.67 percent of OPEC), has the

TABLE 2.2

INTERNATIONAL PRODUCTION OF CRUDE OIL
(Million Barrels Per Day)

Countries	1960	1970	1973	1978	1979	1980
China	0.10	0.60	1.14	2.08	2.12	2.13
Indonesia	0.41	0.85	1.34	1.64	1.56	1.57
Iran	1.07	3.83	5.86	5.24	3.17	1.69
Iraq	0.97	1.55	2.02	2.56	3.48	2.71
Kuwait	1.69	2.99	3.02	2.14	2.50	1.67
Libya	([1])	3.32	2.18	1.99	2.09	1.80
Mexico	0.27	0.49	0.45	1.22	1.46	1.93
Nigeria	0.02	1.08	2.05	1.90	2.30	2.05
Saudi Arabia	1.31	3.80	7.60	8.30	9.53	9.86
United Kingdom	([1])	([1])	0.01	1.08	1.57	1.61
United States	7.04	9.64	9.21	8.71	8.55	8.60
USSR	2.91	6.97	8.42	11.22	11.47	11.70
Venezuela	2.85	3.71	3.37	2.17	2.36	2.16
Total OPEC	8.70	23.41	30.96	29.80	30.93	27.13
Other	2.32	6.46	9.16	9.94	10.21	6.56
Total World	20.96	45.29	55.83	60.19	62.40	59.65
OPEC as % of World	.4150	.5169	.5545	.4950	.4956	.4548

[1]Less than 5,000 barrels per day

Source: U. S. Department of Energy, Energy Information Administration, 1980 Annual Report to Congress, April 1981, page 79.

TABLE 2.3

ESTIMATED OPEC CRUDE OIL AND NATURAL GAS PROVED RESERVES, DECEMBER 31, 1980

Country	Crude Oil (billion barrels)		Natural Gas (trillion cubic feet)	
Kuwait	67.9	15.63%	33	3.28%
Qatar	3.6	.83	60	5.96
United Arab Emirates	30.4	7.00	21	2.09
Saudi Arabia	168.0	38.67	112	11.13
Algeria	8.2	1.89	132	13.12
Ecuador	1.1	.25	4	.40
Gabon	.5	.12	1	.10
Indonesia	9.5	2.19	24	2.39
Iran	57.5	13.24	485	48.21
Iraq	30.0	6.91	27	2.68
Libya	23.0	5.29	24	2.39
Nigeria	16.7	3.84	41	4.08
Venezuela	18.0	4.14	42	4.17
Total	434.4	100.00%	1,006	100.00%
World Total	648.5		2,639	
Total OPEC/World Total		66.99%		38.12%

Source: U. S. Department of Energy, Energy Information Administration, 1980 Annual Report to Congress, April, 1981, page 43.

highest level of reserves. After Saudi Arabia, Kuwait and Iran 67.9 billion (15.63 percent of OPEC) and 57.0 billion (13.24 percent of OPEC) barrels, respectively, are the dominant reserve holders of the crude oil.

OPEC members hold only 38.12 percent of the world total natural gas reserves of 2,639 trillion cubic feet. Iran, with 485 trillion cubic feet, holds 48.21 percent of OPEC's total natural gas reserves. After Iran, Algeria has 13.12 percent and Saudi Arabia has 11.13 percent of the total natural gas reserves of OPEC.

OPEC's Reserve/Production Ratio

One way to measure the level of production relative to the level of reserve for different members of OPEC is the reserve/production ratio. The ratios for 1960, 1973, and 1980 are shown in Table 2.4. Since we used the level of production per year for this measure, the number of years that each member's reserve will last is presented. It should be noted that, historically, proved reserves of different countries have been increasing. Therefore, the reserve/production ratio is a rough measure and may change over time, although the magnitude of change may not be significant. Also, this ratio may be high for some countries because of the later discovery of oil reserves. The best example from the table is Libya in 1960.

With these reservations, the reserve/production ratio can be used as an indicator of the rate of exploitation of crude oil. The higher the ratio, the lower the rate of exploitation of crude oil. Furthermore, over the three periods of 1960, 1973, and 1980, the

TABLE 2.4

RESERVE/PRODUCTION RATIO
(YEARS) FOR CRUDE OIL, SELECTED OPEC COUNTRIES

Countries	1960	1973	1980
Indonesia	64.36	19.69	16.81
Iran	149.27	27.26	94.51
Iraq	85.91	41.25	30.75
Kuwait	111.60	62.45	112.94
Libya	12,777.78	29.31	35.49
Nigeria	2,319.44	22.63	22.63
Saudi Arabia	356.23	61.40	47.33
Venezuela	17.54	14.84	23.15
Total OPEC	138.70	38.98	44.48
Total World	85.94	32.26	30.20

Source: Original proved reserves and production from U. S. Department of Energy, Energy Information Administration, 1980 Annual Report to Congress, April 1981.

ratio had increased for some members of OPEC (see, for example, Venezuela from 1973 to 1980). These cases happened because the level of production was reduced.

In 1960 and 1973, Venezuela had the lowest reserve/production ratio. The highest ratios were held by Libya in 1960, Kuwait and Saudi Arabia in 1973, and Kuwait and Iran in 1980. In 1980, Indonesia exploited at the highest rate.

Obviously, those OPEC members with the higher levels of reserves and, consequently, higher levels of productions, like Saudi Arabia and Kuwait (see Table 2.3), are more influential and important in OPEC policy decisions than members with low reserves and low levels of production, such as Indonesia. While the current level of production may be crucial for the short-run influence, the level of reserves is more important in the long-run influence and inputs of the OPEC-cartel decisions.

Solidarity of OPEC

At the beginning of its formation, oil companies and oil importing countries did not take OPEC seriously. They regarded it as a transitory challenge and even after the price revolution of 1973, experts and politicians in the oil importing countries, including the United States, expected cooperation among OPEC members would falter and the cartel would break.

It was believed that there are at least three major internal threats to OPEC as a united cartel.

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First, in a cartel, the temptation to cheat is great. However, the organization of the petroleum industry and its physical limitations dampen large-scale cheating; the tell-tale computer reveals the trail of all shipments, prices, deliveries, ports, companies, buyers, and sellers (7). OPEC members do not intend to break the cartel; they just want to make higher profits. Without doubt, if OPEC members do not control their own production, the organization will collapse. But the members know that if that happens, they lose large amounts of money they have been making since the early seventies. Furthermore, a cutback in production now may yield even more revenue later. That is, the future price of oil might be higher than the future value of the present oil revenue invested in the money market or internal infrastructure and industries. This is due to the fact that oil is an exhaustible resource, and cannot be produced like other commodities. As a consequence of that exhaustible nature and the possibility of higher future prices of oil, the motivation for cheating among the members decreases. In addition, money is not the only goal of the OPEC members, even though oil money is fundamental for most of the other goals of economic development, defense, prestige and political influence.

Second, the unanimous vote required to determine the price of oil can be another source of conflict among the members. At certain times, some members desire large price increases, others want moderate increases and, recently, some members want no price increases or price reductions. Price disagreement is a serious threat to OPEC

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solidarity. The disagreement stems from each member's view of the market condition and the consequences of a price increase on the world as well as their own economies and oil revenues. Price conflicts usually have resulted in either no change of price or in two prices prevailing for a short time. Because slight differences exist, there is divergent pressure on both sides to compromise, and the next bargaining session often unifies the price (7).

Third, OPEC members also have different trading and investment patterns, which can result in conflict among members. Countries, such as Indonesia, Iraq, and Libya, which import more from appreciated currency countries, like Germany and Japan, bear a higher burden than the countries which have close trade ties with the depreciated currency countries, such as Italy or the United Kingdom. Considering the dollar-denominated asset holdings of OPEC members, the impact of the depreciation of the dollar is also obvious. The depreciation of the dollar hurts holders of dollar-denominated assets and benefits the net external debt holders which are in the denomination of the dollar. Therefore, because of the lack of homogenity in OPEC member countries with regard to trade and investment patterns, any serious discussion concerning the switch from a dollar oil-pricing system to any other currency system or basket of currencies faces serious difficulties (24).

There are other differences among OPEC members in terms of geographical location, language, culture, population, economic growth, the stage of industrialization, and international political linkage.

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Although none of the members of OPEC is a communist country, some members have varying degrees of tolerance toward communism. At one extreme are the three Arab nations of Algeria, Iraq, and Libya, which regard themselves as socialist, not communist countries, and they often accept Soviet aid, including arms, and support Soviet policies. But with all that, they are not satellites and remain strong Arab nationalists. At the other extreme is Saudi Arabia, which accepts capitalism as the best economic system the world has to offer (7).

With all the divergencies, difficulties, and differences in many aspects which work against OPEC members' cooperation, there are some common interests which help to tie the members together. In foreign policies, members' attitudes in most cases are either indifferent or supportive. Furthermore, none of the members wants political or economic weakness in the industrial countries (7). OPEC members want political stability in the regime of the members because political instability reduces and endangers their cooperation.

In conclusion, there is no major indication the members have forgotten the top goal of solidarity, and there are no foreseeable conflicts which are expected to destroy OPEC as a cooperative organization for the achievement of its goals and objectives. However, the recent price disagreement among OPEC members, which coincided with the oil glut in the world market, could be very crucial in terms of the stability and future of OPEC.

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Summary

In its early formation, OPEC did not use its market control concerning pricing, production, marketing, and control of oil facilities. Later, due to the unilateral reduction in the price of oil by oil companies, special circumstances increasing the demand for energy, and the Arab oil embargo, OPEC members became more cooperative in manipulating the level of production and, consequently, unilateral price determination of their oil.

OPEC was officially founded in 1960 and registered in the United Nations Secretariat in November, 1962. The organization of OPEC has three organs: the Conference, the Board of Governors, and the Secretariat. The main objectives of OPEC are coordination and unification of petroleum policies of member countries and the determination of the best means for safeguarding their interests, individually and collectively.

In their resolutions and negotiations with oil companies, OPEC members requested many concessions and received most of them. Among these concessions were OPEC's concern about the depreciation and instability of the United States dollar and its adverse effect on the purchasing power of their oil revenue. Also, OPEC members asked for price adjustments in light of a change in the parity of monies of major industrialized countries. They made resolutions to include provisions for adjustment in oil revenues based on an index measuring changes between the exchange rates of the dollar and nine other currencies. A later resolution expanded the number of other currencies to eleven.

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The level of production and the proved reserves of crude oil of OPEC members are the major reasons for OPEC's market power and its future role in the supply of energy. The reserve/production ratios of the OPEC members indicate that if OPEC members produce at the 1980 level of production, Indonesia's reserves will be fully exploited in less than 17 years (minimum), and Kuwait's reserves will be fully exploited in almost 113 years. Other OPEC members' reserves will be exploited somewhere between these periods. At the current production level, total OPEC and world reserves will be fully exploited in forty-four and thirty years, respectively.

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CHAPTER III

OPEC PRICE STRATEGY

Introduction

The purpose of this chapter is to examine recent behavior of OPEC oil prices and to provide an examination of analytical models which explain OPEC pricing behavior under various assumptions and profit maximization. In this regard, two dynamic models as a sample, under certain assumptions and behavioral goals, will be examined and evaluated.

Any price structure requires consideration of the consumer's reaction. In that respect, the issues of price and income elasticity of demand will also be discussed.

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Prices of OPEC Oil

Before discussing and measuring the dollar fluctuation and inflationary impact on the price of oil, it is important to review briefly the market structure of OPEC oil.

Before the establishment of OPEC in 1960, oil importing countries paid a fixed price for oil to oil exporting countries of the Middle East (6). The major multinational oil companies, through integrated channels, were in charge of production of oil, and set the prices of oil unilaterally (6).

In 1971, the Tehran Agreement between OPEC and the oil companies strongly asserted OPEC's role as a price "co-administrator"; accordingly,

the price of oil was determined through negotiations between OPEC and oil company officials.[7]

In October, 1973, OPEC emerged as a monopoly cartel, and for the first time, unilaterally set its own price of oil. The nominal price of Saudi Arabian light crude, the so-called marker crude, increased by 42 percent during 1973 (see Table 3.1). Subsequently, OPEC increased its nominal oil prices by 261 percent in 1974, 9 percent in 1975, 7 percent in 1976, another 7 percent in 1977, 2 percent in 1978, and 33 percent during 1979, compared to previous years. These nominal price increases by Saudi Arabia and other OPEC members occurred even during some years in which the international demand for and production of oil dropped (see Table 2.3).

Table 3.1 compares the price of Saudi Arabian light crude oil with the United States Producers Price Index (PPI). The real prices of oil, adjusted by the U. S.-PPI for 1970 and 1975 prices, are also shown in the table. Accordingly, the real prices increased in each year between 1971 to 1980 except in 1972 and 1978. However, the prices were fairly stable between 1975 to 1978, but increased sharply in 1974 and 1980.

It appears that such increases of the nominal as well as the real prices of oil, in spite of the reduction of the international demand in some periods, were due to the increased use of market power of OPEC. However, to the extent that OPEC is not the only source of oil in the world market, it does not have all of the characteristics of a joint

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TABLE 3.1

COMPARISON OF THE WHOLESALE PRICE OF SAUDI ARABIAN CRUDE OIL
WITH THE U.S.-PPI AND THE REAL PRICES OF OIL 1970-80

Year	Actual Prices U.S.$/barrel[1]	Changes in Nominal Prices %	U.S.-PPI 1967=100[2]	U.S.-PPI 1970=100	U.S.-PPI 1975=100	Real Price of oil in 1970 Prices	Real Price of oil in 1975 Prices
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1970	1.80	---	109.9	100.00	67.18	1.80	2.68
1971	2.19	+ 21.66	112.9	102.73	69.01	2.13	3.17
1972	1.90	- 13.24	116.6	106.10	71.27	1.79	2.67
1973	2.70	+ 42.11	129.2	117.56	78.97	2.30	3.42
1974	9.76	+261.48	149.3	135.85	91.26	7.18	10.69
1975	10.72	+ 9.84	163.6	148.86	100.00	7.20	10.72
1976	11.51	+ 7.37	169.7	154.41	103.73	7.45	11.10
1977	12.40	+ 7.73	180.7	164.42	110.45	7.54	11.23
1978	12.70	+ 2.42	194.9	177.34	119.13	7.16	10.66
1979	16.97	+ 33.62	217.9	198.27	133.19	8.56	12.74
1980	28.67	+ 68.95	248.9	226.48	152.14	12.66	18.84

[1]From International Monetary Fund, International Financial Statistics, different issues.

[2]From U. S. Department of Labor, Bureau of Statistics.

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profit maximizing monopoly cartel. Yet, it can be viewed as the major producer in a world of oligopolistic market.

Since 1973, when OPEC gained market power, the crude oil prices of OPEC members generally became less rigid, and have been subject to change without notice (27). Saudi Arabia, in consultation with other member countries through the conference, determines the price level by specifying the price of its most abundant crude, Saudi Light, 34° API gravity.[8] This is the "marker crude price" or "list price". Each country then selects a price, which could be different mostly due to the quality differences from the marker crude. This price is sometimes called the transaction price. The difference between the price of a given crude and the price of the marker crude is called the "differential" (27).

The "official" price is established by the producer country and is actually the price in effect on the date a tanker arrives at the loading port, whereas "spot prices" may change daily because each tanker load or portion thereof is subject to negotiation (27). The spot prices are determined in the free market and their differences from the contract prices can be regarded as the degree of pressure of the demand versus supply of the oil market.[9]

Spot prices always lead contract prices because an oil company buying on contract can immediately resell on the spot market and reap windfall profits. These profits could just as well be accruing to the OPEC countries. Therefore, relatively high spot prices influence OPEC members to raise and adjust their contract prices and reap the profits.

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OPEC Price Strategy Models

Since the early seventies when OPEC began to gain market control and started to set its prices of oil unilaterally, different groups and experts, private as well as public, tried to use different models to forecast the future price strategies by OPEC. The knowledge of the future oil prices is important to producers, consumers, and governments of the oil importing countries, among others. A number of models have been built with a wide range of sophistication and assumptions, time ranges, grouping versus subgrouping of OPEC members, and different economic theories (monopoly, cartel) and rules of thumb.[10]

Some of these earlier formal models projected the relative prices of oil would fall by the late seventies and determined that high prices are not in the best interest of OPEC (17, 23, 42). Later, the consensus of the studies suggested that oil prices are not too high in light of the prospective excess demand in the future, and that oil prices may not even be high enough.[11] As a result, any particular price projections of these models cannot be given with much confidence. Furthermore, it cannot specify and predict the future price policies of OPEC accurately. While the forces of the world supply and demand for oil are the fundamental determinants of the price, the variation of demand by the world and the control of the supply by OPEC can influence the price.

The problems with the projections from these earlier models may be the result of improper specifications, simplification, overestimation of the elasticities of demand for and supply of oil, and others. There

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is a wide range of freedom in deciding on the appropriate model specification and variable selection for the models (36).

The optimal price strategy by OPEC, as a monopoly cartel, was considered more recently by Soladay (80), Pindyck (70), Stiglitz (81), Cremer and Weitzman (23), and others. To see the nature of these models and the optimal real price path of OPEC oil under certain assumptions, constraints, and behavioral goals, we will look at two models by Cremer-Weitzman (23) and Pindyck (70).

Cremer-Weitzman Model

This simplified model (23) attempted to quantify what long term oil prices would be if the members of OPEC colluded in a rational, concentrated action to maximize present discounted profits. The model divides the world supply of oil into two markets of OPEC and non-OPEC or "competitive fringe".

The Competitive Fringe's Problem

Assuming $F(Q)$ is the cumulative functions of total costs for the production of Q units of petroleum at the beginning period t, and Q_{t+1} is the amount of petroleum extracted during period t, the cost of production in period t is

$$(3.1) \quad C_t = F(Q_{t+1}) - F(Q_t),$$

with the assumption of increasing costs. That is,

$$(3.2) \quad F''(Q) \geq 0.$$

Cremer-Weitzman assumed that capacity constraint exists, but that it grows geometrically of the form

$$(3.3) \quad Q_{t+1} - Q_t \leq \beta (1+\alpha)^t,$$

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where β is equal to the capacity of the competitive fringe (non-OPEC oil exporters) in 1975, and α is the maximum allowable growth rate of capacity. Given the price of oil set by OPEC, the competitive fringe sets its production schedule so as to maximize present discounted profits. That is, according to Cremer-Weitzman, they have the problem of

$$(3.4)\quad \text{Max.} \sum_{t=o}^{\infty} \{P_t(Q_{t+1}-Q_t) - C_t\}/(1+r_c)^t$$

subject to

$$Q_{t+1} \geqq Q_t$$

$$(Q_{t+1} - Q_t) \leqq \beta\ (1+\alpha)^t$$

$$C_t = F(Q_{t+1})-F(Q_t)$$

$$Q_o = 0$$

where r_c is the discount rate appropriate to the competitors and presumed constant over time, Q the level of output, and P price of oil per barrel.

The Monopolist's (OPEC's) Problem

Cremer and Weitzman assume that the total world demand for crude oil in period t is a function of that period's real price, or,

$$(3.5)\quad D_t = D_t\ (P_t)$$

and the supply of oil by competitors depends on the sequence of real prices of crude oil, Ps, as

$$(3.6)\quad S_t = S_t\ (Ps).$$

Subtracting (3.6) from (3.5), we have net demand ND_t function of

$$(3.7)\quad ND_t(Ps) = D_t(P_t) - S_t\ (Ps),$$

which is the demand that the monopolist faces.

The monopolist (OPEC), according to the model, faces the problem of

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$$(3.8)\quad \text{Max.} \sum_{t=o}^{\infty} \{P_t ND_t - (G(Y_{t+1}) - G(Y_t)\}/(1+r_m)^t$$

subject to

$$Y_{t+1} \geq Y_t$$

$$Y_{t+1} - Y_t = D(P_t) - S_t(Ps)$$

$$Y_o = 0$$

where G is the cumulative cost function, Y_t the cumulative production up to period t, and r_m the monopolist's discount rate. The solution of (3.8) is a dynamic equilibrium.

Demand for Oil

The Cremer-Weitzman estimated linear world demand for oil with the data of the preferred specification (see footnote of Table 3.2) is

$$(3.9)\quad D = 21-0.6\ P$$

in billion barrels per year and a long run elasticity of 0.4 at $10 per barrel, where the demand is set equal to 15 billion barrels per year. The demand is zero at a real price of $35 per barrel (in 1975 dollars). Assuming that demand increases at g percent per year, the oil demand, starting with t=o in 1975, is $D_t(P_r) = (21 - 0.6P_t)(1+g)^t$.

Supply of Oil

Cremer-Weitzman divided the costs of supplying oil into two parts. First, the capital costs (exploration and development of new fields), which depend on the amount of oil left in the ground, and second, transportation and current costs which are independent of the quantity of oil already extracted.

Letting K(t) be the capital cost at time t, and assuming that capital costs are inversely proportional to the quantity of unexploited reserves, we have

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$$(3.10) \quad K(t) = K_o R_o/(R_o - Q(t))$$

where K_o and R_o are capital costs and reserves at time 0, respectively, and $Q(t)$ is the total amount extracted between time 0 and time t.

Cremer-Weitzman assumed the value of β in equation (3.4) equal to the production of non-OPEC countries in 1975 and fixed at three percent per year. In the preferred specification (see footnote of Table 3.2), r_m is set at five percent and r_c at eight percent after inflation has been subtracted out. Also, the discount rate for OPEC was assumed to be somewhat lower due to a belief that these countries have fewer productive outlets for accumulated funds.

Results

Time periods are ten years. This corresponds to the notion that the model has validity only for showing medium to long-run trends. For the first period (1975-85), they assumed OPEC's cost of production, C, not to change. For the second and following periods, the costs of production are assumed to increase and the size of reserve R to decrease. These assumptions result in stable prolonged real prices of oil.

The results of the model are shown in Table 3.2. All prices are constant prices in 1975 dollars. Accordingly, the price of oil is in the range of \$6.1 to \$12.3 per barrel in the first ten years (see figure 3.1). However, in the following ten years, it is relatively stable, but it increases sharply to reach \$20 per barrel in the period 2005-2015.

For the first twenty years, OPEC produces less than a third of the total world production. Its share starts increasing in 1995 until it eventually holds a complete monopoly.

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TABLE 3.2
CREMER-WEITZMAN MODEL'S RESULTS†

Specification	Years 1975-1985	Years 1985-1995	Years 1995-2005	Years 2005-2015	Static Monopoly Price
1. Preferred	$9.8 5/13*	$10.3 6/17*	$14.7 14/12	$20.8 21/4	8.9
2. α=0.05	8.7 4/14*	9.7 5/19	15.4 15/10	21.0 21/3	8.0
3. α=0.01	10.7 5/12*	12.7 8/13*	14.9 11/14*	19.3 20/7	9.6
4. $\beta=\infty$	6.1 0/20	9.9 10/13	15.6 15/10	21.1 21/3	
5. r_m=3%	11.1 4/13*	11.9 5/17*	16.7 10/14	22.4 19/2	8.9
6. r_c=5%	9.7 5/13*	10.9 18/5	16.2 0/23	21.8 18/5	8.9
7. r_c=12%	9.8 5/13*	10.4 6/17*	15.0 13/12	20.9 22/3	8.9
8. g=1%	8.1 4/13*	7.0 5/14	10.5 8/11	15.1 11/6	8.0
9. g=6%	12.3 6/13*	15.7 12/17*	20.6 24/15	27.6 36/2	10.1
10. a=25,b=1 in(Ψ)E=2/3	12.3 7/13*	8.9 8/17*	11.8 17/11	15.8 23/4	7.6
11. a=19.3,b=0.43 E=0.29	11.2 4/13*	11.9 5/17*	17.7 12/13	25.8 20/4	10.2
12. Reasonable cost changes	Virtually no differences				

†First number is price per barrel; second and third OPEC and non-OPEC annual production(bbl), respectively. The preferred specification uses the following data: α=0.03, β=11, r=5%, r=8%, g=3%, a=21, and b=0.06. For all the variations of the demand curve the demand at $10 bl is 15 bbl year. E is the elasticity of demand at that price. In the preferred specification it is equal to 0.4. Asterisks indicate that the competitive fringe is producing at maximum capacity. (Ψ) is the linear demand curve.

Source: Cremer, J. and Weitzman, M. L. "OPEC and the Monopoly Price of World Oil." European Economic Review. 8 (August 1976): 155-164.

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The fourth line of the table presents the results for a complete run which assumed no limit on non-OPEC production. As expected, prices in the first twenty years are much lower than in the preferred specification; but from 1995 those two experiments yield very similar results. The consequences of modifying the demand curve are shown in lines 10 and 11. It turns out that the static monopoly model predicts these changes very well in the short run.

The most significant result of those experiments is the consistent finding that real oil prices will not change much in the next twenty years. The alternative specifications affecting the initial price should not change sharply in the near future. That is, the model projected that there would not be any more sharp price increases as experienced in the early seventies.

The projected prices of the preferred specification of the model (first row of Table 3.2) and the actual real prices (all in 1975 constant prices) are compared in figure 3.1. The actual real prices have been higher than the projected prices during the whole period of 1975 to 1980, and the gap is the largest in 1980. The major reason for the price gap in 1980 was that the model did not include any oil interruption from OPEC members. Furthermore, the demand for oil did not grow at the annual rate of three percent as the model assumed. In fact, recently the growth of demand for oil was reduced to zero and even became negative.

In conclusion, Cremer-Weitzman used a dynamic optimization model to explain the price behavior of OPEC viewed as a monopoly cartel

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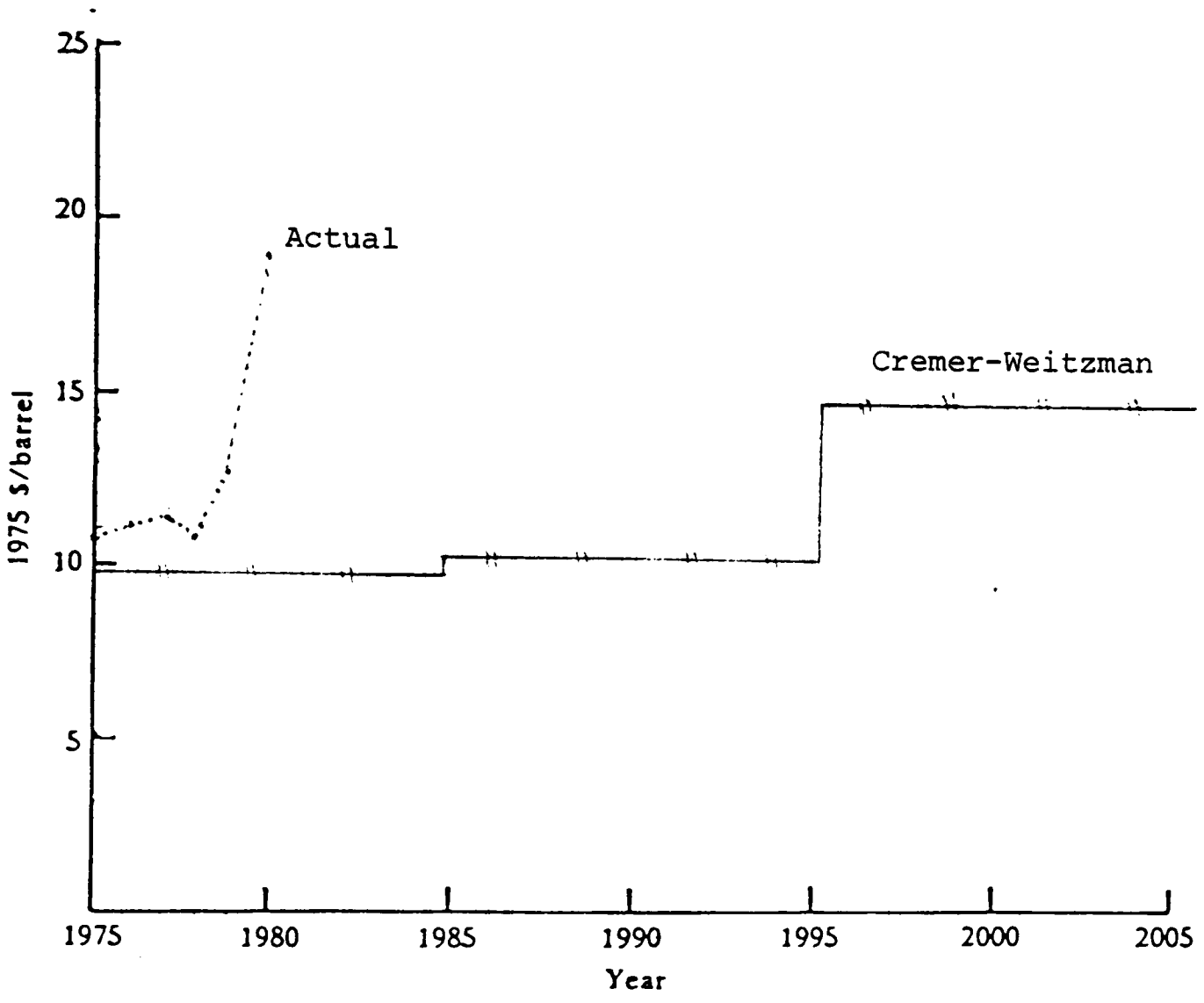

FIGURE 3.1

COMPARISON OF THE ACTUAL WITH CREMER-WEITZMAN'S PROJECTION OF OPEC'S REAL PRICES OF OIL

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sharing the oil market with a competitive sector. A distinctive feature of this approach is that both OPEC and the competitive fringe act like rational profit maximizers, rather than follow some (other) behavioral rule. The model is really crude because it ignores uncertainty, including price uncertainty, and rough estimation of costs, as indicated by its authors. The model focuses on demand. The demand side has to make all the adjustments while the supply constraints are treated as exogenous constraints.

Pindyck Model

There are a number of problems which make somewhat uncertain OPEC's optimum price in the long term. This is not only a concern of the experts and OPEC members, but also of oil importing nations including the United States. Robert Pindyck (70) looked at these problems and used a model of optimal OPEC oil pricing with these constraints to measure roughly the possible impact of future problems for OPEC.

According to Pindyck, OPEC faces at least two major problems. The first is the allocation of production cutbacks by Saudi Arabia and other members in the case of oil glut. Only five of the thirteen members--Saudi Arabia, Kuwait, Libya, the Emirates, and Qatar--are usually running annual surpluses; other members are dipping into their reserves to finance import needs, or borrowing heavily from abroad.

The second potential problem for OPEC is the possible emergence of Mexico and others as major oil producers. It now appears that Mexico has potential recoverable oil reserves of 150 to 300 billion barrels. By comparison, Saudi Arabia has proved reserves of 150

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billion barrels and potential reserves of about 500 billion barrels. The impact of a major increase in Mexican production would be a reduction of the net demand for OPEC oil, reduction of the market power of OPEC and of the net revenue maximizing price of OPEC oil.

The objective of OPEC is to maximize the equity value of its oil reserve. Pindyck assumes the average cost of production for the cartel to rise hyperbolically, as the reserve of the cartel decreases, i.e., $\frac{d(MC)}{dt} > 0$. He also assumes that as oil reserves decrease, the initial reserve level is taken to be 500 billion barrels and initial average cost is fifty cents per barrel, and the planning horizon N is chosen to be large enough to approximate the infinite horizon problem (N = 40 years usually provides a close enough approximation). According to Pindyck, the objective of OPEC, as a monopolistic cartel, is to maximize the discounted profits as follows:

$$(3.11) \quad \text{Max.} \quad W = \sum_{t=1}^{N} \frac{1}{(1+r)^t} (P_t - 250/R_t) D_t$$

where D_t is the demand for cartel oil (billions of barrels per year--(bb/yr); R_t is the reserves of the cartel (bb/yr); and P_t is the price of oil ($ per barrel), in real 1975 dollars; r = the discount rate.

Pindyck described the world oil market by the following equations, all of which were parameterized to be consistent with the reserve, production and elasticity estimates of the Organization for Economic Cooperation and Development (OECD), and with average elasticity estimates obtained from aggregate time series data:

$$(3.12) \quad TD_t = 1.0 - 0.13P_t + 0.87TD_{t-1} + 2.3(1.015)^t$$

$$(3.13) \quad S_t = (1.1 + 0.10P_t)(1.02)^{-CS/7} + 0.75\, S_{t-1}$$

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$$(3.14)\quad CS_t = CS_{t-1} + S_t$$

$$(3.15)\quad D_t = TD_t - S_t$$

$$(3.16)\quad R_t = R_{t-1} - D_t$$

TD_t = total demand for oil (bb/yr),

S_t = supply of competitive fringe (bb/yr),

CS_t = cumulative supply of competitive fringe (bb).

In (3.11), because average costs become infinite as R_t approaches 0, a resource exhaustion constraint need not be introduced explicitly, so that equations (3.12) to (3.16) represent a classical, unconstrained, discrete-time optimal control problem, and numerical solutions are easily obtained.

Equation (3.12) is based on a total demand of eighteen billion barrels per year at a price of six dollars per barrel, and at that price, the short-run and long-run price elasticities are 0.04 and 0.44, respectively (with a Koyck adjustment); at a twelve dollar price, the elasticities are 0.09 and 0.90, respectively. The last term in equation (3.12) provides an autonomous rate of growth in demand of 1.5 percent (a long run income elasticity of 0.5 and a three percent real rate of growth in income). Equation (3.13) determines supply for the competitive fringe (non-OPEC oil producers) and is based on a level of 6.5 billion barrels per year at six dollars per barrel. At the six dollar price, the short-run and long-run price elasticities are 0.09 and 0.35, respectively; at a twelve dollar price, they are 0.16 and 0.52, respectively. After a cumulative production of 210 billion barrels (e.g., 7 billion barrels per year for 30 years) by the competitive

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fringe, supply would fall (assuming a fixed price) to 55 percent of its original value.

Pindyck's results of the optimal price trajectory, OPEC production, OPEC reserves, and discounted profits for a discount rate of r = .05 are shown in Table 3.3 and Figure 3.2. The optimal OPEC price is thirteen to fourteen dollars in the first year (1975), declining over the next five years to about ten dollars, and then increasing slowly. The results are dependent on the particular model and parameter values of the model. Yet, changing the model's parameters does not have any significant effect on the numerical results. For example, if the elasticities (short and long-term) of total demand and competitive supply are increased by one hundred percent (doubled), optimum prices decrease by less than twenty percent and about ten percent, respectively. Finally, increasing or decreasing the initial OPEC production by one hundred percent or changing the initial level of OPEC reserves from five hundred billion barrels to eight hundred billion barrels has less than a ten percent change on the optimal price trajectory.

Pindyck also showed how the optimal cartel price would change in different scenarios of output cutback allocations and Mexican oil. The first scenario assumes the cartel consists only of Saudi Arabia, Kuwait, Qatar, and the Emirates (Abu Dhabi and Dubai); and the other OPEC members are to produce at capacity (independent of price), which is expected to decrease from its actual 1978 level at a rate of depletion equivalent to that in the competitive fringe countries. Thus,

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the depletion factor of equation (3.13) for the competitive fringe also is applied to the exogenous production level of these other OPEC members. In this scenario, the optimal pricing decision resides with Saudi Arabia and the other "core" countries just mentioned, given the supply function for the competitive fringe and given the exogenous production of the other OPEC countries.

Saudi Arabia, in the second scenario, absorbs all production cutbacks by itself, and every OPEC country, except for Saudi Arabia, produces at capacity, with exogenous production again declining at the same rate of depletion.

The third scenario is OPEC's optimal price of oil by a significant increase in Mexican oil over the next several years. Here, Pindyck included all of OPEC's members in the cartel and assumed that it behaves as a monopolist. With an additional source of supply, we replace equation (3.15) with

$$(3.17) \quad D_t = TD_t - S_t - ME_t$$

where ME_t is Mexican production as exogenous variable. Pindyck assumed that Mexican production rises yearly from one million barrels per day in 1975 to seven million barrels per day (2.55 billion barrels per year) in 1985, and further, it is assumed that its production declines with the same rate of depletion as in the competitive fringe.

Figure 3.2 shows the optimal price trajectories in these scenarios and the base case.[12] If Saudi Arabia, alone, or Saudi Arabia, together with a group of core countries, is left to bear the full burden of production cutbacks, the optimal price is significantly lower than it would

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otherwise be, particularly during the first fifteen or twenty years. For example, in 1985, the price is about twenty percent below that in the base case. The existence of Mexican oil tends to reduce the optimal cartel price, though less than ten percent and only after 1980. Observe also that the optimal cartel price is actually higher in the first one or two years if an increase in Mexican production is anticipated. This is because the incentive in Mexican production means that there is less to lose later on from a resulting increase in competitive fringe production and a decrease in world oil demand.

In this study, Pindyck found that if OPEC cannot arrange for distributing production cutbacks, a significant decline in the cartel price could be expected and cartel control over the market would be greatly reduced. Also, if OPEC can arrange successfully to distribute production cutbacks among all of its members, it could reduce the impact of Mexican production on the monopoly price, even though OPEC's share of the oil market would be reduced.

It appears that the results of the Pindyck model were not quite similar to what actually occurred (see Figure 3.2). First, the model predicted that, starting in 1975, the optimum real price of OPEC oil would drop until 1980 when it would begin increasing. This did not happen. In fact, since 1975 (except in 1978), the nominal as well as the real price of OPEC oil has increased.

One explanation of the deviation of the actual from the projected real price of oil can be that actual prices of OPEC oil were not the optimum price for profit maximization. Second, the model's prediction

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that if OPEC cannot arrange the distribution of production cutbacks, a significant decline in the cartel price could be expected was weak. In fact, only in 1975, 1978 and 1980 did the production of OPEC oil drop but the real price of OPEC did not decline except very slightly in 1978 (see table 2.2). Of course, these production cutbacks were due to the reduction of demand in 1975 and 1980 and the Iranian revolution in 1978, and not necessarily to OPEC arrangements. The world production of oil dropped in 1975 and 1980.[13]

In conclusion, Pindyck used a dynamic optimization model to explain the price behavior of the OPEC cartel facing oil glut due to Mexican production increases. Considering the demand for cartel oil as a residual and sensitive to price, he examined the optimum OPEC oil prices under different scenarios. He found that if OPEC cannot find a means of distributing production cutbacks, we could expect to observe a significant decline in the cartel price. He recommended that the United States should be doing whatever it can do to encourage greater Mexican energy production because, as he showed, the impact of increased Mexican production on OPEC's optimal price is not likely to be large, but it certainly would be noticeable and desirable for other reasons as well.

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OPEC Price Strategy: Summary and Conclusive Remarks

The actual and projected optimal prices of OPEC oil by Cremer-Weitzman and Pindyck are shown in Figure 3.3 for comparison. Both models' price projections are close to the actual real prices between

TABLE 3.3

BASE CASE SOLUTION*

t	Projected Price (in 1975 dollars)	TD	D	R	π_d (profit)
1975	13.24	17.24	9.94	488.5	126.5
1976	11.19	16.88	9.23	478.6	93.8
1977	10.26	16.72	8.94	469.3	78.9
1978	9.90	16.66	8.97	460.4	71.7
1979	9.82	16.66	8.91	451.5	67.9
1980	9.88	16.69	9.00	442.6	65.7
1985	10.84	16.96	9.67	396.3	60.6
1990	11.98	17.32	10.40	346.5	56.3
1995	13.18	17.74	11.15	293.0	51.8
2000	14.46	18.22	11.91	235.7	47.1
2005	15.92	18.75	12.66	174.6	42.5
2010	20.29	18.67	12.55	110.5	41.0

*Base Case refers to the scenario that OPEC members are cooperative in terms of production cutbacks and behave as a pure monopoly cartel.

Source: Pindyck, Robert S. "Some Long Term Problems in OPEC Oil Pricing." The Journal of Energy and Development. 4-2 (Spring 1979): 259-72.

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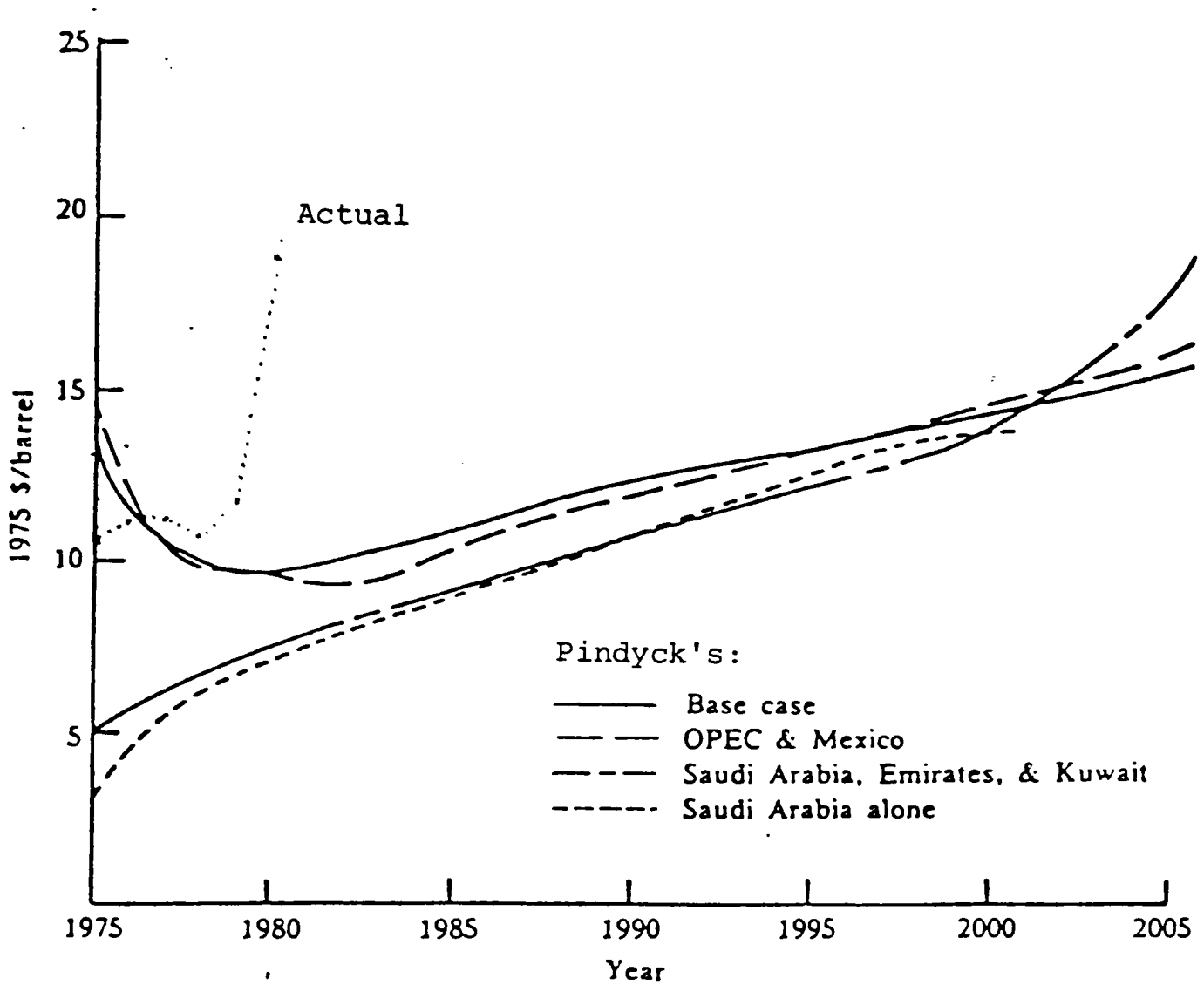

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FIGURE 3.2

COMPARISON OF THE ACTUAL WITH PINDYCK'S PROJECTIONS
OF OPEC'S REAL PRICES OF OIL

1975 to 1978; but in later years the projections are underestinated and the gap between these two widened.

As mentioned earlier, the major reason for the wide gap between the price paths of both models and the actual real prices was the short supply of oil due to the interruptions which were not included in either model. According to these models, with all of their assumptions and specifications, the recent high prices are not in the best interest of OPEC as a unit, in the sense of wealth maximization. Of course, when the assumptions of the models change, the argument is not necessarily valid.

One price strategy likely to serve OPEC very well in the foreseeable future, both in terms of yielding high profits and avoiding the dangers of greatly underutilized capacity, is the rule-of-thumb strategy which is relatively cautious about further major, abrupt price increases (36).

According to this strategy, oil prices increase only gradually when the market and economic conditions of the world warrant and are cut aggressively if necessary to defend OPEC's market position.

Since OPEC members do not have the same goals and objectives, and there are many differences among them, another price strategy suggested is based on a two part cartel group of OPEC (38). OPEC consists of two economic groups: "spender countries" and "saver countries" (38, 70). The "spender countries" of Iran, Venezuela, Indonesia, Algeria, Nigeria, and Ecuador have large cash needs and a higher rate of discount. Saudi Arabia, Libya, Iraq, Abu Dhabi,

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Bahrain, Kuwait, and Qatar, the "saver countries", have little immediate need for cash and would thus use a low rate of discount in their net present value of oil profits. The latter group also has considerably greater proven reserves than does the former group. The differences in proven reserves and discount rates reinforce each other and result in differences in desired policies for each group (38). The constraint in this policy is the agreement between the two groups and is based on their differences in objectives and bargaining power. Their negotiations will be over the allotment of output shares over time, because price strategy follows almost directly from output strategy.

Accordingly, the optimal output strategy is that saver countries must produce nothing for the first ten to twelve years.[14] Any deviation from this output policy results in losses, particularly for spender countries. But a compromise policy might be adopted, because it is not anticipated that OPEC members would agree to the suggested policies.

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OPEC Price Strategy and Elasticity of Demand

The oil demand elasticity measures have been different in different models and studies (33). The time frame, method of measurement, taxes, regulations, and other factors assumed can significantly affect the calculated value of the elasticity.[15] For example, at a price of six dollars per barrel for all sectors, Pindyck came up with the short-run and long-run price elasticities of 0.04 and 0.44, respectively (with a Koyck adjustment), while at a twelve dollar price he got the elasticities of 0.09 and 0.90, respectively (70). J. M. Griffin's (37)

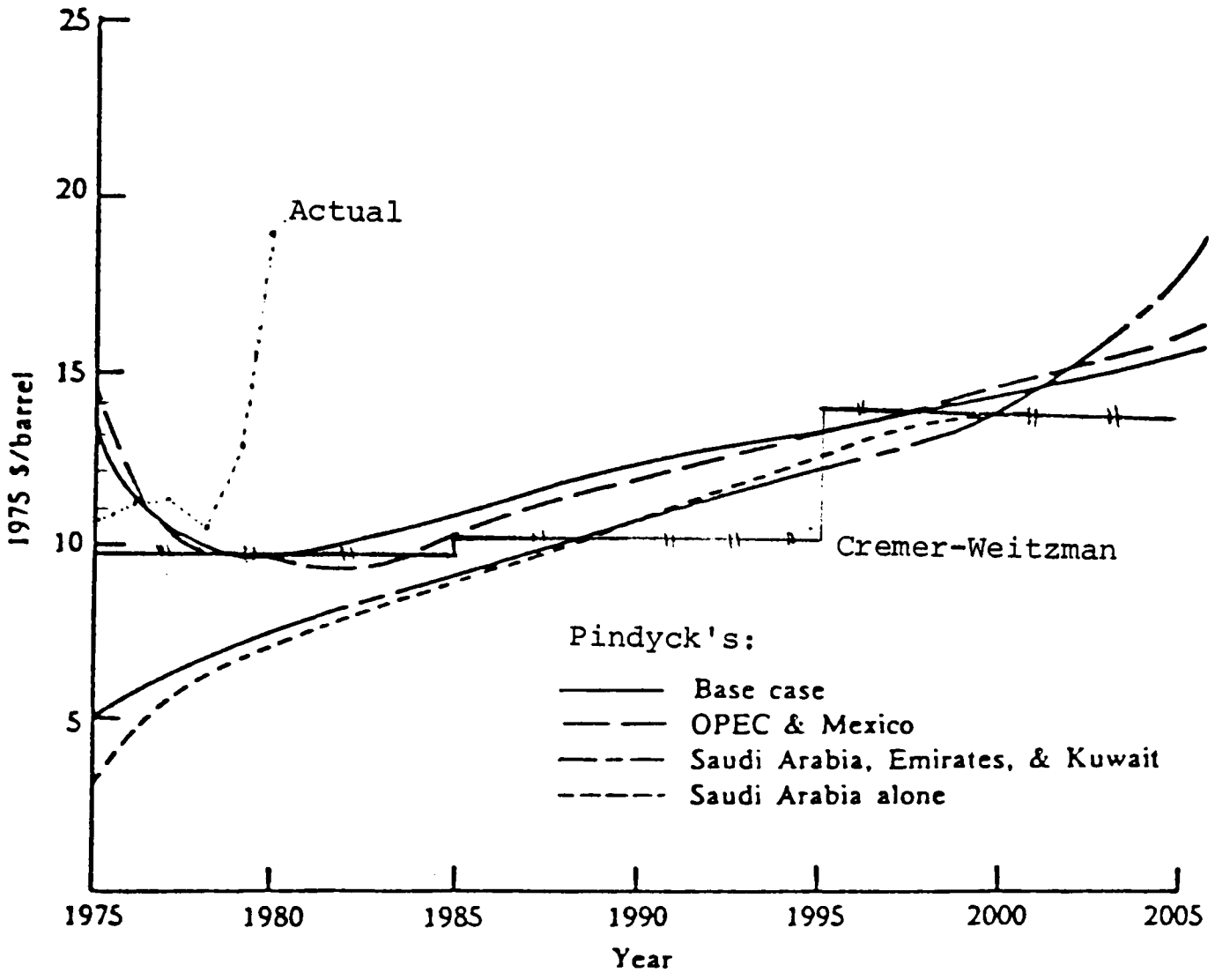

FIGURE 3.3

COMPARISON OF THE ACTUAL WITH CREMER-WEITZMAN'S AND PINDYCK'S PROJECTIONS OF OPEC'S REAL PRICES OF OIL

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results for the long-run price elasticities of demand are 0.5 for all sectors together and the transportation sector, 0.9 for the residential sector, and 0.3 for the commercial/industrial sector. Baughman-Joskow's figures for long-run elasticity of demand are 0.6 for all sectors together, 0.4 for industrial, and 0.8 for the residential/commercial sector (14).

Several reasons have been given for the low price elasticity of demand for oil, and placed in the familiar context of Alfred Marshall's determinants of elasticity. First, the lack of substitutes for oil is the major factor which makes the demand for oil inelastic. There are, as yet, no adequate substitutes for oil available in quantities sufficient to meet demand.

Second, the demand for oil is a derived demand for the production of other commodities. At this stage of technology, production of many important products, industrial as well as agricultural, is dependent upon oil (26). Furthermore, the demand for many of these products is itself inelastic (35).

Third, to the extent that the elasticity of supply of other factors of production is low the elasticity of demand for oil is low.

Fourth, at the same time that oil is crucial for the production of many commodities, the cost of oil as a portion of total costs of production is relatively low compared to the share of labor and/or capital costs (35). This relatively low portion of total cost for oil further makes the demand for oil inelastic.

However, in the medium and long terms, significant price increases by OPEC would eventually lead to higher elasticity, operating not only

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through the demand schedule of the individual consumers, but also through the policy reactions of the consuming nations which are probably a more important determinant of aggregate demand for energy and of the process of conservation, conversion and replacement by other substitutes (6).

Most evidence suggests that OPEC has gained market power it did not have before 1970, and it can be regarded as a cartel, even though a loose one. To be rational, OPEC should operate at a price and output level that maximizes its profit. The neoclassical "static theory" of monopoly suggests that OPEC, as a unit cartel or monopolist, maximizes its profits at a price and output to assure that the associated demand schedule is elastic.

But because of the known fact that the short-run price elasticity of demand for oil is less than one, it might be concluded that to be a rational profit maximizer, OPEC must cut production and increase its price to the elastic section of the demand schedule. In other words, in the short run, OPEC is simply losing profit at the current prices as long as the price elasticity of demand for oil is inelastic.

Those studies concerned with the optimal extraction of an exhaustible resource by a monopoly suggest that at each time period the monopoly price is necessarily elastic (70, 8). This argument, in a static sense, again contradicts the observed low price elasticity of demand, and the failure of theory to provide an explanation of OPEC pricing policies. However, these conclusions are based on the static model and in the short run and not in the long run. Yet, some other explanations are suggested.

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One attempt to explain OPEC's price and output strategy is called entry prevention by "limit price." According to this theory, a monopolist produces greater quantities and charges lower prices than the profit maximizing quantities and prices to discourage entry (15). An example of potential large scale entry for OPEC might be any substitute for oil, including synthetic fuels or raising domestic oil production in the United States by decontrolling the oil prices and/or other policies. Of course, most of these policies' impact relative to the size of the OPEC reserve are not significant.[16] However, the cost of synthetic fuel is still higher than current prices of oil.

Another explanation for the presumed lower price of OPEC oil than the monopoly cartel profit maximizing price is based on the concept of "endogenous uncertainty" (16). This idea is the probability of retaliatory action by the oil importing countries, including a military intervention, synthetic fuel and oil import taxes. The higher the price of OPEC oil, the higher the probability. Therefore, based on the endogenous uncertainty concept, OPEC seeks to maximize "expected" profits, under the uncertainty of the retaliatory action by the oil importing countries by charging lower oil prices than the profit maximizer monopolist.

The possible retaliatory action by oil importing countries does stem mostly from the gross national product (GNP) impact on the oil importing countries, rather than the oil price increase itself, because any price increase has a direct national income reduction impact in the oil importing countries. The wealth effect, transferring wealth from the oil importing to the oil exporting countries, is beyond the price

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increase impact. In other words, any price changes by OPEC are not a "zero sum game;"[17] they have more impact on the GNPs of the oil importing countries than the wealth transfer to the oil exporting countries.

Other attempts at explanation of OPEC price strategies are based on the consideration of OPEC as a group of countries with different goals, objectives, proved oil reserves, economic structures, political systems, populations and welfare functions. Because of these differences, a coordinated price and output policy is not fully possible and can result in the instability of the OPEC cartel. These differences in oil price setting by OPEC members recently are more evident. Saudi Arabia's position with respect to price and the level of output of oil vis-a-vis some hawkish members of OPEC, such as Libya and Algeria, in the recent OPEC meeting is an example of the result of the differences.

Finally, and more importantly, it can be argued that the OPEC price strategy based on the neoclassical static theory probably ignores the dynamic aspects of the profit maximization as wealth maximization. Even though it seems the observed price policy by OPEC contradicts the static model, considering the possible future substitutes, "endogenous uncertainty," lack of full coordination among OPEC members and others in the long run, it may be the optimum price policy.

Income elasticity of demand for energy in general, as well as for most specific uses, is high. In most cases, income elasticity is close to unity, and economic growth has a direct bearing on energy consumption (6, 65, 84). In their model, the Nuclear Energy Policy

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Study Group (65) used income elasticity of 1.0, both for electrical and nuclear sources of energy. Income is assumed to grow at 3.5 percent per year to 2000, 3.2 percent per year from 2000 to 2025, and 2.9 percent per year thereafter (65). According to the World Enerty Conference model (84), income elasticities are 0.95 in the OECD region and 1.1 elsewhere.

Pindyck's model provides a long-run income elasticity of 0.5, with a three percent real rate of growth in income (70).

There is a relatively strong, but not invariant, relationship between total energy requirements and GNP. Consequently, any pricing policy by OPEC and/or consuming nations' governments, through tax policies, cannot ignore the effects of prices on the economies of consumer states.

Cross elasticity of demand for oil is also important for any price policy by OPEC,[18] because changes in the prices of oil substitutes, like synthetic fuel, coal, and nuclear power, have impact on the demand for oil. However, due to the weak adaptability of substitution of oil for other sources of energy, cross elasticity of demand for oil is low. The Nuclear Energy Conference model arrived at the cross elasticity coefficient of 0.25 for oil versus non-oil sources of energy (65).

Summary

Usually, the "marker price" of oil is determined by the leading producer of OPEC, currently Saudi Arabia, in consultation with other member countries through the conference. Because of the conflict among OPEC members, sometimes price agreement is impossible and split prices

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happen. The forces of supply and demand in the international oil market determine the spot prices which always lead the price increases by OPEC.

Various price strategy theories and models on exhaustive resources in general and OPEC oil, specifically, have been suggested. Most of these models were not very successful for the projection of future prices of OPEC oil. There were many factors which made the projections of the models different from the actual price of OPEC oil, including the uncertainty factor, assumptions and specifications of the models.

According to the projection of the Cremer-Weitzman model, the real optimum oil prices should not change much in the next twenty years. The Pindyck model's optimum real price of OPEC oil almost follows the same price projections as those of the Cremer-Weitzman model.

The projected optimum prices of both models have had a significant gap from the actual real prices of OPEC oil since 1979. The explanation for this underprojection is due to the oil interruption of Iran, in 1979, which was not built into either model. However, if the optimum projected price paths of these models are correct, current high prices of OPEC oil are not in the interest of OPEC.

The magnitudes of elasticities of demand for oil are important for the price policies of OPEC. According to findings, the price elasticity of demand for oil is between 0.04 to 0.90, and income elasticity of demand for oil is between 0.5 to 1.1, depending on the specifications and assumptions, including the length of time for adjustment of different models.

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CHAPTER IV

INTERNATIONAL PRICING OF OIL: ALTERNATIVE MEASURES

Introduction

The international monetary system has gone through a new era since 1973, when the flexible exchange rate system emerged. The key to this switch was the oversupply and, consequently, the weakness of the United States dollar at that time. As a result, the flexibility and the fluctuations of the value of international currencies against each other made future contracts and trade less certain and costlier.

The experience of OPEC countries was no exception. As early as the beginning of the seventies, OPEC officials were concerned about the fluctuation and depreciation of the dollar. They expressed their concern in their resolutions and agreements with oil companies, and their intentions to switch from the current dollar-pricing system.[19]

The impact of world inflation and the relative depreciation of the United States dollar is the reduction of the purchasing power of OPEC. Even though the nominal price of oil may be increasing over time, the real price of oil could be declining due to the adverse effect of these two factors. The objective of OPEC has been to prevent this decline. In Figure 4.1, the nominal price of oil, P_N, is increasing over time, but the real price, P_r, is decreasing. One

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purpose of OPEC could be to prevent the deterioration of the real price of oil and rotate the curve upward to a price path like P_r, if not to P_N.

Another problem with the present OPEC pricing system is that its oil prices and revenue float with the dollar against other currencies. This results in instability of the price of oil vis-a-vis other currencies. The objective of OPEC is to adjust the price of oil to achieve more stability of the real price of oil in terms of other currencies. As can be seen in Figure 4.2, although the nominal price of oil might be increasing at a stable path, the real price due to the floating exchange rate system is not stable, which results in the instability of real oil prices.

This chapter outlines the problems of the dollar as the international medium of exchange, unit of accounts, and store of value, specifically for the price of OPEC oil. It explores the possibility of developing alternative baskets of currencies for transactions and the price of OPEC oil. It includes also a review of related studies and researches, and the statements of the hypothesis and plan of the dissertation.

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Dollar Pricing Problems

After World War II, most countries needed large amounts of materials and equipment to reconstruct their war ravaged economies. The only source, at that time, was the United States and the dollar was in great demand for the payment of the necessary purchases. On the other

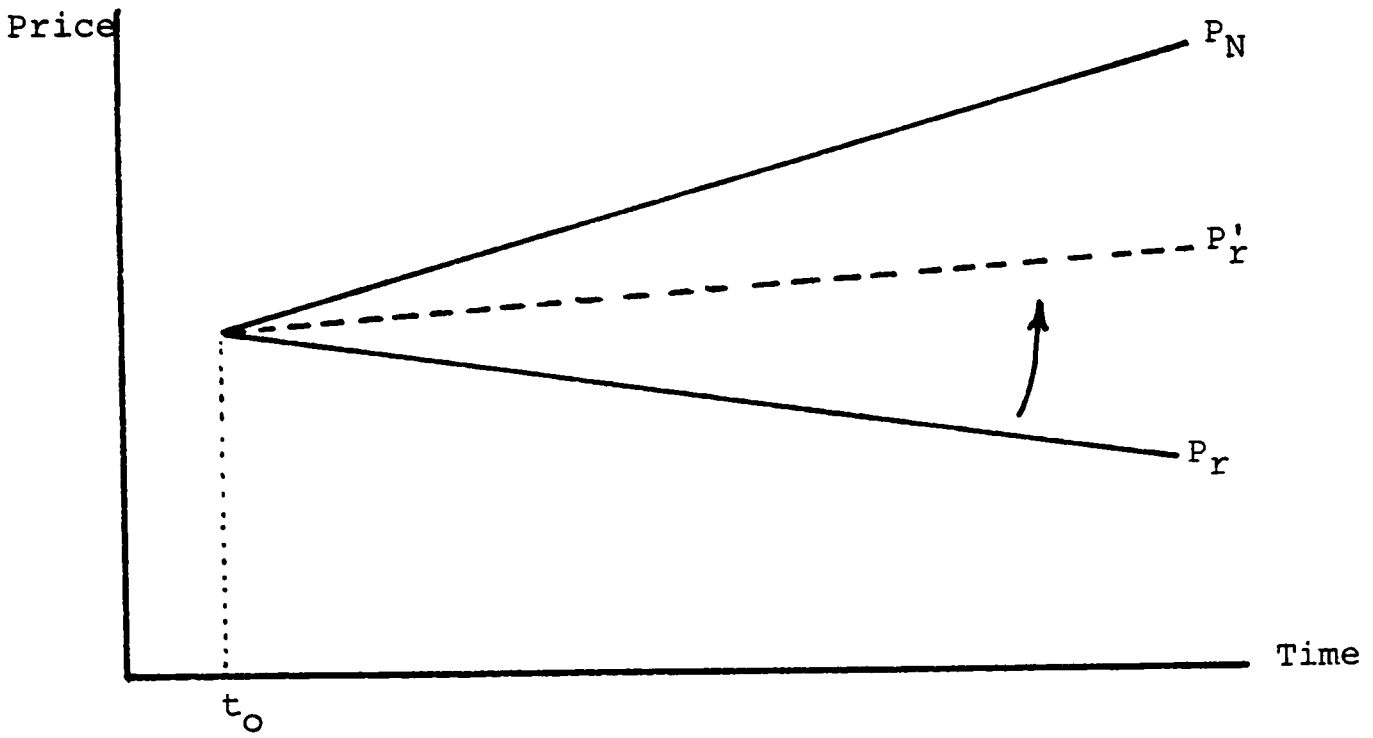

FIGURE 4.1

ADJUSTMENT OF THE PRICE OF OIL

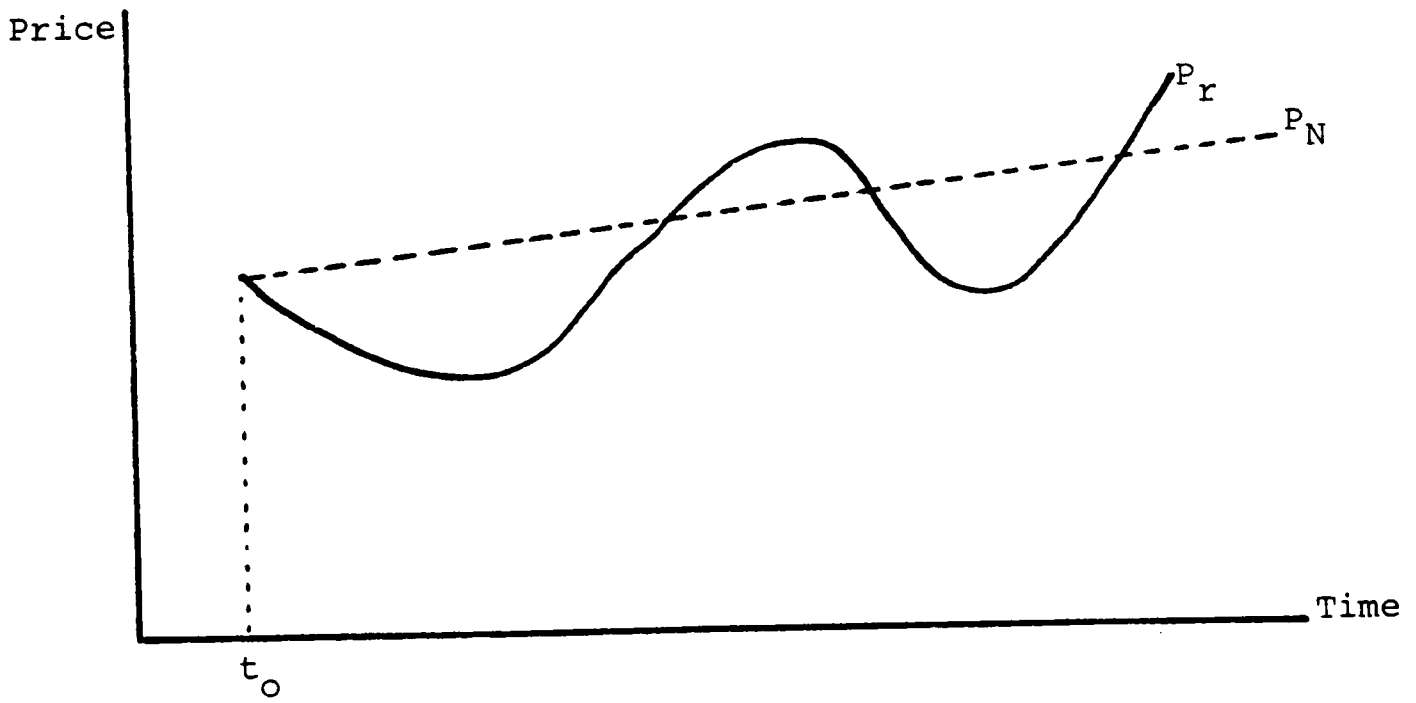

FIGURE 4.2

STABILIZATION OF THE PRICE OF OIL

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hand, the dollar as a reserve asset earned interest in the form of United States bank accounts, treasury bills, and others, and could be converted into gold at $35 per ounce (49).

However, gold reserves did not earn interest. In addition, many international transactions, not involving the United States, began to be financed and/or denominated in the United States dollar. In a sense, the dollar was increasingly assuming the function of gold as an international reserve asset, and banks throughout the world have been maintaining the dollar.

In the fifties, the dollar stood at the center of the gold exchange system and it was the only currency directly convertible into gold (75). With the establishment of the Bretton Woods pegged system, the reserves of most countries evolved into a mixture of gold and dollars, with the dollar assuming a growing role. Subsequently, the supply of the dollar grew and later accelerated to a greater degree, which eventually brought the dollar's weakness and the collapse of the Bretton Woods pegged system. The role of the dollar as an international reserve and money, which remains today, does not eliminate the fact of its weakness during some periods. Furthermore, it does not prevent foreign central banks from diversifying their foreign exchange reserve portfolios. The factors which are the major determinants of their portfolios of currencies are risk and return, which depend on exchange market intervention, interest rate, monetary policy and growth, and exchange rate arrangements.

OPEC and the multinational oil companies have always priced oil and made payments in terms of the dollar. Because of the role of the

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dollar, both as a denominator for pricing crude oil and as a medium of payment between the oil importing nations and the members of OPEC, any changes in the value of the dollar against other currencies has an impact on the real value of OPEC oil prices.

In the early seventies, when the dollar was weakening and depreciated twice, OPEC and the oil companies devised a formula (a basket of currencies) for the pricing of oil.[20] But, when OPEC quadrupled oil prices after 1973, the formula was not used. Although OPEC is setting its oil prices, members have complained about the depreciation of the dollar; yet, they have done nothing about it. But, recent comments by OPEC officials and the OPEC Secretary General indicate that OPEC may switch to another type of international pricing system for its oil. In a recent interview, the OPEC Secretary General said, "OPEC would abandon the dollar in favor of a basket of currencies."[21]

Because a large proportion of OPEC's past accumulated surpluses are invested in dollar denomination assets, the loss incurred as the result of dollar depreciation appears to be substantial (24). For instance, a uniform ten percent depreciation of the dollar against the currencies of other industrial countries will result in a loss of about eight percent in OPEC's real purchasing power and a loss of about $7.6 billion in asset value as calculated on OPEC's total foreign investment at the end of 1977 (9).

The impact of dollar depreciation is on the import cost of individual OPEC members. This impact on the costs of imports has not been uniform for all OPEC members (24), because of different trade linkages

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between OPEC members and industrial nations. Those members which have a close trade tie with countries whose currencies have appreciated against the dollar have been most harmed, while OPEC members which import large volumes from countries whose currencies have been depreciated relative to the dollar have been less adversely affected. This is one major conflict among OPEC members for switching from dollar pricing into any other currency system.

Therefore, as long as there are differences in the trade patterns of OPEC countries, and as long as there is no uniformity in the movements of industrial currencies, different OPEC members will be subject to different costs of exchange rate fluctuations.

Furthermore, OPEC oil revenues suffer from worldwide inflation, in general, and United States inflation, in particular. Table 4.1 shows the nominal as well as the real price of oil for different OPEC members for the period 1970 to 1981. The largest increases of nominal and real price of oil occurred in 1974. Saudi Arabian Light oil increased in nominal price from $2.10 to $9.60 per barrel; the real price of the same quality Saudi Arabian oil increased from $1.99 to $8.35 per barrel. From 1974 to 1979, even though the nominal price of oil increased, the real price of OPEC oil did not increase significantly, and in some years it actually decreased. This is due to the domestic inflationary impact in the United States on the purchasing power of OPEC's petrodollar revenues, and ignores the depreciation of the dollar. Obviously, individual OPEC members suffer from inflation differently, because of different trade ties between OPEC members and industrial nations.

In addition, due to the relatively inelastic demands for the industrialized nations' exports (food, industrial equipment, high-technology

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TABLE 4.1

PRICES[1] OF SELECTED FOREIGN CRUDE OILS, JANUARY 1, 1970-1981
(Dollars Per Barrel)

Year	Saudi Arabian Light-34° API		Iranian Light-34° API		Libyan[3] Es Sider-37° API		Nigerian[4] Bonny-37° API	
	Current	Constant[5]	Current	Constant[5]	Current	Constant[5]	Current	Constant[5]
1970	1.35	1.48	1.36	1.49	2.09	2.29	2.10	2.30
1971	1.75	1.82	1.76	1.83	2.80	2.92	2.65	2.76
1972	1.90	1.90	1.91	1.91	2.80	2.80	2.80	2.80
1973	2.10	1.99	2.11	2.00	3.10	2.93	3.10	2.93
1974	9.60	8.35	10.63	9.25	14.30	12.44	12.60	10.96
1975	10.46	8.33	10.67	8.50	11.98	9.54	11.80	9.40
1976	11.51	8.71	11.62	8.80	12.21	9.24	12.84	9.72
1977	12.09	8.65	12.81	9.16	13.74	9.83	14.33	10.25
1978	12.70	8.46	12.81	8.54	13.80	9.20	14.33	9.55
1979	13.34	8.20	13.45	8.26	14.52	8.92	14.82	9.10
1980	26.00	14.66	[2]30.37	[2]17.12	34.50	19.45	29.99	16.91
1981	32.00	18.04	37.00	20.86	40.78	22.99	40.02	22.56

[1]For periods prior to mid-1974, contract selling prices are shown. The listing of official selling prices for subsequent periods includes premiums or discounts in cases where they were clearly defined and applicable to all clients.

[2]Price for 1980 includes $1.87 market premiums and credit charges.

[3]Prices for 1974 and 1975 are for 40 degrees API gravity. Price for 1980 includes $4.72 in retroactive charges and market premiums.

[4]Prices from 1977 forward include 2 cents harbor dues.

[5]Constant 1972 dollars using GNP average annual implicit price deflator. 1972 = 100. See Units of Measure, Conversion Factors and Energy Equivalents Section, January 1, 1981, based on 1980 average annual price deflator.

Source: Energy Information Administration, 1980 Annual Report to Congress, April 1981, page 97.

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machinery, and arms), the higher prices do not significantly impact on their quantities of exports to less developing countries, including the members of OPEC.

Given these problems of the fluctuation and reduction of the purchasing power of OPEC oil prices due to the floating exchange rate system and the depreciation of the dollar, OPEC has two alternatives. The first is to prevent the reduction and the fluctuation of the purchasing power through a forward foreign exchange market. The second alternative is to switch from the current United States dollar pricing system to a basket of currencies. In this dissertation, we have concentrated on switching to the currency basket price of oil. The currency basket pricing of OPEC oil does not resolve the world inflationary impact. However, OPEC may add an inflationary index to the basket measure for the problem of inflation.

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Functions, Uses and Criteria of a Currency Basket

Since the establishment of the floating exchange rate system in the early seventies and large variations in foreign exchange rates, international financial and business institutions have been exposed to exchange rate risks. This risk of gains or losses in a given period can be greater than gains or losses derived from international investment. As a result, much attention has been given to the choice of currency in which investment is to be held as a part of investment strategy.

While the records of forecasting exchange rates of some experts are better than others, the desired degree of accuracy has generally

been rather poor (51). One alternative to the exchange rate risk is through hedging in the foreign exchange forward market.

Another alternative for reserve holding is the portfolio approach to multiple currency choice, similar to the domestic portfolio diversification approach for investment. Simply, the portfolio diversification is based on three factors: the expected return associated with that asset, the risk that is associated with each individual asset, and the relationship and correlation of all assets in the portfolio to each other (50).

Based on available data, it appears that both banks and non-banking firms are moving toward the basic principle of portfolio diversification of currencies of lower risk and/or higher return than undiversified holdings in any single currency (51). International institutions may rather diversify their currency portfolio than attempt to eliminate exchange rate risks by hedging of long and short positions in the same currency (51).

One of the major functions of a currency basket (diversification) is the store of "real" value and diminishing the value determination impact of a depreciation of one single currency. This was the case explained in Figure 4.1. Another function of a currency basket is the stability of the value. That is, the reduction of the impact of a sharp depreciation, or appreciation, of one currency in the basket. This is the case explained in Figure 4.7.

For instance, a currency with a weight of twenty percent in the basket which depreciated ten percent relative to all other currencies

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actually depreciated by ten percent relative to twenty percent of the value of the basket. Therefore, the value of the depreciated currency in terms of the basket decreased by only

.10 x (1 - .20) = .10 x .80 = .08 or 8%

and the value of the basket depreciated by only

.20 x .10 = .02 or 2%

rather than ten percent.

The higher the weight of a currency in a basket, the more the impact of the depreciation on the value of the basket, and vice versa. The value of the currency basket, as an asset, would be determined by the balance between depreciation and appreciation of other currencies. In the case of worldwide inflation, to keep the value of the basket as an asset at least constant, the basket must be adjusted by some type of inflationary index.

The composition of a basket remains the same, unless it is changed by the authorities. But, as the exchange rates change relative to each other, the value of the basket and the relative weight of each currency in the basket change. The value of a basket can be expressed in terms of any currency, simply through the exchange rate.

A basket of currencies, designed only as a unit of account, is much easier to use and does not need any acceptability by international financial communities other than those who are involved contractually. In that case, its value as a yardstick is converted into one single currency. It does not have to be issued and it does not have to be a tangible asset or credit entry, but is only a unit measurement which does not have problems with the rate of return on that basket.

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The implication of a new currency basket as only a unit of account is that it will not result in a reduction of the international demand for reserve currencies, especially the dollar. The basket is only being used as a unit of account and must be converted into another currency, most likely the dollar which is currently the primary international reserve currency. In other words, as a result of a new currency basket which is used as a unit of account, the role of the dollar as a reserve currency, with all of its past or potential weaknesses, will continue and will not diminish.

If the purpose of the currency basket is more than a unit of account, the issuer should have international credibility. The basket must be backed by sound assets, acceptable worldwide, and not simply issued as a fiat asset. Otherwise, the basket will not be continued. Its success would be doubtful and its termination inevitable.

If a basket of currencies is being used not only as a unit of account, but as a store of value, it must be competitive with other individual currencies as well as other baskets and assets in terms of the expected real return for the same degree of risk of exchange variation. To promote and motivate international financial communities to hold the currency basket, the issuer must carefully adjust the interest rate on the basket so that there is not a large gap between its return and other comparable assets. The composition and the weights of the currencies, themselves, are important determinants of the real return (besides the interest rule, if any) and the degree of risk of the basket.

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Practically, the most use of a currency basket is for the future (like repayments of bonds), transactions (like price contracts for future trade), and pegging of domestic currencies. The purpose of choosing a currency basket, instead of a single currency, in transactions and pegging, is mostly to reduce the large variation of impact of the price change of single currencies in payments and domestic economies, and the store of real value of the payments.

Generally speaking, a basket of currencies must be based on some criteria which are derived from the goals and purposes of the basket. If that is not the case, the basket cannot achieve its purpose and would be useless and its continuity would be doubtful. The criteria for the design of a currency basket reflect on the composition and weights of the currencies and real return on the basket.

The volume of international trade of countries has been widely used as the major criterion for the design of currency baskets. The volume of international trade of each country in the world and trade among the countries of the European Economic Community have been used as the criteria for the design, composition, and the proportional weights of the SDR basket of IMF and European Monetary Unit (EMU),[22] respectively. The weight of the United States dollar in the SDR basket was adjusted even higher due to the unique international role of the dollar. This "international role" can also be considered as a criterion for the weight assignment of the currencies in a basket.

There is a direct and almost proportional relationship between the size of international trade of a country and the demand for the currency

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of that country, other things being constant. Therefore, a higher weight given to the currencies of a basket which have more demand versus the ones which have less demand in the international market can bring more stability of price to the basket. This stability is beyond the one that a basket can provide by its nature, which was explained earlier.

Another criterion which may be used for the weights of the predetermined currencies in the basket can be the exchange rate variations of the currencies, so that the highest or lowest weight is given to the currencies with the lowest or highest exchange rate variation respectively. According to this criterion, the emphasis of the basket is more on the currencies whose exchange rates have less variation, and this results in more stability of the price of the basket.

Both of these criteria of "trade" and "exchange rate variation," especially the latter, have the practical problem of the lack of future knowledge of those measures. That is, a basket which is designed and weighted based on past data and measures may not necessarily be a guide for the future. This is especially true for the exchange rate variation criterion, but may not be too significant for the trade criterion, because, with some extraordinary exceptions, the size of trade of countries has much less variation than the exchange rates of their currencies.

If the purpose of a currency basket is for investment (like a bond), to be competitive, another criterion is the rate of return on the basket in terms of interest rate. To attract investors, the issuer of the basket bond (which is priced in terms of a composite of currencies at the maturity date) must pay a competitive interest rate.

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Since we are living in a dynamic world where most things are changing rapidly, so do the criteria upon which the basket is based. Consequently, the usage of any basket is not permanent; but how often the basket should be changed, because of changes in the criteria, is of major concern. The change of the compositions and weights of the basket itself is a source of instability. Any basket should be designed to last as long as possible, or for the period for which it is designed and for which it best serves the purpose(s). Experience with the Special Drawing Right as a basket of currencies, which has been revised twice, as we will see later in this chapter, is a good case.[23]

In sum, different criteria based on different purposes may be used for the design of a currency basket. The major purposes of a currency basket are the stability and the preservation of the real price of the basket against one single currency in future payments and transactions.

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The Formation of Currency Baskets

The idea of a basket of currencies in transactions is not new. As early as the late Middle Ages, when every kingdom, principality, and small town had its own currency, such artificial currency units as the Mark-Banco of Hamburg and the Florin-Banco of the Amsterdam Wissel Bank were generally used to settle accounts in international trade (10).

By the end of the nineteenth century, however, the old types of artificial currency units had practically disappeared, because the gold standard made possible both monetary stability and smooth settlements in international trade.

After World War I began, instability among national currencies developed, and the emergence of some international institutions and treaties for provisions of some baskets of currencies reappeared (10). For example, from its inception in 1930, the Bank of International Settlements has expressed its financial statements in an artificial currency unit that has a gold weight of .29032 grams of fine gold per unit, which corresponded to the gold content of one Swiss franc before its devaluation in 1936 (10). The European Payments Union, which commenced operation on July 1, 1950, adopted an artificial currency unit called European Unit of Account (EUA)[24] which had a gold weight of .88867 grams of fine gold per unit (10).

Since early times, generally two groups have created some type of basket currencies. The first group is private institutions, mostly private banks, using currency baskets for financial activities. The second group is official institutions which mainly use the basket for official financial settlements. The private currency basket was primarily used before the nineteenth century for international transactions and trade. Wide official use of the basket concept in terms of gold started in the late 1950's and early 1960's for government agreements and settlements (10).

There has been an active exchange of ideas between these two groups. One of the latest examples is the case of the IMF's SDR which consists of a composition of currencies, and is patterned after the basket currencies framework of the Eurco, a private initiative (10).

The SDR basket, as a unit of account, is being used for private contracts and international treaties and by other international organizations, such as the African Development Bank, the Arab Monetary Fund, the Asian Clearing Union, the economic community of west African States, the Islamic Development Bank, and Nordic Investment Bank (42).

Benefits of a Currency Basket to OPEC

Stable Oil Prices

Stable real prices is the most achievable objective of substituting for the United States dollar a currency basket for the price of oil. But the degree of the stability of price resulting from use of a basket depends on the number, composition, and weight of the currencies of the basket, as well as the structure of the trade partners of each OPEC member.

If the OPEC members use a basket of currencies similar to the average compositon of their imports, they would expect stability in the purchasing power of their oil price for imported goods and services. At present, while the price of oil is in terms of the dollar, if any OPEC member imports only from the United States, it would not have any problem of instability of purchasing power for its imports. If, on the other hand, an OPEC member does not import from the United States at all, but imports from other industrialized countries with high variations of their currencies vis-a-vis the dollar, the OPEC member's revenue is subject to the highest variation in terms of its purchasing power.

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The stability to be expected as a result of a currency basket would suggest that oil prices would not respond significantly to changes in exchange rates. This conclusion is appropriate and valid if the numbers and composition, as well as the weights of the currencies in the basket, correspond to the composition and size of the OPEC member's imports from industrialized nations.

As mentioned earlier, while a currency basket might protect the OPEC countries from price changes of their imports owing to exchange rate changes, it would not protect them from price changes due to inflation in the industrialized nations. To protect against the inflationary impact on the price of imports and allow the use of an automatic rule rather than frequent oil price increases for inflation, some kind of composite price indices, or individual price index, of major western countries might be used.

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Dollar Depreciation Protection

Because of widespread skepticism about the future of the dollar, based on the dollar "overhang" accumulated as a result of past United States' deficits in other countries or assets abroad, the dollar depreciated during the early seventies against many of the other major currencies. At the end of 1978 the dollar overhang, as a stock indebtedness, was more than $260 billion for the United States Treasury and the head offices of American banks, plus nearly $170 billion of liabilities to foreigners of the overseas branches of United States banks; the total of $430 billion should be compared with $78 billion at the end of 1969 (83). The total dollar and Eurodollar liabilities

of the United States banks ($89 billion) and their offshore branches ($101 billion) and of European Banks including United States branches ($299 billion) in September, 1978, totaled $489 billion, plus edly, a portion of the $57 billion liabilities of Canadian and Japanese banks (83).

The reaction to the dollar weakness and the possibility of future further depreciation of an already vastly overvalued, overcompetitive dollar came not only from OPEC members. The European Monetary System was another response to this phenomenon (83, 85).

It is argued that if the European Monetary System will be "well" established, most other countries of Western Europe, the Middle East and Africa are likely to associate themselves with it (83). The substitution of the European Currency Unit for the dollar, of course, would reduce the United States' deficit financing facilities.

A currency basket for the price of OPEC oil, with or without the inclusion of the dollar, can at least partially offset the impact of the possible depreciation of the dollar.

Less Publicity of Higher Price Negotiations

Each time representatives of OPEC gather to determine a new price for their oil, they are under worldwide public opinion pressure for their decision. Even if the higher price of oil is simply due to higher rates of inflation in industrialized nations, the political impact is significant. Some of the oil-importing countries blame higher oil prices as the "cause" of inflation or recession rather than the "effect" of inflation. The currency basket will remove, or at

least reduce, worldwide pressures and the campaign against OPEC, and let OPEC adjust its price of oil with less publicity.

Price increases based on any measure, including a currency basket, are politically more convenient because of the argument that oil prices are only being adjusted for exchange rate changes.

Rules versus Authority

At the present time, OPEC raises the price of oil frequently through meeting and voting which depend on the balance of the political atmosphere of the members and the leading member countries, like Saudi Arabia, which dominate. This means members of the organization do not follow a specific rule for price determination, but it is a matter of political bargaining by authorities.

The currency basket will substitute rule for authority and at least reduce, if not eliminate, the discretionary price increases. The price of oil will be changed on the basis of a "rule" of the changes of the exchange rates and/or some inflationary index. This advantage might be regarded as a loss for some OPEC members who want to use price increases as political clout.

Problems of a Currency Basket to OPEC

Different Investment Portfolios and Wealth Loss

Because of the lack of absorptive capacity of oil revenues by some OPEC members, their surplus funds are being invested in different money and capital markets. On the other hand, other OPEC members are net borrowers for domestic as well as defense programs. As a result of different investment structures and differences in net borrower

vis-a-vis net lender positions among OPEC members, the motivations for switching to a basket of currencies for the price of oil are different. Table 4.2 presents the OPEC current account surplus from 1972 to 1980 as a flow of funds. As can be seen from this table, with few exceptions, the surplus fund for OPEC as a whole has an upward trend.

Those OPEC members with less absorptive capacity for spending their oil money have huge investments which mostly are in the denomination of the dollar. One reason for the investment in the denomination of the dollar is that the United States dollar still is the major world currency. Another reason is that the United States' money and capital markets are the largest and one of the safest markets in the world.

Table 4.3 presents the net external assets of OPEC countries for 1976 and 1977 as a stock for different members. As is shown in this table, one group of countries had a net external liability of about $13 billion in 1976 and $15 billion in 1977. In contrast, another group had net external assets accounting for about ninety percent of OPEC's $155 billion net external assets in 1977 (24). Because a predominantly high portion of these assets or debts are denominated in terms of the United States dollar, any depreciation of the dollar will confer a substantial loss or gain to the surplus or deficit countries. It will hurt the surplus nations by eroding the purchasing power of their dollar holdings, but, at the same time, it will benefit the deficit countries by reducing the real value of their dollar-denominated debts (24).

TABLE 4.2

OPEC CURRENT ACCOUNT SURPLUS
1972-1980

Year	Current Account Surplus (billions of $)
1972	2.0
1973	5.7
1974	64.7
1975	30.4
1976	36.3
1977	29.5
1978	9.5
1979	55.0
1980	95.0

Sources: For the years between 1972-1978, OECD Economic Outlook, July, 1978. Years of 1979-80 are estimated from key assumptions made by W. J. Levy in his article,"Recycling Surplus Petrodollars Via International Issued Indexed Energy Bonds," in Middle East Economic Survey, April 7, 1980.

TABLE 4.3

NET EXTERNAL ASSETS OF OPEC COUNTRIES
(in billions of United States dollars)

Country	1976	1977
Kuwait	25	31
Qatar	4	5
United Arab Emirates	12	16
Saudi Arabia	56	120
Algeria	-3	-4
Ecuador	--	-1
Gabon	-1	-1
Indonesia	-9	-9
Iran	18	22
Iraq	5	7
Libya	6	8
Nigeria	5	3
Venezuela	9	10
Total	126	155

Source: Morgan Guaranty Company, World Financial Markets (New York), November, 1977.

Therefore, one of the most important arguments concerning a shift from the dollar to a currency basket for the price of OPEC oil is based on the fear of further depreciation of the dollar and the loss of wealth by those OPEC members whose surplus funds are invested in the denomination of the dollar.

Obviously, if the dollar depreciates, for whatever reason, its conversion into other currencies will result in a loss to OPEC members who have external assets and in a gain to OPEC members who have external liabilities. The degree of losses or gains is more pronounced for OPEC members with a higher degree of concentration of their assets or debts in terms of the dollar than for other member countries.

OPEC's Diverse Economic Structure

All OPEC members do not have the same economic structure. Some are predominantly consumer economies which import almost everything except oil and which would be in serious trouble without oil revenues. As a result of this condition, they are even more dependent on oil than the oil importing nations. This makes their governments politically vulnerable to powerful countries such as the United States, especially due to the fact that the United States is the major oil importing country in the world.

While the dependence on oil applies to all of OPEC, some members have a greater absorptive capacity and are able to produce and develop in areas other than oil. Therefore, because of the variations in the degree of dependency on oil revenue and structure of the economies of

different OPEC members, their willingness to switch to a currency basket politically as well as economically is not the same.

Loss of Political Clout

There is no doubt that OPEC is gaining political power in the international scene based on, and proportional to, the economic power of oil. At the same time, as a result of this economic power, they face conflicting objectives, domestically and internationally. Some OPEC members would prefer to keep the present system of oil pricing in terms of the dollar rather than a currency basket, because of the political power gained by raising prices of oil and/or the idea of oil price increases being coordinated with the condition of the world economy in general and the United States economy in particular. This is another factor which contributes to the resistance among OPEC members to the currency basket idea.

Disagreement on the Basket

Even if OPEC decides to substitute a currency basket for the dollar, the selection of the composition and weights of the currencies in the basket is a problem. The problem arises from the fact that each OPEC member has different trade, economic and political ties with different industrialized nations. Also, an optimum currency basket for OPEC as a whole might not be optimum for each individual OPEC member. However, on the basis of the past ten years' experience, switching from the dollar would have been beneficial to all OPEC members, but to a different degree.

Ex Post versus Ex Ante

Ex post, it is easy to determine the best composition and weight of a basket for the price of oil, given some objective function. But, ex ante, it is difficult and past experience might not be a true indicator for the future. This problem, though still existing, can be diminished by some periodic adjustment of the basket composition and/or its weights.

Effect on Oil Importing Nations

It might be argued that the oil importing countries are going to have a major problem in using a currency basket price of oil. The technical problem arises because it becomes necessary for them to take as many forward positions as the number of currencies in the basket to hedge against the variation of the price of oil in terms of their currencies. This is costly, and there will be some opposition from oil exporting countries to a currency basket for this reason.

Under the present system, each oil importing country, except the United States, can hedge only against the dollar; but, with the basket of currencies, the hedge must be against the number of currencies in the basket.

As far as the United States and the future of the dollar are concerned, the situation is different, because the present price of OPEC oil is in terms of the dollar. The shift from the dollar might bring some problems for the dollar, at least for a short period of time. As a result of the switch, the value of the dollar might drop, and that

could lead to further movement out of the dollar and make the dollar price of oil higher.

At present, the United States is immune to increases in oil costs due to the depreciating dollar, which explains in large part the inelastic response of United States imports to increases in foreign exchange costs (31). A currency basket could eliminate the United States' shield, depending on the weight of the dollar in the basket. Then, depending on the price elasticity of demand for oil, the United States' balance of payments position may be either helped or harmed (31).

The Nature of a Currency Basket

The Case of SDR

The Special Drawing Right (SDR) was created formally on January 1, 1970, for the purpose of increasing international liquidity (71). One SDR, equal to one United States dollar, had the same fixed gold content of 0.8886 grams of gold as the original European Unit of Account (EUA) did. SDR value, in terms of its gold content, did not change by devaluations or revaluations of different currencies. The 0.8889 grams of gold as the value of one SDR was linked to other currencies. Subsequently, the International Monetary Fund (IMF) set the value of the SDR in terms of the par value of the dollar, to set the value of the SDR in terms of other currencies (10).

The floating exchange rate system which started in 1973 caused the value of the dollar and, consequently, the value of the SDR, which was in terms of the dollar, to fluctuate widely vis-a-vis other currencies. Furthermore, the value of the SDR, which was linked to the

dollar, dropped due to the depreciation of the dollar in terms of other major currencies.

As a result, there was growing support to convert the value of the SDR in terms of a basket of major currencies rather than to only one currency, the dollar. It was believed that the change should make the SDR relatively "stable". Consequently, the IMF adopted the method of valuing the SDR in the market value of a basket of sixteen currencies.

The value of the basket in terms of any individual currency can be obtained by the addition of the value of each currency in the basket in terms of that currency. In the SDR, as a basket of currencies, which was announced on July 1, 1974, the United States dollar share was $0.40, Germany's mark was DM 0.38, etc. The basket consisted of sixteen currencies, based on the volume of world trade. It included the currencies of those nations representing one percent or more of total world exports during 1968-1972. Table 4.4 shows the dollar value of exports of goods and services, the relative share of the total exports, and the derivation of the actual weights of the currencies in the SDR basket. There was some adjustment for the dollar's weight from 21.2 percent to 33.0 percent, because of the dollar's role in world trade and liquidity. Column five shows the distribution of the dollar value of SDR, equal to $1.20635 on June 28, 1974. In column six, the dollar exchange rate vis-a-vis the other fifteen currencies in the basket is presented. Dividing column five, the dollar value of each currency in the SDR basket by the dollar exchange rate vis-a-vis the other fifteen currencies in the basket, will give us the units of each currency per SDR basket (see column seven).

TABLE 4.4

SDR WEIGHTING--DERIVATION

Currency	Exports of Goods and Services 68-72 Avg. (1)	Share of Total Exports (2)	Share to Total--Adj. to U.S.-33% (3)	Actual Weight (4)	US $ Value with 1SDR --$1.20635 (5)	US $ Exch. Rate--6/28/74 (6)	Currency Units Per SDR (7)
	billions US $	percent	percent	percent	col. 4 x $1.20635	US $/unit	col. 5 ÷ col. 6-units
U. S. dollar	62.54	21.1	(33.0)	33.0	.4000	---	.40
Deutsche mark	43.45	14.7	12.7	12.5	.1508	.3922	.38
Pound sterling	36.44	12.3	10.5	9.0	.1086	2.3895	.045
French franc	25.07	8.5	7.2	7.5	.0905	.2065	.44
Japanese yen	23.99	8.1	6.9	7.5	.0905	.003522	26
Canadian dollar	19.99	6.8	5.8	6.0	.0724	1.03025	.071
Italian lira	19.70	6.7	5.7	6.0	.0724	.001547	47
Netherlands guilder	15.10	5.1	4.3	4.5	.0543	.3758	.14
Belgian franc	12.59	4.3	3.7	3.5	.0422	.02681	1.6
Swedish krona	8.09	2.7	2.3	2.5	.0302	.2272	.13
Australian dollar	5.80	2.0	1.7	1.5	.0181	1.4925	.012
Spanish peseta	5.15	1.7	1.4	1.5	.0181	.01748	1.1
Norwegian krone	4.83	1.6	1.4	1.5	.0181	.1839	.099
Danish krone	4.69	1.6	1.4	1.5	.0181	.1664	.11
Austrian schilling	4.38	1.5	1.3	1.0	.0121	.0548	.22
South African rand	3.99	1.3	1.2	1.0	.0121	1.5025	.0082

Source: Eaker, Mark R. "Special Drawing Rights and the Pricing of Oil." Journal of World Trade Law. (January-February 1979): p. 29.

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The value of a basket, like the SDR basket, in terms of other currencies can also be arrived at through the exchange rate between currencies. For instance, if

$1 = SDR 0.828948

then

$1.20635 = SDR 1.

If the exchange rate between the dollar and German mark is

$1 = DM 2

then the SDR value of the DM (one deutsche mark)

DM 1 = .828948/ 2.00

= SDR 0.414474

On July 1, 1978, due to the change in the size of international trade of Saudi Arabia and Iran, the composition of the SDR basket changed. The change replaced the Danish krone and South African rand with Iranian rials and Saudi Arabian rials. This new basket of sixteen currencies is based on statistics of world exports for the period 1972-1976 accompanied with a few changes in the weights of some currency. Also, the amount of each of the currencies in the revised basket is such as to keep the value of the SDR in terms of any currency exactly the same as at the time of the basket revision (71). The composition and the weights of the 1978 and 1974 SDR baskets are shown in Table 4.5.

The SDR usage has broadened in the private sector as it became more familiar to people, though still it is in the early stages of use. Also, its usage is limited to "a unit of account" and "a medium of exchange" only for official IMF transactions (42).

TABLE 4.5

COMPARISON OF COMPOSITION AND WEIGHTS OF 1978 AND 1974 SDR BASKETS

	Units of Each Currency		Weight Percent	
Currency	1978	1974	1978	1974
U. S. dollar	0.40	0.40	33	33
Deutsche mark	0.32	0.38	12.5	12.5
Japanese yen	21	26	7.5	7.5
French franc	0.42	0.44	7.5	7.5
Pound sterling	0.050	0.045	7.5	9
Italian lira	52	47	5	6
Netherlands guilder	0.14	0.14	5	4.5
Canadian dollar	0.070	0.071	5	6
Belgian franc	1.6	1.6	4	3.5
Saudi Arabian riyal	0.13	...	3	...
Swedish kfona	0.11	0.13	2	2.5
Iranian rial	1.7	...	2	...
Australian dollar	0.017	0.012	1.5	1.5
Danish krone	...	0.11	...	1.5
Spanish peseta	1.5	1.1	1.5	1.5
Norwegian krone	0.10	0.099	1.5	1.5
Austrian schilling	0.28	0.22	1.5	1
South African rand	...	0.0082	...	1
			100.0	100.0

Source: Polak, J. J. "The SDR as a Basket of Currencies." IMF Staff Papers. 26-4 (December 1979): p. 640.

Problems with the SDR

Since the SDR has converted into a currency basket, a "substitution account" administrated by the International Monetary Fund (IMF), proposed that holders of existing United States dollar balances could exchange them for SDR-denominated claims (51). The purpose of the account was to affect the composition of reserves rather than their level, presumably from the outstanding dollar into SDR-denominated claims.

But, as long as the substitution account holdings are voluntary, SDR proportions in optimally diversified official reserve asset portfolios might be smaller than originally thought and intended by the IMF. Because of the managed floating exchange rates, a movement toward a multiple reserve asset system, with or without a substitution account, has been underway and is expected to continue (50). This phenomenon is based on the fundamental and institutional problems with the SDR.

One problem with the substitution account was that the yield on the two alternatives of the SDR and the United States dollar was not the same, even though the basic purpose of the two as international liquidity was the same. The yield on the SDR was determined by a fraction of weighted short term money market rates in the United States, West Germany, United Kingdom, France, and Japan. The weight for the rate in the United States is forty-nine percent, in West Germany eighteen percent, and for the other three, eleven percent each (42). Because IMF only paid a fraction of the computed weighted

market interest rate on existing SDR assets, this yield was not generally comparable to that obtainable by investing directly in currencies (51).

A second problem is that the SDR, as a substitution account, has a problem of liquidity. Because the SDR is not traded and used in private markets, it could not be used as an intervention medium by central banks (51). To interfere in the exchange markets by central banks, some currency balances would be needed, and due to the conversion costs, among other things, the tendency toward a multiple reserve asset system was inevitable.

Third, the obstacle to institution and promotion of the SDR as a substitution account is the financial solvency of the account itself. This is due to the fact that it is not backed by any of the IMF's own resources, but is backed by dollar assets. If the yield on the SDR account increases higher than the account's dollar assets, the IMF will lose; and if that continues for a prolonged period, "then the SDR's solvency would be possible" (51).

Finally, if the dollar falls relative to the SDR, it can result in the same problem of a financial loss to the IMF.

Because much of the account's assets would consist of United States Treasury claims, it has been suggested that the United States provide a guarantee for the account's soundness. But this means the United States government and taxpayers would pay higher interest to the account than the other holders of government securities, which would be politically impossible.

Another suggestion for the solvency problem which has opposition from the developing countries was to guarantee the SDR-denominated claims with some portion of the IMF's gold stock. But because the gold is owned by IMF members, their approval is required, and since the developing countries have benefited from the sale of IMF gold, they would not agree with this proposal (51).

SDR as a Basket of Five Currencies

In a step to enhance the attractiveness of the SDR, the International Monetary Fund began on January 1, 1981, to use a simplified basket of five currencies for determining its daily valuation. The currencies and their weights are (43):

United States dollar	42 percent
Deutsch mark	19 percent
French franc	13 percent
Japanese yen	13 percent
Pound sterling	13 percent

These five currencies are those that were already used for determining the interest rate on the SDR, and the two baskets were therefore unified.

The method of calculating the United States dollar/SDR exchange rate remains the same. The currency amounts making up the SDR basket are converted into dollar equivalents (carried to six decimal places), then added together, and the reciprocal of this total is rounded to six significant figures to establish the SDR value of the dollar (43). The market rates used in this calculation are the midpoints between

buying and selling rates at noon on the London foreign exchange market, including the rate for the Japanese yen previously obtained from the Tokyo market.

The IMF has calculated the amounts of each of the five currencies which will determine the value of the SDR. Effective January 1, 1981, the value of the SDR was the sum of the values of the following currencies (43):

United States dollar	.54	dollar
Deutsch mark	.46	mark
Japanese yen	34.00	yen
French franc	.74	franc
Pound sterling	.071	pound

The SDR has been strengthened, both as a reserve asset and as a unit of account, in accordance with the objective of making it the principal reserve asset in the international monetary system, although some problems still exist. The basket of currencies has been simplified from sixteen to five, better adapting it for use as a unit of account.

IMF has decided to increase the interest rate on the SDR from eighty percent to one hundred percent of the combined market interest rate of the weighted average of short term interest rates in the United States, Germany, United Kingdom, France and Japan (43).[25]

To make the SDR more attractive to potential users, the IMF eliminated the remaining fifteen percent reconstitution requirement on a participant's holdings of SDRs. The reconstitution obligation required that a participant in IMF's SDR Department maintain a daily

average balance of at least fifteen percent of its SDR allocations over a successive five year period, ending each calendar quarter (43).[26]

Effective May, 1981, IMF has decided that the rate at which it pays remuneration to members on their creditor positions will be eighty-five percent of the SDR interest rate basket instead of seventy-two percent (ninety percent of eighty percent) (43).

IMF has also decided to institute a single rate of 6.25 percent per annum on the daily average outstanding balances of members' purchases. This single rate of change replaces a graduated scale previously in use which progressed from 4.375 percent to 6.875 percent per annum on the daily average outstanding balances of members' purchases, depending on the length of time purchases were outstanding, and averaged 5.23 percent in the twelve-month period ending March 31, 1981 (43).

These changes are the sign of a long process to strengthen the position of the SDR as a full-fledged international reserve asset.

The list of currencies which determines the value of the SDR and the amount of each of these currencies will be revised each five years, beginning January 1, 1976 (43).[27] The currency composition of the basket can be expected to remain unchanged for a considerable number of years, because there is at present a large gap between the value of the exports of the five countries whose currencies are included in the basket and those of other member countries (43).

SDR Interest Rate

The SDR interest rate was set at 1.5 percent per annum in 1969 by the First Amendment to IMF's Articles of Agreement and remained at

that level until 1974 (43).[28] During this period, the SDR interest rate rarely exceeded one-third of the combined market interest rate for the five countries later used for the SDR interest rate basket, and in most periods it was considerably smaller than one-third (43).

In the ensuing years, the SDR interest rate was set first at 5 percent from July 1, 1974, until July, 1975, and was then lowered to 3.75 percent and later to 3.5 percent (43). Starting July 1, 1976, the SDR interest rate was set on the basis of sixty percent of the combined market-short-term interest rates in the United States, United Kingdom, France, Germany, and Japan. On January 1, 1979, the SDR interest rate was set on the basis of eighty percent of the combined market, and, effective May 1, 1981, the rate of interest on the SDR was raised from eighty percent to one hundred percent of the combined market rate and rounded to the nearest two decimal places (43).[29] That is, for the period from May to June, 1981, the rate of interest on the SDR was 12.58 percent rather than 10.125 percent per annum.

The decision to raise the interest rate, together with the simplification of the basket valuation and the abrogation of the reconstitution requirement, was designed to enhance the attractiveness of the SDR as an international monetary asset and to continue the process of establishing the SDR as the principal reserve asset of the international monetary system (43).

Since the SDR is considered only as "a unit of accounts" rather than as a "store of value", lower interest rates on the SDR do not have any impact on the measurement of the SDR price of oil (in Chapter

V). Obviously, the SDR as a "store of value" with an interest rate lower than the market rate would be less attractive for OPEC.

Review of Previous Research on Currency Baskets

The essence of the composite currency, versus a single currency, is based on the reduction of risk of changes in the exchange rates and value reduction. Several studies have been discussed and show that a currency basket compared to a single currency can reduce the exchange rate risk (12, 46, 51, 57, 71).

As the concept of the currency basket grows in importance, more attention is given by researchers. The SDR of the IMF has received the most attention.

For instance, J. J. Polak critically examined the nature and composition of the SDR and its interest rates and suggested some reforms (71, 72, 73). Some of his suggested reforms reflected on the 1981 changes in the SDR. Specifically, the reduction in the composition of the SDR from sixteen currencies to five currencies and the measurement of the interest rate on the SDR reflect his criticism of the old versoion of the SDR. Polak did not discuss the SDR price of OPEC oil; all of his analyses have been devoted to the SDR as a reserve asset and for the purposes of IMF use.

Mark R. Eaker measured the SDR price of OPEC oil for 1974-I to 1977-IV, a period which was characterized by a general strength of the dollar against the SDR (31). He concluded that for the four years as a whole, the average price of oil by dollar pricing was higher ($6.24) than an SDR pricing ($6.13). He found that the SDR

price would have reduced the volatility of the average price of oil, indicated by the lower variance which would have been experienced under SDR pricing than existed under the dollar standard.

He used 1974-I as the base year for the price of oil and adjusted the price by only the United States export-price index for later quarters. Probably, it would have been more appropriate if he had used a composite export price index of the major industrial countries, because OPEC members do not have trade with only the United States.

Mansoor Dailami, in three separate studies using 1970-IV to 1977-IV data, measured the impact of inflation and dollar fluctuation on the purchasing power of OPEC, changes in OPEC's terms of trade, and suggested an optimum currency basket for the price of OPEC oil. It is appropriate to review briefly each of his results.

In his model, Dailami expresses the changes of an OPEC member's terms of trade[30] in three factors:

(1) The rate of growth of the dollar price of OPEC oil.

(2) The weighted average of inflation in the industrial countries.

(3) A measure of the rate of growth of the dollar's fluctuation against other currencies.

He considered the trade shares of OPEC with nine of the key industrial nations: United States, Japan, Belgium, France, Germany, Italy, Netherlands, Switzerland, and United Kingdom.

Table 4.6 shows Dailami's empirical results of the sources of changes of OPEC's terms of trade for the time period 1971-1977. Between 1971 and 1973, the dollar depreciated against most of the other

industrial currencies; its downward movement eroded OPEC's terms of trade by 5.5 percent a year. From 1974 through 1976, when the dollar recovered strongly from its previous low level, its appreciation benefitted OPEC by increasing the implicit price of oil by about 2.3 percent a year. In 1977, when the dollar began its downward trend once again, it cost the oil exporting countries 6.7 percent in their real export revenues. On the average, during the whole period (1971-77), the fluctuation of the United States dollar reduced OPEC's purchasing power by about 2.3 percent a year.

As can be seen in the table, inflation has been a more damaging factor than depreciation of the dollar in eroding OPEC's export earnings. Over the whole period, inflation contributed about 9.03 percent as compared to about 2.3 percent due to the dollar depreciation.

Table 4.7 reports Dailami's measurement of the impact of the value of the dollar and inflation to the rate of change of the unit price of imports for a selected number of OPEC countries. From the information in this table, it can be observed that the impact of the dollar depreciation on the cost of imports has not been uniform for all countries. The cost of imports to some countries increased much more than for others, ranging from about thirty-three percent for Indonesia to only six percent for Libya.

It is interesting and important to note the wide disparity in the experience of different OPEC member countries in bearing the cost of the dollar's depreciation. This suggests the potential conflicts existing in OPEC countries associated with the existing dollar oil-pricing system, and also explains the major source of problems

TABLE 4.6

THE SOURCES OF PERCENTAGE CHANGE IN OPEC'S* TERMS OF TRADE

Year	Term of Trade	Price of Oil	Inflation	Dollar's Fluctuation
1971	16.52	25.14	- 3.99	-4.49
1972	2.908	8.66	- 3.77	-2.51
1973	72.54	96.9	-14.83	-9.52
1974	106.52	130.46	-26.58	+2.63
1975	10.22	10.27	- 1.69	+1.64
1976	-7.90	-.73	- 9.93	+2.76
1977	-6.165	2.98	- 2.43	-6.717
Annual Average	27.80	39.097	- 9.032	-2.31
Relative Contribution	(100)	(140.63)	(-32.48)	(-8.30)

*OPEC member countries included in this calculation are Algeria, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Oman, Qatar, Saudi Arabia, United Arab Emirates, and Venezuela.

Source: The Choice of an Optimal Currency for Denominating the Price of Oil. MIT Energy Laboratory, Working Paper No. MIT-EL 78-026WP, October 1978, Revised February 1979: page 22.

TABLE 4.7

THE IMPACT OF THE DOLLAR'S FLUCTUATION AND INFLATION ON THE RATE OF CHANGE OF UNIT IMPORT PRICE OF A SELECTED NUMBER OF OPEC COUNTRIES, AVERAGED OVER 1971-1977
(Annual Percentage Rate of Change)

Country	Dollar Fluctuation	Inflation	Import Price
Indonesia	3.74 (32.95)	7.61 (67.05)	11.35 (100)
Iran	2.99 (25.98)	8.52 (74.02)	11.51 (100)
Iraq	2.85 (25.16)	8.48 (74.84)	11.33 (100)
Kuwait	2.52 (22.08)	8.89 (77.92)	11.41 (100)
Libya	.66 (5.77)	10.79 (94.23)	11.45 (100)
Saudi Arabia	2.37 (21.42)	8.69 (78.57)	11.06 (100)
Venezuela	1.86 (17.35)	8.85 (82.27)	10.71 (100)

Note: Numbers in parentheses are relative contribution of each item to the rate of change of unit import price.

Source: The Choice of an Optimal Currency for Denominating the Price of Oil. MIT Energy Laboratory, Working Paper No. MIT-EL 78-026WP, October 1978, Revised February 1979: page 24.

facing OPEC in trying to change its current dollar-based system to another currency system

Furthermore, Dailami measured the "rate of change" in the purchasing power of the dollar from OPEC's viewpoint for OPEC as a whole and for major member countries. These results are presented in Table 4.8. The table shows the varying degree of the dollar's loss in purchasing power during this period. Its highest loss was in 1973 and 1974, about twenty-four percent per year. The minimum loss occurred in 1975, about one-half percent per year.

Also, a rather close degree of uniformity in the pattern of change in the purchasing power of the dollar for all OPEC member countries was observed. For OPEC as a whole or for individual member countries, the dollar lost about eighty percent of its purchasing power during the period 1971 to 1977 and about forty percent in the years 1974 to 1977. In other words, one petrodollar in 1977 was equivalent to about twenty cents in 1971 dollar prices and to about sixty cents in 1974 dollar prices.

Dailami made a similar calculation to measure the purchasing power of other industrial currencies, including the United States dollar, the yen, sterling, the German mark, and the Swiss franc. These results are shown in Table 4.9. As the table shows, there is a wide disparity in the performance of the strong currencies (namely, the yen, the Swiss franc, and the Deutsch mark) and weak currencies, such as the British pound and the United States dollar. The loss in the purchasing power of the pound sterling from OPEC's viewpoint is significant,

TABLE 4.8

THE RATE OF CHANGE IN THE PURCHASING POWER OF DOLLAR FROM OPEC'S VIEWPOINT
(Percent Per Year)

Year	Indonesia	Iran	Iraq	Kuwait	Libya	Saudi Arabia	Venezuela	OPEC* as a Whole
1971	- 8.25	- 8.613	- 9.284	- 8.66	- 9.589	- 8.486	- 6.289	- 8.48
1972	- 7.112	- 5.379	- 5.352	-5.835	- 5.563	- 5.812	- 5.731	- 6.28
1973	-25.34	-24.98	-24.24	-24.07	-22.98	-24.26	-24.011	-24.35
1974	-24.34	-23.573	-23.558	-23.94	-26.77	-24.4	-24.315	-23.95
1975	+ 4.321	.483	+ 1.44	+ .56	- 1.207	+ 1.365	- 1.211	- .05
1976	- 8.725	- 7.758	- 8.053	- 7.61	- 5.711	- 7.47	- 6.72	- 7.17
1977	- 9.651	- 9.088	-10.288	-10.265	- 8.367	- 8.352	- 6.62	- 9.147
Cumulative								
1971 -1977	-79.12	-78.88	-79.31	-79.81	-80.16	-77.41	-75.42	-79.42
1974 -1977	-38.39	-39.92	-40.44	-41.25	-42.055	-38.86	-38.86	-40.31

*OPEC member countries included in this calculation are Algeria, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Oman, Qatar, Saudi Arabia, United Arab Emirates, and Venezuela.

Source: Measuring the Purchasing Power of Major Currencies from OPEC's Viewpoint. MIT Energy Laboratory, Working Paper No. MIT-EL 79-022WP, February 1979: page 6.

about 105 percent over the period 1971-77 and about 65 percent over the period 1974-77. Next to the British pound is the United States dollar with losses of about eighty and forty percent, respectively, over the same periods of time. This suggests that OPEC would have been worse off had the pound sterling been as the unit of account for the price of oil. On the other hand, the implicit gain to OPEC would have been highest had the Swiss franc been used as the denominator for the price of oil.

Dailami also suggested a model to stabilize and protect the real export earnings of OPEC from the risk of exchange rate changes by a currency basket called OPECA. He calculated the numerical value of OPECA and its annual growth rate from 1971 to 1977. His results are presented in Table 4.10. From the table, it can be seen that during these years, OPECA appreciated in terms of the dollar by 16.2 percent, an average annual appreciation of about 2.31 percent.

He also measured the OPEC oil revenue for four quarters of 1977 if oil prices were quoted in terms of OPECA and compared that with the actual oil revenue in terms of the dollar. The results are reported in Table 4.11. If OPECA had been used as the denominator for the price of oil, OPEC's revenue would have increased by $2.15 billion in 1977.

Dailami's basket includes the currencies of the nine key industrial countries. The price of oil is adjusted according to their currency fluctuations against the dollar, and is proportional to their trade with OPEC. The basket is used only as a unit of account.

TABLE 4.9

COMPARING THE RATE OF CHANGE IN THE PURCHASING POWER OF MAJOR CURRENCIES FROM OPEC'S* VIEWPOINT
(Percent Per Year)

Year	U.S. Dollar	Yen	Sterling	Swiss Franc	D.M.
1971	- 8.48	1.08	- 4.35	- .16	2.08
1972	- 6.28	.17	-11.75	- 1.85	- 3.15
1973	-24.35	-12.29	-23.67	- 3.86	.43
1974	-23.95	-32.28	-25.83	-10.68	-22.33
1975	- .05	- 1.16	-12.33	4.34	- 2.11
1976	- 7.17	- 3.78	-27.57	1.21	.59
1977	- 9.14	8.55	.26	2.63	- 1.26
Cumulative					
1971-1977	-79.42	-39.71	-105.25	- 8.37	-25.75
1974-1977	-40.31	-28.67	-65.47	- 2.5	-25.11

*For the name of OPEC member countries included in this calculation, see footnote to Table 4.8.

Source: Refer to Table 4.8, page 8.

TABLE 4.10

THE NUMERICAL VALUE OF OPECA (CURRENCY-BASKET)
AND ITS ANNUAL GROWTH RATE
(1971-1977)

Year	Value at End of Year*	Rate of Change
1970	100	---
1971	103.02	4.49
1972	101.97	2.51
1973	111.71	9.52
1974	108.54	-2.63
1975	106.56	-1.64
1976	103.62	-2.76
1977	110.73	6.71
Total		16.20

*Normalized at 100 in the fourth quarter of 1970.

Source: Refer to Table 4.7, page 29.

TABLE 4.11

ESTIMATED OIL REVENUE IF OIL PRICE WERE DENOMINATED IN TERMS OF $ AND OPECA
(Billions of $)

Year	Oil Price in *$ (1)	Oil Price in OPECA (2)	(2) - (1)
1977			
I	31.9	32.15	.25
II	32.6	32.94	.34
III	32.3	32.82	.54
IV	32.3	33.34	1.04
TOTAL	129.1	131.25	2.15

*From: Bank of England Quarterly Bulletin, March, 1978.

Source: Refer to Table 4.7, page 30.

Summary

The United States dollar emerged as an international currency and a substitute for the British pound and gold after World War II. During the fifties, it was at the center of the gold exchange system and directly convertible into gold.

Since the early sixties, the signs of weakness of the dollar vis-a-vis some other major currencies were seen. The weakness was due to the United States' huge reserve deficit, and obviously the process could not continue. In 1971, the United States stopped gold convertibility which resulted in the collapse of the Bretton Woods exchange system.

Because the price of OPEC oil is in terms of the dollar, the depreciation and fluctuation of the dollar have a direct impact on the purchasing power of OPEC oil prices. The order of magnitude of OPEC losses due to the depreciation of the dollar in some periods has been significant and concerns OPEC members. The losses are from dollar denominated assets as well as dollar convertibility into other hard currencies. The depreciation of the dollar in those periods has had impact on the terms of trade of OPEC members and the cost for each member has not been uniform, because of different trade linkages between OPEC members and the industrial nations. World inflation, in general, and costs of imports to the OPEC members, specifically, reduce the real purchasing power of OPEC revenues.

Depending on its nature and weights, a currency basket can be used for several purposes. One is the reduction of the fluctuation of the future payments and/or receipts. Another is to prevent the

reduction of future receipts and/or payments. For these two reasons, currency baskets were used as early as the late Middle Ages, and with the adoption of the floating exchange rate system since the early 1970s they have had more usage. Currency baskets are also being used as diversified multiple assets by central banks and other financial institutions for these purposes and others.

A currency basket in general and for OPEC oil pricing has its own drawbacks and benefits. The major problems in using the currency basket for the price of OPEC oil are differences among OPEC members, including the size and composition of external assets and trade linkages of OPEC members and, consequently, the composition and weights of the possible basket.

The nature, composition, weights, valuation, problems, interest rate, and evolutionary process of the Special Drawing Right were explained. This currency basket may be used for the future price of OPEC oil, as some OPEC officials have mentioned.

The results of Dailami's model show that between 1971 and 1977, on the average, the fluctuation of the dollar reduced OPEC's purchasing power by 2.3 percent per year; however, the impact for different members of OPEC was not uniform. Inflation, as a more damaging factor, reduced OPEC's purchasing power about 9.03 percent per year for the same period, even though OPEC's price increases for most of the years between 1971 to 1980 were more than sufficient to offset those losses.

Dailami's study also found that OPEC's loss of purchasing power varied from 1971 to 1977; its highest loss was in 1973 and 1974, about twenty-four percent per year. For OPEC as a whole or for

individual member countries, the cumulative losses were about eighty percent between 1971 and 1977. The worst single currency for the price of OPEC oil between 1971 and 1977 would have been the British pound and the best would have been the Swiss franc.

Dailami designed a version of a currency basket (OPECA) for the price of OPEC oil, as an adjustment tool rather than a real currency basket with specified compositions and weights for each currency. According to this measure, if OPEC had used OPECA rather than the current pricing system, it could have gained $2.15 billion just in 1977.

CHAPTER V

CONSTRUCTION AND EVALUATION OF BASKETS AND INFLATIONARY INDICES

Introduction

This chapter includes the design, measurement, and evaluation of three currency baskets called the Geneva I, the Geneva II, and trade baskets for the prices of OPEC oil. Also included is the measurement and evaluation of the SDR and Dailami baskets for 1971-1980.

The Geneva I and Geneva II baskets were arranged and negotiated between OPEC officials and oil companies in the early seventies.[31] Originally, these currency baskets were to be used for the adjustment of the price of oil. These two baskets never, at least publicly, are measured and compared, and their performance, as yet, is not known. OPEC officials and OPEC member authorities sometimes mentioned the Special Drawing Right (SDR) basket of the International Monetary Fund as another possible composite currency standard to be used for the adjustment and pricing of oil.[32] The trade basket is constructed in this study and is based upon the trade relationships between OPEC and the major industrial countries. Dailami used a basket of nine currencies for the measurement of the price of OPEC oil for 1971 to 1977. His basket is being updated for 1971-1980 and compared with the other four baskets.

Each of these five baskets will be examined and past data will be used to evaluate and compare their performance for each of the years

from 1971 through 1980 and for the entire period, assuming these baskets were used for the pricing of oil. The results represent rough estimates of the dollar fluctuation impact on OPEC oil prices.

Worldwide inflation has reduced the purchasing power of OPEC members' oil prices. We will use two different indices, the United States Producers Price Index and the Export Price Index (adjusted for the volume of exports from different major industrial countries to OPEC), to measure the impact of inflation on the per barrel price of OPEC oil for each of the years from 1971 through 1980 and for the entire period.[33]

After the measurement and evaluation of each of the currency baskets and inflationary measures are dealt with separately, the terms of trade of OPEC as a whole between 1971 and 1980, and for the entire period, and the 1971-1980 average terms of trade of each of the twelve members of OPEC will be measured and compared.

Geneva I Basket

In early 1971, the United States suspended the gold convertibility of the dollar because the dollar was weak in terms of other major currencies in the market. This process of depreciation of the dollar continued and, in 1973, the Bretton Woods system collapsed and the floating exchange rate system was officially established. This revolutionary change was the result of a long and persistent doubt about the weakness and oversupply of the United States dollar.

Since the price of OPEC oil was set, and still is, in terms of the United States dollar, the switch to the floating rate system had

direct impact on the real purchasing power of petrodollar revenues for OPEC members. The reaction from OPEC members to the depreciation of the dollar started immediately after the first sharp depreciation in 1971.

After negotiations with the oil companies on this matter, on January 20, 1972, agreement was reached in Geneva between OPEC countries and the oil companies for adjustments of oil prices between 1972 and 1975, based on an index measuring changes between the exchange rates of the United States dollar and nine other currencies (66). These nine currencies, known as the Geneva I basket, were the Belgian franc, French franc, German mark, Italian lira, Japanese yen, Netherlands guilder, Swedish kroner, Swiss franc, and the British pound sterling.[34] These are the currencies of major industrial countries with which OPEC members have traded.

The purpose of the basket was to diminish the impact of the weak dollar on OPEC oil prices, especially at that time. The basket was used for the adjustment of the price of oil until 1973 when, after another negotiation, two currencies were added to it and it became known as the Geneva II basket.

The Measurement of the Geneva I Basket Index

OPEC documents are not explicit about the weights of the currencies in the Geneva I basket, but they are explicit about the Geneva II weights, and indicate that the latter had equal weights for each currency (66). In our measurement, we give equal weight to the currencies in the Geneva I basket.

To see how the index of the Geneva I basket would have performed if it had been used for the price of OPEC oil between 1971 to 1980, we measure the annual percentage changes of the exchange rates of those currencies in the basket against the United States dollar. These calculated figures and the basket index for the period 1971 to 1980 are shown in Table 5.1. Since equal weights are given to each of the currencies in the basket, the average percentage changes of the exchange rates would be the basket index, as are shown in the last row of the table.

The positive signs reflect the relative appreciation, and the negative signs reflect the relative depreciation of the United States dollar vis-a-vis the nine other currencies of the basket as a whole. Accordingly, in 1971, relative to 1970, the dollar depreciated by 5.23 percent; in 1972, relative to 1971, the dollar depreciated by 7.59 percent; and so on. Only in 1974 (2.51 percent) and in 1976 (6.88 percent) did the dollar appreciate; in all other years it depreciated. The highest rate of depreciation of the dollar relative to the nine currencies of the Geneva I basket occurred in 1978, by 13.96 percent.

In summary, according to the Geneva I basket standard, 1978 was the worst year and 1976 was the best year for OPEC. In 1978, OPEC's purchasing power due to the relative weakness of the dollar declined by 13.96 percent, and in 1976 OPEC's purchasing power due to the relative strength of the dollar increased by 6.88 percent. During the whole period of 1971-1980, OPEC's purchasing power declined by 38.52 percent.

TABLE 5.1

THE MEASUREMENT OF THE GENEVA I BASKET INDEX

Currency	% Changes of the Exchange Rate $/Units[1]									
	71	72	73	74	75	76	77	78	79	80
Belgian franc	- 2.5	-10.7	- 13.2	00	- 5.8	+ 4.8	- 7.7	- 14.0	- 7.2	-0.3
French franc	0.0	-10.0	- 13.3	+ 7.4	-12.2	+10.3	+ 2.7	- 8.9	- 6.0	-0.7
German mark	- 4.9	- 9.5	- 19.3	- 3.3	- 5.2	+ 2.3	- 8.5	- 15.6	- 9.6	-0.8
Italian lira	0.0	- 6.3	0.0	+11.8	0.0	+20.0	+ 8.3	- 9.1	0.0	0.0
Japanese yen	- 3.6	-10.3	- 15.6	+ 8.1	0.0	0.0	- 8.8	- 29.7	+ 4.2	+4.3
Netherland guilder	- 3.3	- 9.2	- 14.8	- 1.4	- 6.3	+ 4.4	- 7.7	- 13.5	- 7.9	-0.9
Swedish kroner	- 1.1	- 7.5	- 9.0	+ 1.7	- 6.9	+ 4.7	+ 2.8	+ 0.8	- 5.4	-1.3
Swiss franc	-21.0	- 2.0	- 20.6	- 6.3	-15.4	- 3.3	- 4.0	- 25.6	- 7.5	+0.7
British pound	-10.7	- 2.8	+ 2.0	+ 4.6	+ 5.0	+18.7	+ 3.4	- 10.0	-10.5	-9.6
Total	-47.1	-68.3	-103.8	+22.6	-46.8	+61.9	-19.5	-125.6	-49.9	-8.6
Average	- 5.23	- 7.59	- 11.53	+ 2.51	- 5.20	+ 6.88	- 2.17	- 13.96	- 5.54	-0.96

[1]From International Monetary Fund, International Financial Statistics, different issues; (-) signs indicate relative depreciation of the dollar and (+) signs indicate the relative appreciation of the dollar.

That is equal to the annual average of 4.28 percent. In 1974 and 1976, OPEC's purchasing power increased; in other years, it declined This impact does not account for inflation. Also, OPEC price increases for the compensation of these purchasing power changes were not considered. We will take OPEC price increases into account later. Notice also that the United States dollar was not included in this basket.

Geneva II Basket

According to OPEC documents, OPEC countries decided

> to negotiate with the oil companies with a view to amending the Geneva I agreement to offset the devaluation of the United States dollar and avoid further loopholes (66).

In June, 1973, the Geneva agreement between OPEC and the international oil companies reached accord to amend the Geneva I basket. Based on this accord, known as the Geneva II basket, the parties agreed to use the arithmetic average of eleven currencies against the exchange rate of the dollar for the adjustment of the prices of OPEC oil (58). These eleven currencies consist of the nine currencies of Geneva I, with the addition of the Australian dollar and the Canadian dollar.[35] Similar to the Geneva I agreement, the purpose of the Geneva II basket was another step to protect the purchasing power of the OPEC oil prices which were set, and still are, in terms of the United States dollar. The agreement was crucial, since at that time (1973), the system of the floating exchange rate regime was officially established and the value of the dollar dropped further against most of the major currencies of the world.

Similar to the earlier section on the Geneva I basket, in this part we will calculate the index for the Geneva II basket, and the index represents the rough estimate of the magnitude of dollar fluctuation impact on OPEC oil prices.

The Measurement of the Geneva II Basket Index

The same approach which was used for the measurement of the Geneva I basket index is used for the calculation of the Geneva II basket index. The results are shown in Table 5.2. The annual percentage changes of the exchange rates of each of the eleven currencies in the basket are measured. Their average for each year of 1971 to 1980 represents the basket index. This is because equal weights are given to each currency in the basket.

Positive signs reflect a relative appreciation and negative signs represent a relative depreciation of the United States dollar against the eleven currencies of the basket. Hence, in 1971 relative to 1970, the dollar, relative to the eleven currencies of the basket as a whole, depreciated by 4.06 percent. In all other years, the dollar relative to those eleven currencies depreciated, except in 1974 and 1976. In these two years, the dollar relatively appreciated by 1.73 percent (in 1974) and 5.94 percent (in 1976).

Overall, between 1971 to 1980, the United States dollar relative to the eleven currencies of the Geneva II basket depreciated by 37.29 percent, which is equal to an annual average of 3.39 percent. Again, as in the Geneva I, the United States dollar was not included in this basket.

TABLE 5.2

THE MEASUREMENT OF THE GENEVA II BASKET INDEX

Currency	% Changes of the Exchange Rate $/Units[1]									
	71	72	73	74	75	76	77	78	79	80
Belgian franc	- 2.5	-10.7	- 13.2	0.0	- 5.8	+ 4.8	-7.7	- 14.0	- 7.2	- 0.3
French franc	0.0	-10.0	- 13.3	+ 7.4	-12.2	+10.3	+2.7	- 8.9	- 6.0	- 0.7
German mark	- 4.9	- 9.5	- 19.3	- 3.3	- 5.2	+ 2.3	-8.5	- 15.6	- 9.6	- 0.8
Italian lira	0.0	- 6.3	0.0	+11.8	0.0	+20.0	+8.3	- 9.1	0.0	0.0
Japanese yen	- 3.6	-10.3	- 15.6	+ 8.1	0.0	0.0	-8.8	- 29.7	+ 4.2	+ 4.3
Netherland guilder	- 3.3	- 9.2	- 14.8	- 1.4	- 6.3	+ 4.4	-7.7	- 13.5	- 7.9	- 0.9
Swedish kroner	- 1.1	- 7.5	- 9.0	+ 1.7	- 6.9	+ 4.7	+2.8	+ 0.8	- 5.4	- 1.3
Swiss franc	-21.0	- 2.0	- 20.6	- 6.3	-15.4	- 3.3	-4.0	- 25.6	- 7.5	+ 0.7
British pound	-10.7	- 2.8	+ 2.0	+ 4.6	+ 5.0	+18.7	+3.4	- 10.0	-10.5	- 9.6
Australian dollar	- 1.3	- 5.0	- 19.3	- 1.3	+ 9.1	+ 6.5	+9.5	- 3.3	+ 2.3	- 1.9
Canadian dollar	+ 3.7	0.0	+ 0.9	- 2.3	+ 3.8	- 3.1	+3.7	+ 6.8	+ 2.6	+ 0.2
Total	-44.7	-73.3	-122.2	+19.0	-33.9	+65.3	-6.3	-122.1	-45.0	-10.3
Average %	- 4.06	- 6.66	- 11.11	+ 1.73	- 3.08	+ 5.94	-0.57	- 11.10	- 4.09	- 0.94

[1]From International Monetary Fund, International Financial Statistics, different issues; (-) signs indicate relative depreciation of the dollar and (+) signs indicate the relative appreciation of the dollar.

It should be noted that the Geneva II basket was not used for the price adjustment by OPEC. As soon as the agreement was reached on the Geneva II basket, OPEC unilaterally set the price of oil much higher than the Geneva II basket formula, without participation of the oil companies. If the Geneva II basket had been used for the price of oil in 1974, the price should have been 1.9 x 1.1153 = $2.119, rather than $9.76 per barrel, not considering inflationary adjustment.

In sum, according to the Geneva II basket, during 1971-80, OPEC's purchasing power increased in 1974 and 1976 due to the relative strength of the dollar vis-a-vis those eleven currencies of the basket. In all other years, OPEC's purchasing power declined. During the period of 1971-1980, based on the Geneva II basket index, OPEC's purchasing power declined by an average rate of 3.39 percent annually, compared with the average annual rate of 4.28 percent by the Geneva I basket measure. These figures do not account for inflationary impact and higher oil prices by OPEC for the compensation of these impacts.

The Geneva II basket differs from the Geneva I by a different mix of currencies. The intention of the switch to the Geneva II basket by OPEC probably was to make it a better basket at that time, but, as we have seen, during the whole period from 1971 through 1980, OPEC could have been better off in its purchasing power by the Geneva I than the Geneva II basket. The difference between these two is important, since it shows that composition of the basket is important and the past may not be a guideline for the future.

The Trade Basket

As we have seen in earlier chapters, the real purchasing power of the petrodollar depends on two major factors. One is changes of the exchange rates of the United States dollar against the currencies of the trading partners of OPEC members. The other factor is inflation in the trading partners (countries) of OPEC members.

We have constructed a basket called the "trade basket" and its purpose is to protect one part of the terms of trade of OPEC members--the exchange rate changes. That is, the purpose is to protect against the adverse effect of the changes of the values of the currencies of other major trading partners of OPEC countries in exchange for the United States dollar. The other factor of the terms of trade (inflation) can be protected against by some kind of inflationary index.

To this end, the selection of the currencies and their corresponding weights in the basket are made on the basis of OPEC members' imports of goods and services from major industrial countries: the United States, Japan, and the European Common Market countries.[36] Accordingly, the trade basket selected consists of the nine currencies of the United States, Japan, Belgium, Denmark, France, Germany, Italy, Netherlands, and Great Britain. The other members of the European Common Market, and other countries are excluded because their individual sizes of trade are relatively small. These nine countries exported 66 percent of OPEC's total imports in 1971, 73 percent in 1975, and 65 percent in 1980.

The selection of these nine currencies is consistent with the statements and indications that OPEC might use a similar basket.[37]

Also, the SDR was designed on the basis of similar concepts and weighted by the size of trade.

As a result of this approach to the selection of the currencies and weights, if an OPEC member had the average composition of imports from those nine countries, it could, to some degree, expect stability in its price of oil. That is, the purchasing power of its oil will not be changed by the changes of exchange rates vis-a-vis the United States dollar.

This exchange rate stability for the OPEC members is subject to a number of qualifications, as follows. First, it would only apply to the "average OPEC member"--that is, the country whose composition of imports corresponds to the composition and weights of the currencies of those nine countries. Second, this basket, at least in its form, would protect OPEC members only from the price changes owing to exchange rate changes, and not from price changes owing to inflation.

Assuming the relative weight of exports to OPEC from each of the nine industrial countries is W_i, the distribution of the price of one barrel of oil among the currencies in the basket is determined by multiplying the base price of oil, P_o, by the weight of each currency, W_i, as

$$(5.1) \quad P_{oi} = P_o \cdot W_i$$

where P_{oi} is the dollar share of the ith currency per barrel of oil, and $i = 1, 2, \ldots 9$.

From (5.1), we can have

(5.2) $\sum_{n=1}^{9} P_{oi} = P_o \sum_{n=1}^{9} W_i$, and since

(5.3) $\sum_{n=1}^{9} W_i = 1$, $\sum_{n=1}^{9} W_i P_{oi} = P_o$.

To determine the currency units per barrel of oil in the basket, CU, we divide each dollar share of each currency of a barrel of oil, P_{oi}, by its corresponding exchange rate, E_{oi}, or

(5.4) $CU_i = P_o \cdot W_i/E_{oi}$

$= P_{oi}/E_{oi}$,

where E_{oi} is the exchange rate in terms of the dollar per unit of ith currency at the base year.

Once the currency basket is determined, the currency units of the basket are fixed, but the value of the currency basket fluctuates by changes of the exchange rates in the basket.

To get the value of the basket in terms of any currency in the basket, we should multiply the currency units, CU_i, of each individual currency by its corresponding exchange rate in the current year, E_{yi}, or $CU_i \cdot E_{yi}$. Accordingly, the value of the basket, VB, is the sum of all of these operations, or

(5.5) $VB_y = \sum_{n=1}^{9} CU_i \cdot E_{yi}$.

That is, the value of the basket in year y is equal to the sum of the multiplication of the units of each currency by its corresponding exchange rate in the same year y.

Notice that E_{oi} is the exchange rate in the base year, but E_{yi} is the exchange rate in the current year. To substitute (5.4) in (5.5), we get

$$(5.6) \quad VB_y = \sum_{n=1}^{9} E_{yi} \cdot P_o \cdot W_i/E_{oi}.$$

It is clear from (5.6) that, given the base price of oil, P_o, the variable which has impact on the value of the basket price of oil is only the current exchange rate, E_{yi}.

If OPEC decides to also adjust its price of oil for the purpose of inflation, the base price of oil in (5.6), P_o, can be adjusted by some inflationary index.

The Design of the Trade Basket

To get the weights of each of the nine currencies, based on their size of exports to OPEC (OPEC's imports from those nine countries), we add the total imports to OPEC between 1972 and 1978.[38] This is shown in column 1 of Table 5.3. We divide each country's exports to OPEC by the total of OPEC's imports from these nine countries, which results in the weights for each currency in the basket. Accordingly, for the trade basket, the weight of the United States dollar is 24.2 percent, Japanese yen 19.5 percent, Belgian franc 3.0 percent, Denmark kroner 1.1 percent, French franc 9.5 percent, German mark 17.4 percent, Italian lira 9.1 percent, Netherlands guilder 3.8 percent, and British pound 12.4 percent. The sum of these weights is one hundred percent. In the new SDR basket of five currencies, which was seen in the earlier chapter, the weight of the United States dollar is 42 percent, German mark 19 percent, and French franc, Japanese yen,

and British pound each 13 percent. In the old SDR basket, the weight of the United States dollar was 33 percent.

To derive the basket for each year, we use equation (5.1) by distributing the actual price of oil according to the weights of each currency. This is shown in column 3 of Table 5.3 for the 1970 basket. The multiplication of weights in column 1 by the actual price of oil in 1970 ($1.80) is shown in column 3. The number of each currency in the basket can be determined by dividing column 3 by the corresponding exchange rates in column 4.

The 1970 trade basket is shown in column 5 of the table. Accordingly, one barrel of oil in 1970, which is equal to $1.80, is also equal to the sum of 0.4338 United States dollars, 125.3571 Japanese yen, 2.70 Belgian francs, 0.1485 Denmark kroners, 0.95 French francs, 1.1464 German mark, 102.375 Italian lira, 0.2476 Netherlands guilder, 0.093 pound sterling.

Similarly, the trade basket for 1971 is calculated and shown in Appendix 1. Based on this measure, one barrel of oil in 1971, which was worth $2.194, was also equal to the sum of 0.5309 United States dollar, 147.5172 Japanese yen, . . . 0.1118 pound sterling. Identical calculations were used for the 1972-1980 baskets and summarized in Appendix 2. The weights for all are identical and shown in column 1; but the price of a barrel of oil and, consequently, the basket for each year change. The impact of the increase of the price of oil from 1970 to 1980 would have proportional impact on the units of the currencies in the baskets. However, the changes in the exchange rate

TABLE 5.3

BASKET OF NINE CURRENCIES BASED ON THE SIZE OF EXPORTS TO OPEC AND 1970 PRICE OF SAUDI LIGHT--$1.80/BARREL

Currency	72-78 Exports to OPEC[1]	Weights[2]	Price of Oil--$1.80 1.80 x (2)	Exch. Rate $/Units 1970 Avg.[3]	Currency Units in Basket (3)÷(4)
	(1)	(2)	(3)	(4)	(5)
U. S. dollar	64,132	.242	$0.4338	1.0000	0.4338
Japanese yen	51,649	.195	0.3510	0.0028	125.3571
Belgian franc	8,006	.030	0.0540	0.0200	2.7000
Denmark kroner	2,795	.011	0.0198	0.1333	0.1485
French franc	25,266	.095	0.1710	0.1800	0.9500
German mark	46,281	.174	0.3132	0.2732	1.1464
Italian lira	24,267	.091	0.1638	0.0016	102.3750
Netherlands guilder	10,171	.038	0.0684	0.2762	0.2476
Pound sterlin	32,928	.124	0.2232	2.4000	0.0930
Totals	265,495	1.000	1.8000		

[1]Data taken from International Monetary Fund, Directory of Trade Yearbook - 1979, millions of U. S. dollars.

[2]Weights are derived from dividing each country's exports by 265,495; the weights are rounded so that the sum is equal to one.

[3]From International Monetary Fund, International Financial Statistics, different issues.

alter that proportionality, and as a result, each basket would not be similar, nor would the changes be proportional. Non-proportional changes of the currency units are soley due to the changes of exchange rates. As the exchange rates change relative to each other, the value of the basket and weights of each currency in the basket change. The value of the baskets in terms of other currencies is a matter of adjusting the figures by the prevailing exchange rate between the United States dollar and any other currency.

The Measurement of the Trade Basket Index

The basket price of OPEC oil for 1971-1980, by implementing equation (5.5), is measured and shown in Table 5.4. The basket which was designed for each year was used for the calculation of the price for the next year. For instance, the basket price of oil for 1971, in column 1 of Table 5.4, was derived through the sum of the multiplication of the 1970 basket currencies by the corresponding 1971 exchange rates. Similarly, the basket price of oil for 1972 is the sum of the multiplication of the 1971 basket times the corresponding 1972 exchange rates. Based on these calculations, the basket prices of oil are $1.8335, $2.3461, $2.0493, $2.6131, $10.348, $10.1263, $11.7744, $13.9436, $13.1196, $16.9551, for 1971 through 1980 respectively.

The differences between the trade basket and the actual price of oil in the previous year, as the percentages are measured and in the form of the basket index, are shown in the last row of the table. Based on these calculations, the dollar depreciation in 1978 was the highest by 12.45 percent and in 1980 it was the lowest by 0.09 percent.

TABLE 5.4

MEASUREMENT OF THE PRICE OF OPEC OIL BASED ON 9 CURRENCY-TRADE BASKET: 1971-1980

Currency	Multiplication of Currency Units by Their Corresponding Exchange Rates[1]									
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
U. S. dollar	$0.4338	$0.5309	$0.4598	$0.6534	$2.3619	$2.6039	$2.7854	$3.0008	$3.0734	$4.1067
Japanese yen	0.3635	0.4868	0.4154	0.4838	1.9032	2.0982	2.4425	3.1369	2.3733	2.9495
Belgian franc	0.0554	0.0729	0.0645	0.0810	0.3099	0.3074	0.3720	0.4240	0.4086	0.5181
Denmark kroner	0.0200	0.0257	0.0240	0.0295	0.1139	0.1126	0.1275	0.1484	0.1465	0.1774
French franc	0.1715	0.2290	0.2043	0.2375	1.0405	0.9166	1.0637	1.2828	1.2795	1.6534
German mark	0.3284	0.4179	0.3945	0.4851	1.7865	1.8285	2.1727	2.4942	2.4215	3.0518
Italian lira	0.1638	0.2122	0.1729	0.2168	0.8882	0.7834	0.9601	1.2310	1.1557	1.5443
Netherlands guilder	0.0707	0.0910	0.0829	0.1067	0.7943	0.3911	0.4712	0.5346	0.5205	0.7188
Pound sterling	0.2264	0.2797	0.2310	0.3193	1.1496	1.0846	1.3793	1.6909	1.7406	2.2351
Total(baskt. pr.)	1.8335	2.3461	2.0493	2.6131	10.3480	10.1263	11.7744	13.9436	13.1196	16.9551
Basket Index (%)[2]	+1.86	+6.93	+7.86	-3.22	+6.02	-5.89	+2.30	+12.45	+3.30	+0.09

[1]Currency units derived from Appendix 2; exchange rates derived from International Monetary Fund, International Financial Statistics, different issues.

[2]Numbers derived by the % differences between the basket price and the actual price in the previous year; positive signs reflect loss and negative signs reflect gain to OPEC.

During other years, except 1974 and 1976, the dollar relatively depreciated and, consequently, the purchasing power of OPEC declined In 1974 and 1978, because of the relative strength of the dollar, the dollar appreciation impact was 3.22 percent and 5.89 percent pectively. Thus, in these two years, OPEC's purchasing power increased, not considering inflation. For the whole period of 1971-80, OPEC's purchasing power reduction was 3.17 percent. Again, this does not account for inflation nor for OPEC price increases.

In summary, the trade basket was designed to measure the impact of the fluctuation of the dollar against the currencies of nine major industrial nations, with more weight given to the currencies of the countries which have more trade with OPEC. Since the trade basket is different from the other currency baskets in the mix, weights, and number of currencies, the results of the basket are different. Furthermore, there are some years where OPEC had loss according to one currency basket, but gain according to another, due to the same factors.

Dailami's Basket - Updated

Mansor Dailami suggested a basket (called OPECA) which is similar to the trade basket and designed for the purpose of the measurement of the dollar fluctuation impact on the purchasing power of OPEC (26). The results of his measurement for the period 1971-77 were presented in an earlier chapter. In this part, we use the same basket and procedures to measure the basket index for the whole period of 1971-1980.

According to Dailami, the basket index, I, due to the fluctuation of the dollar for each period J, is equal to

$$(5.7) \quad I_J = \sum_{i=1}^{9} W_i \overset{o}{E}_i$$

where $\overset{o}{E}$ is the annual change of the exchange rates of the currencies of the nine industrial countries of Belgium, France, Germany, Italy, Japan, Netherlands, Switzerland, the United Kingdom, and the United States; W_i is the weight of each currency which is proportional to OPEC's imports from those nine countries.[39]

One of the differences between the Dailami basket and the trade basket is that in the former the kroner of Denmark, as a member of the European Economic Community, is substituted for the Swiss franc. Similarly, in the weight measurement, the size of OPEC's imports from Denmark in the trade basket is replaced by the size of OPEC's imports from Switzerland in the Dailami basket. These differences will make the results of these two baskets not exactly the same, though not significantly different.

As mentioned in Chapter IV, there are two good reasons for the preference of the trade basket over the Dailami basket. First, since the Swiss franc has a larger variation of exchange rates, a basket without it could be more stable. This is in spite of the fact that the Swiss franc was relatively appreciating against the United States dollar the most, at least between 1971 to 1977 (26). Second, Switzerland is not a member of the European Common Market, but Denmark is. It is believed that all of the currencies of the common market countries, as an economic body with similar trade policies, should be included in the basket.

Using equation 5.7, the updated results of the Dailami basket index are calculated and presented in Table 5.5. According to the

figures in 1974 and 1976, OPEC's purchasing power increased by 4.40 percent and 5.53 percent, respectively, due to the relative strength of the dollar. These added to the nominal price increases in those two years. In all other years, the weakness of the dollar reduced the purchasing power of OPEC. On the average, based on the Dailami basket between 1971 to 1980, OPEC's purchasing power declined by 2.98 percent annually. Because of the differences in the mix and weights, the results of the Dailami basket were not exactly similar to those of the trade basket.[40]

The percentage changes in the nominal price of OPEC oil between 1971 to 1980 are also presented in Table 5.5. According to these figures, OPEC's nominal price of oil increased in all years of 1971 to 1980, except in 1972 in which it was reduced by 13.24 percent. The highest rate of increase, 261.48 percent, occurred in 1979, and the lowest rate of increase, 2.42 percent, occurred in 1987. During 1971-1980, the annual average rate of increase of OPEC oil was 44.19 percent.

Special Drawing Right Basket

One of the currency baskets which might be used as a unit of accounts for the price of OPEC oil is the Special Drawing Right (SDR) of the International Monetary Fund (IMF).[41] The nature, problems and evolutionary process of the SDR were explained in Chapter IV. In 1974, the SDR was designed to be the value of sixteen currencies. In 1978, two of the sixteen currencies were replaced with two others, and in 1981 the number of currencies in the SDR was reduced to only five.

TABLE 5.5

THE IMPACT OF THE FLUCTUATION OF THE DOLLAR ON OPEC'S PURCHASING POWER BY TRADE, DAILAMI'S AND SDR BASKETS[1]

Year	% Changes in Nominal Price[2]	Trade Basket Index[3]	Dailami's Basket Index	SDR Basket Index
	(1)	(2)	(3)	(4)
1971	+21.66	- 1.86	- 3.42	-8.57
1972	-13.24	- 6.93	- 5.97	0.00
1973	+42.11	- 7.86	- 8.21	-9.79
1974	+261.48	+ 3.22	+ 4.40	-0.89
1975	+ 9.84	- 6.02	- 2.30	-0.95
1976	+ 7.37	+ 5.89	+ 5.53	+4.91
1977	+ 7.73	- 2.30	- 2.35	-1.13
1978	+ 2.42	-12.45	-13.10	-7.23
1979	+33.62	- 3.30	- 3.27	-3.20
1980	+68.45	- 0.09	- 0.47	-8.88
Average	+44.19	- 3.17	- 2.92	-2.77

[1]Negative signs indicate the reduction and positive signs indicate the increase in the purchasing power of OPEC.

[2]From International Monetary Fund, International Financial Statistics, different issues.

[3]From Table 5.4, p. 137.

Probably, there are at least two reasons why OPEC might prefer the usage of the SDR to other currency baskets for the price of oil. First, the SDR is internationally known, OPEC members know how it operates, and over the years in which it has been used its operation and performance have been tested. This reduces the uncertainty about the SDR which is not the case for some other baskets. Second, the SDR represents the currencies of the most important countries in terms of their size of trade and their role in the world financial markets, which tie OPEC members' trade proportionally with the major industrial countries.

One problem with the SDR basket is that it has been designed and originated by the IMF over which OPEC has no control. As a result, the price of OPEC oil would be subjected to the decisions of the IMF about the SDR and its changes. Those decisions and changes, for whatever reasons, might not be in favor of OPEC members. In that case, switching to another measure for the price of oil is another problem which would bring instability to the world oil market and OPEC members' oil prices.

The SDR Basket Index

The measures of the annual relative value changes of the SDR in terms of the dollar are calculated and are shown in column 4 of table 5.5. The positive sign indicates the relative appreciation and the negative signs indicate the relative depreciation of the dollar.[42] The only year that the value of the SDR, relative to the dollar, increased was in 1976, by 4.91 percent. In 1971 and 1973, the dollar

had the sharpest relative depreciation of 8.57 percent and 9.79 percent, respectively. In other years, the relative depreciation of the dollar was not significant, except that in 1978 it was 7.23 percent.

In the context of OPEC's purchasing power, the results in the table suggest that OPEC's purchasing power increased only in 1976, by 4.91 percent due to the relative strength of the dollar against the currencies of the SDR basket. In all other years (except 1972 when there was no change) OPEC's purchasing power was reduced due to the relative weakness of the dollar. The highest reduction (9.79 percent) occured in 1973, and the lowest reduction (0.88 percent) occured in 1980.

In sum, the SDR basket of IMF was used as a measure for the price of OPEC oil between 1971 to 1980. It showed a purchasing power gain in 1976 and purchasing power loss for OPEC in all other years except 1972, not considering the impact of inflation and price increses by OPEC. The composition, mix, and weights of the SDR basket caused its results not to be the same as those of other baskets.

Comparison and Evaluation of the Baskets

Table 5.6 summarizes the characteristics of five currency baskets for the price of OPEC oil. Geneva I, with nine currencies which are equally weighted, was agreed upon between OPEC and the oil companies. Later, the Geneva II basket, with eleven currencies, was substituted. The United States dollar is not included in these two baskets. The trade basket includes the nine currencies of the Common Market countries,

the United States, and Japan. Similarly, Dailami's basket, with nine currencies, is weighted based on OPEC's trade with nine industrial countries. The SDR includes the dollar and is weighted, based on the size of the world trade criterion.

TABLE 5.6

CHARACTERISTICS OF FIVE CURRENCY BASKETS

Basket	# of Currencies	Dollar Inclusion	Weights	Origin
Geneva I	9	Not included	Equal	Agreement between OPEC & oil companies
Geneva II	11	Not included	Equal	Agreement between OPEC & oil companies
Trade	9	Included	Not equal: Based on trade with OPEC	This study
Dailami	9	Included	Not equal: Based on trade with OPEC	Dailami
SDR	16:74-80 5:since 81	Included	Not equal: Based on world trade	International Monetary Fund

In terms of the design and procedures of the measurement, there are two major distinctions between the Geneva I and the Geneva II baskets and the trade, Dailami, and SDR baskets. First, the weights of the currencies in both Geneva I and Geneva II composites are equal. The weights in the other three baskets are not necessarily equal.

For the trade and the Dailami baskets, the weights are based on OPEC's imports from those countries whose currencies are in the baskets. For the SDR, they are based on the size of international trade. Second, the other distinction is that the United States dollar is not included in the Geneva I and Geneva II baskets, but is included, with the heaviest weights, in all of the other three baskets.

There is also another difference between the trade and SDR baskets and the Dailami basket. The weights of currencies in both the trade and SDR baskets are fixed, and do not change each year, whereas the weights in the Dailami basket may change, depending on the changes in OPEC's imports from those nine industrial countries whose currencies are in the basket.

The annual percentage changes of the dollar fluctuation impact on OPEC's purchasing power by five standard baskets are compared in Table 5.7. The numerical values of those five baskets, which are normalized at 100 in 1970, are also shown. In this table, the negative signs indicate the reduction and the positive signs indicate the increases of OPEC's purchasing power.

Based on all five baskets, due to the relative weakness of the dollar, OPEC's purchasing power was reduced in each of 1971 to 1980 years except in 1972, 1974 and 1976. In 1972 the SDR basket index did not change. In 1974 and 1976, OPEC's purchasing power increased by all five basket measures, except by the SDR in 1974.

The annual average and variance of the percentage changes in OPEC's purchasing power by those five baskets are also shown in the table. Accordingly, by all five basket measures, for the 1971-80

average, OPEC's purchasing power was reduced due to the relative weakness of the dollar. The Geneva I basket, with the highest average reduction of the purchasing power of 4.28 percent, appears as the best basket for OPEC; the SDR basket, with the lowest average reduction of 2.77 percent, can be considered as the worst choice for OPEC. As the 1971-1980 average figures in the table indicate, the Geneva II, with the average reduction of 3.39 percent, is the second best; the trade basket, with the average reduction of 3.17 is the third best; and the Dailami, with 2.92 percent reduction, is in the rank of the fourth choice.

The relative better performance of the Geneva I and Geneva II baskets is due to the exclusion of the dollar in both of the baskets. Because the United States dollar, on the average, was weak for the whole period of 1971 to 1980, its exclusion made the baskets perform better.

We notice that in those periods in which the United States dollar was relatively strong, like in 1976, other baskets performed relatively better. In 1976, according to the Geneva I and Geneva II baskets, OPEC had increased its purchasing power by 6.88 percent and 5.94 percent respectively. In the same year, the Dialami basket shows an increase of 5.53 percent; SDR shows an increase of 4.91 percent. The trade basket shows a lower gain compared with the Geneva I and almost equal gain compared with the Geneva II basket.

The degree of the variation of the purchasing power of OPEC in terms of the variance of the percentage changes during 1971-80 by each of the five currency baskets is calculated and shown in the table.[43] Accordingly, the SDR basket, with the lowest variance of 20.31 percent, appears as the most stable, and the Geneva II basket, with the highest variance of 38.67 percent, can be considered as the least stable basket for OPEC. These results are based on the 1970-1980 data and do not consider other factors such as inflationary impact and OPEC higher prices for oil.

The hypothesis that the trade basket is relatively more stable than the Dailami basket appears to be true. The trade basket, with the variance of 26.53 percent, seems to be more stable than the Dailami basket, with the variance of 30.33 percent. Notice that the differences in the performance of these two baskets are not significant. Their minor difference is due to one currency difference and the difference in the weights.

It is clear that the highest variance of the Geneva II versus the lowest of the SDR is due to the relative higher weights which are given to the currencies with higher exchange rate variations in the Geneva II compared to the SDR basket. Also, it is due to the difference between these two baskets in terms of the number of currencies. The Geneva II has nine currencies compared with the SDR basket which had sixteen currencies during the measurement, 1971 to 1980.

The annual averages of the impact of the dollar fluctuation by each of the five baskets for two sub-periods of 1971-1975 and 1976-1980 are

TABLE 5.7

COMPARISON OF THE IMPACT OF THE FLUCTUATION OF THE DOLLAR ON OPEC'S PURCHASING POWER BY DIFFERENT BASKETS[1]

Year	Geneva I		Geneva II		Trade		Dailami		SDR	
	% Change	Value[2]	% Change	Value	% Change	Value	% Change	Value	% Change	Value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1970	---	100.00	---	100.00	---	100.00	---	100.00	---	100.00
1971	- 5.23	105.23	- 4.06	104.06	- 1.86	101.86	- 3.42	103.48	- 8.57	108.57
1972	- 7.59	113.22	- 6.66	110.99	- 6.93	118.92	- 5.97	109.59	0.00	108.57
1973	-11.53	126.27	-11.11	123.32	- 7.86	117.48	- 8.21	118.59	- 9.79	119.20
1974	+ 2.51	123.10	+ 1.73	121.19	+ 3.22	113.70	+ 4.40	113.37	- 0.89	120.20
1975	- 5.20	129.50	- 3.08	124.92	- 6.02	120.54	- 2.30	115.98	- 0.95	121.20
1976	+ 6.88	120.59	+ 5.94	117.50	+ 5.89	113.44	+ 5.53	109.57	+ 4.91	115.44
1977	- 2.17	123.21	- 0.57	118.17	- 2.30	116.05	- 2.35	112.14	- 1.13	116.74
1978	-13.96	140.41	-11.10	131.29	-12.45	130.50	-13.10	126.93	- 7.23	125.18
1979	- 5.54	148.19	- 4.09	136.65	- 3.30	134.81	- 3.27	131.08	- 3.20	129.19
1980	- 0.96	149.61	- 0.94	137.93	- 0.09	134.93	- 0.47	131.70	- 0.88	130.33
Average 71-80	- 4.28	(#1)	- 3.39	(#2)	- 3.17	(#3)	- 2.92	(#4)	- 2.77	(#5)
Variance	38.52	(#4)	38.67	(#5)	26.53	(#2)	30.33	(#3)	20.31	(#1)
Average 71-75	- 5.41	(#1)	- 4.64	(#2)	- 3.89	(#4)	- 3.10	(#5)	- 4.04	(#3)
Average 76-80	- 3.15	(#1)	- 2.15	(#4)	- 2.45	(#3)	- 2.73	(#2)	- 1.51	(#5)
C. V.[3] 71-80	1.45	(#1)	1.83	(#4)	1.62	(#2)	1.89	(#5)	1.63	(#3)

[1](-) signs indicate the reduction and (+) signs indicate the increase in the purchasing power of OPEC; Columns (1), (3), (5), (7), (9) from Tables 5.1, 5.2, 5.4, 5.5 and 5.6, respectively.

[2]All values in Columns (2), (4), (6), (8), and (10) normalized at 100 in 1970.

[3]C. V. is coefficient of variation and equal to the standard deviation divided by the average.

measured and shown in the table. For the period 1971-75 compared with 1971-80, the ranks of the baskets did not change. That is, the Geneva I is still the best choice; the Geneva II, the trade, the Dailami and the SDR baskets are ranked in order. But the rank of the baskets changed for 1976-1980 as follows: Geneva I ranked as number one, Dailami as two, the trade as three (as for the other two periods), Geneva II as fourth, and the SDR as fifth (as for the other two periods). The reasons for the differences are that first, during 1976-80, the United States dollar was not as weak as during 1971-75; second, the strong Swiss franc in the Dailami basket made it better for the 1976-80 period. These differences again suggest that a basket which can perform the best during one period may not necessarily do so in other periods. Thus, the past may not be a good guideline for the future.

The measure of the coefficient of variation for each of the five currency baskets for 1971-1980 is calculated and shown in the last row of the table. This measure combines the overall indices of stability and the protection of the value criteria. The Geneva I basket, with the lowest coefficient of variation, appeared as the best, and the Dailami, with the highest coefficient of variation, appeared the worst among the five baskets. The SDR looked the second, and the trade the third basket.

In sum, based on the 1971-80 average of the dollar fluctuation impact on the purchasing power of OPEC, the Geneva I basket appeared to be the best choice for OPEC. But according to the degree of variation of the purchasing power criterion, the SDR looked the best. Combining the measures of stability with the average of the indices, by the coefficient of variation, the Geneva I basket seemed the best and the

Dailami basket seemed the worst choice for OPEC. The differences in the results are due to the differences in the time period of measurement, numbers, composition and weights of currencies in each basket.

The Impact of Inflation

Another and more important factor than dollar fluctuation which has impact on the purchasing power of OPEC revenue is worldwide inflation and specifically, inflation in the trade-partner countries of OPEC. In this section, we calculate the impact of inflation on OPEC's purchasing power by two inflationary indices, the United States Producers Price Index (U.S.-PPI) and the index called the "weighted export price index."[44] We utilize the export price indices of the major European Common Market countries, Japan, and the United States, with mote emphasis (higher weights) on those countries which have the greatest exports to OPEC countries.

United States Producers Price Index

The U.S.-PPI (base year 1967 = 100), from the United States Department of Labor, Bureau of Statistics, is shown in colum (1) of Table 5.8. These data are transformed into 1970 = 100 basis in column (2), and their corresponding percentage changes are shown in column (3) of the table. In all years of 1971 to 1980, there were increases in the changes of the U.S.-PPI. The highest percentage increase (11.80 percent) occurred in 1979, and the lowest percentage increase (2.73 percent) occurred in 1971. Between 1971 to 1980, the rate of increase (as a rate of inflation) was about an annual average of 8.61 percent. The changes in the U.S.-PPI can be interpreted as a measure of the changes in OPEC's purchasing power due to inflation. Accordingly, in each year of 1971 to 1980,

TABLE 5.8

COMPARISON OF THE CHANGES IN THE U.S.-PPI AND CHANGES IN THE NOMINAL PRICES OF OPEC OIL

Year	U.S. PPI 1967=100[1]	U.S. PPI 1970=100	Changes in PPI (%) 1970=100	Nominal Price of Oil $/bar[2]	Changes in the Price of Oil (%)	Weighted Exp. Price Index[3]
	(1)	(2)	(3)	(4)	(5)	(6)
1970	109.9	100.00	---	1.80	---	---
1971	112.9	102.73	+ 2.73	2.19	+ 21.66	+ 4.94
1972	116.6	106.10	+ 3.28	1.90	- 13.24	+ 8.48
1973	129.2	117.56	+10.80	2.70	+ 42.11	+19.54
1974	149.3	135.85	+15.56	9.76	+261.48	+24.26
1975	163.6	148.86	+ 9.58	10.72	+ 9.84	+ 1.10
1976	169.7	154.41	+ 3.73	11.51	+ 7.37	- 0.04
1977	180.7	164.42	+ 6.48	12.40	+ 7.73	- 0.89
1978	194.9	177.34	+ 7.86	12.70	+ 2.42	+ 1.29
1979	217.9	198.27	+11.80	16.97	+ 33.62	- 0.08
1980	248.9	226.48	+14.23	28.67	+ 68.95	+ 0.21
Annual Ave.			+ 8.61		+ 44.11	5.88

[1]From United States Department of Labor, Bureau of Statistics.

[2]From International Monetary Fund, International Financial Statistics, different issues.

[3]From Appendix 4

OPEC's purchasing power declined; the highest reduction was in 1974, 16.56 percent, and the lowest was in 1971, 2.73 percent. The annual average reduction was about 8.61 percent. The nominal price increases were much higher than the rate of inflation in all years between 1971 to 1980, except in 1972 and 1978. This suggests that although OPEC's purchasing power declined due to inflation, its price increases were much more than enough to compensate for the loss.[45]

Adjustment: Weighted Export Price Index

It can be argued that the U.S.-PPI is not a good index for the measurement of the inflationary impact on OPEC purchasing power. First, no OPEC member has been importing all of its imports from the United States, and some of the OPEC members' share of imports from the United States is not significant. Second, the U.S.-PPI does not really represent, at least fully, the price changes of the commodities that OPEC imports. To be more realistic, we used the export price index of the major seven Common Market countries, the United States, and Japan.[46]

This index represents the inflationary impact on OPEC's imports in a more realistic fashion. Also, equal weights are not given to the index of each country. The measurements of weights of exports to OPEC by nine major industrial nations for each year are calculated and shown in Appendix 3. Using these weights, the export price index is adjusted to come up with a new adjusted composite of weighted export price index to be employed for the measurement of the inflationary impact on OPEC members. The results of these measurements are calculated in Appendix 4, and shown in column (6) of Table 5.8.

According to these measures, OPEC's purchasing power, due to deflation, increased in 1976, 1977, and in 1979. The highest increase

occurred in 1977, 0.89 percent. In all other years the inflationary impact reduced OPEC's purchasing power. On the average, OPEC's purchasing power declined by 5.88 percent annually between 1971-1980. Notice that this figure is relatively lower than the annual average based on the PPI of 8.61 percent. Also, according to the PPI measure, in all of the years between 1971 to 1980, OPEC's purchasing power was reduced. This was not the case for the Weighted Export Price Index. The worst year for OPEC based on both of the inflationary measures was 1974.

Impact on the Terms of Trade of OPEC

In this section, we will measure the net effect of OPEC oil price increases, the fluctuation of the dollar, and inflation between 1971 and 1980. Based on these measures, we will be able to see how much OPEC relatively gained or lost from higher prices of oil.

Assuming oil is the only export commodity of the OPEC members, the terms of trade, t_i, in each year for OPEC members as a whole can be defined as

$$(5.7)\quad \dot{t}_i/t_i = \dot{P}_{oi}/P_{oi} - P_i\dot{I}W_i/PIW_i - E\dot{X}_i/EX_i$$

where t is the terms of trade, P_{oi} is the price of oil, PIW_i is the weighted export price index, and EX_i is the measure of the changes of the value of the dollar against other currencies of different baskets. The (.) on the top of any variable denotes the time derivative of that variable.[47]

Using equation 5.7, the numerical results of the terms of trade for each year between 1971 and 1980, based on the four currency basket

measures of the fluctuation of the dollar, are shown in Table 5.9. In column 1, the percentage changes of the price of oil are shown. In 1972, the price of OPEC oil dropped 13.24 percent. In other years, the price increased from a low of 2.42 percent in 1978 to a high of 261.48 percent in 1974. The average price increase for the whole period, 1971-1980, was 44.19 percent. In column 2, the annual rate of inflation measured by the weighted export price index for 1971 to 1980 is shown. In 1976, 1977 and 1979, this index dropped. In all other years, it increased. The highest increase occurred in 1974, 24.26 percent, and the lowest increase of 0.21 percent occurred in 1980. The average net increase for the whole period was 5.88 percent.

Columns 3, 4, 5, and 6 report the percentage changes of the value of the dollar against the currencies of the Geneva I, Geneva II, trade, and SDR baskets, respectively. Implementing equation (5.7), the terms of trade based on different measures of the four currency baskets are calculated and shown in the last four columns of the table. For instance, OPEC's terms of trade in 1971, measured by the Geneva I basket, are as follows: +21.66-4.94-5.23 = +11.49, which is shown in the final row of column (7). Similarly, the terms of trade based on the Dailami basket and inflationary measure are calculated and shown in Table 5.10. Notice that the Dailami basket and weights, which were also used for the measurement of the dollar fluctuation impact, were used for his weighted export price index and his terms of trade.

According to the calculations which are presented in both tables, in 1972 and 1978, the terms of trade of OPEC deteriorated by all of the

five currency basket measures. In 1972, the Geneva I basket, which resulted in a reduction of the terms of trade of 29.31 percent, shows the sharpest deterioration, and the SDR basket, which resulted in a reduction of the terms of trade of 21.72 percent, shows the lowest deterioration of the terms of trade. In 1978, measuring by the Geneva I basket, the terms of trade of OPEC declined by 12.83 percent (the highest); measuring by the SDR basket, the reduction was 6.10 percent (the lowest). The deterioration of the terms of trade by the other three basket measures, in 1978, were 12.19 percent by the Dailami, 11.32 percent by the trade, 9.97 percent by Geneva II, and 6.10 percent by the SDR measure.

In all other years, and based on all of the five currency basket measures, the terms of trade of OPEC members improved. The highest rate of improvement occurred in 1974: 241.66 percent (Dailami basket), 240.44 percent (trade basket), 239.73 percent (Geneva I), 238.95 percent (Geneva II) and 236.33 percent (SDR basket). Next to 1974, the year 1980 was the best year for OPEC, measured by the terms of trade improvement and based on any of the five currency basket standards. In that year, the terms of trade improved at least by 67 percent.

The average changes of the terms of trade for the whole period of 1971-1980 are calculated and shown in the table. The average terms of trade for each of the five baskets were measured by using equation 5.7, as follows:

+44.19-5.88-4.28 = +34.04	Geneva I Basket
+44.19-5.88-3.39 = +34.92	Geneva II Basket
+44.19-5.88-3.17 = +35.14	Trade Basket
+44.19-5.88-2.17 = +35.54	SDR Basket
+44.19-6.22-2.92 = +35.05	Dailami Basket

Accordingly, on the average, between 1971-1980, the terms of trade of OPEC increased annually by 34.04 percent, 34.92 percent, 35.14 percent, 35.54 percent, and 35.05 percent by Geneva I, Geneva II, trade, SDR, and Dailami baskets, respectively. That is, by all five basket standards, OPEC's terms of trade improved substantially during the period 1971-1980. This suggests that even though OPEC's purchasing power declined due to the relative weakness of the dollar and inflation, its oil prices were much higher.

In conclusion, based on the changes of the terms of trade criteria, among the four baskets in Table 5.9, the Geneva I measure shows the lowest and the SDR basket shows the highest average annual improvement in the terms of trade of OPEC. Therefore, the Geneva I appears to be the best choice and the SDR appears as the worst choice for OPEC. This is consistent with the earlier comparison and conclusions about the baskets. Notice the terms of trade based on the Dailami measures are not compared, because the Dailami basket used a different inflationary measure.

The Impact on Individual OPEC Members

Inflationary Impact

Using the weighted export price index approach which was used for OPEC as a whole earlier, the 1971-80 average impact of inflation each of the twelve OPEC members is measured separately and presented in column (2) of Table 5.11. That is, the export price index of the nine industrial countries whose currencies are in the trade basket is

TABLE 5.9

PERCENTAGE CHANGES IN OPEC'S TERMS OF TRADE BY FOUR DIFFERENT BASKETS[1]

Year	Change in Price of Oil	Inflation: Weighted Export Price Ind.[2]	Fluctuation of the Dollar by[3]				Terms of Trade: (1)-(2)-			
			Geneva I	Geneva II	Trade	SDR	(3) Geneva I	(4) Geneva II	(5) Trade	(6) SDR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1971	+21.66	- 4.94	- 5.23	- 4.06	- 1.86	-8.57	+ 11.49	+12.66	+ 14.86	+ 8.15
1972	-13.24	- 8.48	- 7.59	- 6.66	- 6.93	0.00	- 29.31	-28.38	- 28.65	- 21.72
1973	+42.11	-19.54	-11.53	-11.11	- 7.86	-9.79	+ 11.04	+11.46	+ 14.71	+ 12.78
1974	+261.48	-24.26	+ 2.51	+ 1.73	+ 3.22	-0.89	+239.73	+238.95	+240.44	+236.33
1975	+ 9.84	- 1.10	- 5.20	- 3.08	- 6.02	-0.95	+ 3.54	+ 5.66	+ 2.72	+ 7.79
1976	+ 7.37	+ 0.04	+ 6.88	+ 5.94	+ 5.89	+4.91	+ 14.29	+13.35	+ 13.30	+ 12.32
1977	+ 7.73	+ 0.89	- 2.17	- 0.57	- 2.30	-1.13	+ 6.45	+ 8.05	+ 6.32	+ 7.49
1978	+ 2.42	- 1.29	-13.96	-11.10	-12.45	-7.23	- 12.83	- 9.97	- 11.32	- 6.10
1979	+33.62	+ 0.08	- 5.54	- 4.09	- 3.30	-3.20	+ 28.16	+29.61	+ 30.40	+ 30.50
1980	+68.95	- 0.21	- 0.96	- 0.94	- 0.09	-0.88	+ 67.78	+67.80	+ 68.65	+ 67.86
Avg.	+44.19	- 5.88	- 4.28	- 3.38	- 3.17	-2.77	+ 34.03	+34.92	+ 35.14	+ 35.54

[1]All figures in percentages.
[2]From Appendix 4.
[3]From Table 5.7.

TABLE 5.10

PERCENTAGE CHANGES IN OPEC'S TERMS OF TRADE
BY DAILAMI'S BASKET AND INFLATIONARY MEASURES

Year	Change in Price of Oil[1]	Inflation Weighted Export Price Index -Dailami's	Fluctuation of the Dollar by Dailami's Basket	Terms of Trade (1)-(2)-(3)
	(1)	(2)	(3)	(4)
1971	+ 21.66	- 5.02	- 3.42	+ 13.22
1972	- 13.24	- 8.61	- 5.97	- 27.82
1973	+ 42.11	-20.13	- 8.82	+ 13.16
1974	+261.48	-24.22	+ 4.40	+241.66
1975	+ 9.84	- 2.00	- 2.30	+ 5.54
1976	+ 7.37	+ 0.05	+ 5.53	+ 12.95
1977	+ 7.73	+ 0.95	- 2.35	+ 6.33
1978	+ 2.42	- 1.51	-13.10	- 12.19
1979	+ 33.62	- 1.73	- 3.27	+ 28.62
1980	+ 68.95	+ 0.03	- 0.47	+ 68.51
Ave.	+ 44.19	- 6.22	- 2.92	+ 35.05

[1]From International Monetary Fund, International Financial Statistics, different issues.

is weighted separately according to the size of their exports to each OPEC member. The results are shown in column (2) of the table.

According to the results, on the average, inflation measured by the weighted export price index reduced the purchasing power of all OPEC members. However, inflation hit the OPEC members almost equally, with a small variation. The variation of the inflationary impact measured by variance was equal to 0.056 percent for the mean of 5.86 percent.

The impact of inflation was most for Algeria, 6.25 percent, and least for United Arab Emirates (UAE), 5.29 percent. It is obvious that this variance is due to the differences in each member's trade relationship with the nine industrial countries with different export price indices.

The average of the inflationary impact on each OPEC member, which is about the same as that of OPEC as a whole and which was calculated earlier, is shown in the table and is equal to 5.86 percent. Those members whose figures are less or more than 5.86 percent average perform better or worse than others.

Dollar Fluctuation Impact

The 1971-80 average impact of the dollar fluctuation for each OPEC member, based on the trade basket measure,is calculated and shown in column (3) of the table. As the figures indicate, between 1971 to 1980, on the average, the dollar fluctuation had a net depreciation impact and, consequently, reduced the purchasing power of all OPEC members. The impact to Algeria was 4.60 percent, and the most severe, as

it was the case for the inflationary impact. Next to Algeria, Indonesia's purchasing power declined by the average of 3.34 percent. The lowest purchasing power reduction impact was on Venezuela. These differences are due to the differences in the trade ties with the nine industrial countries. Specifically, because Venezuela has a relatively stronger trade tie with the United States, the impact of the dollar depreciation was the lowest.

The variance of the dollar fluctuation impact among OPEC members was also measured and shown in the table. The variance of 0.563 percent for dollar fluctuation is much higher than the variance of the inflationary impact of 0.056 percent. This suggests that the changes in the purchasing power impact of the dollar fluctuation are more discriminating than the inflationary impact on the OPEC members.

The Changes in the Terms of Trade

Using equation 5.7, the 1971-80 average changes in the terms of trade of each individual OPEC member are calculated and shown in column (4) of the table. Also, the average changes in the price of oil, 44.19 percent, is shown in column (1). For instance, the average change in the terms of trade of Algeria as a result of the net impact of the oil prices, inflation and the weakness of the dollar was measured as follows:

+44.19-6.25-4.60 = +33.34 percent.

Based on these figures between 1971 to 1980, the annual average of purchasing power of OPEC members increased between 33 and 36 percent. During that period, Libya gained the most, about 35.8 percent, annually, and Algeria gained the least, about 33.34 percent, annually, by the terms of trade measures.

TABLE 5.11

THE MEASUREMENT OF THE AVERAGE TERMS OF TRADE FOR INDIVIDUAL OPEC MEMBERS[1]

	Average Changes in Oil Prices 1971-80	Inflation: Weighted Exp. Price Index	Dollar Fluctuation: Trade Basket	Terms of Trade
	(1)	(2)	(3)	(4)
Algeria	+44.19	-6.25	-4.60	+33.34
Indonesia	+44.19	-5.64	-4.34	+34.21
Iran	+44.19	-5.88	-3.05	+35.26
Iraq	+44.19	-5.76	-4.11	+34.32
Kuwait	+44.19	-5.88	-3.23	+35.08
Libya	+44.19	-6.08	-2.22	+35.89
Nigeria	+44.19	-5.89	-3.40	+34.90
Oman	+44.19	-6.00	-2.91	+35.28
Qatar	+44.19	-5.94	-3.88	+34.37
Saudi Arabia	+44.19	-5.80	-2.70	+35.69
UAE	+44.19	-5.29	-3.17	+35.73
Venezuela	+44.19	-5.88	-2.48	+35.83
Average	44.19	-5.86	-3.34	+34.99
Variance	0.0	0.056	0.563	0.626

[1]All figures in percentages.

The variation of the increases in the terms of trade among the OPEC members was relatively low during 1971-80. The variance of the terms of trade among the OPEC members was 0.626 percent compared to the mean of 34.99 percent.

In sum, the impact of inflation and dollar fluctuation was not the same for each of the OPEC members due to different trade ties with the industrial nations which had different rates of inflation and different price changes of their currencies against the United States dollar. However, it appears that the dollar fluctuation impact is more discriminating than the inflationary impact.

Conclusions

Although during 1971-1980, inflation and the relative weakness of the dollar have reduced the purchasing power of OPEC, the terms of trade of OPEC have substantially improved. This is because OPEC increased its oil prices much more than the compensation for inflation and dollar weakness.

The results suggest that the inflationary impact on the real purchasing power of OPEC was more severe than the impact of the relative weakness of the dollar (see Table 5.9). This suggests that even an optimum currency basket for the price of OPEC oil cannot solve the inflationary impact on the price of oil, unless that basket is combined with some inflationary index.

Different currency baskets and inflationary measures result in different measures for dollar fluctuation, inflationary impact, and terms of trade. These differences are due to the different mix and

weights of currencies and their degree of depreciation or appreciation against other currencies. During periods that our measures showed loss or gain to OPEC due to the fluctuation of the dollar, the dollar was relatively depreciating or appreciating. Consequently, during these periods, the terms of trade were deteriorating or improving. If the dollar had been relatively appreciating, OPEC would have gained rather than lost, and the terms of trade would have improved even more. Things could have been even worse for OPEC if the dollar had depreciated more than it did.

For the period 1971-80, the Geneva I basket appeared to be the best choice and the SDR the worst choice for the protection of OPEC's purchasing power from the impact of the dollar fluctuation. The SDR basket, with the lowest variance, proved to be the best in terms of the risk of instability of the purchasing power. Overall, and for 1971-80, the Geneva I basket appeared as the best choice for OPEC.

No basket or inflationary measures can protect all of the OPEC members equally due to different trade ties of OPEC members with industrial nations. Among the OPEC members, the terms of trade of Algeria improved the least during 1971-80, because the impact of inflation and the dollar fluctuation on Algeria was greater than on any other members of OPEC.

In 1973, when the Geneva II basket was agreed upon, it performed better than the Geneva I basket, because in that year the Canadian dollar appreciated against the United States dollar (see Table 5.2). But in most other single years and for the whole period of 1971-80, Geneva I performed better. Thus, the OPEC switch to the Geneva II

basket pricing of oil in 1973 would not have been beneficial to OPEC if that basket had been used. This substantiates the point that past experience is not necessarily a good guideline for the future.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The purpose of this dissertation was to explore the nature, functions, benefits, and problems of establishing a currency basket, as an alternative to the use of the dollar in international trade in oil. Because of the depreciation and fluctuation of a single currency in the world of the floating exchange rate system, OPEC expressed concern about using indexes of currencies for pricing of oil. Given the OPEC pricing of oil, the study included the construction and evaluation of three alternative baskets and evaluation of two others for the measurement and protection of the real price of OPEC oil. The study also measured the impact of inflation on oil prices, and the changes of the terms of trade of OPEC as a whole and individually between 1971 to 1980.

As background material, the foundation, structure, organization, objectives, level of production, reserves and solidarity of OPEC were discussed. Although OPEC was officially founded in 1960, it gained its market power in 1973 due to several circumstances. The market condition at that time resulted in a higher demand for oil, and relatively large amount of world oil supply and reserves belonged to OPEC. Furthermore, OPEC members became more cooperative in terms of price and production policies and in the framework of the statute of OPEC, despite many socio-economic and political differences among the members.

Since the early seventies when OPEC began to gain market power, it asked many concessions from the oil companies, including increases in prices and adjustment of the prices of oil by indexes of currencies. However, after the oil embargo and boycott, OPEC gained full control of setting oil prices, unilaterally.

The structure of OPEC has three distinct organs: the Conference, the Board of Governors and the Secretariat. The Conference is the highest authority of OPEC, and the Board of Governors supervises the administration of OPEC, which is executed by the Secretariat. According to OPEC documents, the main objective of OPEC is the unification and coordination of the petroleum policies of member countries and the determination of the best means for safeguarding their interests, individually and collectively. However, there are several major internal threats to OPEC as a unified cartel, including differences in optimum price policies for each member and differences in trade, investment, and political ties with other countries of the world.

A review of OPEC pricing was undertaken in light of actual experience and several simulation studies. The simulation models are based on various assumptions and the behavorial goal of profit maximization. The comparisons showed that there was a gap between the actual and the projected optimal real prices since 1979 due to the interruption of the supply of oil in that period. The actual price of oil is determined by the leading member of OPEC, currently Saudi Arabia, in consultation with the other members. The gap between official prices and spot prices represents the degree of pressure of demand versus

supply in the oil market. Spot prices always lead the official prices of OPEC.

Since consideration of the magnitude of the coefficients of price, income, and cross elasticity of demand for oil are important for the price policies of OPEC, a review of these measures was undertaken. According to findings, the short run price elasticity of demand for oil is low. This is mostly because of the lack of a perfect substitute for oil and oil dependency for production of many important products. However, the long run price elasticity of demand for oil is not low due to longer time for response by consumers, producers, and policy makers. Depending on different assumptions, including the length of time, different studies arrived at different price elasticity coefficients of demand for oil. Similarly, different studies, for the same reasons of different assumptions, came up with different income elasticity coefficients. But the range of variations of the income elasticity coefficients is smaller than the range of the variations of the price elasticity coefficients.

To reduce any loss from reliance on a single country's currency, the benefits and costs of a currency basket as a substitute were discussed and the experience with the SDR reviewed. The purposes of a currency composite could be for the protection and stability of the real price or payment for the future contract, investment, and pegging of domestic currencies. Different criteria may be used for the design, composition and weights of the currencies in a basket. A basket might be used only as a unit of account or for some other purpose such as a

store of value. The idea of a currency basket in transactions is not new; it goes back to the late Middle Ages. Specifically, a basket of currency versus a single currency pricing of OPEC oil could relatively stabilize and protect the real price of oil, and provide a rule for oil price adjustment. Yet, the switch to a currency basket for the price of oil seems difficult and uncertain for the following reasons: (1) differences in the investment portfolio, economic structures, and political ties of OPEC members; (2) difficulty of agreement on the composition and weights of the currencies of the baskets by OPEC members; (3) possible opposition from the oil importing countries; and,(4) finally, unknown future performance of different currencies.

The Geneva I and Geneva II baskets for the adjustment of the price of oil were mentioned in the OPEC documents. Yet their performances are not known outside OPEC. The major contribution of this dissertation was the examination of the performance of these two baskets and two others, the Dailami and the SDR for 1971-1980. Another contribution of this dissertation was the designing of new basket of nine currencies and the measurement, evaluation, and comparison of its performance with those of the other four baskets. The final contribution was measurement of the changes in the terms of trade of OPEC members as a whole and individually.

The number of currencies in the Geneva I basket is 9; Geneva II has 11 currencies and their weights are equal. The number of currencies in the Dailami and trade baskets are each nine and proportional to OPEC's imports from the countries whose currencies are in the basket. The

number of currencies in the SDR basket was originally sixteen and their weights were based on the size of the international trade of those countries whose currencies are in the basket, but in 1981 its currencies was reduced to five. Although the United States dollar is not included in either the Geneva I or Geneva II baskets, it is most heavily included in the other three baskets.

The results of the measurements made in this study were consistent with the hypothesis that OPEC's purchasing power declined due to the relative weakness of the dollar in most of the years between 1971 to 1980. Based on the 1971-80 experience, the results of the annual average reduction of the purchasing power of OPEC due only to the fluctuation of the dollar and not considering other factors suggest that the performance of the Geveva I basket was the best. The order of the ranks of the other four baskets are as follows: Geneva II second, trade basket third, Dailami basket fourth, and the SDR the last choice for OPEC. This conclusion is not necessarily true for each single year between 1971-1980, because the performance of each basket in each single year depends on the relative performance and weights of the currencies in that year. For the period 1976-80 the the Geneva I basket and for 1972 only the SDR basket appeared as the best choices. For 1976 the results of all five baskets suggested increases in the purchasing power of OPEC due to the relative strength of the dollar. That is, in that year the dollar pricing of oil indeed had been beneficial to OPEC.

Based on the stability criterion, the SDR with the lowest variance and the Geneva I basket with the highest variance appeared as

the best and the worst choices for OPEC, respectively. This conclusion is just the opposite of the one which was based on the purchasing power protection criterion. Thus, a conflict of objectives appears in the selection of the baskets.

Also, the results were consistent with the hypothesis that the trade basket is more stable than the Dailami basket. The reason for less stability of the Dailami versus the trade basket is inclusion of the more unstable Swiss franc in the former and inclusion of the less unstable Denmark kroner in the latter.

Based on the measure of the coefficient of variation, overall, the Geneva I basket appeared as the best, the SDR the second best and the Dailami basket appeared as the last choice for OPEC.

The United States Producers Price Index and the weighted export price index were used to measure the inflationary impact on OPEC's purchasing power. The figures were consistent with the hypothesis that inflation reduced OPEC's purchasing power. According to the weighted export price index, which appears to be a better measure of the inflationary impact on OPEC, the purchasing power of OPEC increased in 1976, 1977, and 1979. The increase in purchasing power was due to higher prices of oil in those years and also a relatively stronger dollar in 1976. In all other years, OPEC's purchasing power was reduced due to inflation.

Combining higher prices of OPEC oil with the impact of inflation and dollar fluctuation, the terms of trade of OPEC were measured for 1971 to 1980. The results of the measurements by all of the five baskets suggest that in each single year between 1971 to 1980 the terms of trade of OPEC improved, except in 1973 and 1978. The improvement

in the terms of trade of OPEC in some years was substantial. The highest improvement occurred in 1974, by at least 236 percent. The 1971-1980 average of the increases in the terms of trade of OPEC was at least 34 percent. This suggests that OPEC's increases in the price of oil have been more than sufficient to offset inflation and dollar fluctuation.

The impact of the dollar fluctuation, inflation and the terms of trade on each of the OPEC members was measured separately. According to the results of the 1971-80 averages, all of the OPEC members' purchasing power was reduced due to either inflation or the dollar fluctuation. The impact of inflation was the most for Algeria and the least for the United Arab Emirates. The impact of the dollar fluctuation was, again, the most for Algeria and the least for Libya. On the average, the impact of inflation on OPEC members was more than that of dollar fluctuation. Furthermore, the impact of inflation was less discriminatory (less variance among the members) than the impact of the dollar fluctuation. Combining these two impacts with oil price increases by the terms of trade measure, the results suggest that OPEC members' terms of trade improved in the range of 33.34 percent (the lowest for Algeria) to 35.89 percent (the highest for Libya). These results imply that any basket or inflationary indices for OPEC as a whole cannot necessarily protect all of the OPEC members equally.

The use of any currency basket pricing of OPEC oil should be in the light of the future structure and pattern of the trade of OPEC members with the industrial nations, and specifically with the United States. Also, it should be in the light of other measures of the

degree of competitiveness of the industrial countries in the world market, including the rate of inflation and the trade elasticity of substitutions.

The differences in the trade ties, investments, and debts of the OPEC members with the industrial countries can prevent an agreement on the weights and currencies of the basket for the price of oil. One way of solving some of these issues related to the differences among the OPEC members is to apply the principle of compensation. This requires solving two problems: the determination of the optimum basket and the identification of the losers and gainers among OPEC members.

This study was abstracting important variables for the evaluation of the currency basket pricing of oil. However, it was not concerned with the price path policies of OPEC, the impact of currency basket pricing of oil on OPEC investment, surplus assets, debts, retaliation, and any responses in the oil importing countries to the oil price changes by OPEC. Furthermore, the purpose was to evaluate the currency basket for the purpose of protecting the real price of oil and not necessarilly oil revenues. But as long as the price elasticity of demand for oil is less than one, the protection of oil revenue can also be achieved. Yet, the study assumed no changes in the trade elasticity of substitution between OPEC members and the industrial nations and no changes in the income elasticity of demand for oil in the latter countries. It should be kept in mind that the relaxation of some of these assumptions might invalidate the results of the performance of the currency baskets.

The evaluations were limited to the decade of the seventies, and the experiences of the past cannot necessarily be used as a good guideline for the future. If the dollar remains strong, as it is now, probably dollar pricing of oil will be better than any of those five currency baskets. But, obviously, if the dollar in the eighties follows the same path as in the seventies, any of the currency baskets will be better for the pricing of OPEC oil and will improve OPEC's terms of trade.

The differences in the performance and ranks of the currency baskets, as we have seen, are due to the time period and differences in the objectives of the baskets. These objectives most likely are not compatible. In the case of choosing a basket for the price of oil for the future, its performance further depends on the composition, weights, and relative exchange rate changes of the currencies in the baskets. The last factor is something which is hard to predict and, consequently, makes the decisions on the composition and weights of the currencies in the basket difficult and, therefore, the future performance of any basket uncertain.

FOOTNOTES

[1]Changes in terms of trade among countries reflect the impact of changes in price and exchange rates on imports and export revenues. There are several alternatives for the concept of terms of trade. The most widely used is called "net barter" terms of trade. If trade between two countries is balanced, then by definition: $P_x \cdot Q_x = P_m \cdot Q_m$ or $P_x/P_m = Q_m/Q_x$, where P_x, P_m are the prices of exports and imports, and Q_x, Q_m are the quantities of exports and imports respectively. The ratio P_x/P_m is called the "net barter" terms of trade; the ratio of Q_m/Q_x is called the "gross barter" terms of trade. The higher either of the ratios is for a country, the more that country is able to import for any quantity of exports. If for the same quantity of exports Q_x a country can import more or less commodities, its terms of trade improve or depreciate, other things being constant. In the rest of this dissertation, the terms of trade refer to the "net barter" terms of trade. For the concept of other alternatives of terms of trade, see 79.

[2]See Appendix 6.

[3]See 66 or "OPEC might switch to SDRs if dollar plummets," official says, "New York Times, August 4, 1972; also see interview with OPEC's Secretary General in Worldview, March 1979, p. 43.

[4]See Appendix 6; also see footnote 3.

[5]See footnote 3.

[6]U. S. Department of Energy, Energy Information, 1980 Annual Report to Congress, April 1980, Table 1, page 3.

[7]See page 21.

[8]Since the Conference meets at least twice annually and since Saudi Arabia can ultimately change its prices twice at any time, the Conference's decision is not carved in stone. In December 1976, the first open split occurred within OPEC on oil prices since the oil embargo. "Price unity" was restored in June 1977, when Saudi price was raised to $12.70 and equal to that of the other members. Also, very recently, an open price split occurred among the OPEC members due to the oil glut.

[9]Spot prices are not collected by a government agency, but determined by daily trade publications such as Patts' Oil Price Service. The principal locations for spot market price quotations are Rotterdam, New York, Italy, and the Caribbean. For more detail, see 27.

[10]See, for example, 34, 38, 54.

[11]See, for example, Exxon Background Series (1977); Workshop Alternative Energy Strategies (1977), and 36.

[12]This is the scenario that OPEC members are cooperative in terms of production cutback and behave as a pure monopoly cartel.

[13]See 1980 Energy Information Administration. 1980 Annual Report to Congress, Volume Two: Data, April 1981, p. 79.

[14]This was suggested in 1976; see 38.

[15]The price elasticity of oil demand is the percent reduction (increase in oil demand produced by a 1-percent increase (reduction) in oil price. Similarly, the income elasticity of oil demand is the percent increase (reduction) in oil demand produced by a 1-percent increase in oil demand produced by a 1-percent increase (reduction) in income.

[16]See "World Energy Outlook". Exxon Background Series. December 1980.

[17]A "game" can be defined as a situation in which two or more participants confront one another in pursuit of certain conflicting objectives. A "zero sum game" is a special case in which losers' payoffs must be equal to the winners' payoffs.

[18]Cross elasticity of demand for oil can be defined as the percentage reduction (increase) in oil demand produced by a 1-percent reduction (increase) in the price of oil substitutes.

[19]See OPEC resolutions in Chapter 2, pages 21 to 23; see also footnote 3.

[20]See footnote 3.

[21]Interview, Worldview, March 1979, p. 43.

[22]The European Monetary Unit (EMU) is the currency basket of the European Monetary Union which recently is called the European Monetary System (EMS). EMS is the creation of a closer monetary cooperative, leading to a zone of monetary stability and eventually a monetary integration in Europe. The efforts to launch the process of monetary and economic union were to take place along three lines to be followed simultaneously: a) the European exchange rate agreements, b) the reciprocal credit mechanisms to be consolidated with the creation of the European Monetary Fund, and c) the measures in favor of the less prosperous member states. For more detail, see 82 and 83.

[23]See 71.

[24]See footnote 22.

[25]See 43, May 4, 1981, page 129.

[26]Ibid, page 145.

[27]See 43, January 26, 1981, page 18.

[28]See 43, May 4, 1981, page 145.

[29]Ibid, page 13.

[30]For the definition and the concept of terms of trade, see footnote 1.

[31]See Appendix 5 and 6.

[32]See footnote 3.

[33]Export Price Index, called export unit value and published by the IMF, is a measure of changes in price of exports of different major industrial countries.

[34]See Appendix 5.

[35]See Appendix 6.

[36]These countries are the major exporters to OPEC and suggested by Dr. Walter Krause.

[37]See "Saudi Dollar Up; Loses Gold Falls Vote." The Journal, Oklahoma City, September 16, 1980--Original Source: UPI.

[38]Earlier than 1972 figures were not used for the measurement of weights, because in those periods most of the OPEC members were net borrowers and, consequently, their trade patterns and composition were different from the later years. 1979 and 1980 years also were not used because some of the major OPEC members had domestic political problems and oil shut-down.

[39]Notice the methodology of the measurement of the basket index is practically the same as that of the trade and SDR baskets. The trade basket index, I, measured as $I = (VB - Po)/Po$, where VB is the basket price and Po is the base price of oil. Substituting equation 5.6 in the index, I, we get $I = \{(\Sigma E_{yi}\ Po\ W_i/E_{oi} - Po)\}/Po$. Since Po is constant, we can have $I = Po\{(\Sigma\ E_{yi}\ W_i/E_{oi} - 1)\}/Po$, or $I = \Sigma W_i - E_{yi}/E_{oi} - 1$, or $I = \Sigma W_i\ (E_{yi} - E_{oi})/E_{oi}$, or $I = \Sigma W_i\ E_i$, the same as the Dailami basket index.

[40]The updated results of the Dailami basket are not exactly similar to the corresponding dates (1971 to 1977) of his measure. This differences probably are due to the differences in the dates of the sources or types of data.

[41]See footnote 3.

[42]At any point in time, there has been one SDR Basket, even though we can distinguish three types of SDR baskets in terms of the numbers or mix of the currencies in the basket. However, the price of SDR at any time in terms of other currencies was fixed. Therefore, we used the price of SDR in terms of the dollar and measured the SDR index during 1971-1980. Obviously, in our measurement, we used 1971 non-basket SDR for 1971 to 1973, 1974 SDR basket for 1974 to 1977, and 1978 SDR basket for 1978 to 1980. 1981 SDR basket was not used for the measurement.

[43]Variance can be defined as $S^2 = \Sigma(X-\overline{X})^2/(N-1)$, where S^2 is the sample variance, X, $\overline{X}$ and N are the percentage annual value changes of baskets in each year, average value changes, and the number of years, 10, respectively.

[44]For the explanation of the export price index, see footnote 33.

[45]For the value measures of the real price of OPEC oil adjusted for the U.S.-PPI, see Table 3.1 in Chapter III.

[46]For the concept of the export price index, see footnote 33.

[47]For the definition and concept of the terms of trade see footnot 1.

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APPENDIX 1

BASKET OF NINE CURRENCIES BASED ON THE SIZE OF EXPORTS TO OPEC AND 1971 PRICE OF SAUDI LIGHT--$2.194/BARREL

Currency	Weight[1]	Price of Oil--$2.194 2.194 x (1)	Exch. Rate $/unit 1971 Avg.[2]	Currency Units in Basket (2) ÷ (3)
	(1)	(2)	(3)	(4)
U. S. dollar	.242	0.5309	1.0000	0.5309
Japanese yen	.195	0.4278	0.0029	147.5172
Belgian franc	.030	0.0658	0.0205	3.2098
Denmark kroner	.011	0.0241	0.1348	0.1788
French franc	.095	0.2084	0.1805	1.1546
German mark	.174	0.3818	0.2865	1.3326
Italian lira	.091	0.1997	0.0016	124.8125
Netherlands guilder	.038	0.0834	0.2854	0.2922
Pound sterling	.124	0.2721	2.4344	0.1118
Total	1.000	2.1940		

[1]From Table 5.3.

[2]From International Monetary Fund, International Financial Statistics, different issues.

APPENDIX 2

BASKETS OF NINE CURRENCIES BASED ON THE SIZE OF EXPORTS TO OPEC--1971-1980 BASE YEARS

Currency	Weight[1]	1971-$2.194		1972-$1.90		1973-$2.70		1974-$9.76	
		Exch. Rate[2]	Currency Units[3]	Exch. Rate	Currency Units	Exch. Rate	Currency Units	Exch. Rate	Currency Units
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
United States dollar	.242	1.0000	0.5309	1.0000	0.4598	1.0000	0.6534	1.0000	2.3619
Japanese yen	.195	.0029	147.5172	.0033	112.2727	.0037	142.2973	.0034	559.7647
Belgian franc	.030	.0205	3.2098	.0227	2.5110	.0257	3.1518	.0257	11.3930
Denmark kroner	.011	.1348	0.1788	.1439	0.1452	.1653	0.1797	.1641	0.6545
French franc	.095	.1805	1.1546	.1983	0.9102	.2245	1.1425	.2079	4.4598
German mark	.174	.2865	1.3326	.3136	1.0542	.3742	1.2555	.3864	4.3949
Italian lira	.091	.0016	124.8125	.0017	101.7059	.0017	144.5294	.0015	592.1333
Netherlands guilder	.038	.2854	0.2922	.3116	0.2317	.3577	0.2868	.3719	0.9973
Pound sterling	.124	2.4348	0.1118	2.5018	0.0942	2.4522	0.1365	2.3390	0.5174

[1]From Table 5.3.
[2]From International Monetary Fund, International Monetary Statistics, different issues.
[3]For the calculations,see Table 5.3.

APPENDIX 2--Continued

BASKETS OF NINE CURRENCIES BASED ON THE SIZE OF EXPORTS TO OPEC--1971-1980 BASE YEARS

Currency	Weight[1]	1975-$10.76		1976-$11.51		1977-$12.40		1978-$12.70	
		Exch. Rate[2]	Currency Units[3]	Exch. Rate	Currency Units	Exch. Rate	Currency Units	Exch. Rate	Currency Units
		(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
United States dollar	.242	1.0000	2.6039	1.0000	2.7854	1.0000	3.0008	1.0000	3.0734
Japanese yen	.195	.0034	617.1176	.0034	660.1471	.0037	653.5135	.0048	515.9375
Belgian franc	.030	.0272	11.8676	.0259	13.3320	.0279	13.3333	.0318	11.9811
Denmark kroner	.011	.1740	0.6805	.1654	0.7654	.1666	0.8187	.1813	0.7705
French franc	.095	.2333	4.3815	.2092	5.2271	.2035	5.7887	.2216	5.4445
German mark	.174	.4065	4.6057	.397	5.0446	.4307	5.0095	.4979	4.4382
Italian lira	.091	.0015	652.8000	.0012	872.8333	.0011	1025.8182	.0012	963.0833
Netherlands guilder	.038	.3954	1.0341	.3782	1.1565	.4074	1.1566	.4622	1.0441
Pound sterling	.124	2.2218	0.6005	1.8062	0.7902	1.7455	0.8809	1.9195	0.8204

[1]From Table 5.3.
[2]From International Monetary Fund, International Monetary Statistics, different issues.
[3]For the calculations, see Table 5.3.

APPENDIX 2 --Continued

BASKETS OF NINE CURRENCIES BASED ON THE SIZE OF EXPORTS TO OPEC--1971-1980 BASE YEARS

Currency	Weight[1]	1979-$16.97		1980-$28.67	
		Exch. Rate[2]	Currency Units[3]	Exch. Rate	Currency Units
		(18)	(19)	(20)	(21)
United States dollar	.242	1.0000	4.1067	1.0000	6.9381
Japanese yen	.195	.0046	719.3913	.0041	1363.5854
Belgian franc	.030	.0341	14.9296	.0347	24.7867
Denmark kroner	.011	.1901	0.9821	.1806	1.7464
French franc	.095	.2350	6.8604	.2410	11.3017
German mark	.174	.5456	5.4120	.5639	8.8466
Italian lira	.091	.0012	1286.9167	.0012	2174.1667
Netherlands guilder	.C38	.4985	1.2937	.5556	1.9609
Pound sterling	.124	2.1216	0.9918	2.2536	1.5775

[1]From Table 5.3.
[2]From International Monetary Fund, International Monetary Statistics, different issues.
[3]For the calculations, see Table 5.3.

APPENDIX 3

THE MEASUREMENTS OF WEIGHTS OF EXPORTS BY NINE COUNTRIES TO OPEC

Country	Export to OPEC[1] 1971	Weight	Export to OPEC 1972	Weight	Export to OPEC 1973	Weight	Export to OPEC 1974	Weight
Belgium	201	.02	295	.03	466	.03	697	.03
France	1057	.13	1166	.11	1734	.12	2832	.11
Germany	1123	.14	1440	.14	2225	.16	3998	.16
Italy	666	.08	943	.09	1198	.08	2218	.09
Japan	1336	.16	1835	.18	2689	.19	5362	.21
Netherlands	303	.04	385	.04	572	.04	841	.03
Denmark	70	.01	79	.01	115	.01	191	.01
United Kingdom	1238	.15	1442	.14	1780	.13	2614	.10
United States	2206	.27	2627	.26	3440	.24	6403	.26
Total	8200	1.00	10212	1.00	14219	1.00	25056	1.00

[1] In Millions of Dollars.

APPENDIX 3--Continued

THE MEASUREMENTS OF WEIGHTS OF EXPORTS BY NINE COUNTRIES TO OPEC

Country	Export to OPEC[1] 1975	Weight	Export to OPEC 1976	Weight	Export to OPEC 1977	Weight	Export to OPEC 1978	Weight
Belgium	1139	.03	1306	.03	1837	.03	2177	.03
France	4576	.11	4703	.10	5554	.10	6231	.09
Germany	6762	.16	8179	.17	10619	.18	12077	.18
Italy	3696	.09	4240	.09	5827	.10	6944	.10
Japan	8294	.20	9208	.19	11873	.20	14178	.20
Netherlands	1353	.03	1712	.04	2040	.03	2467	.04
Denmark	350	.01	381	.01	477	.01	581	.01
United Kingdom	4719	.12	5266	.11	6968	.12	8603	.12
United States	10370	.25	12163	.26	13483	.23	16013	.23
Total	41259	1.00	47156	1.00	58678	1.00	69271	1.00

[1]In Millions of Dollars

APPENDIX 3--Continued

THE MEASUREMENTS OF WEIGHTS OF EXPORTS BY NINE COUNTRIES TO OPEC

Country	Export to OPEC[1] 1979	Weight	Export to OPEC 1980	Weight
Belgium	2286	.03	2988	.04
France	7150	.11	9388	.11
Germany	10911	.16	12459	.14
Italy	7678	.12	9702	.11
Japan	13244	.20	18582	.21
Netherlands	2943	.04	4027	.05
Denmark	579	.01	712	.01
United Kingdom	7443	.11	10779	.13
United States	14411	.22	16942	.20
Total	66145	1.00	86838	1.00

[1]In Millions of Dollars

APPENDIX 4

WEIGHTED EXPORT PRICE INDEX BY THE SIZE OF EXPORTS 1971-80

Country	1971			1972			1973		
	dP_{EX}[2] (%)	Weights Wi[3]	dP_{EX}xWi	dP_{EX} (%)	Weights Wi	dP_{EX}xWi	dP_{EX} (%)	Weights Wi	dP_{EX}xWi
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Belgium	-1	.02	-0.02	13	.03	0.39	24	.03	0.72
France	6	.13	0.78	11	.11	1.21	25	.12	3.00
Germany	8	.14	1.12	10	.14	1.40	24	.16	3.84
Italy	6	.08	0.48	10	.09	0.90	17	.08	1.36
Japan	3	.16	0.48	12	.18	2.16	22	.19	4.18
Netherlands	5	.04	0.20	10	.04	0.40	22	.04	0.88
Denmark	4	.01	0.04	12	.01	0.12	29	.01	0.29
United Kingdom	7	.15	1.05	8	.14	1.12	11	.13	1.43
United States	3	.27	0.81	3	.26	0.78	16	.24	3.84
Total		1.00	4.94		1.00	8.48		1.00	19.54

[1]Negative signs indicate the reduction of the export price index.

[2]Changes in the Export Price Index, from International Monetary Fund, International Financial Statistics, different issues.

[3]From Appendix 3.

APPENDIX 4--Continued

WEIGHTED EXPORT PRICE INDEX BY THE SIZE OF EXPORTS 1971-80

Country	1974			1975			1976		
	dP_{EX}[2] (%)	Weights Wi[3]	$dP_{EX}xWi$	dP_{Ex} (%)	Weights Wi	$dP_{EX}xWi$	dP_{EX} (%)	Weights Wi	$dP_{EX}xWi$
	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Belgium	26	.03	0.78	0	.03	0.00	1	.03	0.03
France	16	.11	1.76	1	.11	0.11	-1	.10	-0.10
Germany	19	.16	3.04	-4	.16	-0.64	1	.17	0.17
Italy	27	.09	2.43	4	.09	0.36	-7	.09	-0.63
Japan	29	.21	6.09	-8	.20	-1.60	-3	.19	-0.57
Netherlands	34	.03	1.02	3	.03	0.09	1	.04	0.04
Denmark	18	.01	0.18	16	.01	0.16	1	.01	0.01
United Kingdom	22	.10	2.20	1	.12	0.12	-5	.11	-0.55
United States	26	.26	6.76	10	.25	2.50	6	.26	1.56
Total		1.00	24.26		1.00	1.10		1.00	-0.04

[1]Negative signs indicate the reduction of the export price index.

[2]Changes in the Export Price Index, from International Monetary Fund, International Financial Statistics, different issues.

[3]From Appendix 3.

APPENDIX 4--Continued

WEIGHTED EXPORT PRICE INDEX BY THE SIZE OF EXPORTS 1971-80

Country	1977			1978			1979		
	dP_{EX}[2] (%)	Weights Wi[3]	$dP_{EX}xWi$	dP_{EX} (%)	Weights Wi	$dP_{EX}xWi$	dP_{Ex} (%)	Weights Wi	$dP_{EX}xWi$
	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
Belgium	1	.03	0.03	0	.03	0.00	1	.03	0.03
France	-3	.10	-0.30	0	.09	0.00	2	.11	0.22
Germany	0	.18	0.00	3	.18	0.54	-2	.16	-0.32
Italy	4	.10	0.40	-5	.10	-0.30	3	.12	0.36
Japan	2	.20	0.40	10	.20	2.00	-9	.20	-1.80
Netherlands	0	.03	0.00	-4	.04	-0.16	3	.04	0.12
Denmark	-1	.01	-0.01	-2	.01	-0.02	-1	.01	-0.01
United Kingdom	-6	.12	-0.72	7	.12	0.84	6	.11	0.66
United States	-3	.23	-0.69	-7	.23	-1.61	3	.22	0.86
Total		1.00	-0.89		1.00	1.29		1.00	-0.08

[1]Negative signs indicate the reduction of the export price index.

[2]Changes in the Export Price Index, from International Monetary Fund, International Financial Statistics, different issues.

[3]From Appendix 3.

APPENDIX 4--Continued

WEIGHTED EXPORT PRICE INDEX BY THE SIZE OF EXPORTS 1971-80

Country	1980 dP_{EX}[2] (%)	1980 Weights Wi[3]	$dP_{EX} x Wi$
	(28)	(29)	(30)
Belgium	2	.04	0.08
France	1	.11	0.11
Germany	-4	.14	-0.56
Italy	7	.11	0.77
Japan	-5	.21	-1.05
Netherlands	4	.05	0.20
Denmark	-4	.01	-0.04
United Kingdom	10	.13	1.30
United States	-3	.20	-0.60
Total		1.00	0.21

[1]Negative signs indicate the reduction of the export price index.

[2]Changes in the Export Price Index, from International Monetary Fund, International Financial Statistics, different issues.

[3]From Appendix 3.

APPENDIX 5

ORGANIZATION
OF THE PETROLEUM EXPORTING COUNTRIES

PI/LO/577
May 29, 1981

Mr. Mohammad Shaaf
Texas Tech University
Economics Department
Box 4470
Lubbock, Texas 79409
U.S.A.

Dear Mr. Shaaf,

Thank you for your letter of May 14, 1981. Please find below the names of the nine currencies requested:

Belgian Franc
French Franc
German Mark
Italian Lira
Japanese Yen
Netherlands Guilder
Swedish Krona
Swiss Franc
Pound Sterling

Should you need further information, please do not hesitate to contact us.

Thanking you for your interest in our Organization, we remain,

Sincerely yours,

Hamid Zaheri, Head
Public Information Department

APPENDIX 6

ORGANIZATION
OF THE PETROLEUM EXPORTING COUNTRIES

PI/LO/609
June 10, 1981

Mr. Mohammad Shaaf
Texas Tech University
Economics Department
Box 4470
Lubbock, Texas 79409
U.S.A.

Dear Mr. Shaaf,

With reference to your letter of June 6, 1981 requesting further information on the Geneva Agreements, the eleven currencies embraced by Geneva II consist of the nine currencies of Geneva I specified in our first letter of May 19, with the addition of the Australian Dollar and the Canadian Dollar.

With regard to your remaining questions concerning the optium basket of currencies for the pricing of OPEC oil, please be informed that this is the subject of continuing research in the OPEC Secretariat and that no conclusions have as yet been reached.

Thanking you for your interest in our Organization, we remain,

Sincerely yours,

Dr. E. T. Omotoso
Officer in charge
Public Information Dept.