THE CHOICE OF AN OPTIMAL CURRENCY FOR 
DENOMINATING THE PRICE OF OIL 

by 
Mansoor Dailami 

Energy Laboratory Working Paper No. MIT-EL 78-026WP 

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1. Introduction

Recently much concern has been expressed about the impact of the dollar depreciation on the real export earnings of OPEC and the implications of any protective action taken by OPEC on world economic conditions and the future stability of the dollar. With approximately 80 percent of OPEC imports originating outside the United States and with a predominantly large proportion of OPEC's past accumulated surpluses invested in dollar denominated assets, the loss incurred as the result of dollar depreciation appears to be substantial. Moreover this loss will be heavier in the future if the historical trend of OPEC's trade shares with the strong currency countries such as Japan and Germany, continues its upward momentum.

To protect its export earnings, OPEC can, in principle, either change the dollar price of oil or shift from its existing dollar-oil pricing system to a system based on a currency basket. Adopting the first option, the main problem is the determination of the exact amount that the price of oil should be raised to compensate for any fall in the real price of oil arising from movements in the value of industrial currencies. The second option, namely adopting a currency basket, also poses some serious problems. In this case, the problems are of two kinds: one, the determination of a weighting scheme to be used in the calculation of the currency basket which would be acceptable to all OPEC member countries, and second and more crucial, the feasibility and practicality of any basket-currency unit-pricing mechanism within the existing international monetary system. Considering the wide differences existing among OPEC member countries in terms of their trading structures
and their balance of payment positions, the adoption of any common basket currency is apt to impart different costs and benefits to different member countries and hence result in conflicts of economic interests. Clearly each country would, ideally, like to see the chosen weighting scheme be more closely aligned with its own trade and investment patterns. Thus, a solution must be found to resolve these conflicts of interest if OPEC's adherence to a unified oil pricing policy is to be continued in the future.

The objective of this paper is to analyze the impact of the dollar fluctuation on the purchasing power of OPEC's oil revenues and to identify some of the major problems facing OPEC in its attempt to substitute any other currency or a "basket of currency" for the dollar.

The study is set out in four sections. Section two will explore some of the general issues concerning the role of the dollar in the existing oil pricing system and how its fluctuation may affect different OPEC member countries differently. Section three begins with a careful study of OPEC's terms of trade and its sources of change. We decompose the sources of growth of OPEC's terms of trade into three parts. These are: (a) the growth in the dollar price of oil; (b) a part due to inflation in OPEC's trading partners; and (c) a part due to the fluctuation of the dollar vis-a-vis other industrial currencies. Within the analytical framework developed in this section, a formula is derived which determines the value of a currency basket called OPEC, in terms of the U.S. dollar, which has the property of cushioning the real price of oil from the risk of exchange rate changes if it is used as a denominator for the price of oil. This currency basket which is composed of the
currencies of the major OPEC trading partners provides OPEC with a solid basis for determining the necessary changes in the dollar-price of oil in order to keep its real export earnings immune from the risk of exchange rate changes. To achieve this objective all that is required is to adjust the dollar price of oil by the amount that the optimum currency basket fluctuates with respect to the dollar. Section four finally concludes the paper with a brief summary and some important conclusions.

2. The Problem

I

Since, at present, the United States dollar serves both as a denominator for pricing crude oil and as a medium of payment between the oil-importing nations and the members of the Organization of Petroleum Exporting Countries (OPEC), then, any movement in the value of the dollar against other currencies affects the real export earnings of OPEC. Any downward movement in the value of the dollar in the foreign exchange markets results in an erosion of OPEC purchasing power by making the OPEC imports originating outside the United States more expensive. Conversely, any upward movement in the value of the dollar increases the implicit price of oil and thereby results in a windfall gain in OPEC's fortune.

With approximately 80 percent of OPEC imports originating outside the United States and with a predominantly large proportion of OPEC's past accumulated surplus invested in dollar-denominated assets, the loss or gain incurred as the result of dollar fluctuation appears to be substantial. For instance, a uniform 10 percent depreciation of the
dollar against the currencies of other industrial countries will result in a loss of about 8 percent in OPEC's real purchasing power and in a loss of about $7.6 billion in asset value as calculated on OPEC's total foreign investment at the end of 1977.1

With the continued depreciation of the dollar in the foreign exchange markets since the beginning of 1977 and with a shadow of uncertainty surrounding its future value, the question in the mind of most economists and international financial experts is, how long the oil exporting countries are prepared to tolerate the shrinkage of their export earnings by accepting payments in a declining dollar. The options open to OPEC are rather limited. To protect the real value of its exports OPEC can, in principle, either increase the dollar price of oil or change its pricing mechanism to a currency basket.

Increasing the dollar price of oil will not by itself necessarily increase OPEC's revenues. It may very well be the case that the positive effect of an oil price increase may be offset partly or entirely by a cutback in oil consumption. In this case, the cutback in oil consumption will most likely come from the United States where the oil price increase exerts its fullest impact. With oil priced in terms of the U.S. dollar, any increase in the price of oil will hit the U.S. economy by exactly the same amount. Whereas the impact of an oil price increase on the other industrial countries is moderated to the extent that their currencies increase with respect to the dollar, and assuming that the recent upward movements in the value of the industrial currencies continue in the future, the real shock of any oil price increase on these economies may be moderated and therefore the induced oil consumption cutback coming
from these countries may not be significant. In fact, looking at the recent past, one realizes that the devaluation of the dollar against other industrial currencies, especially the strong currencies, has been an important factor in cheapening the cost of imported oil to the Western European countries and Japan, and thereby has allowed a higher rate of economic growth for these countries than might otherwise have been the case.

Apart from the important role that the behavior of the dollar in the foreign exchange markets can play in shaping the world's demand for oil and thereby determining the limits of OPEC maneuvering in the area of oil price policy, there are the behaviors of other non-OPEC oil-producing countries which have a direct influence on the final outcome of any unilateral oil price increase on OPEC's oil revenues. However, allowing for the influences of the actions taken by these countries in response to any oil price hike administered by OPEC, can only make the picture more complicated. Part of this complication stems from the lack of understanding and information regarding the oil production and export policies of these countries. For example, it is not clearly known whether these countries will follow OPEC in the case of an oil price increase administered by OPEC or whether they will stay with the lower price and use this as a means of increasing their share of the market.

The second option open to OPEC is to adopt a currency basket for oil-pricing purposes. It is important to realize that although this approach has the advantage of stabilizing the real earnings of oil to OPEC, it poses two serious problems: one, technical, namely the determination of a weighting scheme for the calculation of the currency
basket; and, second, the feasibility and the practicality of a currency basket within the existing international monetary system. The problem of the determination of a currency basket which would be considered optimum from the viewpoint of OPEC's economic interests and the problem of its feasibility as a unit of account for price of oil will be discussed in great detail in Section three of our study. However, for the moment it is important to come to the realization that such a procedure works like a double-edged knife. It benefits OPEC if the dollar continues its recent plunging, but it will deny OPEC of a windfall gain if the dollar recovers from its present low level and moves up in the future.

II

But the uncertainties surrounding the future value of the dollar are both worrisome and real. Under the existing floating exchange rate, system governments are not committed to maintain the par value of their national currencies by intervening in the foreign exchange markets anymore. The fate of exchange rates has been largely left to market forces, and fluctuations in exchange rates are considered to be part of the rule rather than the exception. With the capital markets of most of the industrial countries connected together through the massive and expanding Euro-currency markets, and with divergent underlying economic fundamentals, such as inflation rates, growth rates, productivity differences and degrees of openness between the United States and other industrial countries, it is hard to expect any degree of stability for the future value of the dollar unless these underlying differences are smoothed out.
It is indeed with reference to these underlying economic fundamentals and their relative significance in determining exchange rates in the long run that some people have come up with some gloomy pictures about the future stability of the dollar. According to these people, so long as the United States runs its present enormous current-account deficit, and lags behind in the growth of productivity, and is the forerunner in the growth of inflation, the dollar will continue losing value in the foreign exchange markets.

On the other hand, under the floating exchange rate system, the movements in exchange rates are supposed to act as equilibrating forces in reducing the payment imbalances among the industrial countries. However, from the recent experience of the major currencies it has been learned that reliance on exchange rate policy for reducing trade imbalances may be self-defeating if it is not accompanied by suitable monetary and fiscal policies.

III

The loss in OPEC's purchasing power due to the dollar depreciation is more likely to be heavier in the future if the historical trend of OPEC's trade shares with the countries of Western Europe and Japan continues its upward momentum. As is revealed by the information in Table 1.1 the Japanese and German shares of OPEC's imports have, especially, increased tremendously over the period 1970-1977. In 1970, Japan supplied about 9.94 percent of OPEC's total import needs, where in 1977 it supplied about 15 percent resulting in an increase of about 5 percent. The gain in German shares is less significant, from a value of 11.03 percent in
Table 1.1

The Change in OPEC's Import Shares*

<table>
<thead>
<tr>
<th></th>
<th>1970 (1)</th>
<th>1977 (2)</th>
<th>(2)-(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>21.02</td>
<td>17.41</td>
<td>-3.61</td>
</tr>
<tr>
<td>Japan</td>
<td>9.94</td>
<td>15.0</td>
<td>5.06</td>
</tr>
<tr>
<td>Belgium</td>
<td>2.17</td>
<td>2.27</td>
<td>.10</td>
</tr>
<tr>
<td>France</td>
<td>9.35</td>
<td>6.96</td>
<td>-2.35</td>
</tr>
<tr>
<td>Germany</td>
<td>11.03</td>
<td>13.74</td>
<td>2.71</td>
</tr>
<tr>
<td>Italy</td>
<td>5.58</td>
<td>7.55</td>
<td>1.97</td>
</tr>
<tr>
<td>Netherlands</td>
<td>2.88</td>
<td>2.73</td>
<td>-.15</td>
</tr>
<tr>
<td>Switzerland</td>
<td>1.79</td>
<td>1.84</td>
<td>.05</td>
</tr>
<tr>
<td>U.K.</td>
<td>10.32</td>
<td>9.19</td>
<td>-1.13</td>
</tr>
</tbody>
</table>

Note: These shares are based on OPEC's total imports coming from the industrial countries considered here, not on its total world trade. These data were taken from the IMF Direction of Trade, various issues.
10

1970 to a value of 13.74 percent in 1977. The main loser, as is evident from Table 1.1 has been the United States. The U.S. share of OPEC's imports declined from a value of 21.02 percent in 1970 to a value of 17.41 percent in 1977.

To express any intelligent thought on the likelihood of further decline in U.S. share of OPEC's imports, due attention should be paid to three sets of considerations: (a) the future behavior of the dollar in the foreign exchange markets; (b) the inflation differential between the U.S. and other industrial countries, and (c) OPEC's trade elasticities of substitution. (a) and (b) combined, along with other factors, determine the U.S. competitive position in the foreign markets in general and in OPEC's market in particular. With a given level of inflation differential any downward movement in the value of the dollar will enhance the U.S. competitive position against other industrial countries and consequently will make U.S. exports more attractive in foreign markets. However, the effect of the dollar depreciation on the U.S. competitive position may very well be offset partially or entirely by a higher rate of inflation prevailing in the U.S. than in other industrial countries.

Comparing the recent history of U.S. inflation with two of its major trade competitors, namely Japan and Germany, we get a rather mixed picture. From 1974 to 1976 Japan, with an average annual rate of inflation of 13.43 percent, comes to the top of the list; second is the U.S. with an average annual rate of 8 percent, and third is Germany with a rate of 5.03 percent. However, this picture changes dramatically from the beginning of 1977 with the U.S. surpassing the other two countries in
terms of inflation, and this trend continues to the first quarter of 1978
where the rates were 2.3%, 4.3% and 5.7% for Japan, Germany, and the
U.S., respectively.

It appears in retrospect that it has been precisely partly due to the
higher rate of inflation prevailing in the U.S. since 1977, that the
tremendous devaluation of the dollar against the currencies of other
countries has not improved the U.S. competitive position appreciably.
Table 1.2 sets out the movements in the exchange rates of a number of key
industrial countries vis-a-vis the dollar, and the changes in their
competitive positions as measured by the changes in their real effective
exchange rates. From these observations it can be realized that, in
general, the changes in the real effective exchange rates of most of the
European countries and Japan are smaller than the amount their currencies
have appreciated against the dollar. For instance, during the period
June '77 to July '78, the Swiss franc and the Japanese yen appreciated by
40 percent and 37.7 percent respectively against the dollar, whereas the
changes in the real effective exchange rates of these two countries
amounted only to 23.1 and 24.3 percent. Although the relatively
substantial increase in the real effective exchange rate of the Swiss
franc and yen indicates a sizeable decline in the competitive position of
Switzerland and Japan, these values are much below the amount their
currencies have appreciated against the dollar. In the case of Germany,
the favorable inflation differential in this country has indeed more than
offset the effect of the appreciation of the mark against the dollar and
has resulted in a slight improvement in this country's competitive
position.
Table 1.2

Exchange Rate Changes and the Change in
The Competitive Position of the Key Industrial Countries

June 1977 - July 1978

<table>
<thead>
<tr>
<th>Currency</th>
<th>Vis-a-Vis U.S. Dollar</th>
<th>Competitive Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. dollar</td>
<td>-</td>
<td>-6.4</td>
</tr>
<tr>
<td>Japanese yen</td>
<td>37.7</td>
<td>24.3</td>
</tr>
<tr>
<td>British pound</td>
<td>12.</td>
<td>6.3</td>
</tr>
<tr>
<td>Swiss franc</td>
<td>40.</td>
<td>23.1</td>
</tr>
<tr>
<td>German mark</td>
<td>15.2</td>
<td>-3.3</td>
</tr>
<tr>
<td>French franc</td>
<td>12.3</td>
<td>5.7</td>
</tr>
<tr>
<td>Italian lira</td>
<td>5.1</td>
<td>-1.1</td>
</tr>
<tr>
<td>Belgian franc</td>
<td>12.2</td>
<td>-2.0</td>
</tr>
<tr>
<td>Dutch guilder</td>
<td>12.4</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Even if we assume that the dollar devaluation in the future will actually improve the U.S. price-competitive position, the question still remains, whether this by itself can induce OPEC countries to switch their import expenditures away from Japan and Germany and towards the United States. To answer this question, an examination of factors determining the import shares of OPEC with the major industrial countries is necessary. Broadly speaking, it can be argued that the degree to which any change in the relative export prices can lead to a redirection of import patterns towards the country with a lower price depends on OPEC's trade elasticities of substitution and the significance of other non-price related determinants of OPEC's trade structure. If OPEC's trade elasticities of substitution are high, then any reduction in relative prices brought about by a devaluation of the dollar is expected to have a stimulative impact on the U.S. exports to OPEC, otherwise the effectiveness of devaluation on expanding U.S. share of OPEC's imports is rather low. Even though the U.S. has been losing its share of exports in OPEC's markets during the time period 1970-1977, OPEC has increased its importance as a market for U.S. exports. In 1970 the OPEC economies as a whole absorbed about 4 percent of total U.S. exports, where in 1977 they absorbed about 11 percent. This significant increase in the importance of OPEC as a market for U.S. exports is clearly due to the fact that, during this period, U.S. exports to OPEC have increased much faster than U.S. exports to all other countries. The relatively higher rate of growth of U.S. exports to OPEC is partly due to the phenomenal economic growth enjoyed by OPEC economies during the period 1973-1977 and partly due to the establishment of a closer economic and political tie between U.S. and some countries, namely Iran and Saudi Arabia.
Because OPEC member countries differ in terms of their trading and investment patterns, the impact of the dollar depreciation varies considerably from country to country. It is clear that countries such as Indonesia, Iraq, and Libya, which purchase a large proportion of their import needs in markets outside the U.S., bear a higher burden of foreign trade exchange losses than countries such as Iran, Saudi Arabia, Kuwait, and Venezuela which have a closer trade tie with the United States. If we take into account the losses incurred on the dollar asset holdings the picture gets more complicated.

In this regard, however, a distinction has to be made between the countries who have a substantial proportion of their accumulated surplus or their outstanding debt in dollar-denominated assets and those countries who have achieved a more balanced currency diversification of their assets or debts across all currencies. Clearly, the losses or gains incurred as the result of dollar depreciation are more pronounced to member countries who have a higher degree of concentration of their assets or debts in terms of the dollar than the rest of the countries.

The lack of homogeneity in OPEC member countries with regard to their trade and investment patterns imparts a number of serious difficulties in any serious discussion concerning the switch from a dollar oil-pricing system to any other currency system or basket of currencies. The major difficulty in the case of opting for a basket-type accounting unit is the determination of a weighting scheme which is acceptable to all member countries. Clearly each country would, ideally, like to see the chosen weighting scheme be more closely aligned with its own trade and investment pattern.
Recognizing this divergence of underlying economic situations and the resulting divergence of interests, a solution must be found which would lead to a commonly acceptable weighting scheme if OPEC's adherence to a unified oil-pricing policy is to be continued. It is therefore necessary that the problem of choosing an optimal weighting scheme be solved within a general framework which encompasses the various considerations regarding the trade and investment demands of different OPEC member countries for different currencies. Within this calculation explicit account should be taken of the vast differences existing among OPEC member countries in terms of their balance of payment situations in addition to their different trade structures.

Table 1.3 presents some data on the net external assets of OPEC countries for the years 1976 and 1977. As can be seen from this table, there are four countries, Algeria, Ecuador, Gabon, and Indonesia, whose external liabilities greatly exceed their external assets. These countries as a group had a net external liability of about $13 billion in 1976 and about $15 billion in 1977. Contrasting these countries are four other countries--Kuwait, Saudi Arabia, Iran, and UAE--whose net external assets accounted for about 90 percent of OPEC's $155 billion net external assets in 1977. Since a predominantly high proportion of these assets or debts are denominated in terms of U.S. dollars, then any devaluation of the dollar will confer a substantial loss or gain to the surplus or deficit countries. It will hurt the surplus countries 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. Given this divergence of economic situation
Table 1.3
Net External Assets of OPEC Countries
(billions of U.S. dollars)

<table>
<thead>
<tr>
<th>Country</th>
<th>1976</th>
<th>1977</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kuwait</td>
<td>25</td>
<td>31</td>
</tr>
<tr>
<td>Qatar</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>UAE</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>56</td>
<td>68</td>
</tr>
<tr>
<td>Algeria</td>
<td>-3</td>
<td>-4</td>
</tr>
<tr>
<td>Ecuador</td>
<td>--</td>
<td>-1</td>
</tr>
<tr>
<td>Gabon</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>Indonesia</td>
<td>-9</td>
<td>-9</td>
</tr>
<tr>
<td>Iran</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>Iraq</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Libya</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Nigeria</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Venezuela</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

TOTAL          | 126  | 155  |

prevailing in OPEC countries and given the substantial loss and gain at stake, a solution must be found to resolve some of the resulting conflicts of interest if OPEC's cohesiveness is to be maintained in the future. One way of resolving some of these issues is to apply the principle of compensation. This principle dictates that if a change from state A to state B, which is considered to be 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. In applying this principle to the case of OPEC, it is first of all necessary to solve the problem of the choice of an optimum currency basket based on the assumption that OPEC is a homogeneous entity, and then to try to identify the losers and the gainers if the currency basket option is adopted. This is the procedure which we will pursue in the next section. After determining the optimum currency basket for OPEC as a whole, an assessment of the costs and benefits conferred to the individual member countries arising from the implementation of the proposed solution will be made.

3. The Erosion of OPEC Purchasing Power by Worldwide Inflation and Exchange Rate Changes

3.1 Introduction

The primary objective pursued in this section is to analyze the fluctuation in OPEC's terms of trade and its sources of growth over the period 1970 (IV) to 1971 (IV). With the price of oil quoted in terms of U.S. dollars and constant price of oil, the terms of trade can change either as the result of movements in the value of the dollar or as the result of inflation in OPEC's trading partners. Thus, a question of
great concern is to separate the influences of these two factors and to see to what extent the continuous decline in OPEC's terms of trade after the four-fold oil price increase of October 1973, can be attributed to the falling value of the dollar and to what extent to the high rates of inflation prevailing in the industrial countries.

3.2 The Model

Assuming oil is the only export of the OPEC countries, the terms of trade, $t_i$, of the $i$th member country can be written as

$$ t_i = \frac{P_o}{P_{mi}} $$

(3.1)

where $P_o$ is the price of oil and $P_{mi}$ is the unit import price for $i$th country, both expressed in terms of the same currency (dollar in this case).

From (3.1) the rate of growth of $t_i$ can be written as the difference between the rates of growth of $P_o$ and $P_{mi}$, that is,

$$ \frac{\dot{t}_i}{t_i} = \frac{\dot{P}_o}{P_o} - \frac{\dot{P}_{mi}}{P_{mi}} $$

(3.1a)

where $\dot{}$ on the top of any variable indicates the time derivative of that variable.

To derive the unit import price index for $i$th country we first write the total value of its imports in U.S. dollar as,

$$ V_i = \sum_j X_{ij} P_j R_j $$

(3.2)

where $X_{ij}$ is the quantity of imports of $i$th OPEC country coming from $j$th country, $P_j$ is the export price of $j$th country expressed in terms of its domestic currency and $R_j$ is the exchange rate of $j$th country defined as
the price of domestic currency in terms of U.S. dollar.

Differentiating both sides of (3.2) with respect to time and then converting them into growth rates yields:

\[
\frac{\dot{V}_i}{V_i} = \sum_j b_{ij} \frac{\dot{X}_{ij}}{X_{ij}} + \sum_j b_{ij} \frac{\dot{P}_j}{P_j} + \sum_j b_{ij} \frac{\dot{R}_j}{R_j} \tag{3.3}
\]

whereby \( b_{ij} \) is the proportion of ith country's imports originating from the jth industrial country.

Equation (3.3) expresses the rate of growth of imports of any country in terms of three items: (a) the rate of growth of the quantity of that country's imports; (b) the rate growth of inflation in the industrial countries, and (c) a measure of dollar's fluctuation against other currencies.

By integrating both sides of (3.3) we can write the total value of imports as the product of three terms, namely,

\[
V_i = A_i . X_i . P_i . R_i \tag{3.3a}
\]

where

\[
P_i = \int \sum_j b_{ij} \frac{P_j}{P_j} \, dt,
\]

\[
X_i = \int \sum_j b_{ij} \frac{X_{ij}}{X_{ij}} \, dt \text{ and}
\]

\[
R_i = \int \sum_j b_{ij} \frac{R_j}{R_j} \, dt
\]

are the price, quantity, and exchange rate indices for ith country, and \( A_i \) is a constant term.

From (3.3a) it follows that the unit import price index in terms of U.S. dollar for the ith OPEC member country is given by \( P_i R_i \) with its growth rate by,

\[
\frac{\dot{P}_{mi}}{P_{mi}} = \sum_j b_{ij} \frac{\dot{P}_j}{P_j} + \sum_j b_{ij} \frac{\dot{R}_j}{R_j} \tag{3.4}
\]
By substituting (3.4) into (3.1a) we arrive at the final equation which expresses the rate of change in the ith country's terms of trade in terms of its determining factors, that is,

$$\frac{\dot{t}_i}{t_i} = \frac{P_o}{P_o} - \sum_j b_{ij} \frac{\dot{P}_j}{P_j} - \sum_j b_{ij} \frac{\dot{R}_j}{R_j}$$

(3.5)

Equation (3.5) can be interpreted as a decomposition of the ith OPEC member country's terms of trade into three sources: (a) the rate of growth of the dollar price of oil; (b) a weighted average of the inflation rates in the industrial countries$^5$ and (c) a measure of the dollar's fluctuation against other currencies.

3.3 The Empirical Results

In implementing equation (3.5) empirically we have considered the trade shares of OPEC with nine of the key industrial countries. These are: the United States, Japan, Belgium, France, Germany, Italy, the Netherlands, Switzerland, and the United Kingdom. Together these countries account for an overwhelmingly large proportion of OPEC's world trade. For instance, in 1977 they supplied about 76.7% of total OPEC's import needs.

The data on imports of OPEC as a whole and for individual member countries were taken directly from the IMF Direction of Trade. These data refer to total imports of goods and services in millions of U.S. dollars. The data on exchange rates and on export prices were taken from the IMF International Financial Statistics. These include 29 quarterly observations from the fourth quarter of 1970 to the fourth quarter of 1977.
Table 3.1 reports the numerical results of our analysis of the sources of change of OPEC's terms of trade for the time period 1971-1977. Perhaps the strongest impression conveyed by this table is the varying effect that the movement in the value of the dollar has had on OPEC's terms of trade. Over the period 1971-1973 where 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.

However, for the next three years, from 1974 through 1976, when the dollar recovered strongly from its previous low level, and climbed noticeably vis-a-vis the British pound and Italian lira, its appreciation benefited OPEC by increasing the implicit price of oil by about 2.3 percent a year. For the final year 1977, when the dollar set its downward trend once again, it cost the oil exporting countries 6.7 percent in decline in their real export earnings. Averaged over the time period 1971-1977, the fluctuation in the value of the dollar has shrunk OPEC's purchasing power by about 2.3 percent a year. In terms of relative contribution this amounts to about 8.7 percent a year. From the information in Table 3.1 it can also be observed that inflation has been a more damaging factor in eroding OPEC's export earnings than has been the devaluation of the dollar. For instance, averaged over the whole period 1971-1977, the contribution of inflation amounted to about 9.03 percent as compared to about 2.3 percent due to the dollar's fluctuation.

The accompanying chart exhibits the time pattern of OPEC's terms of trade over the period 1971 (IV) to 1977 (IV). From this chart it can be seen that the change in OPEC's terms of trade, except for the sharp jump in the first quarter of 1974 which amounted to about 120 percent, has
Table 3.1
The Sources of Percentage Change in OPEC's* Terms of Trade

<table>
<thead>
<tr>
<th></th>
<th>Term of trade</th>
<th>Price of oil</th>
<th>Inflation</th>
<th>Dollar's Fluctuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>2.908</td>
<td>8.66</td>
<td>-3.77</td>
<td>-2.51</td>
</tr>
<tr>
<td>1973</td>
<td>72.54</td>
<td>96.9</td>
<td>-14.83</td>
<td>-9.52</td>
</tr>
<tr>
<td>1974</td>
<td>106.52</td>
<td>130.46</td>
<td>-26.58</td>
<td>+2.63</td>
</tr>
<tr>
<td>1975</td>
<td>10.22</td>
<td>10.27</td>
<td>-1.69</td>
<td>+1.64</td>
</tr>
<tr>
<td>1976</td>
<td>-7.90</td>
<td>-.73</td>
<td>-9.93</td>
<td>+2.76</td>
</tr>
<tr>
<td>1977</td>
<td>-6.165</td>
<td>2.98</td>
<td>-2.43</td>
<td>-6.717</td>
</tr>
</tbody>
</table>

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.
been rather moderate over the whole period. In fact, it has become continuously negative since the beginning of 1976, after a relatively high rise of about 10.7 percent in the last quarter of 1975.

Referring to the impact of the dollar's fluctuation on the import cost of individual OPEC countries, Table 3.2 presents the contributions of the fluctuation in the value of the dollar and inflation to the rate of change of unit price of imports for a selected number of OPEC countries. Looking at this table we immediately realize that the impact of the dollar depreciation on the cost of imports has not been uniform across all countries. It has increased the cost of imports to some countries much more than to others. For instance, the depreciation of the dollar during the time period 1971-1977 has contributed about 12 percent to the increase in the cost of imports of Indonesia, but it has contributed only 5 percent to the increase in the cost of Libyan imports. For the rest of OPEC countries included in our sample and during the same period of time, the depreciation of the dollar has increased their import costs by about 20 percent a year.

The wide disparity observed in the experience of different OPEC member countries in bearing the cost of dollar's depreciation is both interesting and important. It is important because it brings to the surface some of the potential conflicts existing in OPEC countries associated with the existing dollar-oil-pricing system and, at the same time, it points to the serious problems facing OPEC in trying to change its pricing mechanism from a dollar-based system to any other currency system.
Table 3.2
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)

<table>
<thead>
<tr>
<th>Country</th>
<th>Dollar Fluctuation</th>
<th>Inflation</th>
<th>Import Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>3.74 (32.95)</td>
<td>7.61 (67.05)</td>
<td>11.35 (100)</td>
</tr>
<tr>
<td>Iran</td>
<td>2.99 (25.98)</td>
<td>8.52 (74.02)</td>
<td>11.51 (100)</td>
</tr>
<tr>
<td>Iraq</td>
<td>2.85 (25.16)</td>
<td>8.48 (74.84)</td>
<td>11.33 (100)</td>
</tr>
<tr>
<td>Kuwait</td>
<td>2.52 (22.08)</td>
<td>8.89 (77.92)</td>
<td>11.41 (100)</td>
</tr>
<tr>
<td>Libya</td>
<td>.66 (5.77)</td>
<td>10.79 (94.23)</td>
<td>11.45 (100)</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>2.37 (21.42)</td>
<td>8.59 (78.57)</td>
<td>11.06 (100)</td>
</tr>
<tr>
<td>Venezuela</td>
<td>1.86 (17.35)</td>
<td>3.85 (82.27)</td>
<td>10.71 (100)</td>
</tr>
</tbody>
</table>

Note: Numbers in parentheses are relative contribution of each item to the rate of change of unit import price.
Fig. 3.1 The Rate of Growth of OPEC's Terms of Trade
These potential conflicts stem partly from the wide differences in trade patterns existing among OPEC countries and partly from the erratic behavior of industrial currencies. It is undoubtedly true that as far as there are differences in the trade directions of OPEC countries and as far as there is no uniformity in the movements of industrial currencies, different countries will be subjected to different cost of exchange rate changes. It is also true that the cost will be higher to countries whose import shares are mostly weighted toward the strong-currency countries than countries whose imports are mostly originating from the weak-currency countries. This, in fact, seems to be the main reason behind the big difference observed between Indonesia and Libya in terms of the increase in their cost of imports attributed to the depreciation of the dollar. Indonesia's main supplier of imports, during 1971-1977, was Japan^{6} whose currency has appreciated tremendously against the dollar, whereas Libya's^{7} main trading partner was Italy whose currency has lost value appreciably against the dollar.

3.4. The "Optimum" Currency Basket

One way of insulating the real export earnings of OPEC from the risk of exchange rate changes is to denominate the price of oil in terms of a currency which is composed of the currencies of OPEC's principal trading partners. This approach, though in principle having the advantage of cushioning the real price of oil from currency changes, poses two serious problems: one, technical, namely the determination of the exact weights to be assigned to different currencies; and two, and more crucial, the feasibility and practicality of any currency basket accounting unit
within the existing international monetary setting.

To discuss the issue of the feasibility of any "basket-type" currency-pricing mechanism, it is important to draw a distinction between two rather separable functions that the accounting currency is supposed to serve. It is to serve as the denominator for the price of oil and as the medium of payment, and normally these two functions are separable. This separability property of the accounting currency makes it possible to employ one currency for one purpose and another currency for another purpose. For instance, it is possible to keep the U.S. dollar as the medium of payment but at the same time quote the dollar price of oil in terms of an "optimally determined" currency basket. This procedure, if followed, has the advantage of solving the more difficult and rather impractical problem of paying for oil with different currencies, a problem which would have existed under a complete currency basket pricing mechanism.

Let us call the currency basket which is considered to be optimum from OPEC's point of view, OPECA, then to stabilize the real price of oil in terms of OPECA it is necessary to adjust the dollar price of oil by the fluctuation of OPECA in terms of the dollar. This follows quite easily from the following identity:

\[
\frac{\text{(OPECA)}}{\text{OIL}} = \left(\frac{\text{$}}{\text{OIL}}\right) \cdot \frac{\text{(OPECA)}}{\text{$}} \tag{3.6}
\]

\[X = \frac{Y}{1/R}\]

where \(X\) and \(Y\) are the prices of oil in terms of OPECA and dollars respectively, and \(R\) is the exchange rate between OPECA and dollars defined as the price of OPECA in terms of dollars.
From (3.6) it follows that to stabilize the price of oil in terms of OPECA it is necessary that,

\[ \frac{\dot{Y}}{Y} = \frac{\dot{R}}{R} \]  

(3.7)

The problem is, then, reduced to the determination of OPECA in terms of dollars. However, from our investigation of the impact of the dollar's fluctuation on OPEC's purchasing power in the previous section, it follows that by defining \( R \) according to the following equation

\[ \frac{\dot{R}}{R} = \sum b_j \frac{\dot{R}_j}{R_j} \]  

(3.8)

we are insured that it will serve to insulate the real price of oil from the risk of exchange rate changes. Adopting this definition of \( R \), Table 3.2 contains its numerical value and its annual growth rate for the period 1970 to 1977. The accompanying chart also exhibits its time trend over the same period of time. From Table 3.3 it can be observed that over the whole period 1971-1977 OPECA has appreciated in terms of the dollar by 16.2 percent. This implies an average annual appreciation of about 2.31 percent.

Table 3.4 compares our estimates of oil revenues for the four quarters of 1977 if oil prices were quoted in terms of OPECA with the actual oil revenues in terms of the dollar. The difference for just one year is about $2.15 billion. That means if OPECA were actually used as the denominator for the price of oil, OPEC's revenue would have increased by $2.15 billion in just 1977.
Table 3.3  
The Numerical Value of OPEC (currency-basket) and its Annual Growth Rate  
(1971-1977)  

<table>
<thead>
<tr>
<th>Year</th>
<th>Value at End of Year*</th>
<th>Rate of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>1971</td>
<td>103.02</td>
<td>4.49</td>
</tr>
<tr>
<td>1972</td>
<td>101.97</td>
<td>2.51</td>
</tr>
<tr>
<td>1973</td>
<td>111.71</td>
<td>9.52</td>
</tr>
<tr>
<td>1974</td>
<td>108.54</td>
<td>-2.63</td>
</tr>
<tr>
<td>1975</td>
<td>106.56</td>
<td>-1.54</td>
</tr>
<tr>
<td>1976</td>
<td>103.62</td>
<td>-2.76</td>
</tr>
<tr>
<td>1977</td>
<td>110.73</td>
<td>6.71</td>
</tr>
</tbody>
</table>

Note: *Normalized at 100 in the fourth quarter of 1970.
Table 3.4

Estimate Oil Revenue if Oil Price were Denominated in Terms of $ and OPECA

(billions of $)

<table>
<thead>
<tr>
<th>Year</th>
<th>Oil Price in *$ (1)</th>
<th>Oil Price in OPECA (2)</th>
<th>(2) - (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>31.9</td>
<td>32.15</td>
<td>.25</td>
</tr>
<tr>
<td>II</td>
<td>32.6</td>
<td>32.94</td>
<td>.34</td>
</tr>
<tr>
<td>III</td>
<td>32.3</td>
<td>32.82</td>
<td>.54</td>
</tr>
<tr>
<td>IV</td>
<td>32.3</td>
<td>33.34</td>
<td>1.04</td>
</tr>
<tr>
<td>TOTAL</td>
<td>129.1</td>
<td>131.25</td>
<td>2.15</td>
</tr>
</tbody>
</table>

Fig. 3.2 The Rate of Growth of OPECA
4. Conclusion

In this paper we analyzed the role of the U.S. dollar in the existing oil-pricing mechanisms and tried to determine how its fluctuation has affected OPEC member countries over the period 1971-1977. It was found that the depreciation of the dollar has eroded the real import earnings of OPEC as a whole by about 16.24 percent over the period 1971-1977. The real export earnings of OPEC were further eroded by inflation prevailing in OPEC's trading partners by about 63.2 percent over the same period of time.

In terms of the impact of the dollar's fluctuation on individual OPEC member countries, it was found that Indonesia was the hardest hit and Libya was the least hit by the depreciation of the dollar over the period 1971-1977. The experience of other member countries was more or less uniform. This difference in the experience of OPEC member countries was then attributed to the difference in their trade structure and to the nonuniform behavior of the major currencies against each other.

The problem of how OPEC can protect its export earnings from the risk of currency fluctuation was discussed in detail. Specifically it was shown that OPEC can, at least in principle, insulate its export earnings from the risk of currency fluctuation by denominating the price of oil in terms of a "currency basket" which is composed of the currencies of OPEC's major trading partners. We derived a formula which would explicitly calculate the value of this currency basket, which we called OPEC, in terms of the U.S. dollar. It was then shown that this currency basket can provide a useful basis for determining the necessary changes in the dollar price of oil in order to keep the real price of oil immune from the risk of exchange rate changes.
References


6. International Monetary Fund, Direction of Trade, various issues.