FINANCIAL MARKETS AND THE ADJUSTMENT
TO HIGHER OIL PRICES

by

Tamir Agmon, Donald Lessard, and James L. Paddock*

M.I.T. World Oil Project

Working Paper Number MIT-EL-77-039WP

September 1977

I. INTRODUCTION

A great deal has been written on the actual and potential effects of the oil price increase on world financial markets, but relatively little emphasis has been placed on the role played by financial markets in the adjustment of the energy markets themselves.   This paper explores the linkages between energy and financial markets and points out why these should be taken into account in interpreting energy market adjustments.

The existence of financial markets allows several degrees of freedom which otherwise would not exist. Immediate adjustment to current account balance is not required, as claims on future output of goods and services can be exchanged for oil. Since producer countries can hold claims on future goods as well as oil reserves which they can exchange for goods in the future, they may alter their output and pricing decisions from what they would be in the absence of financial markets. Further, the risk and return characteristics of the claims issued by net consumers of oil need not be the same as those desired by oil producers since these can be altered through financial intermediation. Finally, since the future consumption of the producer countries will depend on returns from their financial portfolios as well as future oil sales, they will have to consider the impact of their output and pricing decisions on financial markets in making these decisions.

Section II of this paper analyzes the role of international financial markets in accommodating the change in oil prices. In particular, it examines the pattern of adjustment over time among importing and exporting countries as they respond to both transitory and permanent changes in relative prices and income. It is shown, by means of a general equilibrium model, that multilateral trade in financial claims (international financial intermediation) facilitates

an otherwise unobtainable continuation of physical flows of oil. This accommodation should be reflected in the observed elasticities of demand for oil. Available empirical evidence on accommodation through financial markets is examined.

Section III presents a portfolio approach to the behavior of the oil exporting countries with respect to their "surplus funds." It focuses on their investment decisions and the possible feedback of these on their pricing and production decisions. Finally, Section IV briefly describes the creation of stress in the international financial system, and the implications of this stress for the behavior of oil exporting countries.

II. FINANCIAL MARKETS AND ADJUSTMENTS IN ENERGY MARKETS

The radical increase of the price of oil at the end of 1973 brought about
a transfer of wealth from the oil-importing countries to the oil-exporting coun-
tries and changed desired patterns of consumption and investment for both groups.
The resulting exchanges between the two groups were of two types: exchanges of
oil for current real consumption and investment goods, and exchanges of oil for
financial claims on future real consumption and investment goods.

The major vehicle for the transfer of current consumption from the oil-
importing countries to the oil-exporting countries was the trade of goods and
services for oil. OPEC imports of goods and services rose sharply in 1974
and have been growing ever since. Table 1 below presents the actual imports
of goods and services for the period 1973-1976 and the preliminary figures for
1977.

TABLE 1

OPEC Imports of Goods and Services

(billions of dollars)

	1973	1974	1975	1976	1977^p
Imports of Goods, fob	n/a	36	59	70	82
Imports of Services	n/a	15	23	30	36
Total Imports	20	51	82	100	118

Sources: Morgan Guaranty, World Financial Markets, September 1976,
Direction of Trade, annual, 1969-75.

p = preliminary

In addition to these current exchanges, substantial exchanges of oil for claims on future consumption took place. The volume of these transfers for the period 1974-1977 is presented in Table 2 below.

TABLE 2

OPEC Current Account Surplus

(billions of dollars)

	1974	1975	1976	1977[p]
Four Arabian Peninsula Countries	37.0	n/a	32.3	33.6
Rest of OPEC	27.7	n/a	5.3	0.5
Total	64.7	32.0	37.6	34.1

Source: Morgan Guaranty, World Financial Markets, September 1976 and June 1977.

The first type of exchange has been referred to as "paying" for oil, while the second type of exchange has been termed "financing" oil. [1/] The transfer of claims for future goods, "financing," is also called recycling. A further distinction is drawn between primary and secondary recycling. [2/] Primary recycling refers to the direct issue of claims on future goods (financial assets which hereafter are termed "bonds") by an oil-importing country to an oil-exporting country. Secondary recycling refers to multilateral exchanges of bonds among oil-importing countries which eventually result in a net transfer of such claims to oil-exporting countries. This net transfer facilitates the flow of oil from exporters to importers. For example, Italy may borrow from (issue bonds to) the U.S. and Germany, and these countries in turn may borrow from (issue bonds to) OPEC countries. The recycling process takes place in a world in which there is multilateral trade in goods as well, and hence some

secondary recycling may be accommodated by current exchanges of goods among the oil-importing countries.

An increase in the relative price of oil changes the allocation of real income and wealth between oil-importers and oil-exporters. Total spending by the two groups will change in obvious directions. The changes in desired spending will depend on how each group views the long-term redistribution of real income resulting from the change in the relative price of oil. The change in actual spending will further depend on the cost of adjusting the rate of spending over time. The real wealth transfer is the present value of the real income changes for all future periods. This wealth transfer, however, may be considerably smaller than suggested by the immediate change in real income. Both the oil-importing and the oil-exporting countries may view the current transfer of real income as reflecting both permanent and transitory elements.

Transitory elements arise for two reasons. First, it takes time to adjust the consumption patterns of the oil-importing countries to the new distribution of wealth, especially when the increase in the price of oil is not fully anticipated. This adjustment time is even more pronounced given the intermediate nature of oil in the production function of the importing group. Until new real investments are made which reflect the new relative price of oil, existing capital-in-place must be used. Once the productive base is changed, however, the demand for oil will become more elastic and the permanent real income transfer will be smaller. Second, there is uncertainty regarding the stability of the new price. If the monopolistic position of the oil-exporting cartel is eroded, perhaps by new technologies which create competition for oil, or by conflicts over price or quantity within the cartel, the future oil price in real terms may be lower than today's price. This also implies a smaller total transfer of real wealth.

The transitory element in the current transfer of real income from the oil-importing countries to the oil-exporting countries gives rise to both primary and secondary recycling. The oil-importing countries realize that the current decline in real income includes a component of transitory loss, and thus they will borrow in order to transfer income from future periods to the current period to reduce transitory changes in their consumption. Also, while adjusting production processes to the new relative price of oil, they must work with the pre-increase system of production and thus their demand for oil will be relatively inelastic in the short term. All these considerations lead the oil-importing countries to adjust more slowly to the new circumstances. If a current account deficit results, they will borrow on capital account to finance the deficit.

Oil-exporting countries face an analogous situation. They too realize that a portion of the shift in income is transitory and, as a result, increase their current consumption by less than the full increase in real income. They can do this by acquiring real capital goods to be employed in the domestic economy or financial claims on other countries. However, the existing physical infrastructure may limit the absorptive capacity for real investment and, thus, much of the adjustment will take place in financial markets.

The simplest adjustment in the international capital market following a change in the terms of trade is a bilateral exchange of capital assets, or in other words, borrowing and lending. In a two-country world in which one country is a net oil-exporter and one country is a net oil-importer, primary recycling (direct bilateral borrowing and lending) will suffice to accommodate the effect of transitory elements and provide the time needed for change to new permanent output and consumption patterns. However, once more than two countries are introduced primary recycling alone may be sub-optimal, and financial intermediation

either through private markets or public institutions may be desirable. It
is a common belief that the gains from multilateral trade are greater than those
of a series of bilateral trade arrangements. The same argument applies to
trade in financial assets and will favor a mixture of primary and secondary
recycling through intermediaries as the mechanism for adjustment.

The precise nature of multilateral trade, whether in goods or financial
assets, can be described in a simple general equilibrium, full-employment paradigm as follows.

Assume a three-country world. One country is a net oil-exporter (country
X) and the other two countries, 1 and 2, are net oil-importers. Within each one
of the three countries there are three all-inclusive markets. One market is
for oil and the other two markets are for other goods and bonds. Without loss
of generality, let us assume that the importing countries each specialize in one
type of composite good and one type of bond—a contract for the future delivery
of the good they produce—respectively, and that the oil-exporting country produces no other goods and no bonds. Assume further that trade in oil, in other
goods, and in bonds can take place only on a bilateral basis between the oil-exporting country and each one of the oil-importing countries directly. For
now, no trade is allowed between the two oil-importing countries.

In such a world of "pure" primary recycling, the world excess demand for
oil can be defined as a function of the relative prices in the two importing
countries, i.e.

$$E_{x1} = E_{x1} \ (P_{x/g1} \ , \ P_{x/b1}) \qquad\qquad (1)$$

and
$$E_{x2} = E_{x2} \ (P_{x/g2} \ , \ P_{x/b2}) \qquad\qquad (2).$$

where: $E_{xj} \equiv$ excess demand for oil (denoted by subscript x) in importing country j measured in some unit of account

$P_{x/gj} \equiv$ price of oil in terms of other good j, j = 1,2 oil importing countries

$P_{x/bj} \equiv$ price of oil in terms of bond j, j = 1,2 oil importing countries

Bonds are claims on future goods and thus share the risk characteristics associated with the future relative price of such goods.

The excess demand for goods and bonds is also a function of the relative prices and can be defined as:

$$E_{gj} = E_{gj} \ (P_{gj/x} \ , \ P_{gj/bj}); \ j = 1,2 \ \text{oil} \qquad (3)$$

importing countries

$$E_{bj} = E_{bj} \ (P_{bj/x} \ , \ P_{bj/gj}); \ j = 1,2 \ \text{oil} \qquad (4)$$

importing countries

where $E_{gj} \equiv$ excess demand for other goods in country j

$E_{bj} \equiv$ excess demand for bonds in country j

all measured in some unit of account.

Given our assumption of the bilateral nature of the trade in oil (where one country is a net oil exporter and the other two are net oil importers) and because the three markets are all inclusive, it follows that:

$$E_{xj} > 0 \qquad j = 1,2 \ \text{oil importing countries}$$

$$E_{gj} \leq 0 \qquad j = 1,2 \ \text{oil importing countries}$$

$$E_{bj} \leq 0 \qquad j = 1,2 \ \text{oil importing countries}$$

and $$E_{gj} + E_{bj} < 0 \qquad j = 1,2 \ \text{oil importing countries}$$

For the exporting country (country X) the excess demand for oil is negative (net exporter) and equal in value terms to the sum of the oil-exporter's excess demands for goods and bonds of the two importing countries 1 and 2. In equilibrium the world system maintains

$$E_{oil} + E_{goods} + E_{bonds} = 0, \text{ in value terms} \tag{5}$$

However, given the assumption of bilateral trade, equation (5) is just the sum of equations (1) to (4). The export of oil by country X, $-E_{xx}$ (measured in physical terms), is equal to the sum of excess demand for oil by the two importers:

$$-E_{xx} = E_{x1} + E_{x2} \tag{6}$$

Once the assumptions on exporter-importer bilateralism are dropped, and multilateral transactions are allowed there will be trade in goods and bonds between the two oil-importing countries, and the relative prices of goods and bonds in terms of oil may differ from those specified above. Triangular transactions may take place and the equilibrium condition (5) will include terms for the excess demand of country 1 for good 2, or the excess demand of country 2 for bond 1. Country X, the oil-exporting country, may now ship oil to country 1 and acquire good 2 (the good which country 2 produces) in exchange. Multilateral trade will give rise to secondary recycling both in terms of goods and in terms of bonds. The effect of multilateral trade on the flow of oil between exporting and importing countries will depend on the price and income elasticities in the three countries. Thus multilateral trade opportunities may change the process of adjustment to permanent and transitory elements.

The fact that the oil-exporting country has a monopoly position changes the precise conditions under which the physical flow of oil will increase, but not the general nature of the solution. To the extent that multilateral transactions effectively shift outward the demand for oil, and given a zero marginal cost of oil, the physical flow of oil will increase. The only case where a monopolist would not behave in this manner is where a cutback in physical production of oil, and thus a change in the relative price of oil, will affect the relative price of other goods in a favorable way given the monopolist's preference function. That is, if the monopolist can affect the relative prices of consumption goods by cutting back the quantity of oil supplied. Assuming no such changes in relative prices of other goods, the direction of the changes in the flow of oil resulting from allowing multilateral trade will be the same under monopoly or in a competitive market. To illustrate the nature of the process by which triangular trade in financial assets may accommodate a larger flow of oil between the trading partners, consider the following example.

Suppose that country 1 is Germany, country 2 is Italy, and country X is Saudi Arabia. Let their three produced goods be steamshovels, wine, and oil, respectively. Under what we have defined as bilateral trade, Germany trades steamshovels to Saudi Arabia for oil. Prior to the trade each country had an excess demand for the other's good. By assumption, no trade occurs between Germany and Italy. Also, no trade occurs between Italy and Saudi Arabia as the latter has no desire for wine at any price. In the multilateral case, however, Italy trades wine to Germany, which does consume wine, for steamshovels. Then Italy trades some of the newly acquired steamshovels for Saudi oil. As previously discussed, the opportunity for multilateral trade may have an effect on the relative prices of these goods.

The same argument applies for financial assets ("bonds") which are viewed here as claims on future goods. By allowing free movement of assets in international capital markets the trading countries can transact more optimally by acquiring financial assets which are better suited to their desired consumption pattern over time. Since the distribution of such financial assets among the importing countries will not correspond, in general, to the distribution of excess demands for oil, some "secondary recycling" of goods and bonds will occur and may increase the world trade in oil. [3/]

In the context of a three-country, three-good general equilibrium model with full employment it can be shown that multilateral trade opportunities in goods and in financial assets may result in a higher volume of trade, depending on the elasticities. Such a model indicates the different components of the total changes in the supply of oil by the oil-exporter. The components include the income and substitution effects on consumption, and the concomitant substitution effects on production in the general equilibrium framework.

The analysis of these components is shown in equation (7) where ΔE_x^x is the total change , in a comparative statics context, in the physical amount of oil supplied by country X after multilateral trade is allowed (between countries 1 and 2). [4/] For reasons of exposition country superscripts will replace the country subscripts heretofore used.

$$\Delta E_x^x = (\eta^1 + \pi^1 + \epsilon^1) \ (\Delta P_{g1/x}^1) E_x^1 + (\eta^2 + \pi^2 + \epsilon^2) \ (\Delta P_{g2/x}^2) E_x^2 \qquad (7)$$

where: E^j_x ≡ excess demand in country j (=1,2,x) for good x (oil)

η_j ≡ country j price elasticity of oil import demand (with respect to $P^j_{gj/x}$).

π^j ≡ country j marginal propensity to consume of its imported good (oil) with respect to a change in its real income.

ϵ^j ≡ country j price elasticity of export supply (with respect to $P^j_{gj/x}$).

$P^j_{gj/x}$ ≡ domestic price in country j of good j relative to oil.

Thus η^j captures the country j substitution in consumption effect with respect to a change in the relative price of its exportable, gj. Likewise π^j represents the real income effect on the country j demand for oil. The change in relative prices also implies a substitution in production effect in country j as captured by ϵ^j.

Equation (7) expresses the change in the supply flow of oil from the oil exporter in terms of the parameters of the importing countries with whom multilateral trade is now allowed. We need only evaluate the right hand side of (7) to determine the conditions under which $\Delta E^x_x > 0$, i.e. country X increases its supply of oil to world markets under multilateral trade. We have:

$\eta^j > 0$ by definition and our demand assumption.

$\pi^j > 0$ by ruling out inferior goods.

$\epsilon^j > 0$ by our production assumption, i.e. if the relative price of our exportable increases then we produce more of it.

$\Delta P^j_{gj/x} > 0$ by our assumption that all goods are gross substitutes.

$E^j_x > 0$ by assumption (i.e. trade exists).

These conditions imply $\Delta E_x^x > 0$, i.e., accommodating flows (via multilateral

trade) of goods and financial assets among importing countries 1 and 2 increase

the supply of oil relative to the level under bilateral trade in goods alone.

More importantly, they imply that in analyzing the adjustment to higher prices,

it is insufficient to focus on the current account balances of single countries

in isolation, let alone the "oil component" of these balances. The adjustment

of any particular country will reflect its role in accommodating the adjustments

of all other countries. For example, a country able to issue financial claims

which are attractive to oil exporters may find it desirable to issue these

claims and, in turn, acquire either goods or financial claims from other oil

importing countries. This may result in a current account deficit which in no

way reflects the strength or basic pattern of adjustment of the country in

question.

Payment for and Financing of Oil--Some Empirical Observations

The preceding analysis suggests that by providing adjustment services,

both for transitory elements and for a slower rate of change to a new per-

manent level, international capital markets allow for a higher volume of

trade in oil. The adjustment takes place through direct exchanges in capital

assets (borrowing and lending) between exporters and importers, as well as

by accommodating flows of goods and bonds among importers of oil. The actual

magnitude of the accommodating flows in 1974, 1975, and

1976   is estimated here. This is done as an indication of the extent by

which the actual trade in oil between OPEC members and the major importing

countries was facilitated by these adjustment flows. However, before we

proceed to examine the data, two caveats have to be stressed. First, the data

represent only three years and although it is true that most of the adjust-

ment may have taken place during this period, the data undoubtedly contain

errors and reflect some indecision on the part of the exporting and the import-
ing countries. Second, the data reflect some adjustments which took place
in markets other than the capital or the goods markets. This is true in
particular with regard to the labor market as some of the adjustment was
carried out by unemployment.

In Table 3 the balance of trade of the six major oil-importing countries
with OPEC is presented. As seen in line (3) for each country, all six coun-
tries run a trade deficit with OPEC, which means that this amount of "fin-
ancing" of oil must take place.

The actual "financing" of the flow of oil in Table 3 was accomplished
both by "primary recycling" and by "secondary recycling" in terms of goods
and financial assets. In the aggregate, the six major importing countries had
deficits with OPEC of 51.9, 32.2, and 41.5 billion dollars in 1974, 1975, and
1976, respectively. These deficits were partially offset by 29.9, 41.8, and
21.8 billion dollar trade surpluses with the other, non-OPEC countries (including
trade among the six importing countries). The balance of trade of the six
importing countries with the non-OPEC countries is presented in Table 4.

The "TOTAL" row in Table 4 reflects the net trade position of the six
major industrialized countries which was accomplished both by intra-six
accommodating flows as well as by exchanges with the non-six, non-OPEC
group. The distribution of net trade positions among the three groups is
presented in Table 5.

TABLE 3

Flows of Trade Between OPEC and Six Major Importing Countries 1973-1976

(billions of current dollars)

	1973	1974	1975	1976
U.S.				
(1) Imports from OPEC	5.0	17.0	18.4	26.6
(2) Exports to OPEC	3.8	7.0	11.2	12.2
(3) Trade deficit with OPEC				
[(1)-(2)]	1.2	10.0	7.2	14.4
U.K.				
(1) Imports from OPEC	3.7	8.9	7.3	7.4
(2) Exports to OPEC	2.0	2.8	5.0	5.3
(3) Trade deficit with OPEC				
[(1)-(2)]	1.7	6.1	2.3	2.1
West Germany				
(1) Imports from OPEC	4.0	9.2	8.2	9.6
(2) Exports to OPEC	2.3	3.8	6.9	8.2
(3) Trade deficit with OPEC				
[(1)-(2)]	1.7	5.4	1.3	1.4
Japan				
(1) Imports from OPEC	7.5	21.6	21.1	22.5
(2) Exports to OPEC	2.8	5.6	8.6	9.2
(3) Trade deficit with OPEC				
[(1)-(2)]	4.7	16.0	12.5	13.3
France				
(1) Imports from OPEC	3.9	10.3	9.8	11.1
(2) Exports to OPEC	1.9	3.1	5.0	4.7
(3) Trade deficit with OPEC				
[(1)-(2)]	2.0	7.2	4.8	6.4
Italy				
(1) Imports from OPEC	3.4	9.5	7.9	8.1
(2) Exports to OPEC	1.2	2.3	3.8	4.2
(3) Trade deficit with OPEC				
[(1)-(2)]	2.2	7.2	4.1	3.9
Total Deficit of Six With OPEC	13.5	51.9	32.2	41.5

Sources: _Direction of Trade_ and _International Financial Statistics_

TABLE 4

Balance of Trade of Six Major Oil-Importing Countries
With Other, Non-OPEC Countries, 1973-1976
(billions of current dollars)

	1973	1974	1975	1976
U.S.	3.2	7.6	17.9	-0.2
U.K.	-6.7	-9.4	-7.2	-7.6
West Germany	14.4	25.0	16.5	15.2
Japan	3.4	9.4	10.4	15.7
France	1.1	0.8	3.7	-0.8
Italy	-3.4	-3.5	0.5	-2.5
TOTAL	12.0	29.9	41.8	21.8

Sources: Direction of Trade and International Financial Statistics

TABLE 5

Net Trade Positions of the Major Groups in the World 1973-1976
(billions of current dollars)

With OPEC	1973	1974	1975	1976
OPEC with Six	13.5	51.9	32.2	41.5
OPEC with Others	8.4	33.5	24.6	23.9
Total OPEC	21.9	85.4	56.8	65.4
Six with Other Non-OPEC	12.0	29.9	41.8	21.8
Other Non-OPEC with OPEC and Six	-20.4	-63.4	-66.4	-45.7

Sources: Direction of Trade and International Financial Statistics

Of the six major oil importing countries, West Germany was able to finance all of its OPEC trade deficit by exporting goods to non-OPEC members. Japan, the U.S., and France accommodated part of their oil-related deficit by exports to non-OPEC countries. Italy and the U.K. have maintained a trade deficit with the other non-OPEC countries in addition to their oil-related deficit. Italy and the U.K. have financed their total trade deficit by the sale of financial assets. The U.K. sold capital assets directly to the oil-exporting countries (primary recycling), while Italy sold capital assets mostly to the U.S. and West Germany (secondary recycling).

In addition to financing their own trade deficits with OPEC, several of the six major countries played a role in financing the overall deficits of the other non-OPEC countries vis-a-vis OPEC and the industrial group. This can be seen in Table 6, which shows the net capital flows for each of the six countries. Countries with negative flows are "exporting" capital funds (e.g., financing deficits) and "importing" financial claims from net deficit countries.

TABLE 6

Computed* Net Capital Flows of Six Major Oil-Importing Countries 1973-1976
(billions of current dollars)

	1973	1974	1975	1976
U.S.	-3.2	0.7	-4.1	17.0
U.K.	7.5	15.1	10.9	8.4
West Germany	-22.0	-18.9	-16.6	-10.0
Japan	7.5	5.3	2.8	1.4
France	2.4	6.0	-2.7	4.3
Italy	5.3	10.2	5.7	8.3
Total	-2.5	18.4	-4.0	29.4

Sources: Direction of Trade and International Financial Statistics

*Computed as a balance of payments' residual.

III. FINANCIAL MARKETS AND THE BEHAVIOR OF OIL PRODUCERS

The previous section showed that financial markets allow oil importing countries time to adjust to higher oil prices and enable them to offer a wider range of goods and claims on future goods in payment for oil whether or not these are directly acceptable by oil producers. This section focuses on the role financial considerations play in producers' output/pricing decisions.

The problem faced by each oil producer is analogous to the consumption/ investment decision of an individual seeking to maximize his expected utility of consumption over time. The producer country must make three decisions:

1) How much oil to sell in the current period in the form of:

    a) physical production

    b) financial claims issued against oil in the ground

The remaining unsold oil will be retained as an asset in the owner's portfolio.

2) How much to consume in the current period. The remainder of revenues, positive or negative, will be added to the investment portfolio .

3) How to allocate non-oil assets among domestic real investment and financial claims on other countries, both riskless and risky.

One major role of financial markets is to allow the producer to separate production and consumption decisions. In the absence of a capital market the owner of the oil cannot accumulate any claims on future consumption and thus must match consumption and production over time. This can be readily illustrated under an assumption of certainty in a two period model.

If the oil producer is a cartel leader, it faces a downward sloping demand function for oil and will seek to equate marginal cost with marginal revenue

over time. In such a world the producer may choose between two ways of allo-
cating consumption over time. One is the market for oil, and the other is the
market for financial claims. In the market for oil the owner faces a concave
transformation curve. The rate of transformation of future consumption into
present consumption (by selling one more barrel of oil) is changing over the
production range.

Competitive financial markets, on the other hand, offer a constant rate
of transformation--the market rate of interest. The two mechanisms for the
allocation of consumption over time are depicted in Figure 1 below. The rate
of production is determined by equating the rate of transformation in the oil
market to the given market rate of interest. The actual consumption per period
is determined by the owner's preference function. There is no portfolio allo-
cation decision to be made in this certainty model, since there is only one
investment asset. Further, the decision to sell claims against oil is identical
to borrowing against future production since oil prices are known with certainty.

When uncertainty is introduced, a variety of investment assets is needed
to gain insight into the production/investment decisions of the owner of the
oil reserves. At a minimum, three types of assets must be considered. The
first is a fund consisting of risky assets excluding oil in the ground (e.g.,
the world market portfolio of common stocks); the second is the oil itself (or,
equivalently, financial assets whose value is linked to oil); and third is a
riskless asset. Oil is a risky asset because of market uncertainties on both
the demand and supply sides. Once the consumption decision has been made, the
producer must decide how to allocate his holdings between these three assets.
This can be viewed in the context of the single-period portfolio choice problem
developed by Markowitz (4).   [5]/ It involves selecting that combination of
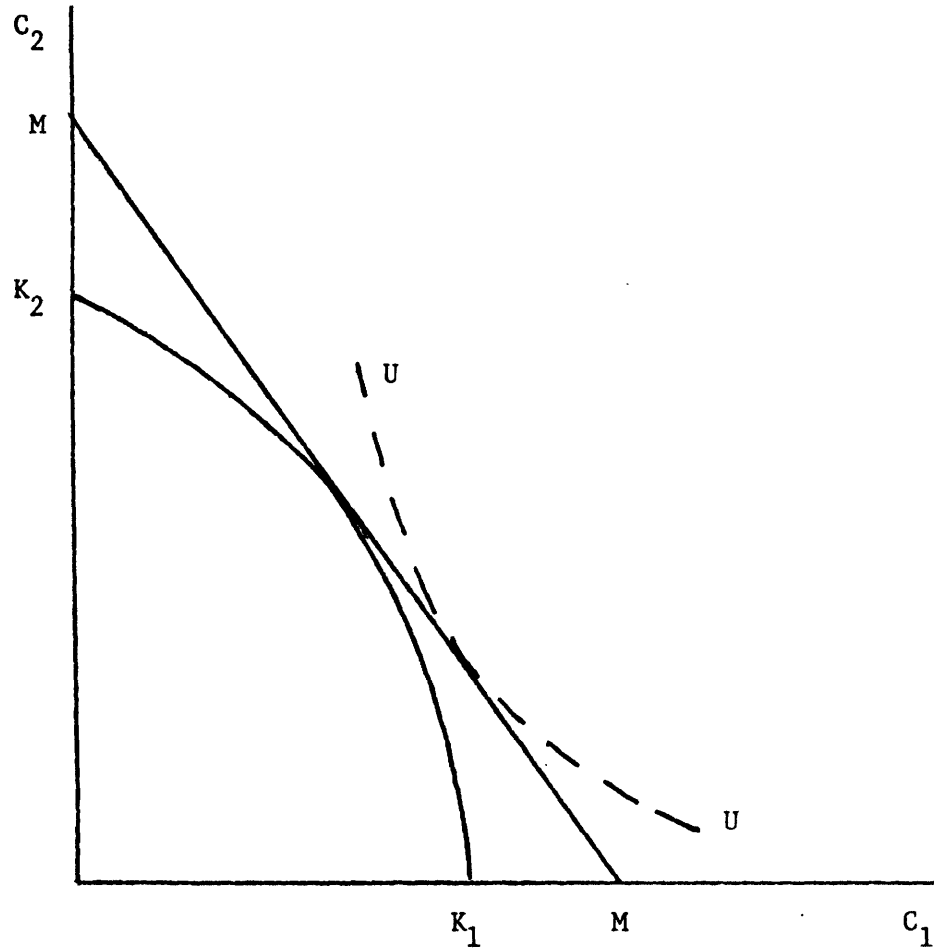assets which maximizes expected utility, where both asset payoffs and the

FIGURE 1

where: C_1 axis measures consumption possibilities in period i

K_1K_2 is the oil-production possibility frontier

MM is the producer's budget line with constant slope as determined by the market rate of interest

UU is the producer's preference curve

individual's utility are described in terms of the expected value and standard deviation of end-of-period wealth, $\overline{W}$ and σ_w, respectively.

The situation of the producer country in the absence of financial trans-actions is analogous to that of an individual who has no access to a capital market. As shown in Figure 2a, the frontier of potential investments will be a single point E, reflecting the endowment of oil reserves and other human and physical capital. By trading oil or claims linked to oil for other risky assets and/or riskless claims, utility can be increased in two ways. By lending, i.e., exchanging oil or risky claims linked to oil for riskless assets, the risk/return mix can be altered by moving along BL to B, as shown in Figure 2b. By diversifying risky holdings, i.e., trading oil or claims linked to oil for other risky assets which are less than perfectly correlated with the oil asset, the producer can move to point R on the frontier of risky opportunities D as shown in Figure 2c. Point E lies below the frontier since it is highly concentrated in the oil asset and, as a result, reflects almost all of the risk of the oil asset even though much of this risk could be diversified away within the world economy. By both diversifying and altering the riskiness of the portfolio by lending, the producer can move to an overall optimum, 0, as shown in Figure 2d.[6/]

Two factors limit the extent to which a producer can alter its portfolio. First, because of physical constraints and market considerations, it cannot exchange a large proportion of its oil holdings for financial assets in any particular time period. It could get around this constraint if it could sell arbitrary amounts of financial claims linked to oil, but such sales will be constrained by the "moral hazard" or "sovereign risk" associated with them. The source of this moral hazard is that the future value of the oil-linked claims is depen-dent on the producer's behavior. For example, the producer might renege on the contract to pay the claimholder when the oil eventually is sold or it might no longer act within the cartel so as to maximize the value of the oil asset once it has sold its oil-linked claims.
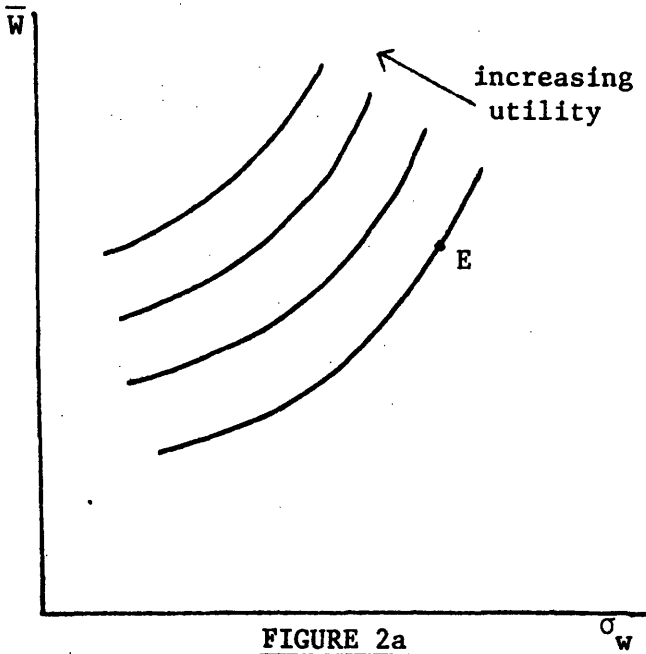
FIGURE 2a

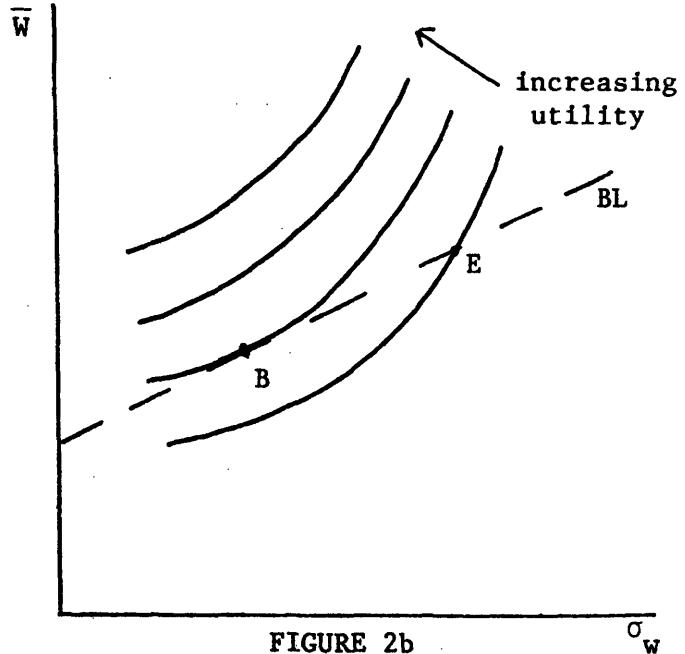Initial Position of Individual (Country) Without Access to Capital Markets

FIGURE 2b

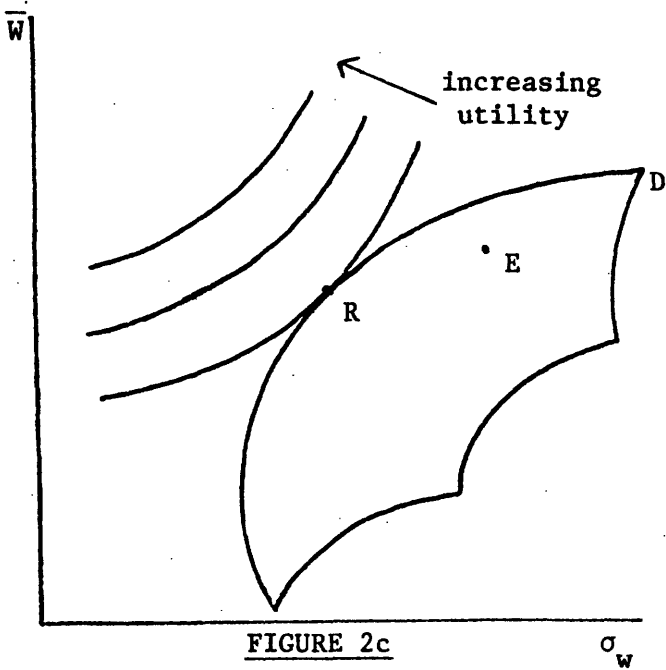Effects of Riskless Borrowing-Lending

FIGURE 2c

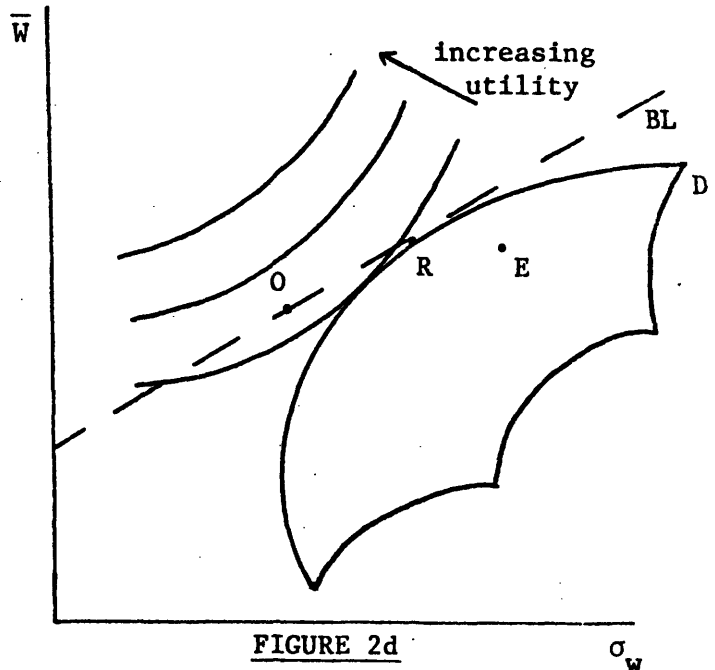Effect of Diversifying Risky Portfolio

FIGURE 2d

Combined Effects of Borrowing Lending and Diversification

The above discussion does not provide a solution to the general inter-temporal production/investment problem for a producer with some degree of monopoly power, but it does make clear that financial considerations come into play at several important points. Producers will take into account both the expected stream of revenues and the risk associated with those revenues in choosing among output/pricing programs. Their decisions will be conditioned by the extent that they can shift these risks to others through financial transactions in international financial markets. Since their ability to sell claims linked to oil will be constrained by considerations of sovereign risk, it is likely that they will seek to generate greater oil revenues than required for current consumption (i.e., a surplus on current account) in order to gradually shift to a more desirable portfolio with a less uncertain path of future consumption possibilities.

Table 7 shows the changing composition of OPEC financial holdings since the price rise. While transitory considerations undoubtedly influenced the size and composition of these holdings in early years, it appears that sub-stantial external financial holdings represent part of a long-run production/investment strategy. These financial holdings, along with massive investment in the domestic economy, lessen the concentration of the domestic portfolio in the oil asset. The changing composition of the holdings suggests that transitory factors no longer play a major role. They probably were the reason for the early (1974) concentration in riskless assets. However, by 1976 more investment is in risky securities such as equities and real estate.

Table 7

Financial Investments of OPEC 1974-1976
Billions of Dollars

	1974	1975	1976
United States			
Treasury Bonds and Notes }	6.0	2.0	4.2
Treasury Bills		0.5	-1.0
Bank Deposits	4.0	0.6	1.6
Other (Equity, Property)	1.0	6.9	6.7
To tal	11.0	10.0	11.5
United Kingdom			
Government Stocks	0.9	0.4	0.2
Treasury Bills	2.7	-0.9	-1.2
Sterling Deposits	1.7	0.2	-1.4
Other (Inc. Equity)	0.7	0.3	0.5
Foreign Currency Deposits	15.0	4.3	6.4
Total	21.0	4.3	4.5
Other Countries			
Bank Deposits	9.0	5.0	5.5
Other Investment	11.9	12.4	9.7
Total	20.9	17.4	15.2
International Organizations	3.5	4.0	2.0
All Financial Investment	56.4	35.7	33.2

Source: Bank of England

IV. STRESS IN THE WORLD FINANCIAL MARKET--FEEDBACKS FROM CONSUMER TO

PRODUCER BEHAVIOR

As was pointed out in Section II above, the flow of oil to many countries

in the period 1974-1977 was facilitated by multilateral financial transfers.

This group includes all the non-OPEC LDCs and some of the weaker industrialized

countries.

Although the world financial system was able to accommodate the demand for

oil at roughly the same physical levels as in 1973, this accommodation created

substantial financial stress. This stress was due to the fact that OPEC mem-

bers, and in particular the Arabian peninsula countries, were willing to accept

financial claims only if they had low risk, while many users of the funds,

especially LDCs and the weaker industrialized countries, could only offer risky

claims. This gap is bridged by financial intermediation in which individuals

or financial institutions buy risky financial assets from the oil importing

countries and sell low risk assets to OPEC members which have "surplus funds."

The financial intermediaries, whether they are governments, international

organizations or banks, assume the difference in risk. This intermediation

function is rewarded by risk premiums, in the case of debt contracts the inter-

est differential between creditor and debtor rates.

The scope of this kind of financial intermediation is quite impressive.

The accumulated current account surplus of OPEC for the period 1974-1977 is

153.5 billion dollars. According to recent data published by the Morgan

Guaranty, the external debt of the non-OPEC LDCs has risen to 180 billion dollars,

of which 77 billion dollars were lent by commercial banks. This amount is dis-

tributed between U.S. banks (about two-thirds) and non-U.S. banks (about one

third). An approximate distribution of the total financing among the different

sources is presented in Table 8 .

TABLE 8

The Distribution of LDC External Financing

Source	Percent of Total
Direct Investment	12.0
Concessional or Assistance Loans	12.0
IMF Credit	8.0
International Bond Issues	13.0
Bank Credit	55.0
Total	100.0

Source: Morgan Guaranty, World Financial Markets, June 1977

Given the similarity of the total LDC debt and the OPEC surplus, it is tempting to attribute the deficits entirely to the increased cost of oil imports. This, however, fails to take into account other contributing factors. For example, attempts by industrialized countries to restore current account balance by restricting aggregate demand and/or imports also must have played a role. Nevertheless, it is reasonable to assume that there is a linkage between oil prices and financial stress.

Increased external debt implies an increased risk of default or rescheduling. The repayment depends on the economic strength, in particular on the foreign exchange earning power, of the debtor as well as on its political decisions. Some measures of the ability of major borrowers to service their foreign obligations are shown in Table 9 .

Table 9

External Debt Related Measures for Major
International Borrowers

Country	External Debt end-1976. Billions of Dollars	Gross External Debt as % of exports of goods and services	Real Growth in External Debt in % 1973-1976	Debt Service ratio 1976
Argentina	9.0	185	o[a]	40.9
Brazil	28.6	216	62	45.9
Finland	9.0	109	67	10.3
Korea	9.5	111	73	12.8
Greece	3.9	78	18	11.1
Mexico	27.6	361	103	31.7
Peru	4.4	226	61	27.9
Philippines	5.5	121	67	15.9
Taiwan	3.9	43	86	4.1
Turkey	5.7	128	33	9.9

Source: Morgan Guaranty, World Financial Markets, June 1977.

a = the zero growth for Argentina reflects mostly the market decision
    not to lend.

The price of oil is an important factor in the determination of the flows and the imbalances of world trade, especially in the short run. As such the price of oil is one of the underlying factors of the ability of the debtors to service and refinance their loans. Even without further specification it is clear that any further increases in the price of oil are likely to lead to new and heavier borrowing and hence increase the financial risk associated with both the existing and the new debt. The potential losers from default or from rescheduling are the intermediaries which sold time deposits and other low risk assets to the major oil exporters and, if losses are substantial, holders of claims against these intermediaries. Thus although OPEC countries use the international banking community to intermediate the risk, they also have a stake in its success or failure.

It would appear that the Arabian peninsula countries, which also are major holders of international financial claims, should take into account the impact of any price hike on the world financial system. As a result, they probably will seek to moderate price changes, although no definitive statements can be made without further specifying other elements of the producer decision. If OPEC gives in to pressures to finance LDC deficits directly, the linkage between financial factors and price/output decisions will be strengthened.

FOOTNOTES

1. The terms "paying" and "financing" oil were coined by Alexander [2].

2. See Alexander [2].

3. When bonds are risky, the existence of multilateral exchange of them in
    secondary markets will provide an additional advantage--it will allow
    increased diversification by individual portfolio holders across countries.

4. The derivation of (7) is given in an Appendix to Agmon, Paddock, and
    Lessard [1] which is available from the authors.

5. The portfolio choice problem is truly a simultaneous, intertemporal decision
    process. Production, consumption and investment allocation are related in
    a complex manner, particularly when a monopoly is involved, and closed form
    solutions are very difficult to obtain analytically. But much insight can
    be gained by first looking at a single-period portfolio decision problem
    where the production and consumption decisions are assumed to be made. For
    a rigorous, complete treatment of the individual's intertemporal consump-
    tion/investment decision, see Merton [5]. The complexity of the intertem-
    poral cartel solution, even when uncertainty and financial considerations
    are ignored, can be seen in Pindyck [6].

6. See Lessard [3] for further discussion of the portfolio problem faced by
    a commodity producer.

REFERENCES

1. Agmon, T., D. R. Lessard, and J. L. Paddock, "Accommodation in the International Capital Markets and the Recycling of Oil Funds," M.I.T. Energy Lab Working Paper, 1976.

2. Alexander, S. S., _Paying for Energy: Report of the Twentieth Century Fund Task Force on the International Oil Crisis_, New York: McGraw-Hill, 1975.

3. Lessard, D. R., "Risk Efficient External Financing Strategies for Commodity Producing Countries," M.I.T. Working Paper, July 1977.

4. Markowitz, H. M., "Portfolio Selection," _Journal of Finance_ (March 1952).

5. Merton, R. C., "Optimum Consumption and Portfolio Rules in a Continuous-Time Framework," _Journal of Economic Theory_ (December 1971).

6. Pindyck, R. S., "Gains to Producers from the Cartelization of Exhaustible Resources," forthcoming, _Review of Economics and Statistics_.