

FINAL REPORT

2

AMERICAN SECURITY
AND THE
INTERNATIONAL ENERGY SITUATION

ADA 028480

Volume III: *The Petromoney Question*

HI-2239-RR

15 April 1975

Prepared for
Advanced Research Projects Agency

DDC

RECEIVED
AUG 20 1976



Hudson Institute

Quaker Ridge Road, Croton-on-Hudson, New York 10520
1 Rue du Bac, Paris 75007, France
1-11-46 Akasaka, Minato-ku, Tokyo, Japan

POLICY RESEARCH
IN THE PUBLIC INTEREST

APPROVED FOR PUBLIC RELEASE
DISTRIBUTION UNLIMITED

ACCESSION for				
NTIS	White Section <input checked="" type="checkbox"/>			
ETC	Buff Section <input type="checkbox"/>			
UNANNOUNCED	<input type="checkbox"/>			
JUSTIFICATION				
Per Hr. on file				
BY				
DISTRIBUTION AVAILABILITY CODES				
DISC.	USPIL	ALL	OR	SPECIAL
A				

9 FINAL REPORT

6 AMERICAN SECURITY AND THE INTERNATIONAL ENERGY SITUATION. VOLUME II THE PETROMONEY QUESTION By Haim ben-Shahar

10 Haim/ben-Shahar
Uzi B. Arad, Principal Investigator (914) 762-0700
Barry J. Smierloff, Associate Investigator

14 HI-2239-RR-Vol-3

11 15 Apr 1975
12 102p.

ARPA Order No. 2773

15 MDA903-74-C-0286 / ✓ ARPA Order - 2773

This research was supported by the Advanced Research Projects Agency of the Department of Defense under Contract No. MDA903 74 C 0286. The Views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the Advanced Research Projects Agency or the U.S. Government.

HUDSON INSTITUTE, INC.
Quaker Ridge Road
Croton-on-Hudson
New York 10520

D D C
RECEIVED
AUG 20 1976
D

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited.

172000

JB

TABLE OF CONTENTS

INTRODUCTION iii

PART ONE: THE WORLD OIL MARKET

I. THE SUPPLY OF ENERGY AND OIL i

 A. Petroleum 4

 B. Coal 14

 C. Natural Gas 15

 D. Other Sources of Energy 16

 E. Non-Oil World Energy Supply 16

 F. U.S. Non-Oil Energy Supply 17

II. THE DEMAND FOR ENERGY AND OIL 19

 A. The Price Elasticity 20

 B. The Income Elasticity 21

 C. Empirical Estimates of the Price and Income
 Elasticities of Demand for Oil 21

 D. Estimates of 1980 World Energy Demand 24

 E. Estimates of World Demand for Oil, 1980 27

 F. Estimates of 1980 U.S. Energy and Oil Demand 31

 G. Estimates of 1980 U.S. Demand for Import of Energy 35

III. THE OIL MARKET STRUCTURE 41

 A. Classification of Market Structures 41

 B. Main Factors in the Oil Market 41

 C. The Oil Market In the 1950s and 1960s 49

IV. FUTURE OIL PRICES 51

 A. M.E. OPEC as a Cartel 51

 B. S Countries as Price Leaders 56

 C. U.S.A. Pricing Policy 57

 D. The Demand for OPEC Oil 60

 E. Summary of the Market Scenarios Outcome 60

 F. The Revenues 71

 G. Prices 71

 H. Concluding Comments 73

PART TWO: ACCUMULATION OF CAPITAL

V. SETTING RITLES FOR DOMESTIC INVESTMENT 77

 A. Consumption 77

 B. Domestic Investments vs. Foreign Investments 79

 C. Capacity Constraints to Domestic Investments 82

VI.	THE FRAMEWORK OF ECONOMIC GROWTH AND FOREIGN CAPITAL ACCUMULATION	85
	A. The Model	85
	B. The Assumptions	88
	C. Summary	95
VII.	PROJECTIONS OF FOREIGN CAPITAL ACCUMULATION	97
	A. Introduction	97
	B. Summary of Alternative A1	106
	C. National Income and Product Uses Under Different Revenues under Various Alternatives	114
	D. Foreign Capital Accumulation and Net Imports under Various Alternatives	117
	E. Shifting Revenues Among Countries	117
PART THREE: INVESTMENT STRATEGIES OF OIL REVENUES		
VIII.	STRATEGIES FOR EXTERNAL INVESTMENT OF OIL REVENUE	125
	A. Investment Criteria	125
	B. Classes of Foreign Investment Forms	127
	C. Specific Forms of Foreign Investments	128
	D. The Investment Forms and the Goals	131
	E. Foreign Investments of Commitments (as of August 1974)	142
IX.	ECONOMIC IMPLICATIONS	145
	A. The Pure Economic Elements	145
	B. Frictions in the Adjustment Process	152
	C. Conclusions	165
APPENDIX 1: The Price Elasticity of Supply in the Normal 48		
APPENDIX 2: The Methodology of Estimating the Energy Demand Function for 1980		
APPENDIX 3: Real Economic Effect on Oil Importing Countries (No Frictions)		

INTRODUCTION

→ This volume →

The purpose of this work is to explore some possible future outcomes of the recent increase in oil prices. The study investigates the pattern of the future price structure of oil and energy, the resulting flow of revenues to the OPEC countries, in particular to the Arab oil producing countries, and the implication of these developments to the economic growth and foreign capital accumulation of the Middle Eastern countries on one hand and to the world economic, financial and monetary structure on the other hand.

Accordingly, the study is divided into three parts. Part ¹ One deals with the market for energy and oil and derives some future scenarios with the emerging projections of ^{oil} the prices of oil. Part ² Two projects alternative levels of oil revenues to the oil-producing countries and derives from these projections and other assumptions estimates of the future economic growth of the Middle Eastern countries and ~~the implied~~ ^{their} accumulation of foreign capital by these countries.

Part ³ Three discusses the possible investment strategies concerning the accumulated capital that may be implemented by the Middle East oil-producing countries and analyzes the implications of the world economy. It suggests some alternative estimates of investment portfolios to which the oil revenues may be directed.

The final chapter summarizes the findings and the main economic and political conclusions.

PART ONE: THE WORLD OIL MARKET

Our main purpose is to lay out some possible scenarios of future possible prices of oil. Many experts have tried in the past to forecast oil prices and failed. We would like very much to avoid it. We shall therefore present the complexity of the problem involved and derive several alternative future price patterns. The reader will be able to add his subjective evaluation to each of these patterns. We will use them in order to derive alternative levels of future oil revenues and then concentrate on their implications for the (a) international money markets, (b) the international trade, (c) the economic growth of the Middle East Countries, (d) their investment strategies and (e) the economies of the oil importing countries.

Three complex forces determine oil prices:

1. The supply of oil;
2. the demand for oil;
3. the competitive structure of the world oil market.

Since oil is only one form of energy source, it must be regarded as a part of the energy market as a whole. Therefore, our discussion will have the following structure:

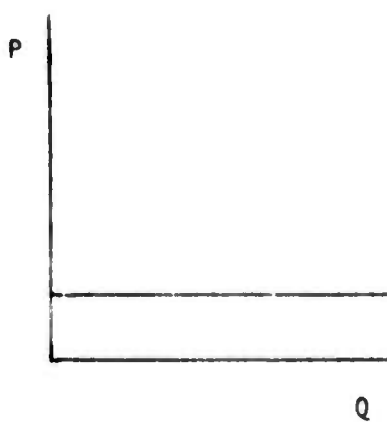
1. Estimations of supply of energy, where oil is treated separately from non-oil energy sources. (Chapter I)
2. Estimations of demand for energy. (Chapter II)
3. Estimations of oil demand as a residual between total energy demand and non-oil supply. (Chapter II)
4. A description of the competitive structure of the world oil market. (Chapter III)
5. Analysis of various scenarios of world oil market structures. For each of these scenarios the relevant demand and supply of oil will be analyzed, from which price estimates will emerge. (Chapter IV)

Chapter I

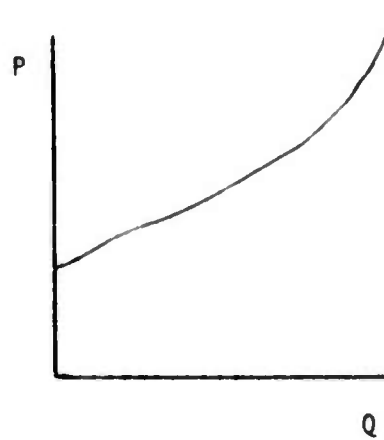
SUPPLY OF ENERGY AND OIL

We shall define the supply of oil (and energy) as a schedule (function) of output associated with various price levels. Thus the estimate of oil (and energy) supply for any future period is not a total of a certain unique quantity, but a schedule of quantities increasing with price. With the increase in energy prices, there is a greater incentive to invest in exploration and to produce incremental oil and other energy sources at higher production costs. The greater price covers the higher incremental cost and provides profits for those who are engaged in this activity.

One should differentiate between the short-term supply schedule and the long-term one. Since development of new oil fields and substitutes takes time, the long-term supply schedule is greater than the short-term one. This may help to understand the basic structure of the oil supply schedule. Due to the low prices of oil in the recent past, each country that had oil fields limited its output and exploration to a very low pace. In the Middle East the situation was, however, somewhat unique. Tremendous oil reserves were proven by relatively low investment and the availability of oil has been very large. The cost of extracting the oil is only between \$0.10 and \$0.20 per barrel and this includes also recovery of past investments. This unique position requires that we break down the world oil supply into two components as shown in the diagram on the following page.



Middle Eastern Schematic
Oil Supply



Non-Middle Eastern Schematic
Oil Supply

DIAGRAM I

The diagrams are of course only a schematic representation. They indicate that the Middle East can produce oil in very high quantities at relatively very low and quite constant cost before its oil reserves are depleted.

For the rest of the world the situation is more "normal". The diagram shows first that the initial cost is higher than in the Middle East and also that further increases in oil production entail escalating costs.

Technically, we could combine these two diagrams into one and claim that the resulting schedule reflects the world oil supply. This, however, is very misleading since it distorts the actual market structure. It would be right only if the oil market would operated under "free" competition, which is clearly not the case.

In the following sections we shall present some rough estimates of the long-term supply schedule of oil and other non-oil sources of energy.

We define "long-term" as the period required both for the development of new sources of fields (from the beginning of exploration to normal output), and the period required to develop substitute sources and achieve normal output. The period required is roughly five to fifteen years.

Again, in the Middle East new oil fields may be recovered and increase the total proven reserves in the long run. It is thus possible that the maximum feasible output of oil at the very low prices (either constant or rising slowly) is much greater than the present maximum feasible level. Yet despite the fact that we are not able to estimate these long-term supply curves in the Middle East, it is not expected that the Middle-East output will reach even its present maximum feasible output in the next decade. We shall concentrate, therefore, on estimating the long-term supply of oil and non-oil energy in the non-Middle East countries.

The supply of energy (as a function of energy prices) is the sum total of the supply of the main source of energy: petroleum, gas, coal, water power (hydroelectricity, nuclear energy, solar energy and other sources). The supply of petroleum is the sum of the supply of oil from oil fields and the supply of synthetic fuels: shale-oil, tar sands, liquefaction of coal. Extracting oil from these sources is based on certain production processes, which add to the cost of the oil.

We shall first summarize estimates of the supply of oil from its various sources, and then add some indicative estimates of the supply of other sources of energy.

A. Petroleum

The supply of petroleum will be broken down into the following "components":

United States "Normal" 48
 United States--new sources
 Western Europe--new sources
 OPEC--Middle East
 OPEC--non Middle East
 "Rest of the World" including Canada, Latin America and others*
 Oil substitutes

1. U.S. "Normal" 48

Total output in 1972 was 3.4 billion bl. This output referred to market price not higher than \$3 bl. At this price the output indicated a trend of decline of about 2 percent a year.

Studies made in the 1960s** indicate a price elasticity of supply of oil from this source between .3 to .8. This is a sum total of price elasticities of wildcat drillings, success ratio and size of discoveries***.

Before applying these studies to our purposes, we should note that:

- From the 1950s to 1980s there has been a trend towards a decline in the scale of the supply functions, due to the exhaustion of the available resources.

*Excluding the communist countries (see above)

**Fisher, F.M., Supply and Costs in the U.S. Petroleum Industry, Two Econometric Studies. Baltimore, Md.: Johns Hopkins Press, 1964

Erickson, E.W., and Spann, R.M., "Price, Regulation and the Supply of Natural Gas in the U.S.," in Resources for the Future, Keith Brown, ed.

Mancke, R.M., "The Long-Run Supply Curve of Crude Oil Produced in the U.S.," Antitrust Bulletin, Winter 1970, pp. 727-56.

***See Appendix I for summary of these studies' findings.

- The estimates of these findings refer to the lower section of the supply curve (at a low price range) only.

The scale effect will be accounted for by the assumption that the whole supply curve shifts to the left at two percent a year, so that at a price level of \$3 per crude barrel, output will decline. At higher prices we apply the lower estimates of elasticity, about .3, to the lower scale output. We regard this as the long-term elasticity, which will be reflected in the 1980 output (thus "long-term" in our case is seven years). Specifically, this means that the estimated 1980 supply at \$3 is about 87 percent of the 1973 supply, i.e., 2.5 billion bbl. At higher prices the amount supplied (at .3 arc elasticity) is estimated as follows:

TABLE I

ESTIMATED SUPPLY SCHEDULE
OF "NORMAL" 48 AT 1980

Price \$	Output (b.bl)
\$3	2.5
\$4	2.7
\$5	3.0
\$6	3.2
\$7	3.3
\$8	3.5
\$9	3.6

For 1985 we assume the same supply curve.

The Federal Energy Administration (FEA) estimates of the normal 48 output at different prices are considerably lower. For 1980 it estimates an output of 2.1, 2.2, and 2.4 billion bbls. at prices of \$4, \$7 and \$11 per bbl. At these same prices, output will reach 2.1, 2.6 and 3.3 billion bbls. in 1985. The range of price elasticity of supply for 1980

estimated by the FEA is extremely low: .08 to .2. For 1985 these elasticities are somewhat higher (.35 to .5).

2. United States--New Sources^{*}

- a) Secondary and tertiary recovery of old oil fields. The normal technique extracts only about 1/3 of the oil. Using available techniques for further recovery will result in estimated cost of about \$10 per barrel. The reserves are estimated at 30 bbl. However, assuming that by 1985 more efficient techniques will be applied it will be possible to extract about one half of these reserves at a cost of \$5-6 per barrel. Annual output in 1985 is thus estimated at 1/2 billion barrels. Additional output of 1/2 billion barrels is possible at \$10 per barrel. No output is accounted for in 1980.
- b) Offshore 48: The reserves are estimated between 10-50 billion barrels. Annual output in 1980--1/2 billion barrels and in 1985--1 billion barrels. Cost: \$4-5 per barrel. (The FEA estimates are similar).
- c) Alaska--Prudhoe Bay: Reserves are estimated at 15-30 billion barrels. Cost: \$4-5 per barrel. Output in 1980 (and 1985)--1 billion barrels. (The FEA unofficial estimates are .3 billion barrels in 1980 and .5 billion barrels in 1985).

* This section draws to a great extent from discussions with Herman Kahn.

- d) Alaska--Naval reserves: This area has been explored only roughly. It indicates a significant probability for tremendously high reserves: 25-120 billion barrels. It is assumed that output from this source will not start before the 1980s. In 1985 however, the output may reach a level of 1 or 2 billion barrels. The cost: \$5-6 per barrel.
- e) Out-continent shelf: This source has not yet been explored. It is assumed that recoverable reserves as of 1985 will reach about 30 billion barrels. Output in 1985 may reach 1 billion barrels. Cost: \$5-6 per barrel.
- f) Other sources: It is reasonable to assume that at high prices the incentive to explore further sources of oil will materialize in some unexpected recoveries. We therefore "gestimate" that by 1985 additional supply will appear at a price range of \$6-8 per barrel. We indicate here a figure of 1 billion barrels.

These supply sources are summarized in the following table:

TABLE 2
ESTIMATED SUPPLY SCHEDULE OF NEW SOURCES
OF OIL IN THE U.S.A.: 1980, 1985

Price (\$)	Source	Output 1980 (billion barrels/year)	Output 1985	Reserves 1985 (billion barrels)
\$4-5	Offshore	0.5	1	10-50
	Alaska--Prudhoe Bay	1.0	1	10-30
	Alaska--Naval Reserve	---	1	25-120
	Total at \$4-5	1.5	3	45-200
\$5-6	Secondary & tertiary recovery	---	0.5	15
	Out continental shelf	---	1.0	30
	Total at \$5-6	---	1.5	45
\$6-8	Tertiary recovery	---	0.5	15
	Other unspecified sources	---	1.0	30 (?)
	Total at \$6-8	---	1.5	45

Total cumulative supply of the U.S. at 1980 and 1985 is the sum total of the Normal 48 output and new sources. This supply schedule is indicated below (at rounded figures).

TABLE 3

ESTIMATED U.S. SUPPLY SCHEDULE: 1980, 1985*
(billion barrels/year)

Price \$/bbl	1980 Output	1985 Output
3	2.5	2.5
4	3.0	3.0
5	4.5	6.0
6	4.7	7.5
7	4.8	8.5
8	5.0	9.5

This "long-term" supply schedule is just a reference base. It is subject to a great number of qualifications, since it is based on a large number of strong assumptions and guesstimates.** And indeed, it differs greatly from the FEA estimates. We feel, however, that the latter projections underestimate the effectiveness of the high price incentive on the development of oil output. Yet, since the whole question is subject to uncertainty, we have no other choice but to select some "reasonable" benchmarks, and apply a sensitivity analysis. This will be made in the course of analyzing the market.

Another point that should be noted is that this schedule assumes certainty with regard to the oil prices. If, for example, future oil prices at the higher range are uncertain, it will greatly reduce the

*The figures are rounded to a direction that "smooths" the schedule somewhat.

**Hopefully the errors in these guesstimates cancel each other, at least partly.

incentive to explore or develop sources which are expected to cost \$6-8 per barrel. This has a direct implication to the price policy in the U.S. (see below).

The supply elasticities implied from this supply schedule are:

TABLE 4

PRICE ELASTICITY OF U.S. PETROLEUM SUPPLY, 1980, 1985*

Price (\$ per barrel)	1980 Elasticity	1985 Elasticity
4	0.60	0.60
5	2.0	4.0
6	0.20	1.25
7	0.20	0.80
8	0.20	0.80

* Figures are rounded

It turns out that the supply elasticity for 1980 at low prices is about .6 (the exception of 2.0 at \$5 results from the Alaskan--Prudhoe Bay's oil that is already being developed. Excluding this source we have at \$5 an elasticity of .67). At a price range greater than \$6, the elasticity is low, about .2.

As to 1985, the supply is more elastic. The high elasticity of the \$4-5 price range results from the estimate that, at this price range, high output will appear from Alaska and offshore. The price elasticity at the higher price range is estimated at .8.

3. Western Europe

There is extremely limited information on which to base estimates of oil supply schedule of Western Europe. The main source is the North Sea. Houthaker and Kennedy** assume that by 1980 the annual oil output

**Houthaker, H. S., and Kennedy, M., "Demand for Energy as a Function of Price," unpublished paper, (December 1973?).

of the North Sea will be close to 1.5 billion barrels. Odell* indicates a total oil output for Western Europe of 2.2 billion barrels by 1980, and 2.75 billion barrels for 1985. Both assume a price level not smaller than \$5 per barrel. These references are the basis for the following rough gestimate.

TABLE 5
WESTERN EUROPE OUTPUT: 1980, 1985
(billion barrels/year)

Price (\$)	1980 Output	1985 Output
3	0.5	0.5
4	1.0	1.0
5-8	1.5	2.75

The implicit assumptions here are:

- a. At low prices there will be some development in the 1970s, but if prices remain low, it will stop in the 1980s.
- b. For technological reasons it is hard to increase output beyond 1.5 billion in 1980. But by 1985 it will be possible to utilize the capacity as predicted by Odell.

This estimate, however, is subject to great uncertainty.

4. OPEC--Middle East

As we have seen, the supply schedule of the OPEC Middle Eastern countries is horizontal at a very low level of \$.10-.20 per barrel.

*Odell, P.R., "The Availability of Indigenous Energy in Western Europe 1973-1998 with Special Reference to Oil and Natural Gas," 1st World Symposium, Energy and Raw Materials, Paris, June 1974.

With transportation cost it amounts to \$1.50 per barrel. We shall treat this source of oil separately when we analyze the role of these countries in the market structure. Having monopolistic power, we do not regard the cost curves of these countries as supply curves.

5. OPEC--Non-Middle East

Since the non Middle East countries provide only a small share of the OPEC oil, we take these countries as a group and assume that they will provide their "normal" output at a price of \$6 per barrel. Higher prices will induce them to increase output gradually, reaching 3 percent growth per year at \$8. Their total 1980 output will be as follows:

TABLE 6
PROJECTED OUTPUT OF OPEC NON-MID EAST COUNTRIES
(1980)

Price (\$)	Output (billion barrels/year)
3	2.9
4	3.0
5	3.2
6	3.3
7	3.5
8	3.6

The implicit price elasticity of this supply schedule is between .1 at the lower price range, and .2 at the higher one. For 1985 we assume an output greater by 10 percent, at each respective price level.

6. "Rest of the World"

The "Rest of the World" output (excluding the communist countries) in 1973 was 2.6 billion barrels. We assume a supply elasticity similar to that of non-Middle East OPEC countries (between .1 and .2). We have the following supply schedule for 1980:

PRICE(\$)	1980 OUTPUT (billion barrels/year)
3	2.4
4	2.5
5	2.7
6	2.8
7	2.9
8	3.0

1985 supply schedule is assumed to be 10 percent greater.

7. Synthetic Fuel

Technologically it is possible to produce oil from various sources, at an estimated cost of \$7-9 per barrel. At this cost there is no long-term economic constraint on supply that may be repaired to fill up a gap between all conventional petroleum sources of supply and world demand. Indeed the cost estimate may change with the gaining of practical experience. Nevertheless, we chose the higher price figures on which to base our analysis. We assume that at a price of \$9 per barrel, the long-term supply of all these sources put together is horizontal (i.e., "unlimited") at the possibly required range of output.

Since it takes time to develop these sources, we assume that the "unlimited" output can be reached by 1985. This may not be the actual case. If programs to develop these substitute sources are not vigorously

pushed ahead, the 1985 supply of oil from these sources may very well be limited. The assumption of "unlimited" supply is based only on technological feasibility, and not on political or institutional possible barriers.

In 1980 the output of oil from substitute sources will of course be limited. We assume it can reach a level of 1/2 billion barrels, all produced in the U.S.

8. Summary

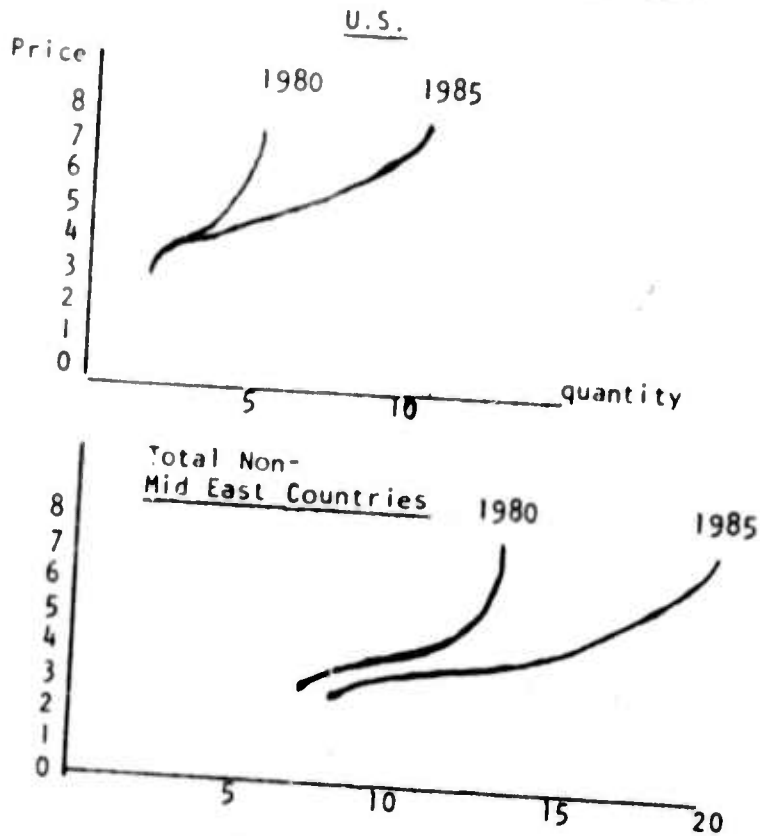
The world estimated schedule of petroleum for 1980 and 1985 (excluding the Middle East and the communist countries) is summarized in the following table and diagram.

TABLE 7

SUMMARY OF ESTIMATED OIL SUPPLY SCHEDULE OF NON-MIDDLE EAST COUNTRIES, 1980, 1985
(billion barrels/year)

Price (\$)	1980			1985		
	U.S.	Other Non-Mid East countries	Total	U.S.	Other non Mid East countries	Total
3	2.5	5.8	8.3	2.5	6.3	8.8
4	3.0	6.5	9.5	3.0	7.0	10.0
5	4.5	7.4	11.9	6.0	9.3	15.3
6	4.7	7.6	12.3	7.5	9.4	16.9
7	4.8	7.9	12.7	8.5	9.7	18.2
8	5.0	8.1	13.1	9.5	10.0	19.5
9	5.5	8.1	13.6	'unlimited'	---	'unlimited'

The supply elasticity for 1980 at the price range of \$3 to \$6 per barrel averages .6, between \$6 and \$8 it averages .25. For 1985 the respective elasticities (excluding substitutes) are 1.0 and .4.

ESTIMATED OIL SUPPLY SCHEDULES 1980, 1985DIAGRAM 2B. Coal

The total coal output in 1973 (excluding the communist countries) amounted to 1560 million tons which is equivalent to about 6.75 billion barrels of oil.* In the total energy consumption it indicates a decline from 61 percent in 1950 to 8 percent in 1973. However, at prices higher than \$4 per crude barrel, its share is expected not to decline any more, but rather to increase. Following Walter Levy,** we assume that

* The coal output will be expressed at equivalent oil barrels.
The conversion ratio is 4.31 oil barrels per one ton of coal.

** W. Levy, "World Oil Cooperation or International Chaos," Foreign Affairs, July 1974.

at a price of \$7 per barrel, the output and consumption of coal will rise 4 percent per year up to 1980. At a price of \$4 per barrel we assume two percent output growth. At prices higher than \$7 per barrel we do not have estimates of coal supply, but given the assumption of "unlimited" supply of oil substitutes, we do not have to rely on such coal supply estimates.

Thus the 1980 coal supply is summarized as follows:

\$3 : 6.75 billion oil bbl. equivalent
 \$4 : 7.75 billion oil bbl. equivalent
 \$5-7: 9.00 billion oil bbl. equivalent

For 1985 we assume a further increase by ten percent (i.e. two percent per year).

C. Natural Gas

The world output of natural gas in 1973 (excluding communist countries) was 34 trillion cubic feet, i.e., 6 billion oil barrels equivalent. This output is assumed to increase stepwise from two percent per year at a price of \$4 to three percent at \$5, four percent at \$6 and five percent at \$7-8. Thus we have the following supply schedule for 1980.

<u>PRICE</u>	<u>1980 GAS SUPPLY</u>
\$3	6.0
\$4	6.9
\$5	7.4
\$6	7.9
\$7-8	8.5

For 1985 we assume a further increase of ten percent (i.e. two percent per year)

D. Other Sources of Energy

Other sources of energy, like hydroelectricity, nuclear energy, solar energy, etc., amounted in 1973 to 2.5 percent of the total output of energy, which is an equivalent of about .8 billion barrels. It is assumed to reach in 1980 and 1985 respective levels of 1.2 and 2.0 billion barrels.

E. Non-Oil World Energy Supply

The above estimates of the non-oil energy supply schedule of the various sources are summarized in the following table. The schedule is "smoothed" somewhat by a simple interpolation.

TABLE 8
ESTIMATES OF NON-OIL WORLD ENERGY SUPPLY 1980, 1985
 (billion barrels/year)

PRICE (\$/bbl)	1980 QUANTITY	1985 QUANTITY
3	14.0	14.0
4	15.8	18.0
5	17.1	19.0
6	18.1	20.0
7	18.5	21.0
8	18.7	21.0
9	18.7	21.0

We shall later make use only of the 1980 estimates. The 1985 ones we brought in order to provoke comments, which may improve them.

F. U.S. Non-Oil Energy Supply

The non-oil energy supply for the U.S. was derived on the basis of the same assumptions as in the preceding world case. The 1980s estimates are summarized below.

TABLE 9

ESTIMATES OF U.S. NON-OIL ENERGY SUPPLY, 1980
(billion barrels/year)

PRICE (\$/bbl)	QUANTITY
3	7.2
4	8.1
5	8.7
6	9.2
7	9.5
8	9.6
9	9.6

Chapter II

THE DEMAND FOR ENERGY AND OIL

During the post World War II period the world oil consumption increased steadily and quite fast, from 2.76 bil. bbls in 1950 to 20.5 bil. bbls in 1973, an annual rate of increase of more than 9 percent. On the basis of this past development, pre-October 1973 projections were made that estimated that total demand would increase roughly at 7 percent per year. According to these estimates,^{*} 1980 consumption would be about 31.8 bil. bbls, or 55 percent greater than in 1973. (This is the medium among three projections.)

Given the relatively small increase in oil production in the non-OPEC countries and the tremendous availability of reserves in the Mid East, it was estimated that by 1980 the Mid East would account for 40 percent of total oil production as compared to 30 percent in 1970 and 25 percent in 1960.^{*} Thus it was generally expected that the dependence of the world on Mid East oil production would increase to critical levels.

These estimates, however, should be viewed in the context of the overall demand for energy. We shall therefore start our discussion with this subject.

Every forecast of future energy (and/or) oil demand must take into account the factors that affect demand by explicitly forecasting the magnitude of these factors and by inquiring into the nature of their effect on demand. Two main factors will be discussed here, the price level and the income level.

^{*}C.f., United Nations, Report of the ad hoc panel of experts on Projections of Demand and Supply of Crude Petroleum and Products, January 1972.

A. The Price Elasticity

The effect of price on the amount demanded is often an important factor. The pre-October 1973 estimates of future oil consumption implicitly assumed that the price of oil would not appreciably rise. This may be a source for errors. Obviously the lower the price the greater the amount demanded. The price effect is measured by its elasticity. Elasticity is a coefficient that shows the percentage by which the quantity demanded rises as a result of a one percent price reduction (or the other way around, i.e., the percentage of quantity reduced resulting from a one percent price increase). Since quantity and price change in opposite directions, the price elasticity is a coefficient less than zero.

During the 1950s and the 1960s oil prices were decreasing from an average of \$2.04 per barrel in 1948 to \$1.30 per barrel in 1967. In view of the world inflation during those years, the real price declined to one-third (!) of its 1948 level. Without shifting the discussion to the reasons for this decline (whether it was an outcome of free competition or was (perhaps) a "grand design" of controlling bodies on the market), it clearly accelerated the rate of increase of oil consumption. This is explained by the following reasons.

1. It encouraged the substitution of oil for coal. And indeed the share of coal in total world energy consumption declined from 61 percent in 1950 to 28 percent in 1973, while the percentage of oil in energy consumption increased from 28 percent in 1950 to 48 percent in 1973.
2. It was profitable to develop energy intensive production technologies, since they substituted other inputs at a declining energy cost.

3. It was not worthwhile to develop technologies and methods that save energy since the value of the savings was lower than the cost.

So the past trend of fast increase in oil consumption resulted not only from the past increase in the national product, but also from the declining price level.

B. The Income Elasticity

The effect of increasing income on demand is measured by the income elasticity of demand. This measure shows the percentage increase of demand resulting from a one percent increase in income or Gross National Product (GNP) under constant prices. Since the historical data on increasing oil consumption reflects a period of declining prices a simple relationship of these two variables overestimates the income effect. In other words, the past ratio of increased consumption to increased income incorporates the positive effect on consumption of the declining prices. Once the price elasticities are estimated, the price effect on past consumption can be separated out and the income elasticity thus estimated without bias. In fact the two elasticities are estimated simultaneously by the same statistical method. One should, however, note that the lower the estimate of price elasticity the greater the associated income elasticity. Thus consistency requires that the selection of income and price elasticities be made together.

C. Empirical Estimates of the Price and Income Elasticities of Demand for Oil

The most comprehensive estimates of the price elasticity and income elasticity of demand for oil products were made by Houthakker. His econometric model estimates the short term elasticity as well as a parameter

which reflects the time adjustment of demand. From these two estimates, the long-term elasticity is derived. Houthakker applied this model to various energy products of different regions and countries in different time periods. A selected summary of his estimates is shown in the following table*:

TABLE 10
LONG-TERM DEMAND ELASTICITIES

	Price Elasticity	Income Elasticity
U.S. Gasoline	-.24	+.98
OECD Gasoline	-.82	+1.30
U.S. Residential Oil	-1.00	+1.60
OECD Residential Oil	-1.58	+1.60
U.S. Residential Electricity	-.80	+1.41

Projections of world demand and supply of oil presented by Houthakker and Kennedy imply price elasticities of aggregate demand for oil on a country basis as follows:

Japan: -.75
Europe: -.20 to -.40
U.S.A.: -.30

The price elasticity estimates for the specific products are extremely high. Yet the implied price elasticities for the aggregate country demand are lower.

Houthakker's findings indicate surprisingly high long-term price elasticity. Even if we take the lower range figure of about -.30, it will have a substantial effect on future demand. If the price level in 1980 is still three times higher than in 1973, the total oil consumption in

*Houthakker, H. S. and Kennedy, M., "Demand for Energy as a Function of Price," unpublished paper, December 1973- ; Houthakker, H. S., "The Price Elasticity of Energy Demand," Mimeo, Committee for Economic Development, December, 1973.

1980 will be about 35 percent lower than it would have been at constant prices. It also means that if the price of energy in 1970 had remained at its real 1948 level, that is some 100 percent above its actual level, total consumption in 1970 would have been 15 percent lower than it actually was.

Indeed, one should read Houthakker's results with care (as he himself indicates). They are based on some oil products in a partial market and moreover they measure the elasticity at the lower price range. Since elasticity at a higher range may be different, it is hard to project from past findings elasticities that apply to the future. That is why we have chosen Houthakker's lower estimates rather than the higher ones.

A second source for calculating elasticity is implicit in the demand forecast by the Federal Energy Office (dated June 3, 1974). From the different consumption levels forecasted for 1985 at \$4, \$7, and \$11 per crude barrel, the implied demand elasticity for energy is -.10 and for oil -.20. The greater elasticity of oil demand is explained by the possible substitution between oil and other energy sources.

On the basis of these findings we chose to analyze the sensitivity of energy demand with respect to the following 20 combinations of price and income elasticities.

Price elasticity: -.10; -.20; -.35; -.50.
 Income elasticity: +.50; +.75; +1.00; +1.25; +1.50.
 For details see Appendix 2.

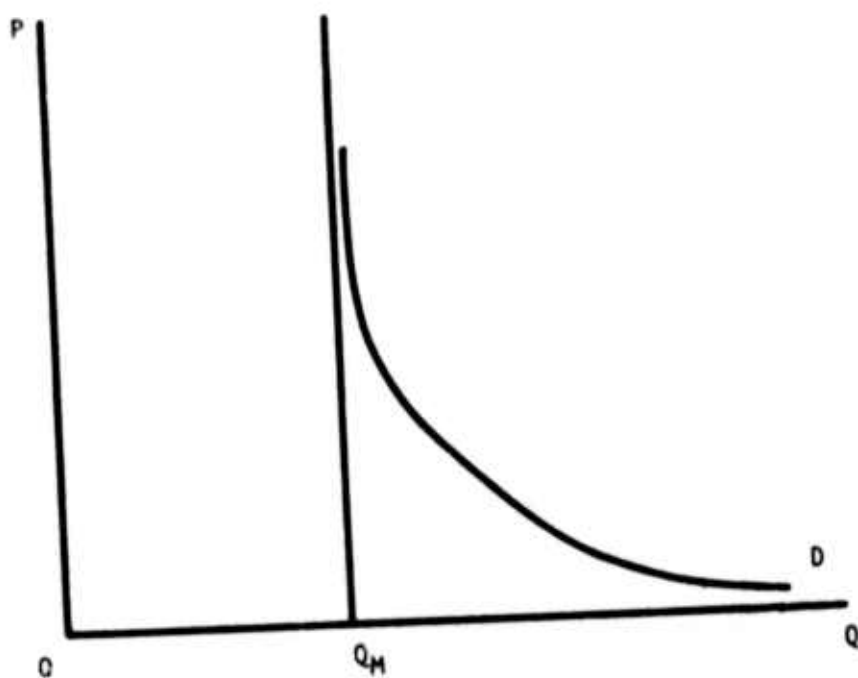
We shall proceed here, however, with 9 plausible combinations of $n_p = -.10, -.20, -.35$ and $N_y = .75, 1.00$ and 1.25 .

D. Estimates of 1980 World Energy Demand

On the basis of the discussion and the considerations presented in Appendix 2, we have chosen to represent the pattern of the demand function for energy by the following schematic diagram.

DIAGRAM 3

SCHEMATIC ENERGY DEMAND



It is assumed here that a minimum consumption of Q_M is essential to any given economy. Thus, even if prices reach extraordinary high levels, demand will not fall below Q_M . However, should prices decline the demand will increase from Q_M up, in such a manner that the elasticity of the demand curve in the section to the right of Q_M is constant and equal to the empirically derived estimates of elasticity. The demand function is:

$$(1) \quad P = \frac{K}{Q - Q_M}$$

Or alternatively:

$$(2) \quad Q = Q_M + \frac{K}{P}$$

The price elasticity of this function is:

$$N_p = -(1 - \frac{Q_M}{Q})$$

Thus, the price elasticity declines as Q decreases (i.e., as price increases).

On the basis of 1973 price and consumption, alternative parameters of K were derived for alternative levels of price elasticity. This provided us with a series of alternative demand functions for 1973. The 1980 estimates are derived from the 1973 functions by increasing the values of the parameters Q_M and K by a certain proportion. Assuming income will rise 31.6 percent in the 1973-1980 period (i.e., 4 percent a year), this proportion is simply $0.316 \cdot N_y$ (N_y = the income elasticity).

The 1980 energy demand function is thus

$$Q_{1980} = (1.316N_y)Q_M + \frac{(1.316N_y)K}{p}$$

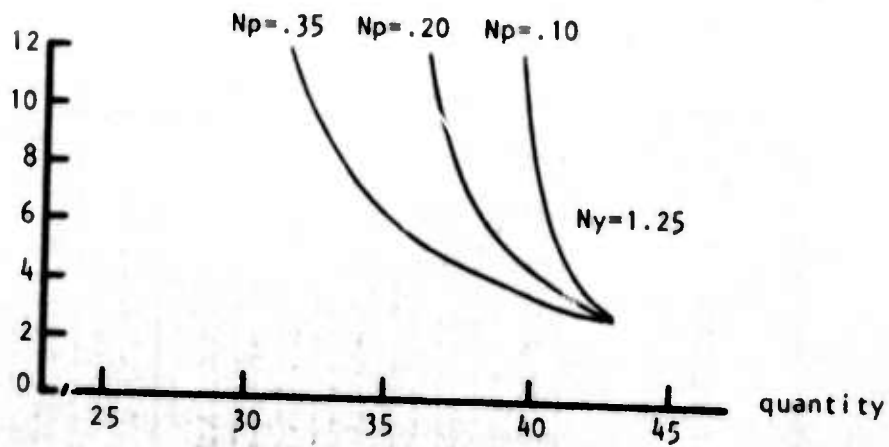
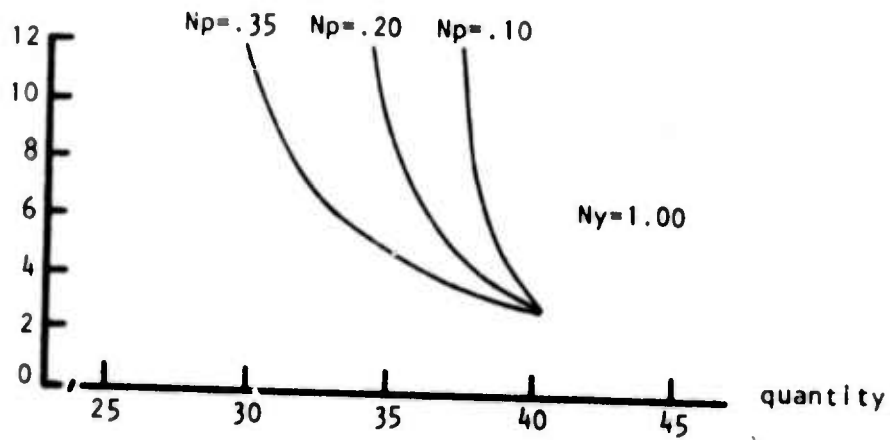
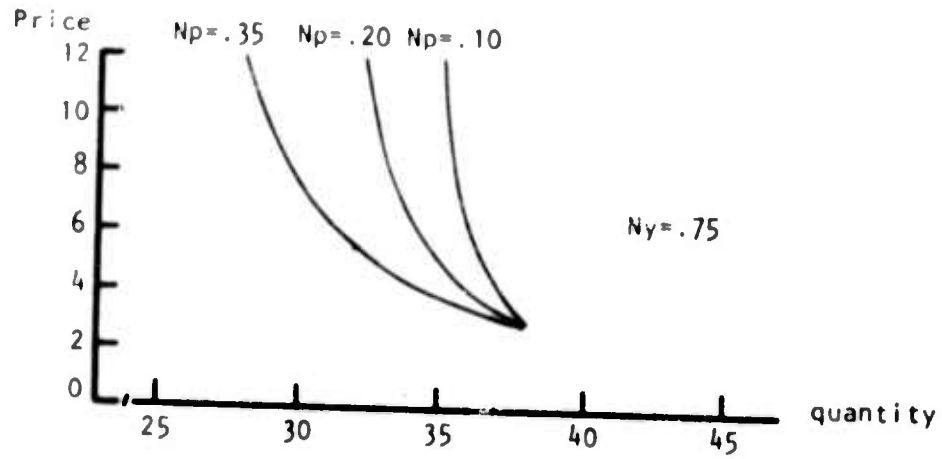
The following table presents nine such world demand schedules of energy for 1980, for various combinations of price elasticities (-.10, -.20, -.35) and income elasticities (0.75, 1.00, 1.25). It is followed by a diagram of these functions.

TABLE 11
ESTIMATED WORLD ENERGY DEMAND SCHEDULE, 1980

Income Elasticity	.75			1.00			1.25			
	Price Elasticity	.10	.20	.35	.10	.20	.35	.10	.20	.35
Price										
\$3	38.0	38.0	38.0	40.4	40.4	40.4	42.8	42.8	42.8	
\$4	37.0	36.1	34.7	39.4	38.4	36.9	41.8	40.7	39.1	
\$5	36.5	34.9	32.7	38.8	37.2	34.7	41.1	39.4	36.8	
\$6	36.1	34.2	31.3	38.4	36.4	33.3	40.7	38.5	35.3	
\$7	35.8	33.6	30.4	38.1	35.8	32.3	40.4	37.9	34.3	
\$8	35.6	33.2	29.7	37.9	35.4	31.6	40.1	37.5	33.5	
\$9	35.4	32.9	29.1	37.7	35.0	31.0	40.0	37.1	32.8	
\$10	35.3	32.7	28.7	37.6	34.7	30.5	39.8	36.8	32.3	
\$11	35.2	32.5	28.3	37.5	34.5	30.1	39.7	36.6	31.9	
\$12	35.1	32.3	28.0	37.4	34.3	29.8	39.6	36.4	31.6	
high	34.2	30.4	24.7	36.4	32.3	26.3	38.5	34.3	27.8	

DIAGRAM 4

ESTIMATED WORLD ENERGY DEMAND SCHEDULE, 1980



It should be noted that the elasticity by which this function is identified, refers only to one point where price = \$3. At higher prices the elasticity falls sharply, reaching zero at high prices. Detailed description of these schedules and their elasticities appear on the computer prints of Appendix 2.

E. Estimates of World Demand for Oil, 1980

The demand for oil is defined as the balance between the demand for energy and the supply of non-oil energy. The demand for oil is more elastic than the demand for energy as a whole, because it is affected by two factors: (1) the price elasticity of energy demand, and (2) the price elasticity of non-oil supply. Thus as price rises, the amount demanded for oil falls more rapidly than that for energy.

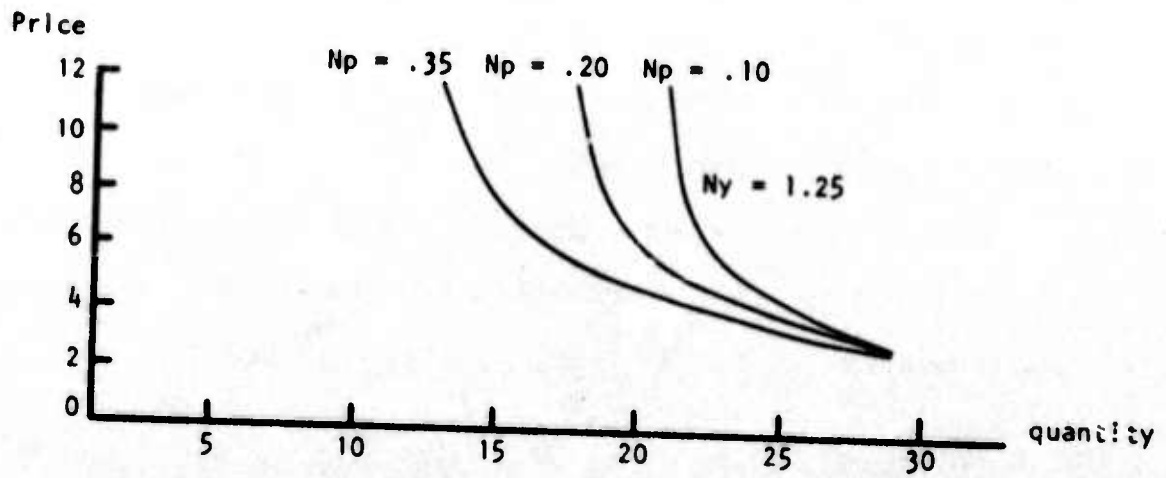
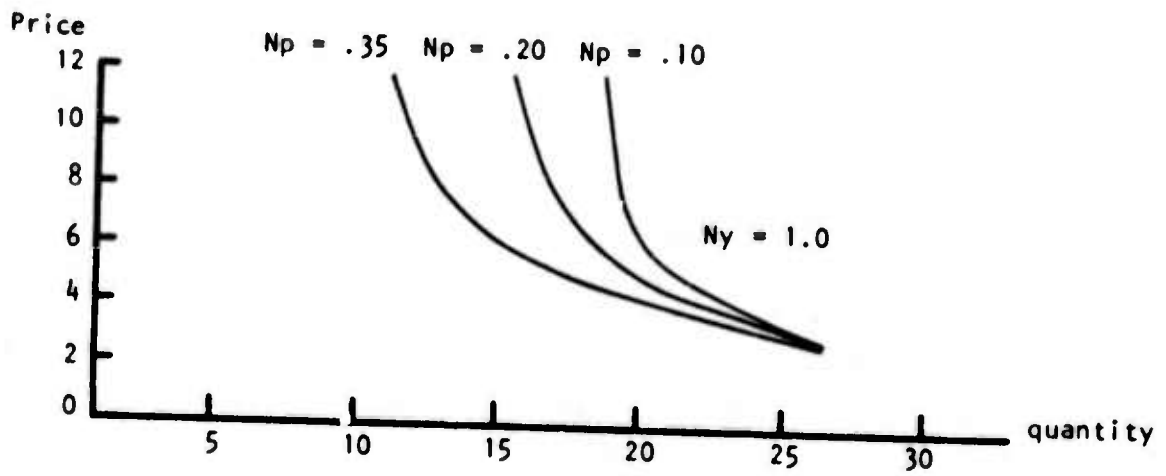
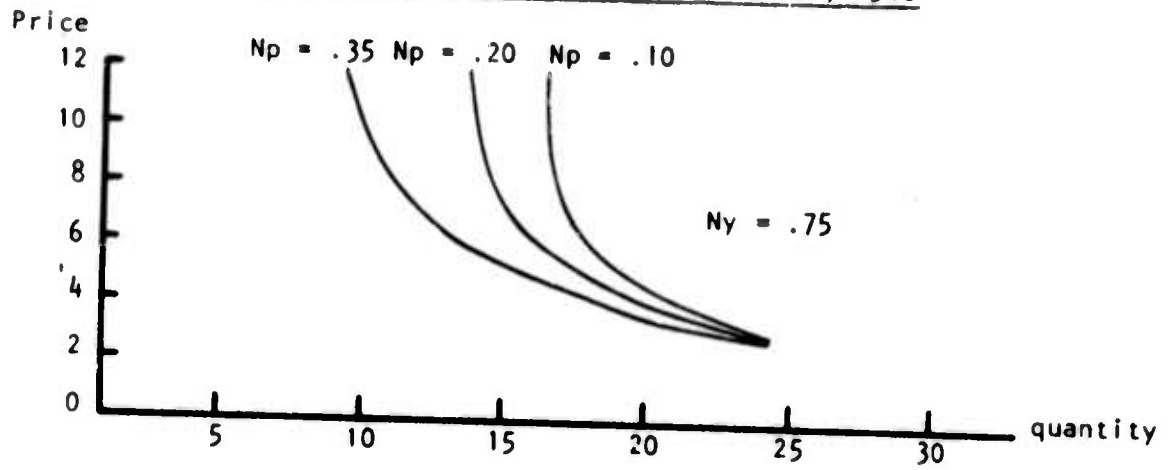
In the following tables and diagrams we present nine alternative oil demand curves for the world. These demand schedules are derived from the nine energy demand functions presented in the preceding section. Thus they constitute combinations of three price elasticities for energy (-.10, -.20, -.35) and three income elasticities (.75, 1.00, 1.25). Altogether we have constructed 27 oil demand curves (for the world and for the U.S.). The nine curves presented here are derived from the base estimate of non-oil supply. Another set of nine curves is constructed under non-oil supply smaller by 10 percent than the base estimate (-10 percent), and the third set is for oil supply greater by 10 percent than the base estimate (+10 percent).

TABLE 12
ESTIMATED WORLD OIL DEMAND SCHEDULE, 1980

Income Elasticity	.75			1.00			1.25		
Price Elasticity	.10	.20	.35	.10	.20	.35	.10	.20	.35
Price									
\$3	24.0	24.0	24.0	26.4	26.4	26.4	28.8	28.8	28.8
\$4	21.2	20.3	18.5	23.6	22.6	21.1	26.0	24.9	23.3
\$5	19.4	17.8	15.6	21.7	20.0	17.6	24.0	22.3	19.7
\$6	18.0	16.1	13.2	20.3	18.3	15.2	22.6	20.4	17.2
\$7	17.3	15.1	11.9	19.6	17.3	13.8	21.9	19.4	15.8
\$8	16.9	14.5	11.0	19.2	16.7	12.9	21.4	18.8	14.8
\$9	16.7	14.2	10.4	19.0	16.3	12.3	21.3	18.4	14.1
\$10	16.6	14.0	10.0	18.9	16.0	11.8	21.1	18.1	13.6
\$11	16.5	13.8	9.6	18.8	15.8	11.4	21.0	17.9	13.2
\$12	16.4	13.6	9.3	18.7	15.6	11.1	20.9	17.7	12.9

DIAGRAM 5

ESTIMATED WORLD OIL DEMAND SCHEDULE, 1980



Reading these demand schedules shows that as a result of price increases, the 1980 oil demand will be considerably lower than at a price of \$3, even in cases where the elasticity is low. The following table shows the expected 1980 demand at higher prices (\$6, \$9 and \$12 per barrel) as a percentage of the expected demand at price of \$3.

TABLE 13

OIL DEMAND AT HIGH PRICES
(Amount at Price \$3=100)

N_y	N_p	\$3	\$6	\$9	\$12
.75	-.10	100	75	70	68
.75	-.20	100	67	59	57
.75	-.35	100	55	43	39
1.00	-.10	100	77	72	71
1.00	-.20	100	69	62	59
1.00	-.35	100	58	47	42
1.25	-.10	100	78	74	73
1.25	-.20	100	71	64	61
1.25	-.35	100	60	49	45

The table shows, for example, that in the cases where the demand elasticity is lowest, the amount demanded at \$9 per barrel will be about 30 percent lower than at \$3. This considerable decline of demand is explained not only by the energy demand elasticity (which causes a decline for energy demand by only 7 percent), but mainly by non-oil supply at the higher prices. (This point might have been overlooked in some estimates of future oil demand at higher prices, that were published recently.)

We turn now to present estimates of energy and oil demand for the U.S. They will be later incorporated within the analysis of alternative market scenarios.

F. Estimates of 1980 U.S. Energy and Oil Demand

The demand for energy in the U.S. is derived exactly like in the world case. The nine alternative demand schedules and diagrams appear below. They are followed by estimated demand schedules for oil, which again, like in the case of the world are derived by subtracting the supply schedule of non-oil energy from the energy demand schedule. In the text the latter table describes nine oil demand schedules derived by subtracting the base estimates of the non-oil supply.

TABLE 14
ESTIMATED U.S. ENERGY DEMAND SCHEDULE, 1980

Income Elasticity	.75			1.00			1.25		
	.10	.20	.35	.10	.20	.35	.10	.20	.35
Price									
\$3	15.6	15.6	15.6	16.6	16.6	16.6	17.6	17.6	17.6
\$4	15.2	14.8	14.2	16.2	15.8	15.1	17.1	16.7	16.0
\$5	15.0	14.3	13.4	15.9	15.3	14.3	17.0	16.2	15.1
\$6	14.8	14.0	12.9	15.8	14.9	13.7	16.7	15.8	14.5
\$7	14.7	13.8	12.5	15.6	14.7	13.3	16.6	15.6	14.0
\$8	14.6	13.6	12.2	15.5	14.5	13.0	16.5	15.4	13.7
\$9	14.5	13.5	11.9	15.5	14.4	12.7	16.4	15.2	13.5
\$10	14.5	13.4	11.8	15.4	14.3	12.5	16.3	15.1	13.3
\$11	14.4	13.3	11.6	15.4	14.2	12.3	16.3	15.0	13.1
\$12	14.4	13.2	11.5	15.3	14.1	12.2	16.2	14.9	13.0
high	14.0	12.5	10.1	14.9	12.3	10.8	15.8	14.0	11.4

DIAGRAM 6

ESTIMATED U.S. ENERGY DEMAND SCHEDULE, 1980

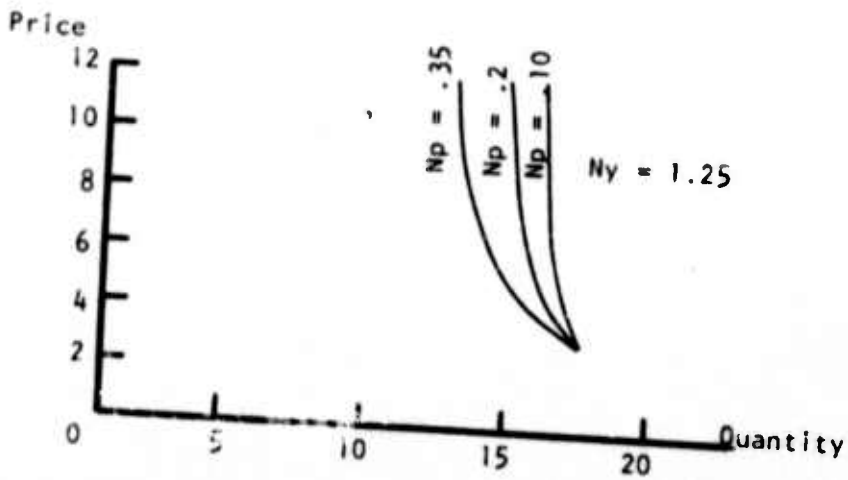
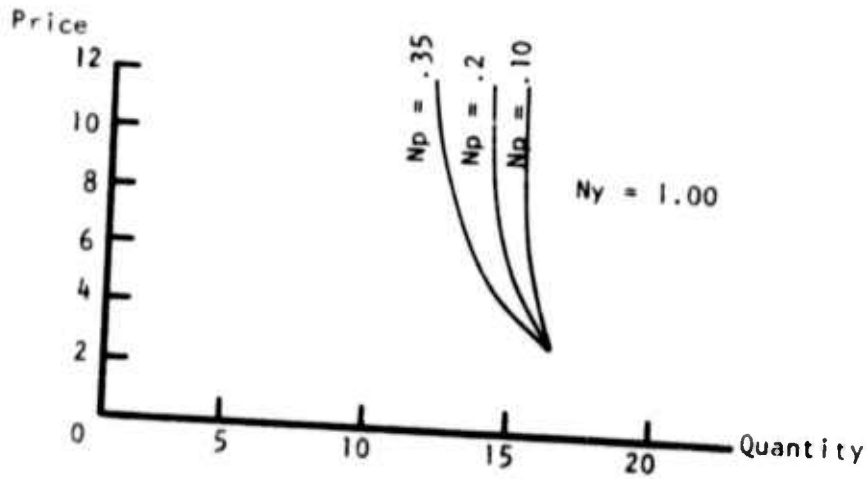
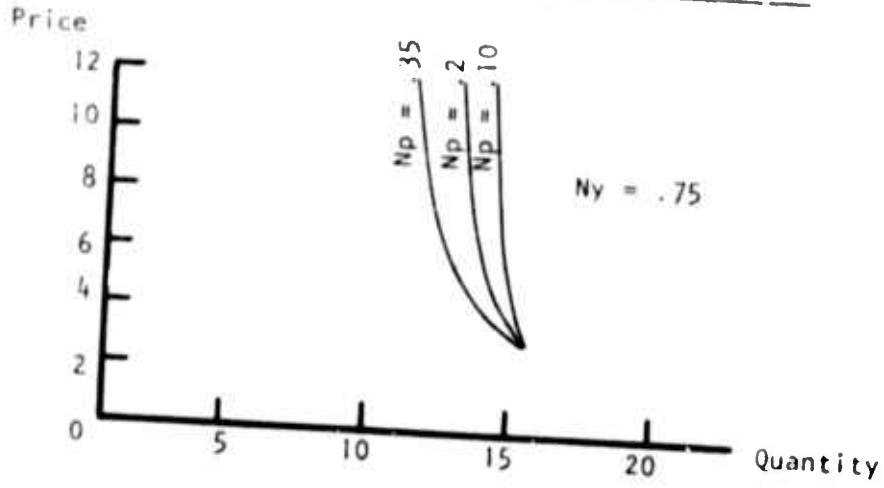
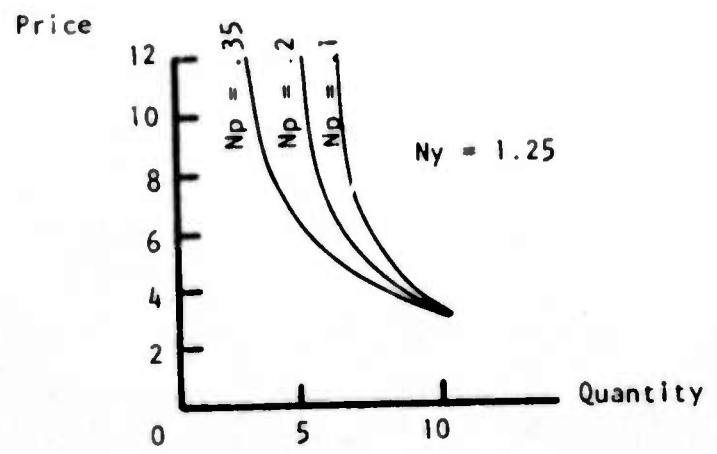
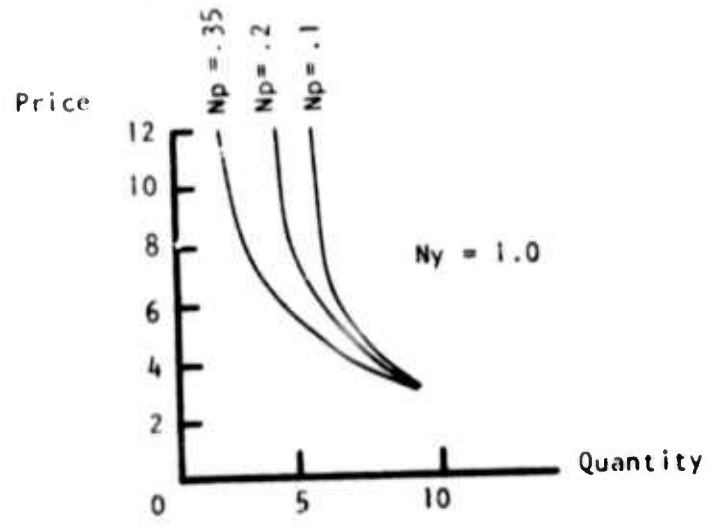
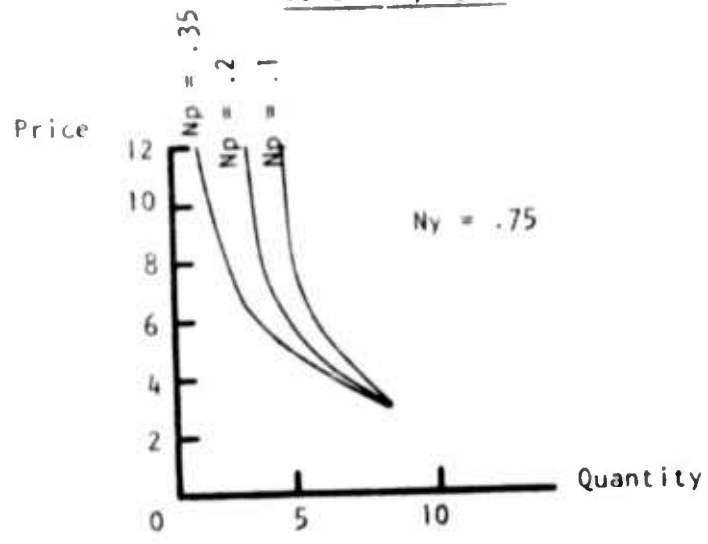


TABLE 15
ESTIMATED U.S. OIL DEMAND SCHEDULES, 1980

Income Elasticity Price Elasticity	.75			1.00			1.25		
	.10	.20	.35	.10	.20	.35	.10	.20	.35
Price									
\$3	8.4	8.4	8.4	9.4	9.4	9.4	10.4	10.4	10.4
\$4	7.1	6.7	6.1	8.1	7.7	7.0	9.0	8.6	7.9
\$5	6.3	5.6	4.7	7.2	6.7	5.6	8.2	7.5	6.4
\$6	5.6	4.8	3.7	6.6	5.7	4.5	7.5	6.6	5.3
\$7	5.2	4.3	3.0	6.1	5.2	3.9	7.1	6.0	4.6
\$8	5.0	4.0	2.6	6.0	4.9	3.7	6.9	5.8	4.1
\$9	4.9	3.9	2.3	5.9	4.8	3.1	6.8	5.6	3.9
\$10	4.9	3.8	2.2	5.8	4.7	2.9	6.7	5.5	3.7
\$11	4.8	3.7	2.0	5.8	4.6	2.8	6.7	5.4	3.5
\$12	4.8	3.6	1.9	5.7	4.5	2.6	6.6	5.3	3.4

DIAGRAM 7

ESTIMATED U.S. OIL DEMAND
SCHEDULE, 1980



The magnitude of the relative effect of the higher prices on the U.S. oil demand is summarized in the following table.

TABLE 16

OIL DEMAND AT HIGH PRICES--U.S.
(Amounts at Price \$²=100)

N_y	N_p	\$3	\$6	\$9	\$12
.75	.10	100	75	58	57
.75	.20	100	57	46	43
.75	.30	100	44	27	23
1.00	.10	100	70	63	61
1.00	.20	100	61	51	48
1.00	.30	100	48	33	28
1.25	.10	100	72	65	63
1.25	.20	100	63	54	51
1.25	.30	100	51	38	33

The table shows that the price effect on the U.S. demand for oil is very considerable, in fact greater than in the case of world demand. Thus again in cases where energy demand assumes lowest price elasticity, the demand for oil at \$9 per barrel will be between 35 percent and 40 percent smaller than at a price of \$3. Again, this effect is attributed not only to the energy demand elasticity (in which case the demand declines by only 6 percent) but primarily to the non-oil supply elasticity. Thus at higher prices it is expected that there will be a considerable increase in the supply of non-oil energy sources which will cut down the net energy demand, i.e., the demand for oil.

C. Estimates of 1980 U.S. Demand for Import of Energy

The U.S. demand schedule for energy import is the balance between the energy demand and supply schedules. In order to derive it, we have now to subtract from the oil demand schedule (in the preceding section) the U.S. supply schedule of oil. As mentioned above, 27 alternative oil

demand schedules were derived. To 21 of them we applied 3 alternative oil supply schedules (base, base +10 percent, base -10 percent). The result was 63 alternative net demand schedules for import of energy (primarily oil and some gas). Twelve of these schedules are illustrated in the following table.

TABLE 17
U.S. NET DEMAND FOR ENERGY IMPORT, 1980
(Bil. bbls per year)

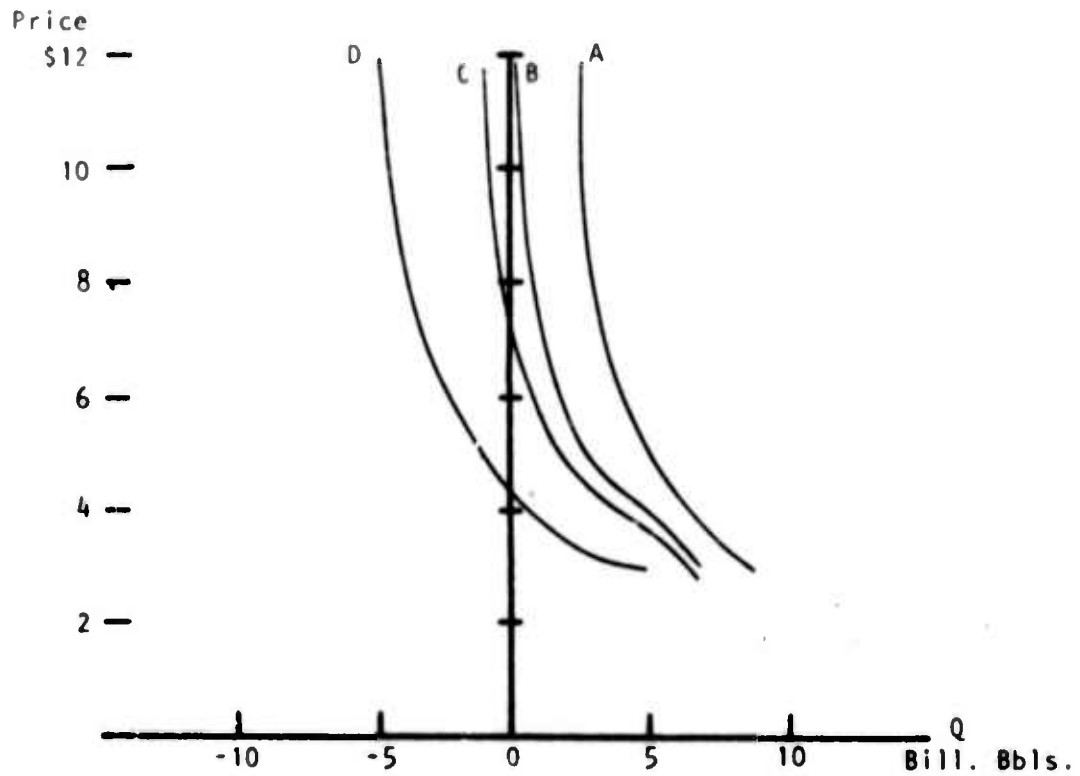
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Income Elasticity	1.0	1.0	1.0	1.0	1.0	1.0	0.75	0.75	0.75	1.25	1.25	1.25
Price Elasticity	0.1	0.1	0.1	0.2	0.2	0.2	0.35	0.35	0.35	0.1	0.1	0.1
Non-oil Supply	+10%	same	-10%	+10%	same	-10%	+10%	same	-10%	+10%	same	-10%
Oil Supply	+10%	same	-10%	+10%	same	-10%	+10%	same	-10%	+10%	same	-10%
Price												
\$3	5.9	6.9	7.9	5.9	6.9	7.9	4.9	5.9	6.9	6.9	7.8	8.8
\$4	4.0	5.1	6.2	3.5	4.7	5.8	2.0	3.1	4.2	4.9	6.0	7.1
\$5	1.4	2.7	4.0	0.7	2.1	3.4	-1.1	0.2	1.5	2.4	3.7	5.0
\$6	0.5	1.9	3.2	-0.4	1.0	2.4	-2.4	-1.0	0.3	1.4	2.8	4.2
\$7	-0.1	1.3	2.8	-1.0	0.4	1.8	-3.2	-1.8	-0.4	0.8	2.3	3.7
\$8	-0.5	0.9	2.4	-1.6	-0.1	1.4	-3.9	-2.4	-1.0	0.4	1.9	3.3
\$9	-1.1	0.4	1.9	-2.2	-0.7	0.8	-4.7	-3.2	-1.6	-0.2	1.3	2.8
\$10	-1.2	0.3	1.8	-2.3	-0.8	0.7	-4.8	-3.3	-1.8	-0.3	1.2	2.8
\$11	-1.2	0.3	1.8	-2.4	-0.9	0.6	-5.0	-3.5	-2.0	-0.3	1.2	2.7
\$12	-1.3	0.2	1.7	-2.5	-1.0	0.5	-5.1	-3.6	-2.1	-0.4	1.1	2.7

The most interesting finding from these data is the price level at which its net demand for oil import is not greater than 5 percent of its total oil demand.

As is the case with world net demand, the table is split into four sections. Columns 1 to 6 give results which follow from the most reasonable assumptions. Columns 7 to 9 represent the extreme case of low demand, while columns 10 to 12 represent the extreme case of high demand. In addition, the table incorporates varying supply assumptions (no change in estimated supply as well as a 10 percent increase and decrease in estimated

DIAGRAM 8

U.S. ESTIMATED EXCESS DEMAND OF ENERGY, 1980



KEY:	A	B	C	D
Ny	1.25	1.00	1.00	.75
Np	-.10	-.10	-.20	-.35
Sup	-10%	BASE	BASE	+10%

supply). Hence, column 12 gives the extreme case where demand is highest and supply lowest. It shows that at a price of \$6, demand for energy in excess of internal supply (imports) is above 4 bil. bbls per year; and at a price of \$9, such demand is close to 3 bil. bbls per year. In order to become independent in this case, the U.S. needs to plan on a long-term price of \$9 and the development of substitutes in the 3 bil. bbl range.

In the extreme opposite case (column 7), characterized by the lowest demand and the greatest supply, the U.S. achieves independence at a price of \$5 and in addition possesses capacity for export in excess of 1 bil. bbls per year, export capacity of 2.4 bil. bbls at \$6, and nearly 5 bil. bbls at \$9. Should this particular case be applied to the whole world, full independence from OPEC Middle East oil is achieved at a price approaching \$6/bbl.

However, it is expected that these extreme cases are highly unlikely to prevail. They are included here to provide the boundaries of the feasible region. It is much more likely that the situation expected to prevail lies in the medium cases. Such a one is here represented in column 5. It gives the U.S. excess demand of 1 bil. bbls per year at $P=\$6$ (7 percent of its energy demand and 18 percent of its total oil demand). At $P=\$9$, the U.S. has excess supply of .7 bil. bbls. Independence is achieved between \$7 and \$8, without recourse to the development of substitutes.

This medium-range result is subject to uncertainty. Excess demand at $P=\$6$ could deviate easily from the prediction by ± 1 bil. bbls, while independence could be achieved at any price between \$6 and \$9.

Given this relatively wide range of possible outcomes, the question is raised over the most appropriate minimum price to be set. In order to make profitable the development of substitutes, the minimum price must be set at \$9. However, such a price appears unrealistically high since it creates considerable excess supply in most of the probable cases. Such a situation will, of course, be welcomed by oil importing nations, which would then be faced with the prospects of a world glut of energy. A minimum price of \$6 is not expected to make the U.S. fully independent, the exceptions being those relatively extreme cases. But, on the other hand, the reasonable dependence on imports is not unmanageable. Should such a price persist in the world, a reasonable net demand for OPEC Middle East oil of 3-10 bil. bbls per year would be created, barring the most extreme cases.

If the minimum price is set above \$6, it will reduce the net demand for imports (or increase the excess supply for export) by about $\frac{1}{3}$ bil. bbls per year for each \$1 incremental increase in price. The usefulness of a very high minimum price can be questioned, since at lower prices \$1 incremental price increase reduces net demand for oil by 1 to 2 bil. bbls per year. Hence, a policy approach aimed at the \$6-7 range of the price scale promises to be more efficient.

At this price oil-substitute development programs are unprofitable; they could be implemented only if government subsidy is secured. However, it may be worthwhile to encourage some development of oil substitutes, in spite of their higher economic cost, in order to provide some "insurance" against unexpected deviations from the forecasted pattern of future oil demands and supply. This would increase the probability for

earlier technological improvements in the production of oil substitutes should the world price increase. If affected on a relatively minor scale ($\frac{1}{4}$ to $\frac{1}{2}$ bil. bbls per year), the total annual subsidy of \$3 per barrel would not constitute an excessive burden on the economy. All research and development of technologies to produce oil substitutes should be encouraged and financed by the government. It should be considered as a long-term investment designed to assure a continuous flow of energy supply in the long term at the lowest possible social cost.

Now that we have derived estimates of supply and demand for oil, for the world and for the U.S., we turn to discuss the market competitive structure. On the basis of these data and structure we shall derive estimates of future oil prices, under various market scenarios.

Chapter III

THE OIL MARKET STRUCTURE

In this chapter we discuss the market structures of the oil market and its implications to the setting of oil prices.

A. Classification of Market Structures

a) Competitive Market

In a competitive market each producer behaves as if he is a price taker and therefore adjusts his output to the current price. Each consumer behaves under the same assumption. There is no agreement either among producers or among consumers or among producers and consumers as to price setting. In this case the market price will be determined by the intersection of the supply and demand curves.

b) Oligopoly

Under an oligopolistic structure, a great share of the production is done by a small number of producers each one of which is relatively large. These big producers may also organize as cartels and thus become a monopoly.

c) Oligopoly with Price Leadership

Under this structure one of the members of the oligopoly is the price leader who sets the prices. It achieves its unique standing either because it is the biggest producer with a size equal, say, to all other producers together, or due to its lower production cost.

d) Oligopoly vs. Oligopsony

This is a structure where there is a small number of producers and against them a small number of consumers. This may happen when each consuming country centralizes its oil purchases. A number of countries can organize in a "consumer cartel."

B. Main Factors in the Oil Market

Neither of the above models describes correctly the complex oil market. Yet the oil market has characteristics of some of the above structure. It is clearly not a free competitive market. It has a

number of big producers (like the big corporations in the past and like the big producing countries at present) and thus has oligopolistic characteristics. Some of the countries may become price leaders and above all some major producers are organized in a cartel, OPEC (Organization of Petroleum Exporting Countries).

Some of the consumers are organized as an oligopsony through the concentration of their purchasing by government, national bodies. The governments of the consuming countries can exercise power on markets by a system of tariffs and subsidies.

In order to understand in a more precise manner the oil market structure, let us review each of the main factors in this market.

1. The Production and Consumption Patterns

Table 18 shows the overall production and consumption pattern in the oil market. The main characteristics revealed in the table are:

- 1) A small group of countries (the OPEC group) produce 55 percent of the total world output. Their exports constitute 96 percent of the total international oil trade.
- 2) A small group of countries are pure consumers. These include Western Europe and Japan. Their total imports constitute 64 percent of the total international oil trade.
- 3) The U.S. is the largest consumer, that produces only 63 percent of its own consumption. Its imports constitute close to 19 percent of total world trade.
- 4) The developing countries are net importers of 12 percent of the total world trade.
- 5) Canada, the communist countries and the rest of the world are self-sufficient, with minor insignificant surpluses or deficits.

Thus the main "participants" in the world oil market are OPEC producing countries, the big pure importing countries, and the U.S.A.

TABLE 13
WORLD PRODUCTION AND CONSUMPTION OF OIL 1973

(millions of barrels)

	Production		%	Consumption		%	Net Exports		%	Net Imports		%
	Millions	%		Millions	%		Millions	%		Millions	%	
OPEC - Middle East	7,630	37	460	2	7,170	64	-	-	-	-	-	
OPEC - Non-Middle East	3,720	18	70	-	3,650	32	-	-	-	-	-	
Total OPEC	11,350	55	530	2	10,820	96	-	-	-	-	-	
U.S.A.	3,780	18	5,950	29	-	-	2,170	19	-	-	-	
Western Europe	170	1	5,460	26	-	-	5,290	47	-	-	-	
Japan	-	-	1,950	10	-	-	1,950	17	-	-	-	
Canada	740	4	600	3	140	1	-	-	-	-	-	
Communist Countries	3,490	17	3,170	15	320	2	-	-	-	-	-	
Developing Countries	980	4	2,290	11	-	-	1,310	12	-	-	-	
Rest Of The World	200	1	240	1	-	-	40	-	-	-	-	
Increase in Inventories	-	-	520	3	-	-	520	5	-	-	-	
Total	20,710	100	20,710	100	11,280	100	11,280	100	-	-	100	

2. The OPEC Countries

Table 19 shows the distribution of production among the OPEC countries. The OPEC countries are divided into four groups: (1) the Arab sheikdoms (the "S" countries); (2) other Arab countries (Libya and Iraq--the "LQ" countries); (3) Iran; (4) non-Middle East countries. Groups (1) and (2) together constitute OAPEC (Organization of Arab Petroleum Exporting Countries). Groups (1), (2), (3) together will be referred to as the Middle Eastern OPEC countries. The relative importance and power in the oil market for each country depends on its share in total output and on its potential output as indicated by the size of its proved reserves. The Arab sheikdoms are by far the most important oil producers. In 1973 they provided 42 percent of total OPEC output and controlled 55 percent of its reserves. Saudi Arabia is the most significant with 23 percent of OPEC output and one-third of its total reserves. The OAPEC provide 56 percent of total output and have 70 percent of total reserves. Iran is second to Saudi Arabia in terms of output, 19 percent, but lagging in terms of reserves (one-sixth).

All the Middle Eastern members together provide 74 percent of total OPEC output and possess close to 85 percent of its total reserves.

As we have seen, the OPEC countries export 96 percent of the total world import of oil. This makes it possible for OPEC to become a very strong monopoly in the world oil market. In order to achieve monopoly power, OPEC must be tightly organized as a cartel. Despite its successful actions in the recent past, it is hard to conceive of OPEC as a tight, stable cartel. Internal conflicts among the countries limit its stability. It is more appropriate to describe OPEC as an oligopoly in

TABLE 19

OPEC OIL PRODUCTION 1973

	Quantity (Millions Of Barrels)	% Of OPEC	% Of Middle East
Saudi Arabia	2,660	23	32
Kuwait	1,010	9	12
Abu Dhabi	460	4	5
Qatar	200	2	2
Other Sheikdoms	450	4	5
Total S. Group	4,780	42	56
Iran	2,140	19	26
Libya	770	7	9
Iraq	710	6	9
Total LQ Group	1,480	13	18
Total Middle East (S., Iran, Iraq)	8,400	74	100
Nigeria	730	6	
Algeria	370	3	
Indonesia	470	4	
Venezuela	1,310	12	
Ecuador	70	1	
Total Non-Middle East	2,950	26	
Total OPEC	11,350	100	

Source: BP Statistical Review of the World Oil Industry, 1973.

which two major producers, Saudi Arabia and Iran, compete for price leadership; OPEC constitutes a framework sometimes operating as an effective cartel (as in the 1973-74 crisis) and sometimes a mere window-dressing to the real two-leader struggle. In this situation three scenarios may emerge.

- 1) OPEC operates as a tight cartel, where Saudi Arabia and Iran compromise on OPEC policy
- 2) Saudi Arabia becomes the price leader, with OPEC either officially dissolves, or remains as a mere formal, insignificant framework
- 3) Iran becomes the price leader

In the following discussion we shall not discuss scenario (3), because we regard it as highly improbable. Scenario (1) will be analyzed as a case of monopoly and scenario (2) as a case of oligopoly with price leadership by Saudi Arabia.

3. The U.S.

The U.S. currently consumes 29 percent of the world oil output. Of this consumption, 63 percent is produced and 37 percent is imported. In 1973 this import constituted 19 percent of total world imports, the highest of any country. Moreover, this import has been increasing fast in the recent years due to increased oil deficiency as indicated from Table 20.

This "oil gap" which was retained quite constant at a one-billion-barrel level during the mid-1960's. However, after 1967 it has been increasing fast as the table indicates. Due to the high U.S. consumption level a relatively modest increase in U.S. consumption with stable, and even somewhat declining output, strongly effected the world market.

TABLE 20

U.S. OIL PRODUCTION AND CONSUMPTION

	Production	Consumption	Deficiency	Def/Con (%)
1963	2,730	3,745	1,015	27
1967	3,197	4,351	1,154	27
1970	3,497	5,074	1,577	31
1973	3,329	5,950	2,619	44

Source: BP, 1973, op. cit.

The U.S. has potential resources for increasing its oil output. As we have seen, the cost of producing from these sources varies between \$4 and \$9 per barrel. At the market prices prevailing before October 1973 there was no encouragement to develop these sources. At the high price of \$8 to \$10 there is a great incentive to develop the new sources. However, uncertainty as to the continuation of the high prices may bar development. To diminish this uncertainty the U.S. government can follow either a policy of administrative support to reach independence (Project Independence), or a policy of assuring a minimum market price by protective tariff, or a combination of both. We shall discuss these policy measures below.

4. Western Europe and Japan

These countries put together are the main importers and consumers of OPEC oil. They have not manifested in the past controlling power in a monopsonistic sense. They may, however, organize yet as purchasing cartels in subgroups or in a single group, with or without the U.S.

5. The Oil Companies

The major oil corporations might also be considered as an oligopoly. The "seven big sisters" (Exxon, Texaco, Gulf, Mobil, Standard Oil of California, British Petroleum and Royal Dutch Shell) control the production of the major part of the Western World output. In the pre-OPEC period this description of oligopoly would have been proper. With OPEC governments taking control of the market and becoming the most significant factor, the impact of the big corporations as an independent market control center has much diminished. This became particularly noticeable

HI-2239-RR

in the period of the 1973 oil embargo when the U.S. oil companies were made to participate (at least officially) in the embargo on their own country.

C. The Oil Market in the 1950s and 1960s

In the 1950s and 1960s the major oil corporations were the most influential bodies in the world market. OPEC was not in existence until 1960 and was not significant until 1970. The oil price policy was thus managed primarily by the major oil corporations.

During this period, the real level of oil prices was declining. In 1948 the price per barrel of Middle East oil was about \$2. In 1967, the effective price was \$1.30 per barrel. Taking into account the world inflation, this 1967 price was about one-third of the 1948 one. This decline in oil prices and its maintenance at low levels until the late 1960s was not a result of free competitive market structure. Already in 1950 the OPEC countries supplied 23 percent of the world oil output and this increased to 28 percent as of 1960 and to 30 percent in 1965. Moreover, the production and marketing of this oil was concentrated in the hands of a few corporations. Thus already at that period it was possible, if not to raise prices at least to retain them at a constant real level. It was by all means possible to avoid the sharp decline in the real price.

Two major consequences resulted from the policy of dampening down the real price of oil. The first is the rapid process by which oil has substituted coal (see above). The second is the discouraging of explorations for new oil reserves, especially in the U.S. And indeed, while in 1949 the U.S. possessed 33 percent of the non-communist world oil reserves,

its share had gradually declined, reaching 7 percent only in 1969, and remaining at this rate ever since. At the same time the Middle East share in the non-communist world oil reserves increased from 33 percent in 1949 to 72 percent in 1969.

As a result of these developments, which were caused by the low price policy, the OPEC countries, and particularly the Middle East ones, reached in the early 1970s a position in which they possessed a monopolistic power on the oil market. An analysis of this situation and the implications for future oil prices are presented in the following chapter.

Chapter IV

FUTURE OIL PRICES

A brief look at the present structure of the oil market indicates the monopolistic power of the OPEC Middle Eastern countries. This constitutes a decisive factor in estimating future oil prices. The second main factor in the world oil market is the U.S.A. which has a great potential to develop oil and other sources of energy. We shall therefore analyze in this chapter the following market scenarios:

1. OPEC

- A. M.E. OPEC countries operate as a cohesive cartel.
- B. M.E. OPEC countries' cartel is broken. The S countries behave as price leaders.

2. U.S.A.

- A. U.S.A. does not exercise its potential power to affect the level of world prices.
- B. U.S.A. determines a domestic minimum price of \$6 per barrel and barrel equivalent.

Thus we have 4 scenarios which constitute the combinations of 1A2A, 1B2A, 1A2B, 1B2B. We shall refer to them as:

- 1A2A: OPEC cartel = OC
- 1B2A: S price leader = SPL
- 1A2B: OPEC cartel + U.S. minimum price = OCUS
- 1B2B: S price leader + U.S. minimum price = SPLUS

A. M.E. OPEC as a Cartel

The cartel operates as a price leader oligopolist. According to this model, it determines its output as if it were a monopolist with regard to the net, residual oil demand which it faces. This net oil demand is the balance between total oil demand and non-Middle East oil supply.

It thus determines its output so as to maximize its profits, within this residual market. The net demand curve for this case is derived schematically in the following diagram.

1. The Demand For Middle East Oil

In the preceding chapters we have made some assumptions with regard to the structure of the demand function for energy and for oil, as well as, the supply function of non-oil energy and of oil.

These assumptions were subject to sensitivity analysis under the following conditions:

Income elasticity of energy demand; .75, 1.00, 1.25
Price elasticity of energy demand: -.10, -.20, -.35
Supply curve of non-oil energy: base, base + 10%, base - 10%
Supply curve of oil: base, base + 10%, base - 10%

This sensitivity analysis provided the following output:

A. Energy demand functions.

We obtained 9 alternative functions, constituting all combinations of the 3 rates of income elasticities times the 3 rates of price elasticities.

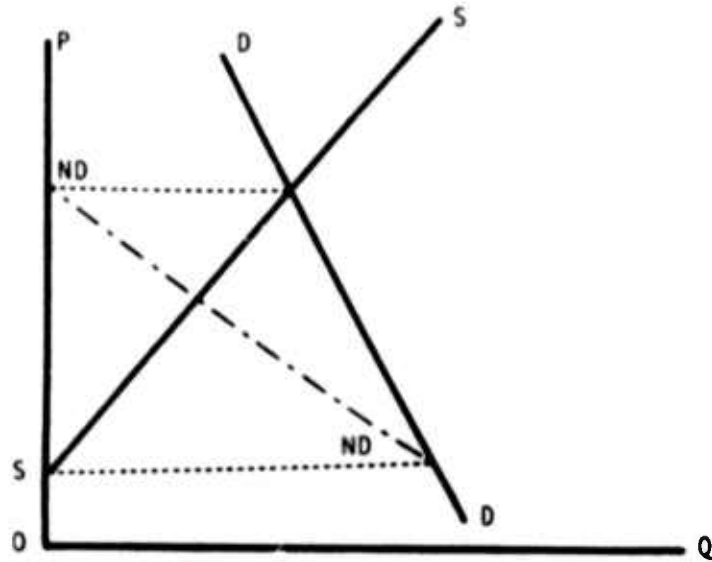
B. Oil demand schedules.

The oil demand schedule is the balance obtained after deducting the non-oil supply from the energy demand. Thus we have altogether 27 oil demand functions (from each of the 9 energy demand, 3 non-oil supply alternative are deducted). These two types of demand schedules were presented in Chapter 2.

C. Net oil demand.

Net oil demand is defined as the balance of oil demand and non-Middle East oil supply. In fact this is the world oil demand from the Mid-Eastern countries.

DIAGRAM 9
OIL DEMAND, OIL SUPPLY AND NET OIL DEMAND



DD = World Oil Demand

SS = Non-Middle East Oil Supply

ND ND = Net Oil Demand for Opec-Mld East Oil

Each of the 3 alternative oil supply was applied to 21 of the 27 oil demand functions (in order to save on uninteresting cases we avoid the combinations of +10 percent on one supply with -10 percent of the other supply). As a result 63 net oil demand schedules were produced.

The following table brings 12 illustrations of these net demand schedules, which represent both the extreme cases and the central ones.

Columns 10 to 12 show cases of extremely high demand for OPEC-Middle East oil. At a low price this demand is excessively high (more than 22 bil. bbls. per year at $P=\$3$); at a price of $\$6$ this demand drops to 13 bil. bbls, and at a price of $\$9$, to 11 bil. bbls. However, this case is very unlikely. The opposite extreme case of excessively low net demand is also very unlikely (columns 7 and 9, especially column 7). Here the demand is high elastic, since from 13.5 bil. bbls. at $P=\$3$ demand falls to zero at a price less than $\$6$. If this case prevailed, the demand for OPEC Middle East oil would disappear in 1980 at $P=\$6$.

Columns 4 to 6 represent a situation closer to the medium range, according to which the expected demand for OPEC oil at $P=\$3$ will lie between 16 and 20 bil. bbls.; at $P=\$6$, between 3 and 9 bil. bbls.; and at $P=\$9$, between zero and 6 bil. bbls. The demand may very well be somewhat greater, as shown in columns 1-3, in which the price elasticity of demand is extremely low.

The demand elasticities for OPEC oil are high because they are derived as a net balance of total demand for energy minus the sum of non-oil and oil supplies. Hence, the elasticity of net demand depends on a weighted sum of the elasticities of overall energy demand and

TABLE 21
 WORLD NET DEMAND FOR MIDDLE EAST OIL 1980
 (billion barrels)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Income Elasticity	1.0	1.0	1.0	1.0	1.0	1.0	0.75	0.75	0.75	1.25	1.25	1.25
Price Elasticity	0.1	0.1	0.1	0.2	0.2	0.2	0.35	0.35	0.35	0.1	0.1	0.1
Non-Oil Supply	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%
Oil Supply	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%
Price												
\$ 3	15.9	18.1	20.3	15.9	18.1	20.3	13.4	15.7	17.9	18.3	20.5	22.8
4	11.6	14.1	16.6	10.6	13.1	15.6	6.8	9.4	11.9	13.9	16.5	19.0
5	6.9	9.8	12.7	5.3	8.2	11.1	0.8	3.7	6.6	9.2	12.1	15.0
6	4.9	8.0	11.0	2.9	6.0	9.0	-	0.9	4.0	7.2	10.3	13.3
7	3.8	6.9	10.0	1.5	4.6	7.7	-	-	2.3	6.1	9.2	12.3
8	2.9	6.1	9.3	0.4	3.6	6.7	-	-	1.0	5.2	8.3	11.5
9	2.2	5.4	8.6	-	2.7	5.9	-	-	-	4.4	7.7	10.9
10	2.0	5.3	8.5	-	2.4	5.7	-	-	-	4.3	7.5	10.6
11	1.9	5.2	8.4	-	2.2	5.5	-	-	-	4.2	7.4	10.6
12	1.8	5.1	8.3	-	2.0	5.3	-	-	-	4.1	7.3	10.5

non-Middle East supply. Thus, all the price elasticities are greater than one, especially at the price ranges below \$9 per barrel.

2. OPEC Price Determination

In this scenario OPEC regards the above demand schedule as a monopolist. It thus sets the price so as to maximize its profits. Taking the cost of production and transportation at \$1.5 per bbl., the maximization of profits actually means maximizing the present value of the net oil revenues derived from the reserves.* This is calculated by the following procedure:

1. Set the annual quantity to be produced.
2. Identify the price associated with this quantity from the net demand curve.
3. Calculate the annual net revenue. $[(P-1.5) \times Q]$.
4. Calculate the number of years, by dividing total reserves over the quantity.
5. Calculate the present value of the annual revenue over the number of years as obtained above.

The results of this procedure will be shown below.

B. S Countries as Price Leaders

The S countries have the capacity to become the sole "price leaders" in the oil market. If they prefer to gain this position, they can make it. They have enough reserves on which to base their price policy, and the high revenues are less essential for them, since they don't have as many domestic opportunities for investments as Iran has. The S countries can become price leaders either with cooperation or without cooperation of Iran and/or the LQ countries. In this case, they will set the price by the following model. They will let Iran and LQ determine their output first, then, after deducting this output from the "net oil demand" curve, they will get their own net demand. With regard to

*Which means: maximizing the present value of the oil reserves.

this demand and market, they will determine their output so as to maximize the net present value of their reserves.

In working some possible outcomes of such a policy, we have made an assumption that Iran and LQ will reach in 1980 a normal output of 5 bil. bbls. We have chosen this figure simply because it constitutes a consensus of several different forecasts (see table).

TABLE 22

NORMAL OUTPUT OF IRAN & LQ COUNTRIES, 1980 (ESTIMATES)
(bil. bbls.)

<u>The Forecast</u>	<u>Iran</u>	<u>Libya</u>	<u>Iraq</u>	<u>Total</u>
Technology Review	2.9	.8	1.4	5.1
Tripartite	3.2	.7	1.1	5.0
Chase	2.8	.8	1.4	5.0

Source: "Projected World Petroleum Demand/Supply Balances," Tetra Tech Inc., Chase Manhattan Bank, July 18, 1974. "Energy Self-Sufficiency, An Economic Evaluation," Technology Review, May, 1974.

The Technology Review and Chase's estimates are almost identical. Despite the Tripartite differs somewhat in the country estimates, its total is also consistent with the others.

Thus the net demand in 1980 for the S countries is simply 5 bil. bbls. less than the demand facing the M.E. OPEC countries put together. The resulting price policy of this scenario will be summarized below.

C. U.S.A. Pricing Policy

The above two market scenarios were made under the assumption that the U.S.A. will not actively intervene in the market. If it does not, it is possible for the OPEC countries to follow a policy of erratic price

fluctuations (around a certain desired mean figure). This will introduce a great uncertainty to the energy business that will discourage and deprive the other countries (and entrepreneurs) from development of their energy sources. As a result, the supply of non-OPEC energy will not reach the levels forecasted in the above supply curves, and the monopolistic power of OPEC will be enhanced.

In order to avoid this development, some certainty with regard to future prices must be introduced. This can be achieved in each importing country simply by fixing a minimum price, below which prices will not go down. The minimum price can be maintained by imposing a protective tariff, adjustable to the world price. Thus if OPEC countries reduce the world market price below this minimum price, any import will be subject to tariff at a rate equal to the appropriate balance.

It is highly inconceivable that all the oil-importing countries will follow this policy. Yet even if the U.S. alone introduces it, it will have a decisive effect on the world prices, merely because the energy supply of the U.S. is the biggest.

Despite it is possible to impose any minimum price, we have chosen only one price for the scenario--\$6 per barrel. We concentrate on this one because it is a turning point at the U.S. energy supply curve. At a lower price this supply curve is elastic, and above this price it is much less so (except net price of \$9 where substitutes are introduced. But as we shall see this is an overshooting).

The introduction of a minimum price policy at \$6 per barrel causes a change in the oil market model we presented above. This change can be incorporated as follows.

Let us look again at the U.S. energy supply curve at price range \$3-\$6 (in bil. bbls.).

Price	Non-Oil Supply	Increase of N.O.S. at Price=\$6	Oil Supply	Increase of O.S. at Price=\$6	Total Increase
3	7.2	2.0	2.5	2.2	4.2
4	8.1	1.1	3.0	1.7	2.8
5	8.7	0.5	4.5	0.2	0.7
6	9.2	0.0	4.7	0.0	0.0

The table shows by how much the U.S. energy supply will increase when the price is \$6 rather than \$3, \$4, and \$5. When the U.S. maintains a minimum price=\$6, the world supply (which includes the U.S.) at lower prices will rise by this increased amount. At prices of \$6 and up, the world supply will not change. As a result the world net oil demand from M.E. OPEC countries will decline by these appropriate amounts, for prices below \$6 and will remain like in the preceding case at prices of \$6 and above. By introducing these changes in the world net demand, we incorporate the impact of the U.S. minimum price policy on the world market.

1. M.E. OPEC as a Cartel, U.S.A. introduces Minimum Price Policy

The analysis of this market scenario is identical to OC scenario. The only difference refers to the demand curve that the cartel faces. In the present case it is smaller than the original one at prices lower than \$6 per barrel, by an amount equal to the increased amount of U.S. supply.

2. S Countries as Price Leaders, U.S. Conducts Minimum Price Policy

Again we have a similar case to the SPL one, where the demand curve of the S countries shifts to the left at prices below \$6 by the increased amount of U.S. supply.

D. The Demand For OPEC Oil

Each of the tables below presents 12 illustrations of the demand schedule for each of the four market scenarios. In each table, columns 1-6 present the more probable "central" type demand schedule. Columns 7-9 present extreme low demand schedules and columns 10-12 extremely high ones. In appendix 3, 63 such demand schedules for each scenario are presented.

An illustration of six of the demand curves is presented in the following set of diagrams. In each diagram four demand schedules are shown for each of the four scenarios. A is the demand curve for OPEC countries and B is the same demand when the U.S. conducts a minimum price policy at \$6. C is the demand for the S countries and D is the same demand with U.S. retaining the minimum \$6 price. All the curves are highly elastic in the lower price range and differ in their elasticity in the higher range. This being effected by the various assumptions with regard to price and income elasticities of total world energy demand and particularly with regard to the various levels of non-oil, energy supply and non-Middle East oil supply.

E. Summary Of The Market Scenarios Outcome

The analysis is made under the assumption that by 1980 the governments of the Middle East will have full control of their oil output and ownership of its related facilities. It is also assumed that their costs of production and transportation of crude oil in 1974 prices will be around \$1.50 per barrel. The most probable price policy for each case is selected by the following procedure.

TABLE 23
 WORLD NET DEMAND FOR MIDDLE EAST OIL 1980
 (billion barrels)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Income Elasticity	1.0	1.0	1.0	1.0	1.0	1.0	0.75	0.75	0.75	1.25	1.25	1.25
Price Elasticity	0.1	0.1	0.1	0.2	0.2	0.2	0.35	0.35	0.35	0.1	0.1	0.1
Non-Oil Supply	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%
Oil Supply	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%
<u>Price</u>												
\$ 3	15.9	18.1	20.3	15.9	18.1	20.3	13.4	15.7	17.9	18.3	20.5	22.8
4	11.6	14.1	16.6	10.6	13.1	15.6	6.8	9.4	11.9	13.9	16.5	19.0
5	6.9	9.8	12.7	5.3	8.2	11.1	0.8	3.7	6.6	9.2	12.1	15.0
6	4.9	8.0	11.0	2.9	6.0	9.0	-	0.9	4.0	7.2	10.3	13.3
7	3.8	6.9	10.0	1.5	4.6	7.7	-	-	2.3	6.1	9.2	12.3
8	2.9	6.1	9.3	0.4	3.6	6.7	-	-	1.0	5.2	8.3	11.5
9	2.2	5.4	8.6	-	2.7	5.9	-	-	-	4.4	7.7	10.9
10	2.0	5.3	8.5	-	2.4	5.7	-	-	-	4.3	7.5	10.8
11	1.9	5.2	8.4	-	2.2	5.5	-	-	-	4.2	7.4	10.6
12	1.8	5.1	8.3	-	2.0	5.3	-	-	-	4.1	7.3	10.5

TABLE 24
 WORLD NET DEMAND FOR MIDDLE EAST OIL WITH U.S. AT \$6, 1980
 (billions of barrels)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Income Elasticity	1.0	1.0	1.0	1.0	1.0	1.0	0.75	0.75	0.75	1.25	1.25	1.25
Price Elasticity	0.1	0.1	0.1	0.2	0.2	0.2	0.35	0.35	0.35	0.1	0.1	0.1
Oil Supply	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%
Oil Supply	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%
Price												
\$ 3	11.7	13.9	16.1	11.7	13.9	16.1	9.2	11.5	13.7	14.1	16.3	18.6
4	8.8	11.3	13.8	7.8	10.3	12.8	4.0	6.6	9.1	11.1	13.7	16.2
5	6.3	9.2	12.1	4.7	7.6	10.5	.2	3.1	6.0	8.6	11.5	14.4
6	4.9	8.0	11.0	2.9	6.0	9.0	-	0.9	4.0	7.2	10.3	13.3
7	3.8	6.9	10.0	1.5	4.6	7.7	-	-	2.3	6.1	9.2	12.3
8	2.9	6.1	9.3	.4	3.6	6.7	-	-	1.0	5.2	8.3	11.5
9	2.2	5.4	8.6	-	2.7	5.9	-	-	-	4.4	7.7	10.9
10	2.0	5.3	8.5	-	2.4	5.7	-	-	-	4.3	7.5	10.8
11	1.9	5.2	8.4	-	2.2	5.5	-	-	-	4.2	7.4	10.6
12	1.8	5.1	8.3	-	2.0	5.3	-	-	-	4.1	7.3	10.5

TABLE 25
WORLD NET DEMAND FOR S COUNTRIES OIL 1980
 (billions of barrels)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Income Elasticity	1.0	1.0	1.0	1.0	1.0	1.0	0.75	0.75	0.75	1.25	1.25	1.25
Price Elasticity	0.1	0.1	0.1	0.2	0.2	0.2	0.35	0.35	0.35	0.1	0.1	0.1
Non-Oil Supply	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%
Oil Supply	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%
<u>Price</u>												
\$ 3	10.9	13.1	15.3	10.9	13.1	15.3	8.4	10.7	12.9	13.3	15.5	17.8
4	6.6	9.1	11.6	5.6	8.1	10.6	1.8	4.4	6.9	8.9	11.5	14.0
5	1.9	4.8	7.7	.3	3.2	6.1	-	-	1.6	4.2	7.1	10.0
6	-	3.0	6.0	-	1.0	4.0	-	-	-	2.2	5.3	8.3
7	-	1.9	5.0	-	-	2.7	-	-	-	1.1	4.2	7.3
8	-	1.1	4.3	-	-	1.7	-	-	-	0.2	3.3	6.5
9	-	.4	3.6	-	-	1.0	-	-	-	-	2.7	5.9
10	-	.3	3.5	-	-	0.7	-	-	-	-	2.5	5.8
11	-	.2	3.4	-	-	0.5	-	-	-	-	2.4	5.6
12	-	.1	3.3	-	-	0.3	-	-	-	-	2.3	5.5

TABLE 26.
WORLD NET DEMAND FOR 5 COUNTRIES OIL WITH U.S. AT \$6, 1980
(billions of barrels)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Income Elasticity	1.0	1.0	1.0	1.0	1.0	1.0	0.75	0.75	0.75	1.25	1.25	1.25
Price Elasticity	0.1	0.1	0.1	0.2	0.2	0.2	0.35	0.35	0.35	0.1	0.1	0.1
Non-Oil Supply	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%
Oil Supply	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%	+10%	Same	-10%
<u>Price</u>												
3	6.7	8.9	11.1	6.7	8.9	11.1	4.2	6.5	8.7	9.1	11.3	13.6
4	3.8	6.3	8.8	2.8	5.3	7.8	-	1.6	4.1	6.1	8.7	11.2
5	1.3	4.2	7.1	-	2.6	5.5	-	-	1.0	3.6	6.5	9.4
6	-	3.0	6.0	-	1.0	4.0	-	-	-	2.2	5.3	8.3
7	-	1.9	5.0	-	-	2.7	-	-	-	1.1	4.2	7.3
8	-	1.1	4.3	-	-	1.7	-	-	-	0.2	3.3	6.5
9	-	.4	3.6	-	-	1.0	-	-	-	-	2.7	5.9
10	-	.3	3.5	-	-	0.7	-	-	-	-	2.5	5.8
11	-	.2	3.4	-	-	0.5	-	-	-	-	2.4	5.6
12	-	.1	3.3	-	-	0.3	-	-	-	-	2.3	5.5

DIAGRAM 10

ENERGY: WORLD DEMAND SCHEDULES
FOR MIDDLE EAST OIL, 1980

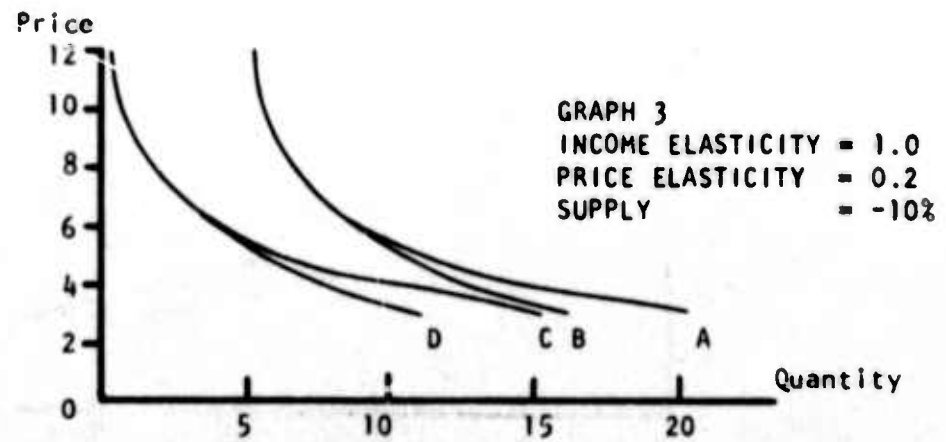
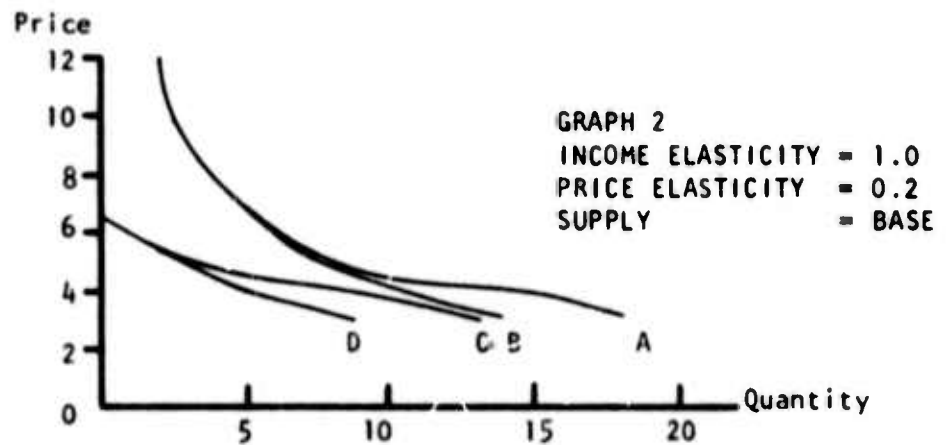
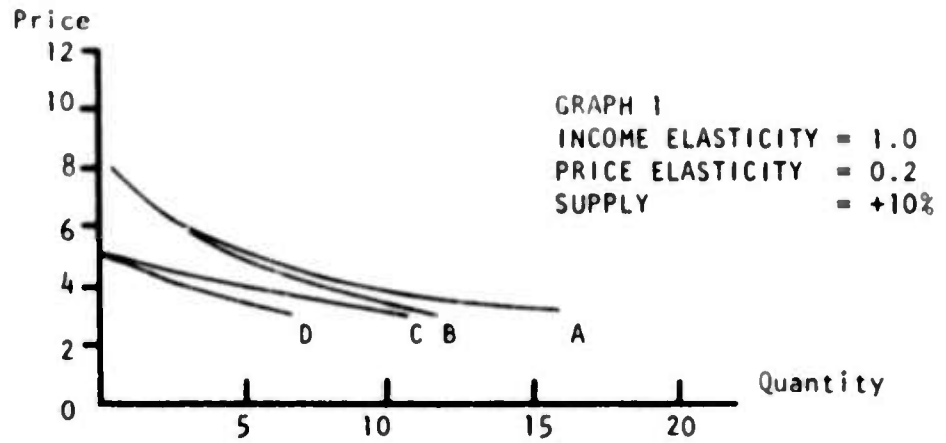
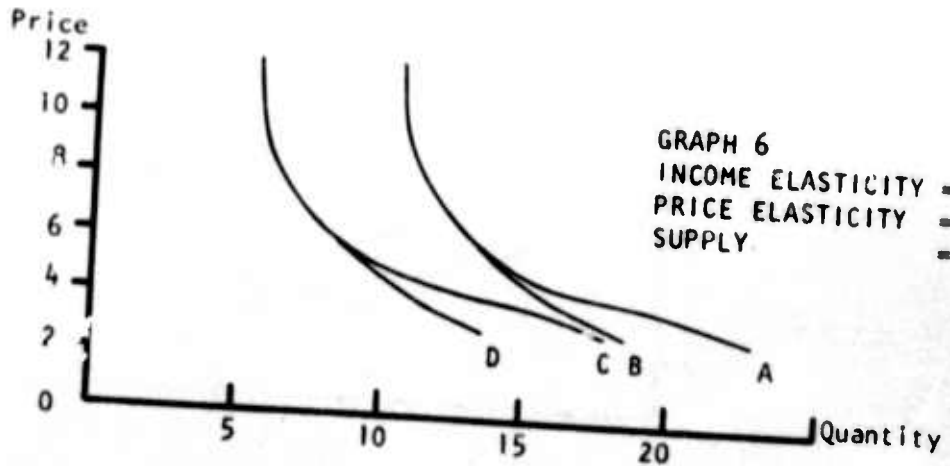
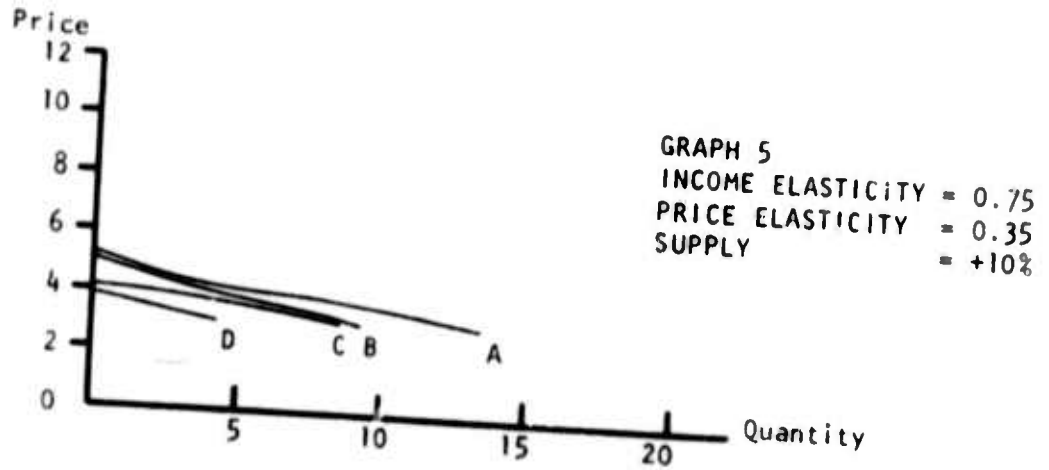
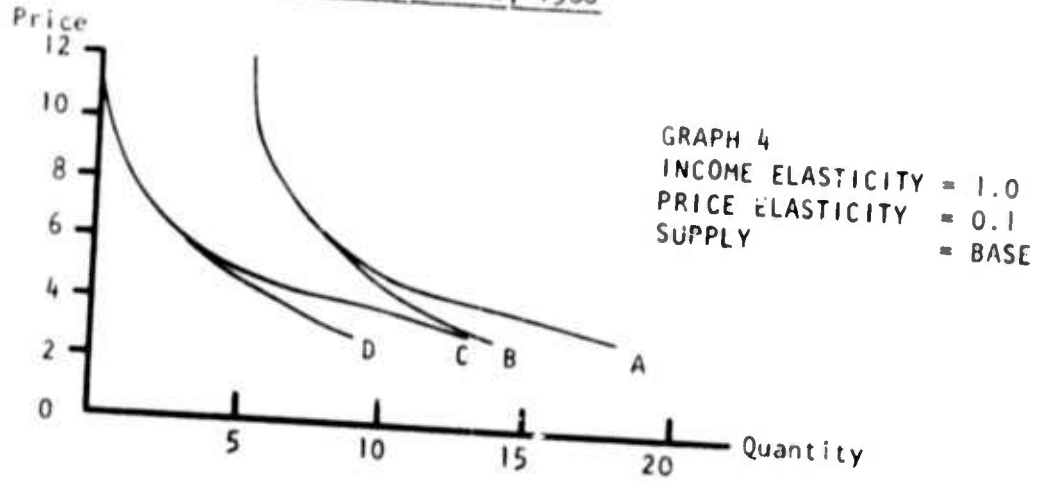


DIAGRAM 11

ENERGY: WORLD DEMAND SCHEDULES
FOR MIDDLE EAST OIL, 1980



For any given demand curve, we calculate first the total net revenue at each price level (after deducting \$1.5 from the price, as production and transportation costs). On the basis of the proven reserves we then calculate the number of years each level of output (and price) can last. We then derive the present value (at 8% discount rate) of these reserves (which is the present value of the flow of the net revenues for that period). The price at which the present value is maximized is the most profitable one.

The following table summarizes the pricing policy which maximizes the present value of reserves under the four market scenarios for 63 sensitivity-analyzed cases. Each case is defined by income (N_y) and price (N_p) elasticities of demand as well as by the level of supply (Normal = 0, 10% lower = -, and 10% higher = +). Each of the scenarios is characterized by 3 figures, the first being the price, the second is annual revenues as of 1980 (in billions of dollars), and the third the number of years of reserves before depletion.

The O.C. column is the OPEC cartel scenario. The SPL column is the scenarios under which the S countries became price leaders. The OCUS column is the OPEC cartel with U.S. minimum price scenario and the SPLUS is the S country price leader scenario with U.S. minimum price. The last two columns of the table represent the estimated annual revenues for the S countries under the OPEC cartel scenario (S/OC), and under this cartel scenario with U.S. minimum price (S/OCUS). Attached to these figures are the following signs:

- + to indicate gain from breaking the cartel
- to indicate loss from breaking the cartel and
- = to indicate indifference.

TABLE 27
 OIL PRICE AND REVENUES FOR VARIOUS MARKET SCENARIOS*

Ny	Np	Sup	O.C.	SPL	OCUS	SPLUS	S/OC	S OCUS
0.75	0.1	--	9,48,54	4,23,24	9,48,54	6,17,60	27-	27-
0.75	0.2	--	8,30,74	4,21,27	8,30,74	4,14,41	17+	17+
0.75	0.35	--	4,30,29	4,17,32	4,23,38	3,13,26	17=	13=
0.75	0.1	-0	9,38,68	4,20,27	9,38,68	5,13,63	22-	22-
0.75	0.2	-0	7,24,80	4,18,30	7,24,80	4,11,49	14+	14-
0.75	0.35	-0	4,27,31	4,15,38	5,17,71	4,8,72	15=	10-
0.75	0.1	0-	9,34,76	4,19,29	9,34,76	5,11,74	19=	19-
0.75	0.2	0-	5,25,49	4,17,33	7,20,92	4,10,57	14+	11-
0.75	0.35	0-	4,26,33	3,17,19	5,15,80	3,11,31	15+	9+
0.75	0.1	00	4,29,29	4,17,33	8,25,90	4,10,57	17=	14-
0.75	0.2	00	4,27,32	4,14,39	5,19,63	3,10,35	15-	11-
0.75	0.35	00	4,23,36	3,16,21	4,16,52	3,10,35	13+	9+
0.75	0.1	0+	4,27,32	4,14,39	7,18,102	4,7,75	15-	10-
0.75	0.2	0+	4,25,35	4,12,47	4,18,49	4,8,40	14-	10-
0.75	0.35	0+	4,21,41	3,15,23	4,14,61	3,8,40	12+	8=
0.75	0.1	+0	5,20,60	4,13,44	6,17,88	4,6,95	11+	10-
0.75	0.2	+0	4,23,37	4,11,53	4,16,53	3,8,44	13-	9-
0.75	0.35	+0	4,19,44	3,14,24	4,12,69	3,8,44	11+	7+
0.75	0.1	++	4,23,37	3,13,27	4,16,53	3,6,53	13=	9+
0.75	0.2	++	4,21,41	3,13,27	4,14,63	3,6,53	12+	8-
0.75	0.35	++	3,20,25	3,13,27	3,14,37	3,6,53	11+	8-

*For description and detailed explanation - see text.

TABLE 27 (CONT'D)

NY	Np	Sup	O. C.	SPL	OCUS	SPLUS	$\frac{S}{OE}$	$\frac{S}{OCUS}$
1.0	0.1	--	9,65,39	9,27,62	9,65,62	9,27,62	37-	37-
1.0	0.2	--	9,44,57	4,27,21	9,44,57	5,19,41	25+	25-
1.0	0.35	--	4,35,24	4,23,25	5,28,42	4,16,36	20+	16-
1.0	0.1	-0	9,55,47	7,21,60	9,55,47	7,21,60	31-	31-
1.0	0.2	-0	9,34,74	4,10,24	9,34,74	5,15,52	19-	19-
1.0	0.35	-0	4,33,26	4,20,50	5,24,50	4,13,42	19+	14-
1.0	0.1	0-	9,51,50	4,25,22	9,51,50	6,19,53	29-	29-
1.0	0.2	0-	9,31,84	4,23,25	9,31,84	4,16,36	18+	18-
1.0	0.35	0-	5,24,49	4,19,30	5,22,54	4,12,48	14+	13-
1.0	0.1	00	9,41,63	4,23,25	9,41,63	4,16,36	23=	23-
1.0	0.2	00	5,29,42	4,20,28	6,27,57	4,13,42	17+	15-
1.0	0.35	00	4,29,29	4,16,34	4,22,39	3,13,25	17+	13=
1.0	0.1	0+	9,30,84	4,20,28	9,30,84	4,13,42	17+	17-
1.0	0.2	0+	4,30,28	4,18,31	6,21,72	4,11,52	17+	12-
1.0	0.35	0+	4,27,32	4,14,40	4,20,44	3,12,28	15-	11+
1.0	0.1	+0	8,27,81	4,18,30	8,27,81	4,11,48	15+	15-
1.0	0.2	+0	4,29,30	4,16,34	6,19,82	4,9,60	17-	11-
1.0	0.35	+0	4,25,34	3,18,19	4,18,47	3,11,30	14+	10+
1.0	0.1	++	4,29,29	4,16,34	6,22,69	4,5,60	17-	13-
1.0	0.2	++	4,26,32	4,14,40	4,19,44	3,10,34	15-	11-
1.0	0.35	++	4,23,38	3,16,21	4,16,54	3,10,34	13+	9+

TABLE 27 (CONT'D)

NY	Np	Sup	O.C.	SPL	OCUS	SPLUS	S/ME	S6/ME6
1.25	0.1	--	9,101,32	9,54,40	9,101,32	9,54,40	58-	58-
1.25	0.2	--	9,60,42	6,28,36	9,60,42	6,28,36	34-	34-
1.25	0.35	--	6,36,43	4,28,20	6,36,43	4,21,26	21+	21-
1.25	0.1	0	9,72,36	9,34,49	9,72,36	9,34,49	41-	41-
1.25	0.2	-0	9,50,51	5,25,32	9,50,51	6,22,45	29-	29-
1.25	0.35	-0	5,33,36	4,26,22	6,30,51	4,19,30	19+	17+
1.25	0.1	0-	9,68,38	9,30,56	9,68,38	9,30,56	39-	39-
1.25	0.2	0-	9,46,55	5,23,34	9,46,55	6,20,51	26-	26-
1.25	0.35	0-	5,32,38	4,24,23	6,28,55	4,17,32	18+	16+
1.25	0.1	00	9,58,44	6,24,42	9,58,44	6,24,42	33-	33-
1.25	0.2	00	9,36,70	4,26,22	9,36,70	5,17,47	21-	21-
1.25	0.35	00	4,34,25	4,22,25	5,25,47	4,15,37	19+	14+
1.25	0.1	0+	9,47,54	4,26,21	9,47,54	6,18,55	27-	27-
1.25	0.2	0+	7,30,62	4,24,24	7,30,62	4,17,34	17+	17=
1.25	0.35	0+	4,32,27	4,20,29	5,21,56	4,13,45	18+	12+
1.25	0.1	+0	9,44,59	4,25,23	9,44,59	5,17,47	25=	25-
1.25	0.2	+0	5,30,39	4,22,25	6,29,54	4,15,37	17+	17-
1.25	0.35	+0	4,30,28	4,18,31	5,19,62	4,11,51	17+	11=
1.25	0.1	++	9,33,77	4,22,25	9,33,77	4,15,36	19+	19-
1.25	0.2	++	4,32,27	4,20,29	5,24,49	4,13,44	18+	14-
1.25	0.35	++	4,28,30	3,20,17	4,21,40	3,14,25	16+	12+

F. The Revenues

The net revenues of the Middle Eastern countries depend on the income and price elasticities of demand for energy, on the one hand, and on the price elasticities of supply, on the other. At one extreme (high demand, low supply), revenues will reach \$100 billion per year, while at the other extreme, revenues will drop as low as \$20 billion per year. The highest revenue seems highly unlikely; the lower revenue has a somewhat greater, but still low, probability. Revenues between \$25 and \$45 billion per year appear to be most probable. They correspond to many combinations of elasticities of demand and supply, at reasonable levels. In any case, revenues above \$60 billion per year are unlikely.

On the basis of these findings, we have chosen to analyze the accumulation of capital and their four alternatives: \$100 billion/year, \$75 billion/year, \$50 billion/year and \$25 billion/year. As to the revenues before 1980, we have made some adjustments to these figures.

G. Prices

The main factors that determine the level of the expected price are, of course, the elasticities of the demand and supply. Most important is the elasticity of supply. Price will remain high even in most of the cases of relatively low demand with supply rising at the slowest pace. Yet, if supply rises in a normal and fast pace, prices will be much lower, except for the case where demand will rise very sharply.

For the cases of high price, \$9 per barrel was chosen as a representative one. In these cases the price may well be higher. However, above \$9, oil substitutes will be developed faster to provide an increasingly greater supply. In the long run, this limits the price of oil to under \$9.

If the OPEC cartel is broken by the S countries, they will tend to determine much lower prices. In many cases, they will gain from it. In the case of $N_y = 1.25$ $N_p = .2$ and $S = 0$, the OPEC cartel will maximize profit at $P = \$9$ and revenues = \$36 billion/year. The S countries, however, in this case will do somewhat better by cutting price to \$4 and getting total revenues of \$26 billion/year. They will gain from it not only in terms of profits but also politically, since at the lower price Iran's income will be smaller and its rate of economic growth and accumulation of foreign capital will be greatly hampered. This will put the S countries in a much stronger relative position in the Middle East. As a matter of fact, this political consideration makes it worthwhile for the S countries to break the cartel and follow their profit maximizing policy at low prices, even if they lose some profits, as in the case of $N_y = 1.25$ $N_p = 0.2$, $S = -10\%$. In this case, their share in the cartel will give them an annual income of \$34 billion/year, while going on their own will provide them with \$28 billion. Prices will be cut from \$9 to \$6. In this case, their income is lower. Yet, politically they gain. So, even in such a case they may prefer to break the cartel. We have made a sensitivity analysis for different demands and supplies that apply to these scenarios. Out of 63 different cases it was found that the S countries will gain from breaking the cartel in 33 cases, and will lose, in terms of income, in 23 cases, and remain indifferent in 7 cases. These losses are always small and may be worthwhile for the political gains. Thus there is a great incentive for the S countries to break the cartel and reduce the prices. One of the reasons that makes this attractive, in terms of profit lies in the fact that the S country reserves are much larger than the other Middle East countries' reserves.

The introduction of a U.S. minimum price policy doesn't have a direct substantial impact on the OPEC cartel pricing. In only a few cases does it change the optimum price for the cartel, and in most of the cases it drives the cartel prices up, the reason being that at prices lower than \$6, the net dividend for the Middle East oil is smaller. This doesn't mean that the minimum price policy has unfavorable effect. By introducing stability, it reduces the incentive for the cartel to follow a policy of unstable, erratically fluctuating, prices. Such a policy would have impaired the development of energy production in the non-OPEC countries.

In the case where the 5 countries break the cartel, the U.S. minimum price policy has also very little effect on the 5 countries' pricing. In a very few cases these prices will be somewhat lower and sometimes higher. However, it sharply reduces the number of cases in which the 5 countries increase their profits by breaking the cartel. In fact it is reduced to 11 cases only, while in 46 cases they lose from breaking the cartel and in 6 cases they are indifferent. The incentive to break the cartel is reduced when the U.S. follows a minimum price policy. In conclusion, the general pattern of the cartel is to keep prices higher, close to \$9/bbl. On the other hand, if the cartel is broken the 5 countries will determine their price around \$4, and only in seldom cases, it will be \$6.

H. Concluding Comments

We now can conclude the analysis as of this stage as follows:

1. For the sake of assuring a constant flow of energy supply it is essential to prevent the oil prices from falling below \$6 per barrel. This can be secured in the U.S. by minimum price policy assisted by adjustable protective tariffs.

2. The S countries are facing a basic dilemma. If they continue to cooperate with Iran and the other OPEC countries in restricting output and keeping prices at a high level, they may gain somewhat in revenues and also extend the period of the revenues before the present reserves are depleted. However, these "advantages" are highly questionable:

A) In fact, in many cases of the sensitivity analysis the S countries gain in breaking the cartel (though most of these cases occur when the U.S. does not secure minimum price).

B) Extending the period of utilization of presently proven reserves beyond thirty or forty years is subject to great uncertainties. First, prices may fall sharply at the end of this long period due to some unexpected technological breakthroughs. Second, new reserves can be found that will anyway extend the period far into the future.

C) Given the limited absorptive capacity for new investments (see discussion in the next part) the S countries will accumulate large funds which will be invested abroad with a declining marginal productivity and utility. Thus the relative importance of some incremental gains that may be achieved by keeping the OPEC cartel is insignificant.

3. Breaking the cartel on the other hand, entails a number of significant political advantages:

A) It can be traded for political favors from each and every major western country. Only imagination is a limit to the number and kinds of favors the S countries can get if they choose to do so.

B) It will reduce Iran's revenues, thereby hampering its rate of economic growth. It will thereby reduce the potential threat for the S countries from a too powerful neighbor.

C) It will induce Iran to invest almost all its revenues domestically, thereby making the S countries the only ones in the world with large foreign financial investments. It will put the S countries into a unique position in the financial world from which they will be able to gain more than otherwise, both politically and businesswise.

Thus it is not inconceivable that in a one-to-four-year period the S countries will cooperate as one unit and will exercise their power to become price leaders in the oil market (the OPEC cartel) either officially or only in practice, and reduce the oil price to a level between \$4 and \$6 per barrel (in 1974 prices).

PART TWO: ACCUMULATION OF CAPITAL

In the previous part we explored some possible patterns for future oil prices. These provided a basis for estimates of alternative flows of oil revenues for the Middle Eastern oil countries. We are now able to investigate the implications of these revenue flows to the economic development and growth of the Middle Eastern oil countries and to the accumulation of capital in the form of foreign investment. This will be presented in this part. Chapter 5 will lay the assumptions underlying a policy of maximizing domestic investments for economic growth. Chapter 6 describes the model of economic growth and capital accumulation we have used in order to make our projections and it will specify the list of alternatives we have made in the course of sensitivity analysis of the model. Chapter 7 summarizes the main projections of economic growth and foreign capital accumulation, as derived from the model, and compares various alternative magnitudes.

PRECEDING PAGE BLANK NOT FILMED

Chapter V

SETTING PRIORITIES FOR DOMESTIC INVESTMENT

In the first part of this study we have developed some alternative projections of oil revenues that the Middle East oil producing countries may expect to receive from the rest of the world in the next decade. The obvious question is: What will these countries do with these revenues? In order to answer this question we must develop a framework of goals and criteria that underlie these countries' decisions with regard to utilization of the revenues.

On the basis of statements made by leaders of these countries, and of opinions of experts and common knowledge, we assume the following set of goals:

1. to build a strong, nonvulnerable, domestic economy;
2. to increase the domestic standard of living;
3. to increase national security;
4. to maintain and strengthen the power of the current regime;
5. to increase the nation's political power in the world.

A. Consumption

It could be argued that the above goals would be achieved simply by utilizing the revenues to increase current consumption to a maximum level. Indeed, this would maximize the standard of living. But it is quite clear that the other goals are not efficiently fulfilled by such a policy. However, consumption can be increased not only by spending the increased revenues on imported goods and services. Another way to increase consumption is first to invest the revenues at home and abroad

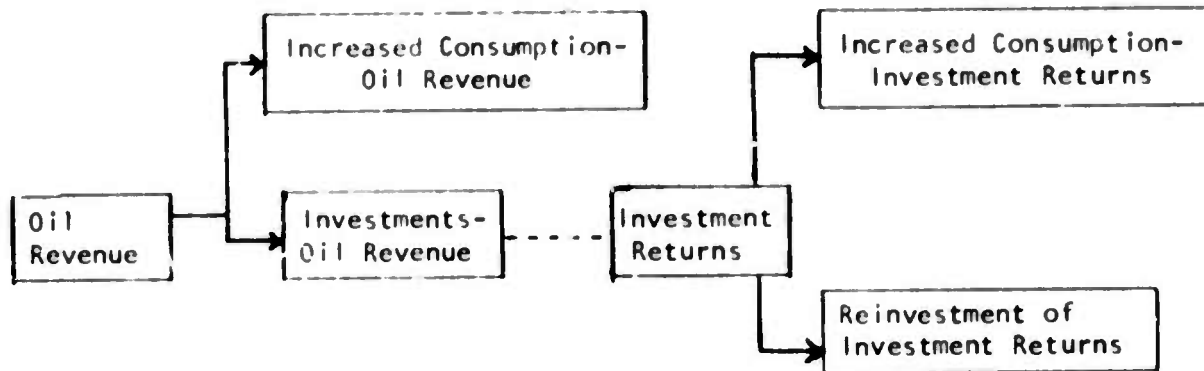
and then use the returns on the investments for consumption. In this way the other goals will be more efficiently met.

These arguments, however, are only theoretical. In practice the increased oil revenues cannot be immediately consumed by the oil-producing countries for a number of reasons that put limits on the rate of the increase in consumption. These reasons are as follows:

1. In many of these countries the population is small relative to the increase in oil revenues. An extraordinary per capita level of consumption would be required to absorb the revenues.
2. A change in any behavior pattern requires time. A Bedouin in a tent is not ready to move directly to a villa.
3. Normally consumption changes as a function of the change in expected future income, much less in terms of current windfalls.
4. The use of outright gifts to the population to induce consumption could undermine the social and economic viability of any country.
5. The oil revenues are expected to flow only for a limited (uncertain) time period. If at least a part of the revenues is not saved and invested, a drastic fall in the level of consumption will occur as soon as the flow of revenues drops.

In view of these limits to increased consumption, the goal of an increased standard of living can reasonably be better met by an investment process that will generate permanent future income rather than by immediate spending on imports of consumption goods and services. The future return on these investments will be utilized partly for increasing the standard of living and partly for further investment and accumulation of capital.

In light of the size of the increase in oil revenues to OPEC countries and the current limits on consumption, it is expected that most of the increased revenues will be invested, while only a small proportion will be immediately consumed. A schematic representation of this process appears below:



B. Domestic Investments vs. Foreign Investments

The first investment policy question refers to the priority with regard to domestic versus foreign investment. The question is simply: Which of the two strategies is more efficient in achieving the set of goals listed above?

1. Building a Strong, Non-vulnerable Domestic Economy. Domestic investments may develop the agriculture and the irrigation system; build an industrial base; provide private and public housing; construct roads, ports, communication systems, and other elements of economic infrastructure; build schools, hospitals, and other social and public institutions; and improve the standard of other services. Foreign investments will merely provide the returns that will finance greater imports. Thus, we can conclude that domestic investment would achieve these goals better than foreign investment would.

2. Increase the Domestic Standard of Living. Both investment strategies will result in increasing the standard of living. It is difficult to determine which strategy, if followed by itself, would achieve

higher levels of productivity and returns that would contribute to the future standard of living. The law of diminishing returns suggests that a mixed strategy, in which the investments would be split between the two, would result in the highest returns and future standard of living.

3. Increase in National Security. Domestic investment strengthens the economic base of the country, thereby increasing the level of national security. Foreign investment, on the other hand, does not have a clear-cut effect on national security. Since foreign investment is subject to political risks of investment confiscation it may have a negative effect on the national security.

4. Maintaining and Strengthening the Power of the Current Regime. Domestic investments have a mixed effect on the stability of the current regime. The short-run prestige of the current regime is enhanced as employment opportunities are created and domestic construction and development attain impressive proportions. In the long run, however, the higher the rate of domestic investment, the larger will be the size of the resulting modern proletariat and intelligentsia within the population, classes that may challenge traditional, less modern regimes. This modernization process can slow somewhat if agriculture and irrigation represent a larger share of domestic investment. Such a course, however, might produce less than satisfactory results with respect to the other goals. Moreover, the capacity of agricultural and irrigation investments is limited. A major domestic investment program cannot avoid industrial development and education expansion. In the long run it may make the current regime more vulnerable.

5. Increasing the Country's Political Power in the World. Both domestic and foreign investment strengthen the country's international political power. Again, it seems that a mixed strategy can maximize it.

The above discussion can be summarized as follows:

- a. Domestic investment is the most efficient policy with regard to goals 1 and 3.
- b. A mixed strategy is the most efficient policy with regard to goals 2 and 5.
- c. With regard to goal 4, it is impossible to determine which strategy is more efficient.

Conclusion: An efficient strategy would be to put a substantial part of the revenues into domestic investments, and a certain balance in foreign investments.

This conclusion should have been more clearly specified if the total revenues were not high enough. In that case the optimum tradeoff between domestic and foreign investment would be reached at a level lower than the absorption capacity of domestic investments. But in fact the revenues in all the alternatives are so high that such a distribution of funds between domestic and foreign investments allocates an investment in the domestic economy that is greater than the economy can absorb.

It follows, therefore, that the efficient strategy should be to use all productive opportunities for domestic investments and to invest the balance in foreign countries.

This conclusion can be interpreted both in a normative and in a positive sense. In the normative sense it constitutes a guideline for investment strategy. And indeed, this is how it was derived here. In the positive sense, however, it constitutes a hypothesis of expected actual behavior and there are significant indications that this is the actual policy pursued by Iran, Iraq, and Saudi Arabia.

C. Capacity Constraints to Domestic Investments

The absorption capacity of domestic investment mentioned above will determine the magnitude of oil revenues that will be invested in the economies. The factors that determine this constraint are enumerated here:

1. The total labor force is limited in size, particularly in Saudi Arabia and the other 5 countries.
2. The specialized labor force (trained workers and professionals) is limited even in countries with large populations. This constraint can be relaxed by investment in training, but it takes time.
3. A special constraint is the small number of experienced local managers in the specialized labor force. This constraint requires more time to relax compared with other forms of skills.
4. Market constraints exist. It is necessary to develop markets and to develop marketing and distribution channels at home and abroad for any new domestic production.
5. The infrastructure of roads, communication, schools, hospitals, etc., is lacking. By making early investments in these, this constraint can be relaxed.

Many of the above constraints can be relaxed by cooperation with foreign corporations in joint ventures. The ideal pattern of cooperation from the point of view of the countries involved would be for the local country to provide the capital and most of the labor force and for the foreign corporations to provide the technology, foreign markets and marketing and distribution channels, and a small amount of entrepreneurship, managerial skills, and skilled labor.

On balance there will remain major constraints on domestic investment, particularly on labor force and economic infrastructure that can not be solved overnight by joint ventures. Internal investment will involve significant time lags. Entrepreneurship will present no real

problem. The countries are awash with their own and foreign suggestions for projects. In light of the constraints, projects can be expected to be capital-intensive because of the relative supply of capital to labor and the resulting low opportunity cost of capital. A large investment in education has priority together with other investments in the economic infrastructure.

Chapter VITHE FRAMEWORK OF ECONOMIC
GROWTH AND FOREIGN CAPITAL ACCUMULATION

The purpose of the chapter is to set the framework in which we make our projections and to specify the assumptions that underlie the input of the formal model, which incorporates the process of domestic investments economic growth and capital accumulation by the Middle East oil producing countries.

A. The Model

The accumulation of foreign investments comes from the surplus of total resources that form the Gross National Income (GNI) over the domestic uses of these resources. The formal structure will be as follows:

1. The Resources

$$(1) \text{GNI}_t = \text{GDP}_t + A_t + rk_t$$

where t denotes the year; A is the total revenue from oil (in royalties, taxes, and other forms); K is the accumulated stock of foreign investments, i.e., the total capital invested abroad; r is the average rate of return on the foreign capital; GDP is the Gross Domestic Product. The GDP includes part of the value added of the oil production industry which is not in the form of revenues paid to the government; GNI is the Gross National Income, i.e., national income and depreciation.

2. The Uses

$$(2) \text{GNP}_t = C_t + I_t + \text{OSP}_t + X_t - M_t$$

C is total consumption, private and public; I is total domestic investment, private and public; OSP is "other spending", i.e. spending "linked" to other uses such as "conspicuous" consumption and non-productive investments, military expenditures, and etc.; X is total exports, i.e., export of oil (including revenues paid to the government) plus exports of all other goods and services; and M is total imports.

Equation (1) can be interpreted as the total resources available to the economy. Equation (2) is the composition of the uses of the above resources. $X - M$ can be interpreted as the net investment in foreign countries.

3. The Foreign Investments

Since GNI and GNP are equal by definition, the identity in equation (3) is established from equation (1) and (2) :

$$(3) \quad GDP_t + A_t + rk_t - C_t - I_t - JSP_t = X_t - M_t$$

Equation (3) can be interpreted in two ways: (a) net investment in foreign countries, i.e., the annual net increment to the total foreign capital; or (b) the surplus of total income from all sources over the domestic uses.

We shall denote either interpretation by the terms NS_t for "net surplus". NS_t constitutes the foreign investments in year t. We also define the term surplus (S_t) as: $S_t = NS_t + OSP_t$. Thus S_t is the surplus before the non-productive spending. It is the maximum surplus that could be invested abroad if conspicuous spending is fully avoided.

4. Foreign Capital Accumulation

The process of accumulating financial capital over time thus has the following pattern:

$$(4) K_{t+1} = k_t + NS_t - OSP_t$$

This process of financial capital accumulation is different from the traditional way by which such accumulation is described in many publications, where it is simply presented as the accumulation of oil revenues, i.e., the sum total of A_t . It may very well happen that with large domestic capital investment and "other spending", the accumulation of capital will be positive only for a certain period of time and then becomes negative. Above all, one should not disregard the return on this capital, which is another source of income and of a further accumulation of capital.

In order to present alternative possibilities of economic growth and foreign capital accumulation computer programming techniques were applied to the above model and a large number of runs were made under various combinations of assumptions with regard to each of the above variables. These runs incorporate data for the following countries: Iran, Libya, Iraq, Saudi Arabia, Kuwait and the other Arab sheikdoms.

5. Net Import

Net import is a balance between the GDP and the total domestic uses. It is calculated as follows:

$$(9) NM_t = GDP_t - C_t - I_t - OSP_t$$

It provides an estimate of the net effect of the oil revenue on international trade. Since it indicates the increase of the net export from the oil-importing countries to the oil-producing ones, it constitutes a quantitative estimate for evaluating the oil revenue effect on the real economic sectors of the oil-importing countries.

B. The Assumptions

1. Oil Revenues

Four alternative flows of oil revenues are hypothesized. They are all based on the estimates of future oil prices and revenues from the market analysis of Part I. These revenues vary between the lower figure of \$25 billion per year and an upper figure of \$100 billion per year, all for the year 1980. On the basis of these findings we have constructed four alternative flows of oil revenues from 1975 to 1985. With regard to the 1980's, these revenues have respectively flows of \$100, \$75 and \$50 billion per year. For the years preceding 1980 we have adjusted the four alternatives to different assumptions. Thus, alternative A₁ assumes that revenues will rise gradually from \$70 billion in 1974 until they reach \$100 in 1975. Alternative A₂ assumes a constant flow of \$75 billion. Alternative A₃ assumes a reduction in prices in the next few years and a continuous increase in output during the whole period. Assumption A₄ assumes a price fall by 1976 and a constant low revenue flow afterward. The four alternative flows of revenue appear in Table 27. The distribution of the revenues among the countries is kept constant over the period on the basis of the early 1970's proportion. That means that Saudi Arabia and the other sheikdoms ("S" country group) will have 57 percent of the total oil revenues, Iran 25 percent and Iraq and Libya ("LQ" country group) 18 percent. The resulting flows, for selective years appear in Table 28.

TABLE 27

OIL REVENUES 1972-1985 ALTERNATIVE ASSUMPTIONS (\$106)

Year	A ₁	A ₂	A ₃	A ₄
1972	10,220	10,220	10,220	10,220
1973	16,000	16,000	16,000	16,000
1974	70,000	75,000	60,000	60,000
1975	80,000	75,000	50,000	40,000
1976	90,000	75,000	40,000	25,000
1977	100,000	75,000	30,000	25,000
1978	100,000	75,000	30,000	25,000
1979	100,000	75,000	30,000	25,000
1980	100,000	75,000	40,000	25,000
1981	100,000	75,000	40,000	25,000
1982	100,000	75,000	40,000	25,000
1983	100,000	75,000	50,000	25,000
1984	100,000	75,000	50,000	25,000
1985	100,000	75,000	50,000	25,000

TABLE 28

OIL REVENUES BY GROUP COUNTRIES, 1972-1985 (SELECTED YEARS)
(millions of dollars)

S	A ₁	A ₂	A ₃	A ₄
1972	5,373	5,373	5,373	5,373
1974	39,900	42,750	34,200	34,200
1980	57,000	42,750	22,800	14,250
1985	57,000	42,750	28,500	14,250
<u>LQ</u>				
1972	2,507	2,507	2,507	2,507
1974	12,600	13,500	10,800	10,300
1980	18,000	13,500	7,200	4,500
1985	18,000	13,500	9,000	4,500
<u>Iran</u>				
1972	2,423	2,423	2,423	2,423
1974	17,500	18,750	15,000	15,000
1980	25,000	18,750	10,000	6,250
1985	25,000	18,750	12,500	6,250

2. Return on Capital

It is assumed that the average return on capital will be 8 percent a year; sensitivity analysis was made for 6 percent and 10 percent.

3. Investments and Gross Domestic Product

The rate of growth of GDP depends on the rate of growth of labor and capital as well as the rate of productivity increase. Assuming an aggregate Cobb-Douglas production function with constant returns to scale, we have the following growth relationship:

$$(5) \frac{GDP_{t+1} - GDP_t}{GDP_t} = \alpha \frac{I_t}{PC_t} + (1-\alpha) \frac{\Delta L_t}{L_t} + PR_t$$

Where: PC = total productive capital in the economy

L = rate of productivity increase

α = output elasticity of capital

$1-\alpha$ = output elasticity of labor

Thus equation (5) simply states that the GDP rate of growth is an average of the rates of growth of capital and labor weighted by their output elasticity, plus the rate of productivity increase.

In particular we assumed output elasticities of $1/3$ for capital and $2/3$ for labor. These rates reflect empirical findings in many countries. We also assume a 5 percent annual rate of productivity increase. The average capital output ratio of these countries in 1973 is estimated at 1.8. The ratio between the incremental investments and incremental output is much higher (3 and up). This incremental capital to output ratio results from the structure of the growth model

we are using (see below).

Equation (5) allows us to obtain projections of the rate of growth of GDP as a function of the volume of domestic investment. Taking the annual rate of increase of population at 3 percent and productivity rate at 5 percent (a higher estimate, thus constituting an upper bound on the resulting rate of growth), equation (5) can be rewritten as:

$$(6) \quad \frac{\Delta \text{GDP}_t}{\text{GDP}_t} = \frac{1}{3} \frac{I_t}{K_t} + .07$$

In the subsequent projections we made the following assumptions with regard to this relationship:

Year	Annual Rate of Domestic Capital Formation %	Annual Rate of GDP Growth %
1974-77	21.0	14.0
1978-80	18.0	13.0
1981-85	15.0	12.0
1986-90	12.0	11.0
1991+	10.5	10.5

Steady state growth is achieved after 1990, with both domestic capital and GDP rising at 10.5 percent p.a. This steady state is reached by gradual approximation.

Given the capital/output ratio for the whole economy as of 1975 (1.8), we derive the annual pattern of the domestic investment, as well as the incremental capital/output ratio (the ratio between annual domestic investment and the increase of GDP), as well as the average ratio. The detailed pattern of growth is shown on the following table where the 1973 GDP = 100, and 1973 productive capital stocks = 180.

TABLE 29
THE ECONOMIC GROWTH MODEL

Year	GDP	Productive Capital Stock	Investments	Δ GDP	Incremental Capital/Output Ratio	Average C/O Ratio	Investment GDP	$\frac{\Delta \text{GDP}}{\text{GDP}}$
1973	100.	180.	38.	14.	2.700	1.800	0.378	0.140
1974	114.	218.	46.	16.	2.866	1.911	0.401	0.140
1975	130.	264.	55.	18.	3.042	2.028	0.426	0.140
1976	148.	319.	67.	21.	3.229	2.152	0.425	0.140
1977	169.	385.	81.	24.	3.427	2.285	0.480	0.140
1978	193.	467.	84.	25.	3.357	2.425	0.436	0.130
1979	218.	551.	99.	28.	3.506	2.532	0.456	0.130
1980	246.	650.	117.	32.	3.661	2.644	0.476	0.130
1981	278.	767.	115.	33.	3.451	2.761	0.414	0.120
1982	311.	882.	132.	37.	3.544	2.835	0.425	0.120
1983	348.	1014.	152.	42.	3.639	2.911	0.437	0.120
1984	390.	1167.	175.	47.	3.756	2.989	0.448	0.120
1985	437.	1342.	201.	52.	3.836	3.069	0.460	0.120
1986	490.	1543.	185.	54.	3.438	3.151	0.378	0.110
1987	543.	1787.	207.	60.	3.469	3.180	0.382	0.110
1988	603.	1977.	232.	66.	3.500	3.208	0.385	0.110
1989	670.	2168.	260.	74.	3.532	3.237	0.388	0.110
1990	743.	2428.	291.	82.	3.563	3.266	0.392	0.110
1991	825.	2719.	286.	87.	3.296.	3.296.	0.346	0.105
1992	912.	3005.	315.	96.	3.296	3.296	0.346	0.105
1993	1007.	3320.	349.	106.	3.296	3.296	0.346	0.105

This table summarizes the absorption capacity of the domestic investments as a function of the 1973 GDP (=100). This capacity is limited by the feasible rate of GDP growth, by the technological ratio of capital to output, and by the rate of investments in housing and economic and social infrastructure. Our assumptions aim to provide some "reasonable" rates of economic growth and productivity increase. They are also consistent with "reasonable" incremental capital to output ratios, which turn out to be between 2.7 and 3.8. These ratios are somewhat above the typical rates for the more developed countries.

Another "test" of these assumptions is the resulting ratio of domestic investment to the GDP. We have here a ratio that varies between 35 percent and 48 percent. These rates are by all means upper bound estimates because they are higher than the rates which were found in the most rapidly growing economies (31 percent in Japan from 1950 to 1965; 24 percent in Germany in the same period; 30 percent in Israel from 1950 to 1970).

The growth model was also tested for some alternative rates of growth:

(a) Growth rate smaller by 3 percent for each year, i.e., assuming productivity increase of only 2 percent per annum.

(b) GDP growth rate of 12 percent per year associated with capital formation rate of 15 percent per year. This is simply a slower growth, with the original 5 percent productivity increase.

4. Consumption

Total private and public consumption was assumed to increase from its 1972 and 1973 level on the basis of the following marginal propensities to consume: MPC1 is the incremental consumption as a percentage of increments to the GDP. This was tested at a level of 80 percent and alternatively at a level of 60 percent. MPC2 is the percentage incremental consumption of increments to the oil revenues. This is assumed to be 10 percent. The reason for the low rate of MPC2 lies in the fact that oil revenues are primarily accumulated by governments and governmental agencies and they are not part of the personal income. The governments indeed could increase the public consumption at a higher rate, but they are not expected to do so for reasons discussed above.

Thus, the flow of consumption over time is as follows:

$$(7) C_{t+1} = C_t + MPC1 (GNP_{t+1} - GNP_t) + MPC2 (A_{t+1} - A_t)$$

5. Other Spending

This item refers to non-productive conspicuous spending. It is assumed to depend on the amount of revenues from oil. The higher the current revenues, the weaker a government is in confronting all types of pressure to spend some of the "easy come" money for "easy go" purposes. Moreover, the government itself may be tempted to initiate "monumental" projects which add very little to the growth of GDP but boost the government's prestige. A major item in this section is military spending. We assume, therefore, that a certain percentage of oil reserves will be "leaked" away from the above accumulation process

This percentage is denoted by α so that:

$$(8) \text{OSP}_t = \alpha A_t$$

α was tested for 10 percent and for 20 percent.

C. Summary

The above described model provides alternative projections under alternative sets of assumptions of the following variables.

1. Accumulation of foreign capital by the Middle East OPEC countries.
2. The growth of the GNP.
3. The growth of the GNI.
4. The growth of domestic consumption.
5. The growth of domestic investments.
6. The growth of the net import.

In the following chapter we shall present some of the findings of this model. They will be summarized for the basic assumptions with regard to productivity, growth, consumption, and return on foreign investment. Finally, a short summary of the sensitivity analysis will be presented for the following cases:

1. Marginal propensity to consume decreases from 80 percent to 60 percent.
2. Return in foreign investment rises from 8 percent to 10 percent per annum
3. Rate of growth of gross domestic product is reduced simultaneously with a appropriate reduction in the domestic capital investment.
4. Rate of productivity increase falls from 5 percent to 3 percent a year.

Chapter VII

PROJECTIONS OF FOREIGN CAPITAL ACCUMULATION

A. Introduction

In this chapter we summarize the main findings from the analysis of the model of economic growth described in the previous chapter. We first present the development of the gross domestic product and the gross national income and then we describe the pattern of consumption and domestic investment flows. From this we derive projections of net imports and then we present projections of balance of payments surplus and foreign capital accumulation. We summarize the above findings under the four assumptions of oil revenues. Finally we summarize the sensitivity analysis with regard to the main assumptions underlying the model.

B. Summary of Alternative A1

In this section we present a summary of the main outcome of the model for alternative A1. This constitutes an illustrated framework of the model output and how it can be presented for each set of assumptions.

1. Gross Domestic Product and Gross National Income and Their Uses

The projections of the GDP, GNI and their major uses for consumption, investment and other spending, under the alternative A1 of high oil revenues, appear in the following table.

a) GDP and GNI

The gross domestic product rises at an annual average rate of 13.2% in the aggregate, from \$29 billion in 1972 to \$145 in 1985. The per capita GDP rises from \$566 to \$1920 in that period.

The GNI for the total of the three groups rises from \$40 billion to \$323 billion in the 1972-1985 period at an annual average rate of 17.4%. During the same period the per capita GNI rises from \$782 to \$4281. However, excluding the sudden increase of oil revenues in 1973-74, the rate of growth of GNI from 1975 to 1985 is 9.6% per annum.

More detailed results appear in the following table.

The pattern of growth of the GDP is quite similar in the three country groups. But this is not true of the GNI. Here the S countries' annual rate of growth is smaller than that of Iran (9.0% vs. 11.0%) for the following reason: the oil revenues constitute a greater percentage of GNI in the S countries, and because these revenues grow at a slower rate they reduce the average rate of growth of GNI. On the other hand the GNI/capita is much greater in S than in Iran simply because the oil revenues per capita are significantly greater there.

b) Domestic Uses

The table presents the projections of domestic main uses of consumption, investment and other spending. Consumption increases with the GDP (the marginal propensity to consume is .8) and also is affected by the level of oil revenues (10% of oil revenues are allocated to consumption). While the average annual rate of growth of total consumption is 14.2% and 11.0% per capita, it differs among the various groups. The highest rate of growth in consumption is in the S group where it reaches a level of almost \$2600 per capita in 1985. The lowest rate of growth is in Iran where a level of \$1350 per capita in 1985 is reached. The reason for this substantial difference is twofold: 1) the overall GDP per capita

TABLE 3
 GROSS DOMESTIC PRODUCT, GROSS NATIONAL
 INCOME, AND DOMESTIC USES, 1972-1985, BY COUNTRY GROUPS
 (\$ 10⁶)

S	GNI	GDP	C	I	OSP	TDS	NM	NSURP
1972	13,105	7,252	4,705	1,445	1,075	7,225	-27	5,880
1975	60,205	10,744	11,521	4,458	9,120	25,099	14,355	35,106
1980	99,664	20,326	20,326	9,425	11,400	41,151	20,825	58,512
1985	142,714	36,140	32,978	16,210	11,400	60,588	24,448	82,126
Total Increase	989%	398%	601%					
Annual Increase	20.2%	13.2%	16.2%					
Per Capita:	9.0							
1972	1506	834	541					
1985	11150	2823	2581					
Tot. Increase	640%	239%	377%					
<u>LQ</u>	<u>GNI</u>	<u>GDP</u>	<u>C</u>	<u>I</u>	<u>OSP</u>	<u>TDS</u>	<u>NM</u>	<u>NSURP</u>
1972	10,021	7,354	5,463	1,743	251	7,457	103	2,564
1975	26,615	10,895	9,485	4,606	1,440	15,531	4,636	11,084
1980	45,531	20,611	17,618	9,738	1,800	29,156	8,545	16,374
1985	69,010	36,649	30,448	16,748	1,800	48,996	12,347	20,014
Total Increase	589%	398%	457%					
Annual Increase	17.5%	13.2%	14.1%					
Per Capita:	10.0							
1972	821	603	448					
1985	3855	2047	1701					
Tot. Increase	370%	239%	280%					
<u>LEAP</u>	<u>GNI</u>	<u>GDP</u>	<u>C</u>	<u>I</u>	<u>OSP</u>	<u>TDS</u>	<u>NM</u>	<u>NSURP</u>
1972	17,063	14,480	11,888	3,387	242	15,517	1,037	1,546
1975	42,615	21,453	19,224	9,055	2,030	30,279	8,826	12,336
1980	72,804	40,584	35,039	19,145	2,510	56,674	16,090	16,130
1985	111,475	72,161	60,290	32,927	2,500	95,717	23,557	15,758
Total Increase	553%	398%	407%					
Annual Increase	15.5%	13.2%	13.3%					
Per Capita:	11.0							
1972	559	475	390					
1985	2488	1611	1346					
Tot. Increase	345%	239%	245%					
<u>TOTAL</u>	<u>GNI</u>	<u>GDP</u>	<u>C</u>	<u>I</u>	<u>OSP</u>	<u>TDS</u>	<u>NM</u>	<u>NSURP</u>
1972	40,189	29,086	22,056	6,575	1,568	30,199	1,113	9,990
1975	129,435	43,092	40,230	18,119	12,560	70,909	27,817	60,190
1980	217,999	81,521	72,973	38,308	15,700	126,981	45,460	91,016
1985	323,199	144,950	123,716	65,885	15,700	205,301	60,352	117,898
Total Increase	704%	398%	461%					
Annual Increase	17.4%	13.2%	14.2%					
Per Capita:	9.6							
1972	782	566	429					
1985	4281	1920	1639					
Tot. Increase	447%	239%	282%					

is much smaller in Iran than in the S countries (\$1600 vs. \$2800 in 1985) and 2) the oil revenues per capita are much greater in the S group than in Iran (\$4450 for the S group in 1985 vs \$550 for Iran).

The domestic investment behaves similarly in all cases. Since we assume similar aggregate production functions and identical rates of productivity increase, the ratio of domestic investment to GDP is the same in all these groups. This ratio constitutes 42% in 1975, 47% in 1980, and 45% in 1985. These are very high ratios and should be taken as upper bounds.

Other spending is assumed to constitute 20% of the revenues in the S group and 10% in the other groups. Thus it amounts to about 16% of total oil revenues. This is a mere guess and it can easily be changed without affecting either the consumption and investment patterns or the GDP. Other spending will only affect the accumulation of foreign capital and the total net imports.

2. Net Imports

Due to the effect of the fast growth of domestic investment in accelerating the GDP growth, the total domestic consumption and investment are greater than the total GDP. This gap rises with the increase in the scale of activities, though the ratio of this gap as a percentage of GDP starts to decline after 1980. This gap constitutes net imports by the Mid East countries that can be related to the increased oil revenues. Other spending must be included for these domestic uses, further increasing the net imports. Thus the net imports of the Middle East countries are expected to reach in 1985 a level of \$60 billion. The model projects a

net import level of \$28 billion as of 1975. One should realize that it may not be possible to materialize the projected high level of net imports so quickly. However, this projection is a direct result of the assumptions concerning domestic investment and other spending. Other spending constitutes almost 1/2 of net imports in 1975 and only 25% in 1985. Thus the net imports in 1975 are indeed very sensitive to the level of other spending.

It should be also emphasized that the S group accounts for more than 50% of the net imports in 1975, but its share declines to 40% in 1985. On the other hand Iran accounts for less than one-third of the net imports in 1975, but its share rises to almost 40% in 1985. These different trends result from the fact that other spending in the S group is much greater than in Iran, and since this item depends on oil revenues, which do not rise as fast as other domestic uses, the rate of growth of total uses in Iran is greater than in the S group.

3. The Balance of Payments Surplus

Total domestic spending is smaller than the GNI in every year. The difference in these two quantities appears as a surplus of the balance of payments and it is accumulated in different forms of foreign investment. This surplus, which was \$10 billion in 1972, rises to almost \$60 billion in 1975, and in the case of high oil revenues it will rise to \$90 billion in 1980 and \$120 billion in 1985, despite the fact that the oil revenues are assumed to remain constant as of 1977. The growth of the return on investment and of the GDP are the causes of this increased surplus.

This surplus will accumulate to an aggregate sum of about \$500 billion in 1980-8 and to almost \$1,000 billion in 1985. About 64% of these revenues will be accumulated by the S group. The remaining will be equally distributed between Iran and the LQ group (18% each).

The pattern of the annual accumulation of foreign capital by the three groups under the four alternative levels of revenues is discussed in the following section.

4. Foreign Capital Accumulation

The following table show that foreign capital will be accumulated to a large extent under all four alternative levels of revenues. In alternative A_1 , where the revenues will sharply decline, the projected accumulation for 1980 is \$160 billion and for 1985 more than \$250 billion. One should note a significant pattern with regard to the different groups. As long as the revenues are relatively high each of the three groups accumulates a steady share of the capital. But when the oil revenues are lower, as in alternatives A_3 and A_4 , a crucial change in the accumulated pattern of Iran takes place. Since Iran has the highest domestic investment capital, it appears that at the lower levels Iran will invest domestically all these revenues. In fact, it will have to decrease its domestic investment if the revenues fall to the lowest alternative. Thus under alternatives A_3 and A_4 Iran accumulates relatively insignificant amounts of foreign capital (we assume that the foreign capital accumulation will not fall below \$10 billion), and most of the accumulation is concentrated in the S group. The LQ group is somewhere between the Iran model and the S model. Specifically, under alternative A_3 , the S group will hold 71% of the total capital accumulation. This rate is 83% under alternative A_4 .

Table 3i and diagram i2 summarize the capital accumulation process under the four revenue levels.

TABLE 31

FOREIGN CAPITAL ACCUMULATION UNDER VARYING ASSUMPTIONS 1972-1985
(millions of dollars)

A 1 Year	S	% Of Total k	LQ	% Of Total K	Iran	% Of Total K	Total K	% Of Total K
1972	6000.	0.60	2000.	0.20	2000.	0.20	10000.	1.00
1973	11880.	0.59	4564.	0.23	3546.	0.18	19990.	1.00
1974	18981.	0.63	7072.	0.24	3995.	0.13	30046.	1.00
1975	48265.	0.61	16494.	0.21	14530.	0.18	79289.	1.00
1976	83371.	0.60	27577.	0.20	26866.	0.20	137814.	1.00
1977	124640.	0.60	40325.	0.20	40889.	0.20	205854.	1.00
1978	172411.	0.61	54711.	0.19	56417.	0.20	283538.	1.00
1979	224152.	0.61	70393.	0.19	73475.	0.20	368020.	1.00
1980	279228.	0.61	86491.	0.19	90249.	0.19	455968.	1.00
1981	337740.	0.62	102865.	0.19	106379.	0.19	546983.	1.00
1982	401618.	0.62	121247.	0.19	125173.	0.19	648038.	1.00
1983	469768.	0.62	140222.	0.19	143747.	0.19	753737.	1.00
1984	542388.	0.63	159690.	0.18	161793.	0.19	868115.	1.00
1985	619671.	0.64	179516.	0.18	178928.	0.18	978115.	1.00

A 2 Year	S	% Of Total K	LQ	% Of Total K	Iran	% Of Total K	Total K	% Of Total K
1972	6000.	0.63	2000.	0.23	2000.	0.20	10000.	1.00
1973	11880.	0.59	4564.	0.23	3546.	0.18	19990.	1.00
1974	18981.	0.63	7072.	0.24	3992.	0.13	30046.	1.00
1975	50260.	0.60	17214.	0.21	15530.	0.19	83040.	1.00
1976	83530.	0.60	27635.	0.20	26946.	0.20	138112.	1.00
1977	118827.	0.61	38228.	0.20	37975.	0.19	195030.	1.00
1978	156158.	0.62	48845.	0.19	48270.	0.19	253273.	1.00
1979	196624.	0.62	60458.	0.19	59676.	0.19	316759.	1.00
1980	239523.	0.63	72161.	0.19	70347.	0.18	382031.	1.00
1981	284883.	0.63	83789.	0.19	79884.	0.18	448556.	1.00
1982	334558.	0.63	97945.	0.19	91559.	0.18	523162.	1.00
1983	387368.	0.65	110484.	0.18	102444.	0.17	600296.	1.00
1984	443421.	0.65	123972.	0.18	112186.	0.17	679579.	1.00
1985	502812.	0.66	137342.	0.18	120352.	0.16	760505.	1.00

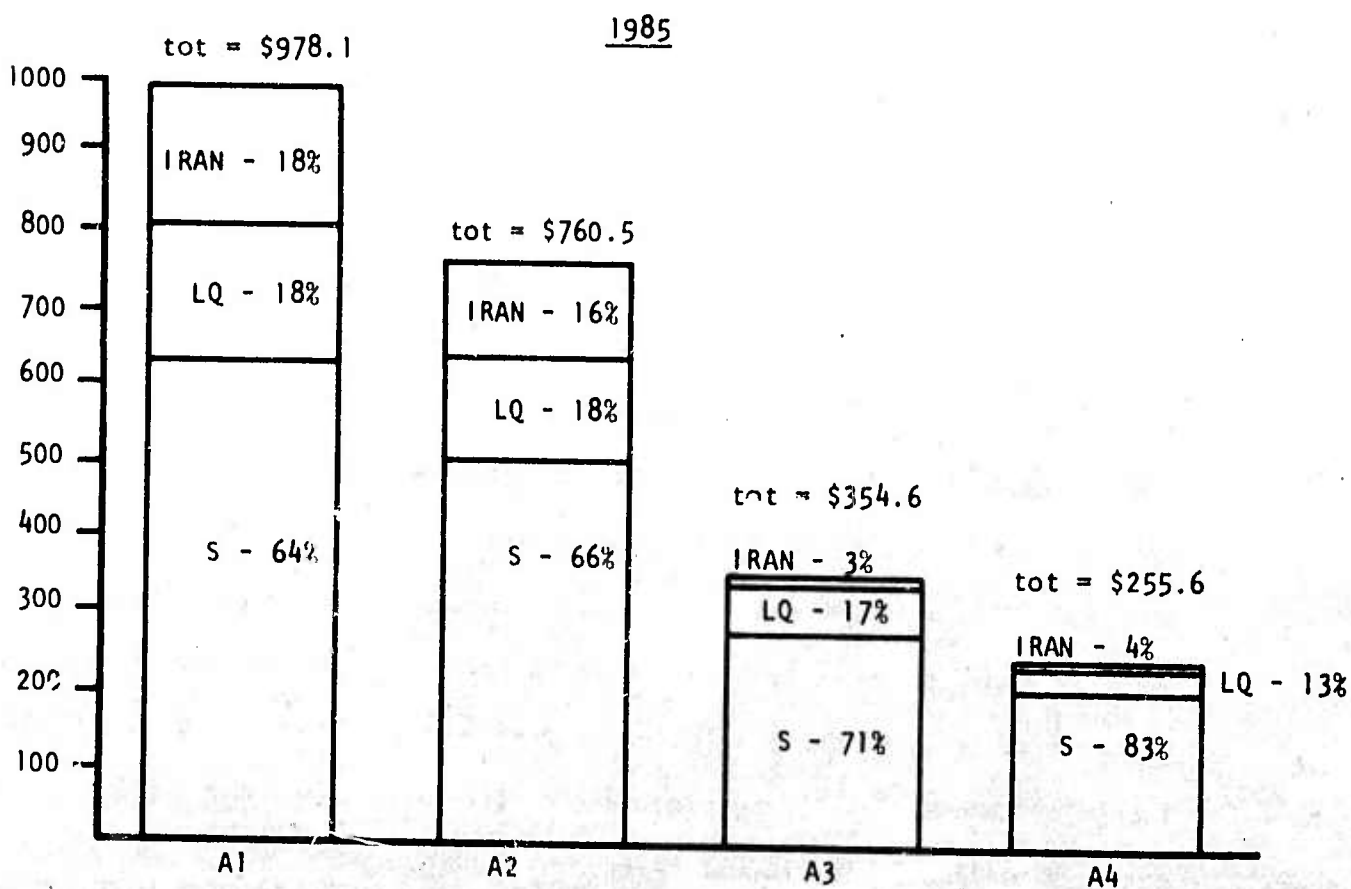
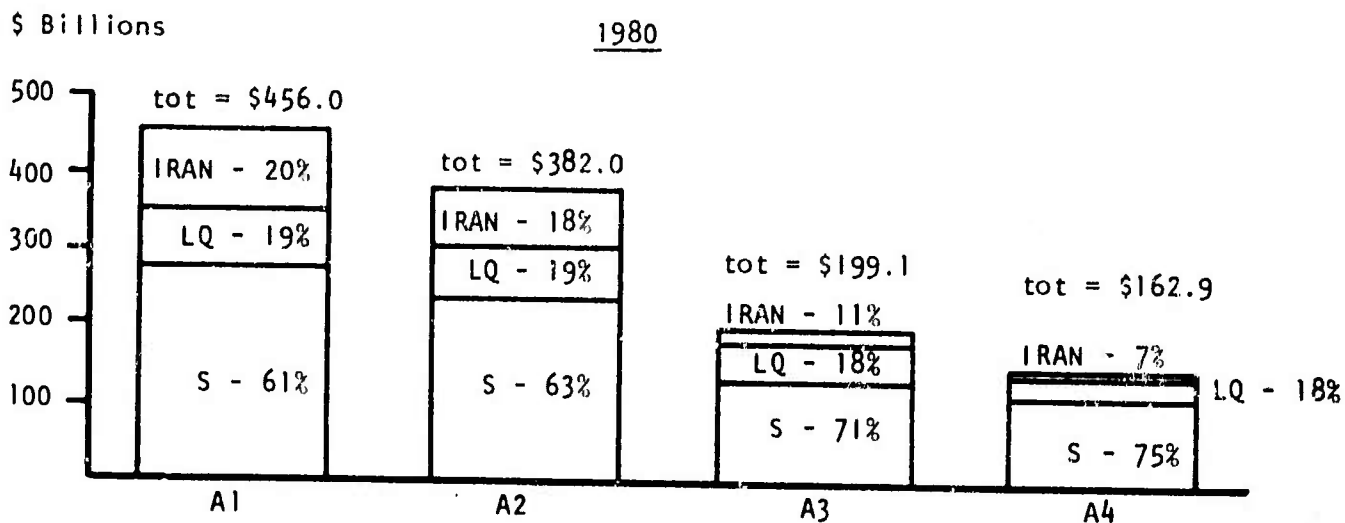
TABLE 3 1 (CONT'D)

A 3	Year	S	% Of Total K	LQ	% Of Total K	Iran	% Of Total K	Total K	% Of Total K
	1972	6000.	0.60	2000.	0.20	2000.	0.20	10000.	1.00
	1973	11880.	0.59	2564.	0.23	3546.	0.18	19990.	1.00
	1974	18981.	0.63	7072.	0.24	3992.	0.13	30046.	1.00
	1975	44275.	0.62	15054.	0.21	12530.	0.17	71859.	1.00
	1976	67092.	0.63	21702.	0.20	18706.	0.17	107500.	1.00
	1977	87109.	0.64	26780.	0.20	22087.	0.16	135965.	1.00
	1978	103947.	0.67	30002.	0.19	22099.	0.14	156048.	1.00
	1979	122281.	0.68	33628.	0.19	22412.	0.13	178320.	1.00
	1980	141277.	0.71	36704.	0.18	21101.	0.11	199082.	1.00
	1981	164813.	0.73.	40455.	0.18	19699.	0.09	224967.	1.00
	1982	190917.	0.74	45205.	0.18	19559.	0.08	255681.	1.00
	1983	218271.	0.76	49457.	0.18	17684.	0.06	285412.	1.00
	1984	250821.	0.78	54463.	0.17	15645.	0.05	320930.	1.00
	1985	284829.	0.80	58672.	0.17	11088.	0.03	354589.	1.00

A 4	Year	S	% Of Total K	LQ	% Of Total K	Iran	% Of Total K	Total K	% Of Total K
	1972	6000.	0.60	2000.	0.20	2000.	0.20	10000.	1.00
	1973	11880.	0.58	4564.	0.23	3546.	0.18	19990.	1.00
	1974	18981.	0.63	7072.	0.24	3992.	0.13	30046.	1.00
	1975	44275.	0.62	15054.	0.21	12530.	0.17	71859.	1.00
	1976	63102.	0.63	20262.	0.20	16706.	0.17	100070.	1.00
	1977	76814.	0.66	23065.	0.20	16916.	0.14	116795.	1.00
	1978	90834.	0.68	25270.	0.19	15526.	0.12	131630.	1.00
	1979	106124.	0.72	27797.	0.18	14313.	0.10	148234.	1.00
	1980	121833.	0.75	29687.	0.18	11355.	0.07	162874.	1.00
	1981	137828.	0.77	30716.	0.17	10427.	0.06	178972.	1.00
	1982	155789.	0.79	32527.	0.16	10713.	0.05	199029.	1.00
	1983	174347.	0.80	33605.	0.15	10273.	0.05	218224.	1.00
	1984	193408.	0.82	33743.	0.14	10469.	0.04	237621.	1.00
	1985	212848.	0.83	32694.	0.13	10032.	0.04	255574.	1.00

DIAGRAM 12

FOREIGN CAPITAL ACCUMULATION - 1980, 1985
BASE ASSUMPTIONS



C. National Income and Product Uses Under Different Revenues

The following four tables duplicate table 35 for the four alternative oil revenues. Some of the findings are summarized in diagrams that follow the tables.

The total gross national income under the four revenue alternatives is shown in Diagram 13.

The gross domestic product for each of the country groups, under alternatives A₁ and A₄ is presented in Diagram 14.

Since oil revenues constitute a substantial part of GNI under the high alternative (A₁), GNI is naturally greatly sensitive to the oil revenues. The greater sensitivity is found of course in the S countries, which have the lowest GDP and the highest revenues. However, GDP is much less sensitive. As a matter of fact, in the S and LQ groups GDP is not sensitive at all. Only in Iran under the lowest revenues (A₄) there is a decline of the rate of GDP from 12% to 11% and 10% p.a. (In A₃ such a decline will start in 1980) This decline results from a more apparent change in the level of domestic investment in Iran which takes place in the case of lower revenues. Thus by 1985 the level of domestic investment is lower by more than 40% than the maximum capacity. This is the reason why the total investment by the three groups amounts in 1985 to \$50 billion in the case of lower revenues, rather than \$65 billion in the cases of higher revenues (see Diagram 15).

The consumption is less sensitive to revenues than investments, but in addition it is slightly affected by the lower level of the GDP in Iran. The total consumption, therefore, reaches \$124 billion in the highest revenues and \$113 billion in the lowest revenues.

TABLE 32 (A1)

GROSS DOMESTIC PRODUCT
GROSS NATIONAL INCOME AND DOMESTIC USES, 1972-1985

S	GNI	GDP	C	I	GSP	TDS	NM
1972	13,105	7,252	4,705	1,445	1,075	7,225	-27
1975	60,205	10,744	11,521	4,458	9,120	25,099	14,355
1980	99,664	20,326	20,326	9,425	11,400	41,151	20,825
1985	142,714	36,140	32,978	16,210	11,400	60,588	24,448
Total Increase	989%	398%	601%				
Annual Increase	20.2%	13.2%	16.2%				
Per Capita:							
1972	9.0						
1985	1506	834	541				
Tot. Increase	11150	2823	2581				
	640%	239%	377%				
<u>LQ</u>	<u>GNI</u>	<u>GDP</u>	<u>C</u>	<u>I</u>	<u>OSP</u>	<u>TDS</u>	<u>NM</u>
1972	10,021	7,354	5,463	1,743	251	7,457	103
1975	26,615	10,895	9,485	4,606	1,440	15,531	4,636
1980	45,531	20,611	17,618	9,738	1,800	29,156	8,545
1985	69,010	36,649	30,448	16,748	1,800	48,996	12,347
Total Increase	589%	398%	457%				
Annual Increase	17.5%	13.2%	14.1%				
Per Capita:							
1972	10.0						
1985	821	603	448				
Tot. Increase	3855	2047	1701				
	370%	239%	280%				
<u>Lran</u>	<u>GNI</u>	<u>GDP</u>	<u>C</u>	<u>I</u>	<u>OSP</u>	<u>TDS</u>	<u>NM</u>
1972	17,063	14,480	11,888	3,387	242	15,517	1,037
1975	42,615	21,453	19,224	9,055	2,000	30,279	8,826
1980	72,804	40,584	35,039	19,145	2,500	56,674	16,090
1985	111,475	72,161	60,290	32,927	2,500	95,717	23,557
Total Increase	553%	398%	407%				
Annual Increase	15.5%	13.2%	13.3%				
Per Capita:							
1972	11.0						
1985	559	475	390				
Tot. Increase	2488	1611	1346				
	345%	239%	245%				
<u>Total</u>	<u>GNI</u>	<u>GDP</u>	<u>C</u>	<u>I</u>	<u>OSP</u>	<u>TDS</u>	<u>NM</u>
1972	40,189	29,086	22,056	6,575	1,568	30,199	1,113
1975	129,435	43,092	40,230	18,119	12,560	70,909	27,817
1980	217,999	81,521	72,973	38,308	15,700	126,981	45,460
1985	323,199	144,950	123,716	65,885	15,700	205,301	60,352
Total Increase	704%	398%	461%				
Annual Increase	17.4%	13.2%	14.2%				
Per Capita:							
1972	9.6						
1985	782	566	429				
Tot. Increase	4281	1920	1639				
	447%	239%	282%				

TABLE 33 (A.1)

GROSS NATIONAL INCOME, GROSS DOMESTIC PRODUCT AND DOMESTIC USES (2)

S	GNI	GDP	C	I	OSP	TDS	NM	NS
1972	13,105	7,252	4,705	1,445	1,075	7,225	-27	5,880
1975	57,515	10,744	11,236	4,458	8,550	24,244	13,500	33,271
1980	82,237	20,326	18,901	9,425	8,550	36,876	16,551	45,361
1985	118,115	36,140	31,553	16,210	8,550	55,313	20,173	62,802
Total Increase	809%	398%	571%					
Annual Increase								
1972-1985	13.5%	13.2%	15.8%					
1975-1985	7.6%							
Per Capita:								
1972	1506	834	541					
1985	9306	2823	2465					
Tot. Increase	518%	238%	356%					
<u>LQ</u>	<u>GNI</u>	<u>GDP</u>	<u>C</u>	<u>I</u>	<u>OSP</u>	<u>TDS</u>	<u>NM</u>	<u>NS</u>
1972	10,021	7,354	5,463	1,743	251	7,457	103	2,564
1975	25,772	10,895	9,395	4,606	1,350	15,351	4,456	10,421
1980	39,084	20,611	17,168	9,738	1,350	28,256	7,645	11,628
1985	61,136	36,699	29,998	16,748	1,350	48,096	11,448	13,040
Total Increase	510%	398%	449%	452%				
Annual Increase								
1972-1985	14.9%	13.2%	14.0%					
1975-1985	10.0%							
Per Capita:								
1972	821	603	448					
1985	3415	2047	1676					
Tot. Increase	316%	239%	274%					
<u>Iran</u>	<u>GNI</u>	<u>GDP</u>	<u>C</u>	<u>I</u>	<u>OSP</u>	<u>TDS</u>	<u>NM</u>	<u>NS</u>
1972	17,063	14,480	11,888	3,387	242	15,517	1,037	1,546
1975	41,445	21,453	19,099	9,055	1,875	30,029	8,576	11,416
1980	64,962	40,584	34,404	19,145	1,875	55,424	10,840	9,538
1985	100,539	72,161	59,665	32,927	1,875	94,467	22,307	6,071
Total Increase	489%	398%	401%					
Annual Increase								
1972-1985	14.6%	13.2%	13.2%					
1975-1985	9.3%							
Per Capita:								
1972	554	475	330					
1985	2244	1611	1332					
Tot. Increase	301%	239%	242%					
<u>Total</u>	<u>GNI</u>	<u>GDP</u>	<u>C</u>	<u>I</u>	<u>OSP</u>	<u>TDS</u>	<u>NM</u>	<u>NS</u>
1972	40,189	29,086	22,056	6,575	1,568	20,199	1,113	9,990
1975	124,732	43,092	39,730	18,119	1,117	69,624	26,532	55,108
1980	807,083	81,521	70,473	38,308	1,175	120,556	39,036	66,527
1985	280,790	144,950	121,216	65,885	1,175	198,876	53,928	81,913
Total Increase	599%	398%	450%					
Annual Increase								
1972-1985	16.3%	13.2%	14.0%					
1975-1985	8.5%							
Per Capita:								
1972	782	566	429					
1985	3719	1920	1606					
Tot. Increase	376%	239%	274%					

TABLE 34 (A3)

GROSS NATIONAL INCOME, GROSS DOMESTIC PRODUCT AND DOMESTIC USES (3)

S	GNI	GDP	C	I	OSP	TDS	NM	NS
1972	13,105	7,252	9,705	1,445	1,075	7,225	-27	5,880
1975	42,736	10,744	9,811	4,458	5,700	19,969	9,225	22,877
1980	54,428	20,326	16,906	9,425	4,560	30,891	10,566	23,536
1985	87,426	36,140	30,128	16,210	5,700	52,038	15,898	35,388
Total Increase	567%	398%	590%					
Annual Increase								
1972-1985	15.7%	13.2%	15.4%					
1975-1985	7.4%							
Per Capita:								
1972	1506	834	541					
1985	6830	2823	2354					
Tot. Increase	354%	239%	335%					
<u>LQ</u>	<u>GNI</u>	<u>GDP</u>	<u>C</u>	<u>I</u>	<u>OSP</u>	<u>TDS</u>	<u>NM</u>	<u>NS</u>
1972	10,021	7,354	5,463	1,743	251	7,457	103	2,564
1975	21,100	10,895	8,945	4,606	900	14,451	3,556	6,648
1980	30,798	20,611	16,538	9,738	720	26,996	6,385	3,751
1985	50,342	36,649	29,548	16,798	900	47,196	10,548	3,146
Total Increase	402%	398%	441%					
Annual Increase								
1972-1985	13.2%	13.2%	13.9%					
1975-1985	9.1%							
Per Capita:								
1972	821	603	448					
1985	2812	2047	1651					
Tot. Increase	243%	239%	269%					
<u>Iran</u>	<u>GNI</u>	<u>GDP</u>	<u>C</u>	<u>I</u>	<u>OSP</u>	<u>TDS</u>	<u>NM</u>	<u>NS</u>
1972	17,063	14,480	11,888	3,387	242	15,517	1,037	1,546
1975	34,955	21,453	18,474	9,055	1,250	28,779	7,326	6,176
1980	52,272	40,584	33,529	19,145	1,000	53,674	13,090	-1402
1985	85,548	72,161	59,090	26,342	1,250	86,632	14,471	-1084
Total Increase	402%	398%	397%					
Annual Increase								
1972-1985	13.2%	13.2%	13.1%					
1975-1985	9.4%							
Per Capita:								
1972	559	475	390					
1985	1909	1611	1318					
Tot. Increase	242%	239%	238%					
<u>Total</u>	<u>GNI</u>	<u>GDP</u>	<u>C</u>	<u>I</u>	<u>OSP</u>	<u>TDS</u>	<u>NM</u>	<u>NS</u>
1972	40,189	29,086	22,056	6,575	1,568	30,199	1,113	940
1975	98,841	43,092	37,230	18,119	7,850	67,199	201,047	35,641
1980	137,448	81,521	66,973	38,308	6,280	11,561	30,041	25,885
1985	223,316	144,950	118,716	59,300	7,850	182,866	40,917	37,450
Total Increase	457%	398%	438%					
Annual Increase								
1972-1985	14.1%	13.2%	13.8%					
1975-1985	8.5%							
Per Capita:								
1972	782	566	429					
1985	2958	1920	1572					
Tot. Increase	278%	239%	266%					

TABLE 35 (A₁)

GROSS NATIONAL INCOME, GROSS DOMESTIC PRODUCT AND DOMESTIC USES (4)

S	GNI	GDP	C	I	JSP	TDS	NM	NS
1972	13,105	7,252	4,705	1,445	1,075	7,225	-27	5,880
1975	37,086	10,744	9,241	4,458	4,560	18,259	7,515	18,827
1980	44,322	20,326	16,051	9,425	2,850	28,326	8,001	15,995
1985	67,418	36,140	28,703	16,210	2,850	47,763	11,623	19,655
Total Increase	414%	398%	510%					
Annual Increase								
1972-1985	13.4%	13.2%	14.9%					
1975-1985	6.2%							
Per Capita:								
1972	1506	834	541					
1985	3463	2823	2242					
Tot. Increase	130%	238%	314%					
<u>LQ</u>	<u>GNI</u>	<u>GDP</u>	<u>C</u>	<u>I</u>	<u>OSP</u>	<u>TDS</u>	<u>NM</u>	<u>NS</u>
1972	10,021	7,354	5,463	1,743	251	7,457	103	2,564
1975	19,300	10,895	8,765	4,606	720	14,091	3,196	5,208
1980	27,486	20,611	16,268	9,738	450	26,456	5,845	1,030
1985	43,764	36,699	29,098	16,748	450	46,296	9,698	-2,532
Total Increase	337%	398%	433%					
Annual Increase								
1972-1985	12.0%	13.2%	13.7%					
1975-1985	8.5%							
Per Capita:								
1972	821	603	448					
1985	2445	2047	1626					
Tot. Increase	198%	239%	263%					
<u>Iran</u>	<u>GNI</u>	<u>GDP</u>	<u>C</u>	<u>I</u>	<u>OSP</u>	<u>TDS</u>	<u>NM</u>	<u>NS</u>
1972	17,063	14,480	11,888	3,387	242	15,517	1,037	1,546
1975	32,955	21,453	18,224	9,055	1,000	28,279	6,826	4,176
1980	47,742	40,584	33,154	14,891	625	48,670	8,086	-927
1985	75,437	68,389	55,394	18,740	625	74,759	6,375	677
Total Increase	342%	372%	366%					
Annual Increase								
1972-1985	12.9%	12.7%	12.6%					
1975-1985	8.8%							
Per Capita:								
1972	559	475	3%					
1985	5893	5343	4328					
Tot. Increase	954%	1025%	1010%					
<u>Total</u>	<u>GNI</u>	<u>GDP</u>	<u>C</u>	<u>I</u>	<u>OSP</u>	<u>TDS</u>	<u>NM</u>	<u>NS</u>
1972	40,189	29,086	22,056	6,575	1,568	30,199	1,113	9,990
1975	88,841	43,092	36,230	18,119	6,280	60,629	17,537	28,211
1980	119,550	81,521	65,473	34,059	3,925	103,452	21,932	16,098
1985	186,619	141,173	113,195	51,698	3,925	168,818	27,696	17,800
Total Increase	364%	385%	413%					
Annual Increase								
1972-1985	12.6%	12.9%	13.4%					
1975-1985	7.7%							
Per Capita:								
1972	782	566	429					
1985	2472	1870	1499					
Tot. Increase	216%	230%	249%					

DIAGRAM 13
GROSS NATIONAL INCOME

GNI Index,
1972 = 100

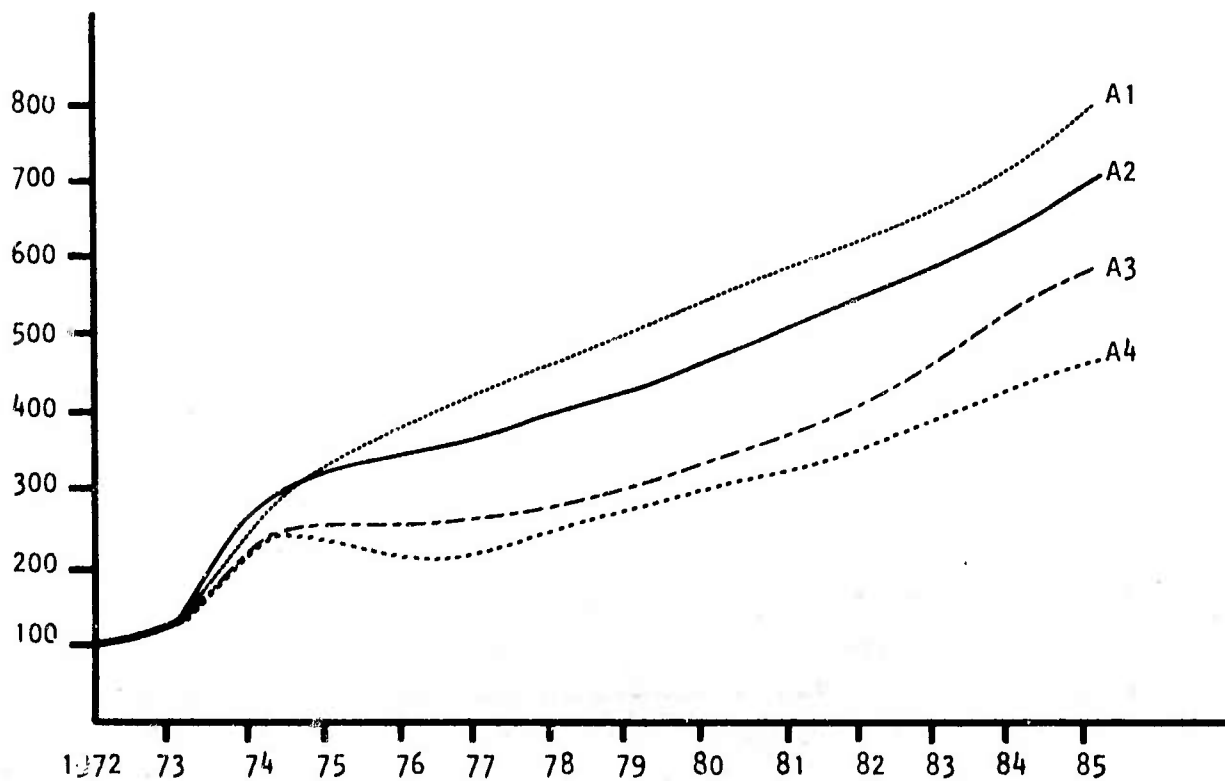


DIAGRAM 14

GROSS DOMESTIC PRODUCT - A1, A4
BASE ASSUMPTIONS

\$ Billions

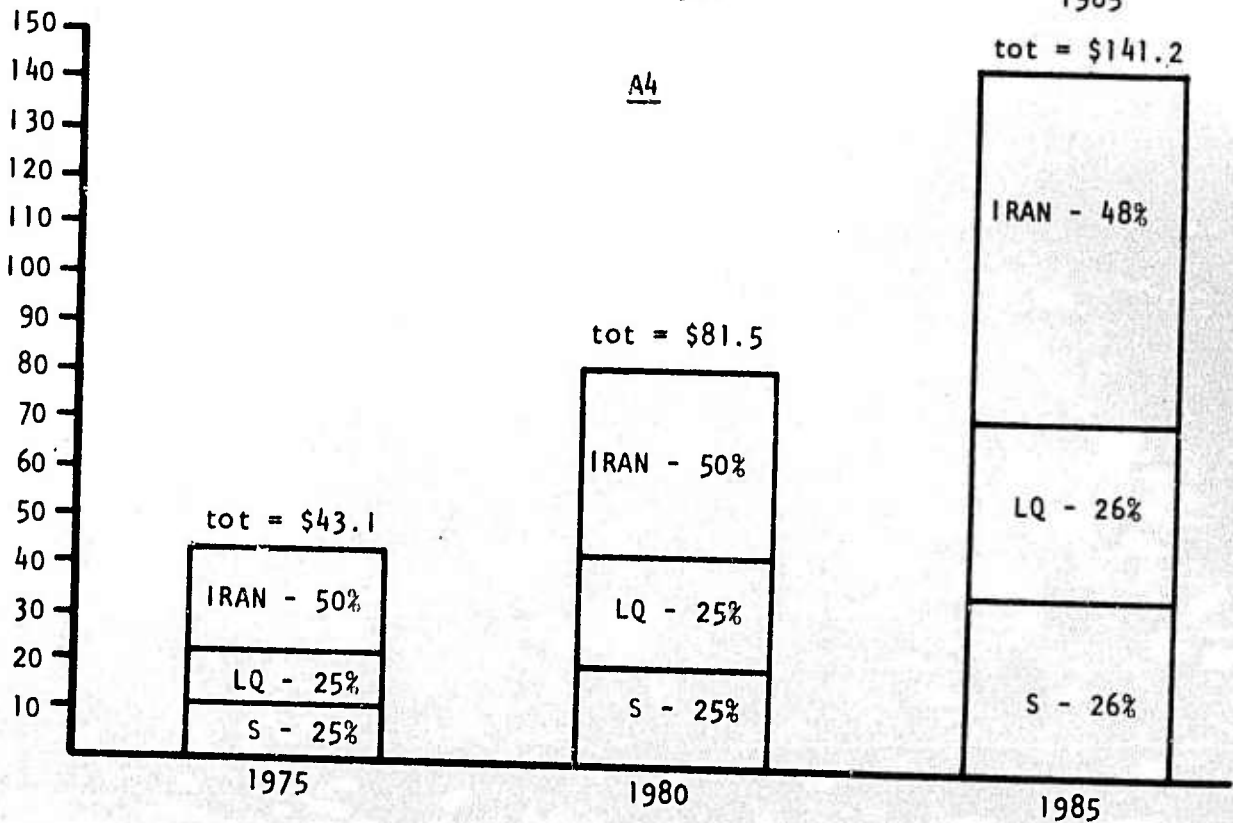
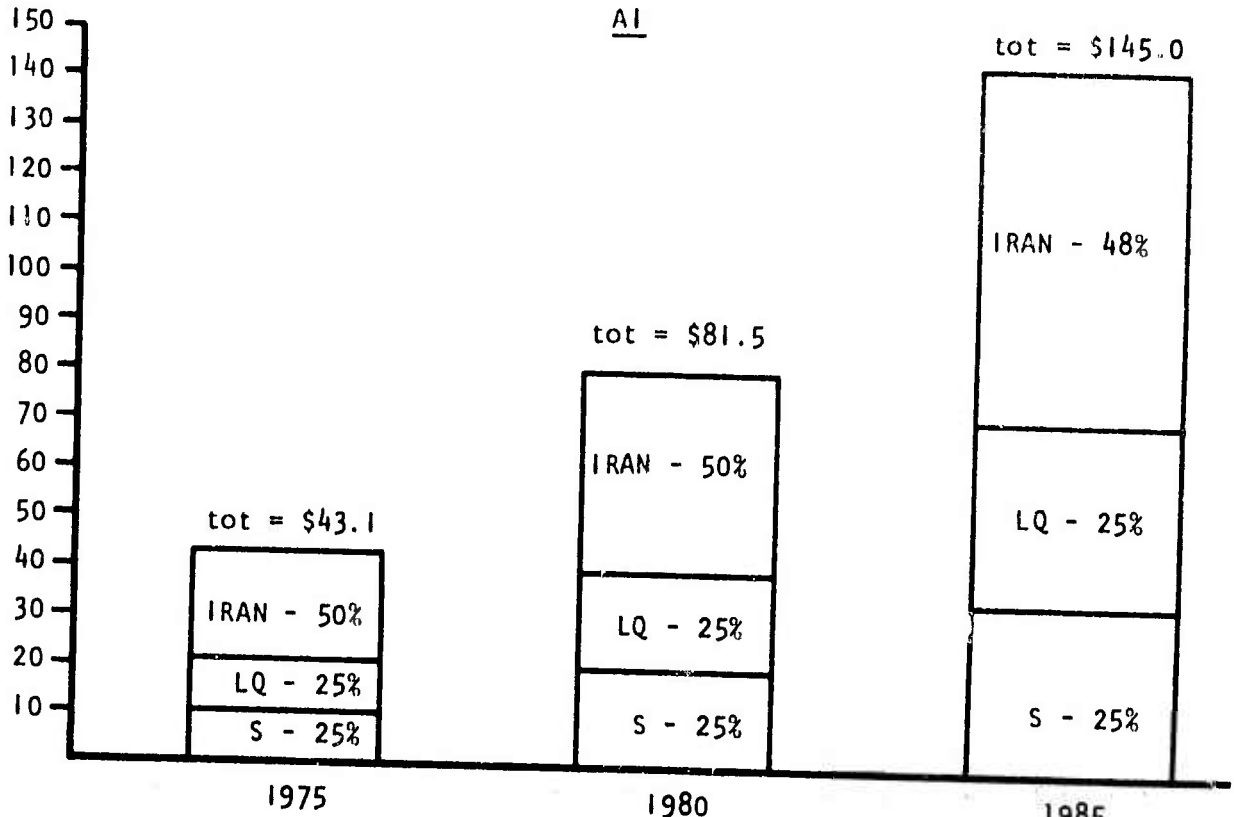
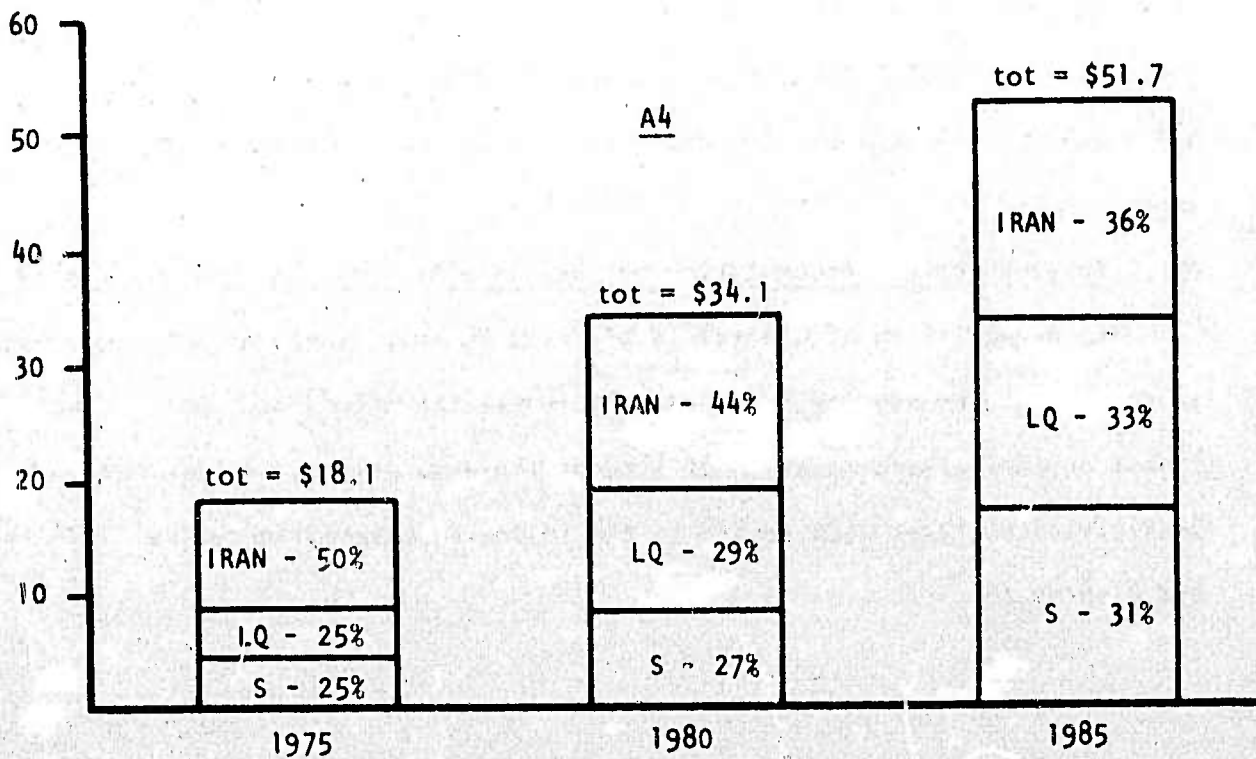
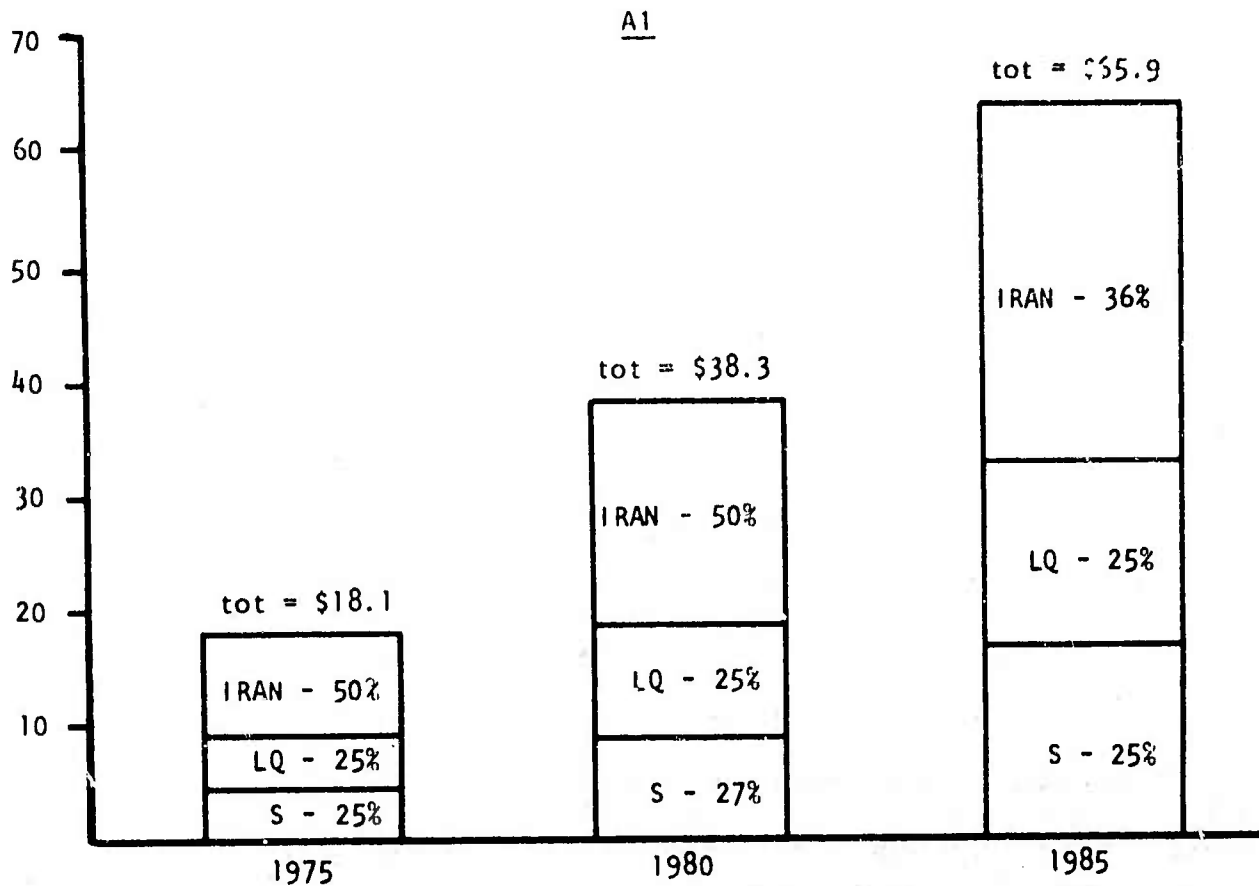


DIAGRAM 15

DOMESTIC INVESTMENT - A1, A4
BASE ASSUMPTIONS

\$ Billions



Other spending changes proportionately with the revenues. As a result, total spending falls from \$205 billion to less than \$170 billion i.e., by about 17%. Thus we can conclude that the total spending for consumption is slightly sensitive to the revenues.

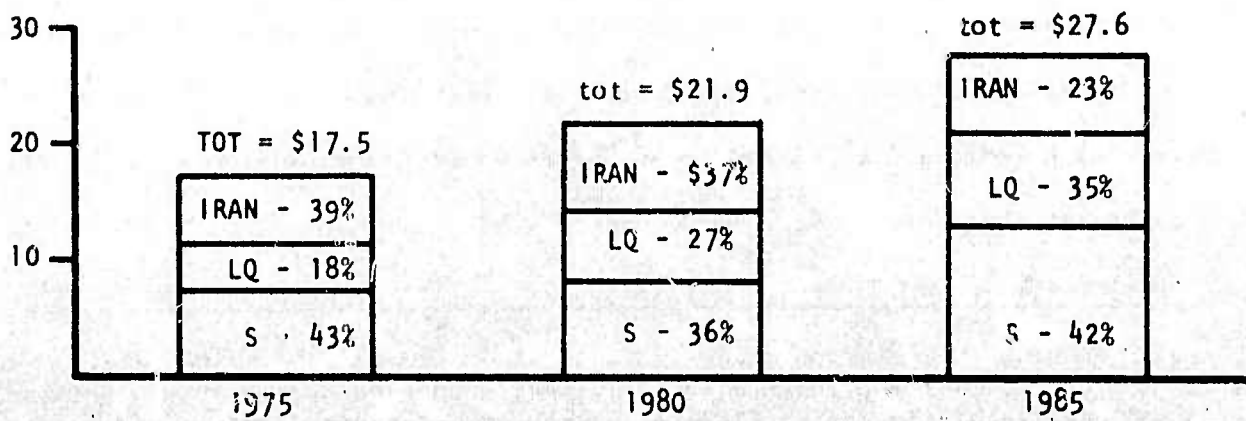
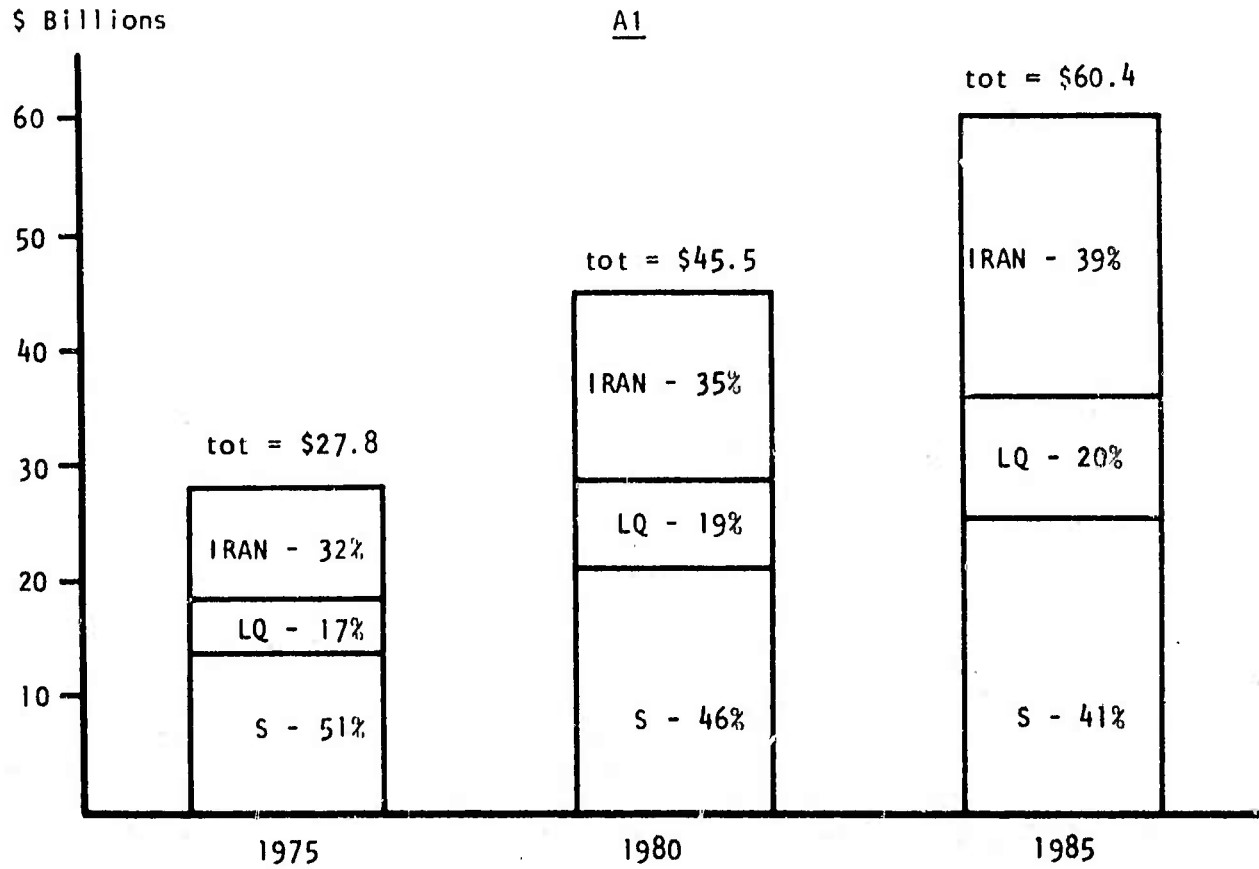
Net imports, however, are largely sensitive since they constitute a net balance between total spending and GDP. In fact, net imports in the lowest revenues are about 50% lower than in the highest revenues, and the magnitude of this relative decline rises with time. The greatest decline in net imports takes place in Iran (1980 - from \$16 billion to \$8 billion in the lowest revenues; 1985 - from \$24 billion to \$6 billion). The net imports of the S group are also affected greatly, simply because oil revenues constitute a great share of the total GNI. In LQ countries the decline of the net imports is the smallest. (See Diagram 16).

Net surplus is the most sensitive factor with regard to changes in the net revenue. From the highest (A_1) to the lowest (A_4) revenue alternatives it falls from \$90 billion to \$16 billion in 1980 and from \$120 billion to \$18 billion in 1985. In Iran it actually becomes negative as of 1980 and total capital accumulation declines. In LQ countries this process starts in 1985.

D. Foreign Capital Accumulation and Net Imports under Various Alternatives

The accumulation of capital is affected by many of the assumptions made in the above presentation. In order to reveal the nature and magnitude of the impact on capital accumulation of some of the assumptions, we have made sensitivity analyses with regard to the following cases [See tables 36 to 39 and Diagram 17].

DIAGRAM 16
NET IMPORTS - 1975, 1980, 1985
BASE ASSUMPTIONS



1. MPC decreased from .8 to .6

In this case the domestic saving rises, increasing the foreign capital accumulation while the net imports decline. The greatest relative effect is on Iran because of its greater population and GDP magnitude. In fact, this makes it possible for Iran to retain the maximum capacity of domestic investment and economic growth even when revenues are lowest, A4, and also accumulate foreign capital amounting to almost \$30 billion in 1980 and close to \$45 billion in 1985. The reduction in the net imports takes place in S and LQ countries consistently at all four levels of revenues. In Iran the decline in net imports when revenues are high is much greater. But when revenues are lower there is an increase in imports to Iran because of the ability to restore domestic investment to the highest capacity.

2. Increase in returns on foreign investment from 8% to 10%

According to the assumptions made, such an increase (or alternatively, a decline) in the rate of return on foreign investment has no effect on domestic spending and therefore neither on net imports.* It only affects the rate and level of accumulation of foreign capital. When revenues are higher the magnitude of this effect is larger because the greater returns are caused by larger accumulations of foreign capital. In any case this effect on capital accumulation is not very significant. Thus, total foreign capital accumulation for each group under A1 (i.e., when the returns are maximized) increases from \$920 billion with an 8% return to \$1100 billion at a 10% return, a 20% increase.

*

Except in Iran, under alternative A4, where the higher return provides some additional sources to finance investment. The net increase of investment in GNP is however insignificant.

3. Decline in the Rate of GDP Growth

In this case domestic investment is lower. Net imports, therefore, are lower and foreign capital accumulation is greater. The total sum of these differences is quite constant at various revenue levels. Thus a decline of 1% in the rate of growth results in an additional accumulation as of 1980 of about \$8 billion for S, \$9 billion for LQ, and \$17 billion for Iran, bringing the total change to \$34 billion.

4. Change in Productivity Rate

A decline in productivity will have an effect on the real GDP figures, but the impact on the accumulation of capital and net imports is very insignificant. This is because such a decline in productivity is associated with a smaller rate of growth of GDP, these two factors neutralizing each other to a great extent. If domestic investment were increased in order to make up for the lower productivity and retain the rate of GDP growth, it would have resulted in a smaller accumulation of capital. This, however, is very unlikely to occur because investment at the highest level of domestic capacity was assumed.

E. Shifting Revenues Among Countries

The above findings were made separately for the three groups of countries under the assumption that each group's share in the total revenue will remain constant. This may not necessarily be the case for various reasons. If the output of oil by one group increases more than by the other, its share in the

TABLE 36 (1)
FOREIGN CAPITAL ACCUMULATION AND
NET IMPORTS UNDER VARIOUS ASSUMPTIONS--TOTAL MIDDLE EAST
 (\$ 10⁶)

A 1 Alternative	Foreign Capital Accumulation			Net Imports		
	1975	1980	1985	1975	1980	1985
1. Base	79,289	455,968	978,115	27,817	45,461	60,352
2. MPC1 = .6	81,911	491,078	1,115,878	25,016	34,974	37,179
3. g = .10*	80,571	482,603	1,098,464	27,817	45,461	60,352
4. pc = .18, pc = .13**	83,460	483,855	998,844	24,693	41,782	72,266
5. pc = .15, pc = .12	87,527	517,242	1,132,750	21,834	32,567	45,367
6. pc = .18, pc = .12	83,267	480,805	984,471	24,914	42,843	75,345
7. Productivity = Down 2%	78,797	446,830	936,292	28,400	48,600	68,900
A 2						
1. Base	83,004	582,031	760,505	26,532	39,036	53,927
2. MPC1 = .6	85,626	417,141	898,269	23,721	28,549	30,754
3. g = .10	84,286	406,830	863,028	26,532	39,036	53,927
4. pc = .18, pc = .13	87,175	409,918	781,234	23,408	35,357	65,841
5. pc = .15, pc = .12	91,242	443,487	915,140	20,549	26,142	38,942
6. pc = .18, pc = .12	86,982	406,867	766,060	23,629	36,418	68,950
7. Productivity = Down 2%	82,422	372,893	718,682	27,195	42,175	62,475
A 3						
1. Base	71,859	199,082	354,589	20,107	30,041	40,917
2. MPC1 = .6	74,481	234,193	492,352	17,306	19,554	24,329
3. g = .10	73,141	216,403	413,187	20,107	30,041	47,502
4. pc = .18, pc = .13	76,030	226,970	375,317	16,983	26,362	57,270
5. pc = .15, pc = .12	80,007	260,538	509,223	14,124	17,147	32,517
6. pc = .18, pc = .12	75,837	223,919	350,944	17,204	27,423	51,994
7. Productivity = Down 2%	71,277	189,945	334,208	20,770	33,180	45,370
A 4						
1. Base	71,859	162,874	255,574	17,537	21,932	27,646
2. MPC1 = .6	74,481	197,904	358,312	14,736	15,699	17,904
3. g = .10	73,141	170,344	300,221	17,537	24,059	27,891
4. pc = .18, pc = .13	76,030	150,762	266,591	14,413	22,507	33,930
5. pc = .15, pc = .12	80,007	224,330	375,184	11,554	13,292	26,052
6. pc = .18, pc = .12	75,837	187,711	259,525	14,634	23,569	36,146
7. Productivity = Down 2%	71,277	157,342	235,897	18,200	22,590	32,758

*g designates rate of growth of GDP.

**pc designates rate of growth of productive capital.

TABLE 17 (2)

FOREIGN CAPITAL ACCUMULATION AND
NET IMPORTS UNDER VARIOUS ASSUMPTIONS--5 COUNTRIES
(\$ 10⁶)

Alternative	Foreign Capital Accumulation			Net Imports		
	1975	1980	1985	1975	1980	1985
A 1						
1. -Base	48,264	279,278	619,670	14,355	20,836	24,498
2. MPC1 = .6	48,918	287,982	654,019	13,657	18,211	18,670
3. g = .10	49,051	295,418	693,813	14,355	20,826	24,448
4. pc = .18, pc = .13	49,290	286,079	624,739	13,587	19,924	27,381
5. pc = .15, pc = .12	50,290	294,328	657,637	12,885	17,660	20,773
6. pc = .18, pc = .12	49,242	285,318	621,156	13,642	20,188	28,156
7. Productivity = -2%	48,120	276,949	609,243	14,520	21,609	26,579
A 2						
1. -Base	50,259	239,522	502,811	13,500	16,551	20,173
2. MPC1 = .6	50,913	248,277	537,160	12,802	13,936	14,395
3. g = .10	51,046	254,727	567,382	13,500	16,551	20,173
4. pc = .18, pc = .13	51,285	246,324	507,880	12,732	15,649	23,106
5. pc = .15, pc = .12	52,285	254,623	540,778	12,930	13,385	16,998
6. pc = .18, pc = .12	51,237	245,613	504,297	12,787	15,913	23,881
7. Productivity = -2%	50,115	237,244	492,383	13,665	17,334	22,304
A 3						
1. -Base	44,275	141,277	284,828	9,225	10,566	15,893
2. MPC1 = .6	44,928	150,031	319,177	8,527	7,951	10,120
3. g = .10	45,061	152,465	325,810	9,225	10,566	15,893
4. pc = .18, pc = .13	45,300	148,128	289,897	8,457	9,664	18,831
5. pc = .15, pc = .12	46,300	156,377	322,795	7,755	7,400	12,223
6. pc = .18, pc = .12	45,252	147,367	286,314	8,512	9,928	19,606
7. Productivity = -2%	44,130	138,999	274,400	9,390	11,349	18,029
A 4						
1. -Base	44,275	121,832	212,847	7,515	8,001	11,623
2. MPC1 = .6	44,928	130,587	247,196	6,817	5,386	5,845
3. g = .10	45,061	132,054	248,020	7,515	8,001	11,623
4. pc = .18, pc = .13	45,300	128,684	217,916	6,747	7,099	14,556
5. pc = .15, pc = .12	46,300	136,933	280,814	6,045	4,835	7,948
6. pc = .18, pc = .12	45,252	127,923	214,333	6,802	7,363	15,331
7. Productivity = -2%	44,130	119,554	202,419	7,680	3,784	13,754

*g designates rate of growth of GDP.

**pc designates rate of growth of productive capital.

TABLE 38 (3)

FOREIGN CAPITAL ACCUMULATION AND
NET IMPORTS UNDER VARIOUS ASSUMPTIONS--IRAN

(\$ 106)

A 1 Alternative	Foreign Capital Accumulation			Net Imports		
	1975	1980	1985	1975	1980	1985
1. Base	14,530	90,249	178,928	8,826	16,090	23,557
2. MPC1 = .6	15,836	107,728	247,511	7,432	10,869	12,020
3. g = .10 [*]	14,736	95,422	202,161	8,826	16,090	23,557
4. pc = .18, pc = .13 ^{**}	16,616	104,192	189,306	7,264	14,250	29,510
5. pc = .15, pc = .12	18,648	120,975	256,255	5,835	9,642	16,060
6. pc = .18, pc = .12	16,519	102,674	182,150	7,374	14,778	31,058
7. Productivity Down 2%	14,241	85,700	158,107	9,156	17,653	27,812
A 2						
1. Base	15,530	70,347	120,352	8,576	14,840	22,307
2. MPC1 = .6	16,836	87,826	188,537	7,182	9,619	10,770
3. g = .10	15,736	75,026	138,707	8,576	14,840	22,307
4. pc = .18, pc = .13	17,616	84,290	130,730	7,014	13,000	28,260
5. pc = .15, pc = .12	19,698	101,672	197,679	5,585	8,392	14,810
6. pc = .18, pc = .12	17,519	82,771	123,574	7,124	13,528	29,805
7. Productivity Down 2%	15,241	65,798	94,531	8,905	16,403	26,562
A 3						
1. Base	12,530	21,101	11,088	7,326	13,090	14,471
2. MPC1 = .6	13,836	38,560	79,671	5,972	7,869	9,520
3. g = .10	12,736	23,767	17,699	7,326	13,090	21,657
4. pc = .18, pc = .13	14,616	35,044	21,466	5,769	11,255	24,864
5. pc = .15, pc = .12	16,648	51,827	88,415	4,335	6,642	13,560
6. pc = .18, pc = .12	14,519	33,526	14,310	5,879	11,778	17,826
7. Productivity Down 2%	12,241	16,552	11,710	7,656	14,653	14,632
A 4						
1. Base	12,530	11,355	10,032	6,826	8,086	6,375
2. MPC1 = .6	13,836	28,834	43,591	5,432	7,119	8,270
3. g = .10	12,736	13,536	10,597	6,826	10,213	6,621
4. pc = .18, pc = .13	14,616	25,298	10,698	5,264	10,500	6,699
5. pc = .15, pc = .12	16,648	42,080	52,324	3,835	5,892	12,310
6. pc = .18, pc = .12	14,519	23,779	10,350	5,378	11,028	7,353
7. Productivity Down 2%	12,241	10,411	11,357	7,156	6,989	7,195

* g designates rate of growth of GNP.

** pc designates rate of growth of productive capital.

TABLE 39 (4)
 FOREIGN CAPITAL ACCUMULATION AND
 NET IMPORTS UNDER VARIOUS ASSUMPTIONS--LIBYA, IRAQ (LQ)
 (\$ 106)

A 1 Alternative	Foreign Capital Accumulation			Net Imports		
	1975	1980	1985	1975	1980	1985
1. Base	16,493	86,490	179,516	4,636	8,545	12,348
2. MPC1 = .6	17,156	95,367	214,347	3,978	5,834	6,489
3. g = .10 [*]	16,784	91,762	202,489	4,636	8,545	12,348
4. pc = .18, pc = .13 ^{**}	17,554	93,583	189,797	3,841	7,608	15,376
5. pc = .15, pc = .12	18,588	103,121	218,856	3,114	5,265	8,533
6. pc = .18, pc = .12	17,505	92,812	181,163	3,897	7,877	16,162
7. Productivity = -2%	16,347	84,180	168,941	4,803	9,339	14,509
A 2						
1. Base	17,213	72,161	137,341	4,456	7,645	11,448
2. MPC1 = .6	17,876	81,038	172,172	3,748	4,994	5,505
3. g = .10	17,509	77,078	156,859	4,456	7,645	11,448
4. pc = .18, pc = .13	18,274	79,254	142,623	3,661	6,708	14,476
5. pc = .15, pc = .12	19,308	87,791	176,682	2,934	4,365	7,633
6. pc = .18, pc = .12	18,225	78,482	138,989	3,717	6,977	15,262
7. Productivity = -2%	17,067	69,850	126,766	4,623	8,439	13,609
A 3						
1. Base	15,053	36,704	58,671	3,556	6,385	10,548
2. MPC1 = .6	15,716	45,581	93,502	2,848	3,734	4,689
3. g = .10	15,344	40,170	69,677	3,556	6,385	10,548
4. pc = .18, pc = .13	16,114	43,797	63,953	2,761	5,448	13,576
5. pc = .15, pc = .12	17,148	52,334	98,012	2,034	3,015	6,733
6. pc = .18, pc = .12	16,065	43,026	60,319	2,817	5,717	14,362
7. Productivity = -2%	14,907	34,393	48,097	3,723	7,179	12,709
A 4						
1. Base	15,053	29,686	32,693	3,196	5,845	9,648
2. MPC1 = .6	15,716	38,563	67,525	2,488	3,194	3,789
3. g = .10	15,344	32,804	41,602	3,196	5,845	9,648
4. pc = .18, pc = .13	16,114	36,779	37,975	2,401	4,908	12,676
5. pc = .15, pc = .12	17,148	45,317	72,034	1,674	2,565	5,833
6. pc = .18, pc = .13	16,065	36,008	34,341	2,457	5,177	13,462
7. Productivity = -2%	14,907	27,376	22,119	3,363	6,639	11,809

* g designates rate of growth of GDP.

**pc designates rate of growth of productive capital.

DIAGRAM 17

FOREIGN CAPITAL ACCUMULATION - A1, A4 - 1980, 1985
 VARIOUS ASSUMPTIONS

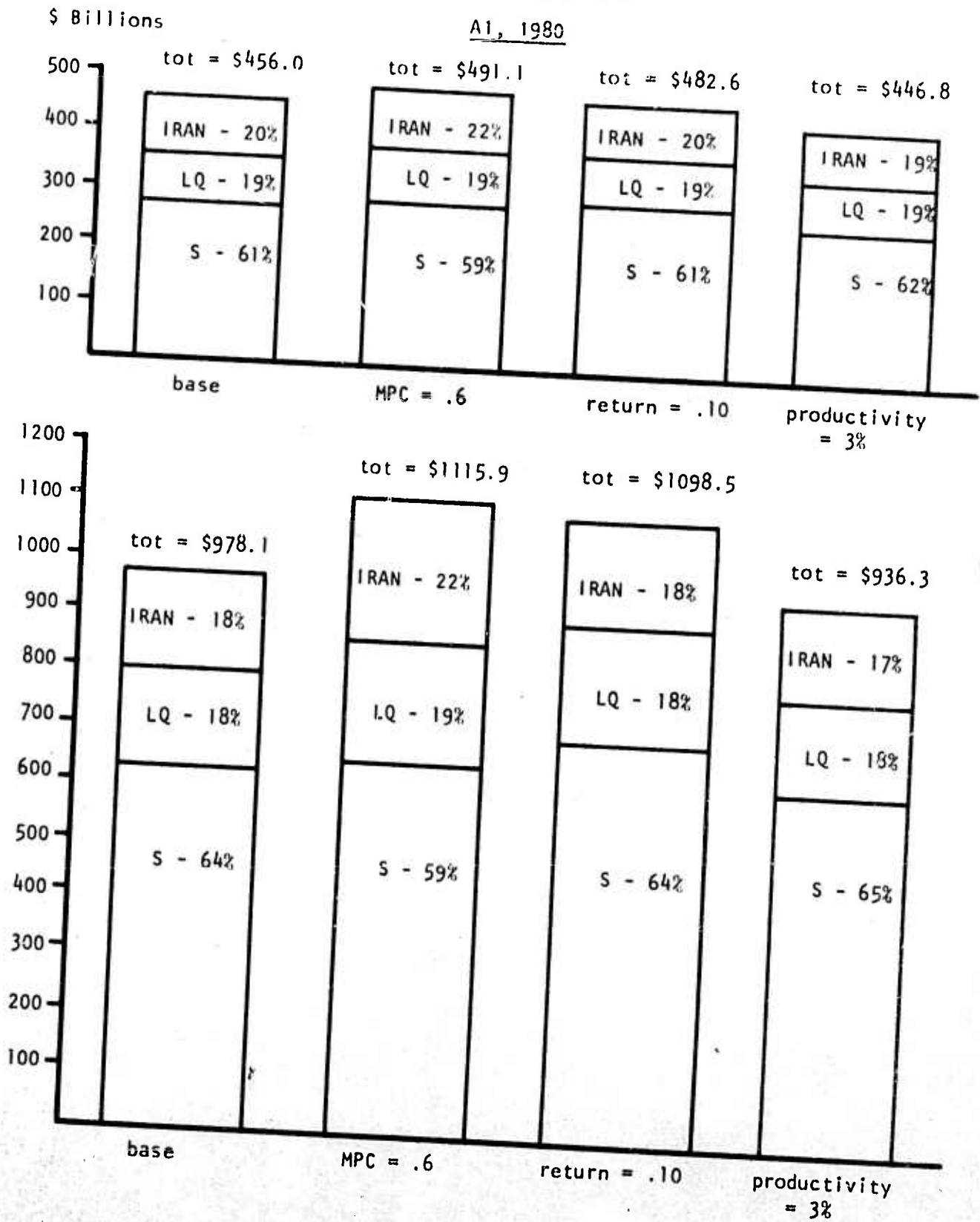
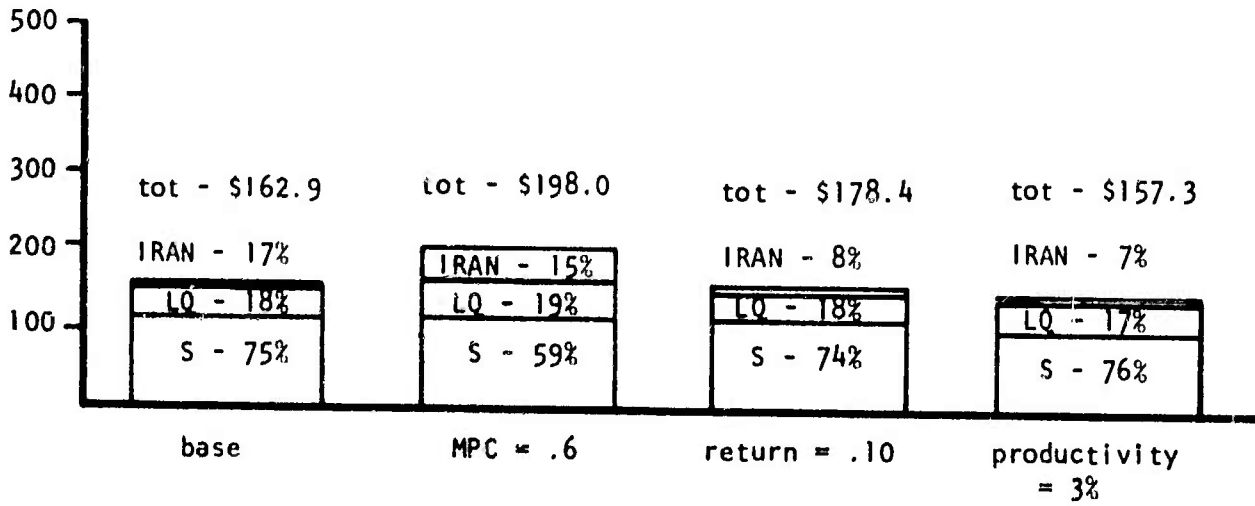


DIAGRAM 18

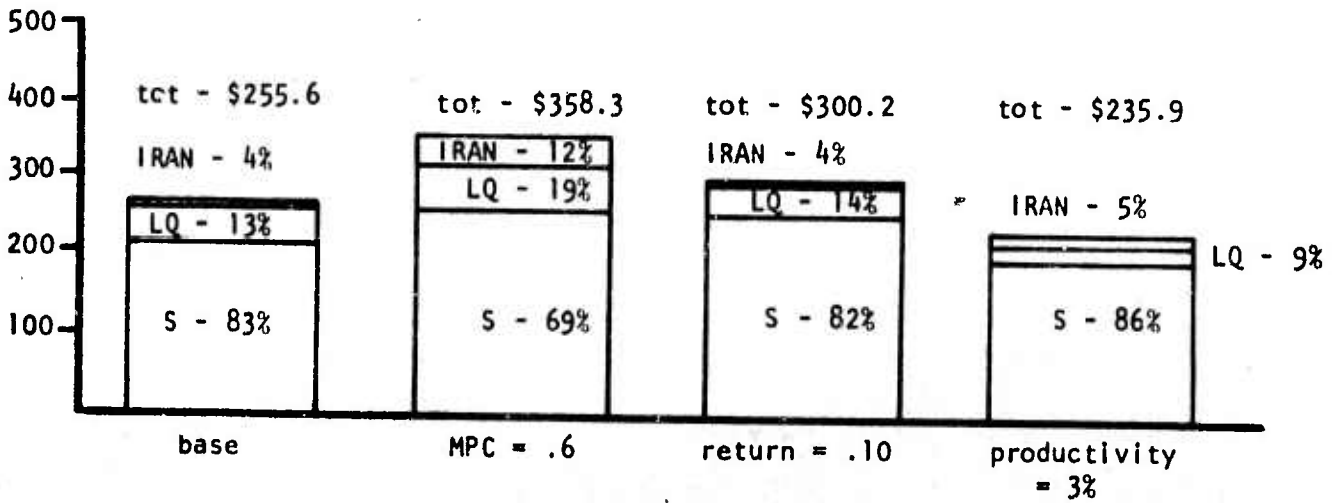
A4, 1980

\$ Billions



\$Billions

A4, 1985



total revenue will increase. How does this affect the overall results? For one thing it changes the structure of distribution of foreign capital, which is obvious. However, in case of lower revenues it has additional, more important effects. Let us take case A4 under which Iran is unable to reach its highest domestic investment capacity. If revenues are shifted from the other countries, especially from Saudi Arabia, to Iran, the other countries' accumulation will decline accordingly; but Iran will not accumulate this capital but will invest it domestically. This will enhance the rate of growth of Iran's GDP without hampering the respective rates of the other countries, and it will show itself also in an increase of net imports and an equivalent decrease in capital accumulation.

The relative magnitude of this effect was analyzed. It was found that if a certain sum of revenues were shifted from the S group to Iran and this shift were distributed over the period in constant annual amounts, the total accumulation of capital would be smaller by 85% of the total revenues shifted. For example, if \$1 billion is shifted annually during 1974 to 1985, from S to Iran (totalling \$12 billion), the total accumulation of foreign capital as of 1985 will be smaller by \$10 billion.

This effect will work until Iran reaches the highest capacity of domestic investment. Therefore, this effect will have large magnitudes only if the revenues are low - in fact, only if they are lower than A4.

PART THREE: INVESTMENT STRATEGIES OF OIL REVENUES

In the previous chapter we have developed alternative forecasts of foreign capital accumulation by the Middle East countries as a result of increased oil prices. The purpose of Part Three is to discuss some possible investment strategies that may be implemented by the Middle East countries and to explore the implications to the world economic, monetary, and financial structure.

Chapter 8 sets the framework of possible investment strategies. Chapter 9 discusses the implications for the world economy. Chapter 10 concludes this study.

CHAPTER VIII

STRATEGIES FOR EXTERNAL INVESTMENT OF OIL REVENUE

One of the findings in chapter 7 referred to the accumulation of capital for foreign investment of the Middle Eastern countries. It was projected to reach a level between \$150 and \$520 billion in 1980 and \$240 and \$1000 billion in 1985, the exact level depending on the various assumptions. This chapter discusses the strategies for investment and suggests a possible investment structure. It then presents some initial indication of actual foreign investments and commitments as of summer 1974.

A. Investment Criteria

As in the case of domestic versus foreign investment, our method is to suggest an investment strategy based on a list of goals. The underlying assumption is that the investors have either an explicit or an implicit list of goals which they try to fulfill. They do this by choosing an investment strategy that subjectively maximizes the level of achievement. We suggest a list of goals which follows. They are consistent with the goals stated in chapter 5 concerning domestic versus foreign investment. Some of them, however, are specified differently in order to make them adjusted to the specific subject, namely the types of foreign investments to be selected. The goals are:

1. To increase the expected rate of return on the investments.
2. To reduce the business risk
3. To reduce the political risk
4. To increase the contribution of the investments to the national security.

5. To increase the contribution of the investments to the country's political power in the world.
6. To increase the contribution of the investment to the stability of the current regime.
7. To make investments that are more manageable within the limits of skilled manpower
8. To adjust the investments to the psychological preferences and constraints of the investors.

These criteria have been stated in a comparative form because most of them are not measurable in a cardinal sense. With multiple goals it will not be possible to devise an investment set that will always be superior on each and every criteria. For example, a set which is better than another with respect to expected rate of return need not be better with respect to political risk of investment confiscation and a set that is better than another with respect to national security need not necessarily be better with respect to business risk nor with respect to expected rate of return.

We will define an investment strategy as a set of specific investments in certain proportions. In fact, it is an investment portfolio.

Any investment strategy will achieve a certain level of each of the above goals. If one set of investments achieves a certain level for each goal which is less than the respective level achieved by a second set of investments, then the first set is clearly inefficient and should be deleted. We therefore have to exclude all such inefficient strategies and retain the so-called efficient strategies. An efficient strategy can thus be defined as a set of investments that for any given level of achievement of any seven of the goals

has the highest level of achievement of the remaining goal. This process of selecting efficient investment strategies is objective though it is difficult because we use only a comparative scale of the goals.

But this is not the end of the process. The efficient strategies are characterized by the fact that each one is better than some others with respect to one goal and worse with respect to some other goals. Thus, the selection of one optimal strategy from the efficient set is a subjective process that depends on the preferences of the policy maker with respect to the different, competing goals. It should be noted that we always speak of a mix of investments because we assume no single investment form could satisfy all the criteria better than some mixture of forms.

We turn now to list the specific classes of foreign investments, and their relative contribution to each of the goals we shall later indicate.

B. Classes of Foreign Investment Forms

The following are the general classes of investment available to the oil producing countries; within each class investment normally takes several specific forms:

1. Short term financial investment in the money markets of the developed countries.
2. Long term financial investment in the securities markets of the developed countries;
3. Direct investment in underdeveloped countries; the term "direct investment" is used in distinction to "financial investment" (or "portfolio investment") and implies that the supplier of capital retains and is expected to exercise some degree of control.

4. Direct investments in neighboring countries.
5. Direct investment in industrially developed countries.
6. Investment in the energy industry (including nuclear; anywhere in the world both in wholly owned enterprises and in joint ventures, including investment in natural resource production, refining, transportation, distribution, and marketing.
7. Neutral investments in developed and underdeveloped countries; the term "neutral investment" is used to identify direct investments in an economy for which the exercise of ownership, foreign or domestic, has little significance for the economy as a whole, such as real estate, or hotels.

Formulating an investment strategy and executing the strategy to arrive at the selected composition of investments requires time. During the planning and execution period accumulated capital must be held in some form that will not prevent its later investment according to the strategy.

The usual form of temporary investment is in bank deposits and short term money market instruments. Until a strategy is formulated, such short term investments may be regarded as passive, automatic, and in lieu of an active selection among alternated investment. It will be useful to distinguish the passive use of such liquid, near riskless holdings from the active decision to maintain a part of ones permanent capital short-term form.

C. Specific Forms Of Foreign Investments

The above list of general classes of foreign investment forms constitutes a framework for the presentation of specific forms and tools of investments as follows:

1. Short-term instruments

- 1.A. Suitable for passive use or as part of a strategy:
 - 1.A1 Demand deposits in U.S. banks (no interest paid by law)
 - 1.A2 Demand deposits in Eurocurrency banks (interest paid)
 - 1.A3 Three month and six month notes issued directly by the U.S. and European governments (Treasury bills)
 - 1.A4 Negotiable certificates of deposits (C.D.'s) issued by major U.S. and foreign banks (U.S. minimum is 30 days)
- 1.B Suitable only as part of a strategy
 - 1.B1 Notes issued by major non-bank financial corporations (finance company commercial paper)
 - 1.B2 Notes issued by industrial corporations guaranteed by a major bank (banker's acceptances and some commercial paper)
 - 1.B3 Notes issued by industrial corporations without third party guarantees (industrial or "dealer" commercial paper)

2. Long-term lending instruments

- 2.1 Bonds of major governments
- 2.2 Bonds of major corporations
- 2.3 Bonds of international institutions
- 2.4 Special oil payment arrangements particularly for developing countries at low interest rates but requiring guarantees of international institutions or of developed countries.
- 2.5 Long-term loans to the U.S. or other developed countries or to international institutions with special provisions, particularly protection from inflation
- 3 Stocks held as a portfolio investment (no participation in control)

4. Direct investments in equity capital for control

- 4.1 Stocks held for minority control
- 4.2 Stocks held for majority control

4.3 Joint ventures with foreign corporations in the home country of the corporation or anywhere else outside of the country of the investor.

- industrial projects
- services, particularly related to tourism
- real estate

4.4 Direct investment for sole ownership

- industrial projects (unlikely)
- services
- real estate

5. Investment in the energy industry

(oil, gas, coal, nuclear, oil substitutes) (sole ownership, joint ventures, corporate minority investment)

- 5.1 Exploration (probably joint venture)
- 5.2 Production (probably joint venture)
- 5.3 Transportation (probably sole ownership)
- 5.4 Refining (sole and joint ownership)
- 5.5 Marketing (probably sole ownership)
- 5.6 Distribution
- 5.7 Development of synthetic fuel.

6. Investment in the development of neighboring countries

- 6.1 Joint ventures with the local country
- 6.2 Joint ventures with multinational corporations

7. Investment in non-neighboring developing countries

- 7.1 Joint ventures with the local country
- 7.2 Joint ventures with multinational corporations

Forms 6 and 7 differ from forms 1 through 6 in that they are made for political and security reasons and may technically be in the forms of loans.

D. The Investment Forms and the Goals

In order to derive efficient investment strategies, given the preceding list of investment forms one needs to estimate for each investment form its contribution to each of the goals. There is a small number of vigorous indications on which to base such estimates. Table 40 shows some selected rates of return on short-term financial investments, and long-term bonds in the U.S., Germany, and the U.K. Table 41 summarizes average rates of return on common stocks in a number of countries. All these rates are subject to wide fluctuation over time and to risk of inflation. Some indication of the risk of fluctuation in the rates of return is shown in table 42. The risk of fluctuations here is measured by standard deviations in the rates of return of common stocks.

Such data as that presented in these tables could help in constructing an investment strategy with regard to expected returns and business risk on financial assets. They are not helpful with regard to other investment forms. The remaining goals are not measurable in a cardinal sense at all and thus we are not able to provide any objectively meaningful index for them. Instead, we have developed a matrix of indices which indicates the contribution of each investment form to each of the goals. The entries are our subjective evaluation based on some interviews but not on any broad formal survey. In the matrix we have classified the

TABLE 4 G

RATES OF RETURN ON SELECTED SHORT
AND LONG-TERM FINANCIAL INVESTMENTS
(in percent)

Year	Treasury Bills			C.D.'s-3 mo.	3-mo. Euro. \$	Corporate Bonds						
	U.S.-3 mo.	U.K.-3 mo.	Germany-6 mo.			U.S.	Japan	U.K.	Germany			
1960	2.87	4.44	3.75			4.41						
1963	3.16	3.75	2.63	3.40	3.95	4.26						
1965	3.95	5.48	3.88	4.31	4.81	4.49						
1968	5.34	6.80	2.75	5.79	6.36	6.18	8.66	9.16				6.43
1970	6.39	6.70	6.54	7.68	8.52	8.04	9.20	10.84				7.77
1971	4.33	5.57	4.54	5.07	6.58	7.39	7.38	9.19				7.59
1972	4.07	5.02	3.04	4.61	5.46	7.21	6.75	10.40				8.58
1973	7.03	9.40	7.00	9.01	9.29	7.44	10.73	13.56				10.33
4/1974	8.33	11.53	5.63	9.04	10.49	8.25	12.07	15.77				11.19

TABLE 4 i
 COMPARISON OF "EFFICIENT" PORTFOLIO CHARACTERISTICS FOR SIX NATIONS

Country	Low Risk-Low Return Portfolio Rate Of Return Standard Deviation	Mid-Risk, Mid Return Portfolio Rate Of Return Standard Deviation	High Risk-High Return Portfolio Rate Of Return Standard Deviation
Netherlands	8.48	8.97	29.58
Australia	19.81	33.44	96.64
Canada	4.89	5.40	6.86
South Africa	18.79	36.22	52.32
England	12.18	20.65	46.45
United States	9.25	18.05	24.43
Philippines	71.38	91.35	212.50
			1,076.85
			13,723.48
			12.83
			2,134.46
			1,509.59
			704.23
			9,081.41

Source: S. Novack, "Investor Benefits From International Portfolio Diversification", unpublished PhD. Dissertation, New York University, 1973.

TABLE 4 2

INDICES OF INVESTMENT PERFORMANCE

	Return	Avoiding Business Risk	Avoiding Risk Of Confiscation	National Security	Political Power	Stability of Regime	Manage-ability	Avoiding Psychological Barriers
Short-Term Bonds	2	5	5	1	1	1	4	4
Institutional Bonds	3	4	4	1	2	1	4	4
Stock-Portfolio	3	4	5	2	5	2	5	5
Stock-Minority	4	3	4	1	1	1	2	3
Stock-Majority	4	2	2	3	3	1	2	2
Joint Ventures-Industry	3	1	1	3	3	1	1	2
Joint Ventures-Services	4	2	2	3	4	1	2	2
Joint Ventures-Real Estate	4	2	3	3	4	1	2	2
Sole Ownership-Services	5	1	3	1	2	1	2	2
Sole Ownership-Real Estate	4	2	2	1	1	1	1	4
Energy	5	1	2	1	2	1	1	4
Neighboring Countries	4	1	2	1	1	1	1	4
Underdeveloped Countries	2	1	4	4	5	3	5	5
	1	1	4	3	5	4	5	5

investment forms into fourteen main groups.

Despite the subjective nature of this matrix some interesting suggestive indications are revealed:

(1) Investment to achieve majority control is clearly less efficient than investment for minority partnership. This implies that direct purchases of corporations in order to control their management is not an attractive investment.

(2) Institutional bonds are more attractive than commercial bonds on the market. They provide greater political benefits and they are more easily managed, while their business characteristics do not necessarily differ from commercial bonds.

(3) A stock portfolio is less attractive than institutional bonds in all but one goal.

(4) Sole ownership in general is somewhat less attractive than joint ventures due to business risk, managability, and political disadvantages. They now have, however, some psychological advantages. Therefore, it is expected that sole ownership will be a limited form of investments.

(5) The investments in the neighboring countries and underdeveloped countries have political advantages and business - related drawbacks.

(6) Short-term investments are relatively safe and managable but are not attractive with regard to the other goals.

(7) Investment in energy has both business and political merits. Without recourse to a vigorous analysis, the following conclusions emerge:

(1) High in the scale of attractiveness are institutional bonds, energy, joint ventures, and institutional bonds, with short-term

investments included as an obvious automatic form of investment during transition periods.

(2) Investments in neighboring countries and underdeveloped countries are attractive only for political reasons and will be limited to the required political extent.

(3) Stock majority and sole ownership are far down on the scale of attractiveness, while stock minority is attractive for pure business consideration.

Thus any efficient strategy should be a certain mix of investments of the following forms: short-term assets, institutional bonds, stock minority, joint ventures, energy, and neighboring and other developed countries. On the basis of this conclusion we have classified the investment forms into six groups, and presented for each group its indicative share in the investment portfolio. The groups are:

- (1) Short-term financial investments.
- (2) Long-term institutional and commercial bonds
- (3) "Neutral" investments (stock portfolio, services, and real estate)
- (4) Energy
- (5) "Direct" investments (stock minority, joint ventures in industry)
- (6) "Political" investments (neighboring countries, underdeveloped countries)

A reasonable strategy would be to split the investments among the six groups approximately as follows: Short-term--10-15 percent; long-term--20-25 percent; neutral--10-15 percent; energy--15-20 percent;

direct--20-25 percent; and political--10-15 percent. This structure will be reached by gradual approximation. It will take some ten years until it emerges in such a form. The process of development and adjustment is not predictable. However, some observations can be made. The main factor is that most of the investment forms can be made only after a period of investigation, evaluation of opportunities, and execution of complicated procedures. They also require high levels of sophistication and skills. Thus, these forms of investments will constitute a small proportion of the portfolio in the first years, but will become more prominent towards the end of the period under review; until the long-term portfolio structure is attained. These considerations bring us to the following conclusions:

(1) Short-term assets will be held in order to provide liquidity and ability to shift investment strategies. At first it will be main because of passive automatic characteristic. But in a relatively short time (1 to 3 years) most of these short-term investments will be transformed into long-term holdings. This the ratio of the capital held in short-term form to the total capital is expected to decrease and be maintained in the following ranges

1975 - 60 percent

1980 - 80 percent

1985 - 10 percent

(2) Institutional bonds (and other forms of bonds) will increase in the ratio to total capital in the next 2 to 4 years. Size of holdings after 4 years will increase slowly so that their proportion may decline somewhat. Thus their pattern over time may be:

1975 - 25 percent

1980 - 30 percent

1985 - 25 percent

(3) Neutral investment will have a small scale in the early period, will rise somewhat towards 1980 and will stabilize, with possibly some decline, in the 1980's.

(4) Investment in energy will be made as opportunities appear. Thus there will be a steady increase in the proportion of energy investment over the period.

(5) Direct investments will have a pattern similar to energy investments, but the total sum will reach somewhat higher proportion.

(6) Political investments will be tied to the level of revenues and be kept low, but effective. We assume they will amount to about 10 percent of the total portfolio.

The following table summarizes these patterns of investment strategy:

TABLE 43INVESTMENT STRUCTURE - 1975, 1980, 1985
(percentages)

	1975	1980	1985
Short-Term Credit	60	20	10
Bonds	25	30	30
Neutral	5	15	15
Energy	0	10	15
Direct	0	15	25
Political	10	10	10
Total	100	100	100

The pattern that emerges is that in the early years most of the investments will be in financial assets. By 1980 the proportion of the short-term investment will drop sharply and total financial investments in short-term assets and bonds will amount to about 50 percent of the total investments. This proportion will further decline to about 1/3 by 1985. Direct investment will steadily increase from 0 percent at present to 15 percent in 1980 and 25 percent in 1985, thus becoming a major form of business involvement in the international economy. Energy will constitute a major single area of investment, while neutral and political investments will maintain a steady proportion of 15 percent and 10 percent respectively.

This pattern of investment strategy is only indicative. Some deviations from it may be demonstrated. Yet some underlying principles seem to be common to any possible outcome.

(1) Business opportunities and the return/risk trade-off will constitute a significant factor in any investment strategy. Money gravitates to opportunity.

(2) These opportunities will be utilized subject to political, and psychological and managerial considerations.

(3) The resulting mixed strategy as defined should not be far from an efficient one and will fairly represent the relative subjective priorities of the ruling sector and policymaker of each country.

(4) There may be a difference in subjective priorities in different countries. Therefore any difference in distribution of ownership of capital may change the mix of the investment strategy.

TABLE 44
SUMMARY OF INVESTMENT PORTFOLIOS
UNDER ALTERNATIVE OIL REVENUES - 1975, 1980, 1985
(millions of dollars)

Year	Short-Term	Bonds	Neutral	Energy	Direct	Foreign	Total
A1:							
1975	48	20	4	0	0	8	80
1980	91	127	68	46	68	46	456
1985	98	245	147	147	245	98	980
A2:							
1975	50	21	4	0	0	8	83
1980	76	115	57	38	57	38	381
1985	76	190	114	114	190	76	760
A3:							
1975	43	18	4	0	0	7	72
1980	40	60	30	20	30	20	200
1985	35	89	53	53	89	35	354
A4:							
1975	43	18	4	0	0	7	72
1980	33	49	24	16	24	16	162
1985	26	64	38	38	64	26	256

The following table summarizes the specific patterns of investments in terms of financial magnitudes that may be accumulated under the four major oil revenue alternatives.

E. Foreign Investments of Commitments (as of August 1974)

The oil-producing countries have invested the recently increased inflow of oil revenues in a number of external and domestic projects and opportunities. There is no accurate list of the investments in the portfolios of the oil-producing countries at any given time, but by using the widespread, though often undocumented reports in a variety of publications (though taking them with a grain of salt), it is possible to obtain indications of the composition of the portfolios. Listed below is a sampling of report dealing with foreign investments, broken down into documented and undocumented sources.

Foreign Investment

1. Documented Investments or Commitments

The following reports summarized by the New York Times, April 25, 1974 indicated that probably under \$100 million has been committed for external investments:

- (1) The Shah of Iran through his Pahlevi Foundation bought 642 Fifth Avenue, New York, for an undisclosed sum;
- (2) A Kuwait group invested \$10 million for one-half the equity in an Atlanta, Georgia, Hilton Hotel and shopping center to be built;
- (3) A Kuwait group paid \$17.4 million to buy a Charleston, S.C., island site for a resort hotel
- (4) A Kuwait group paid \$27 million for a Champs Elysees, Paris site for a luxury office building and bank;

- (5) Adnan Khashaggi, a Saudi living in Beirut, bought a 50 percent interest in two small banks and a finance company in Walnut Creek, California, for an undisclosed sum and also paid \$1 million for undeveloped land

In July Iran agreed to buy a 25 percent interest in Krupp Steel in West Germany and to set up a development company with Krupp. Business Week (July 20, 1974) estimated the market value of the stock purchase at \$60 million although no purchase figure was released.

By August the number of reports had increased but the largest investments reported were in government loans and bonds, suggesting that an intermediate investment is required while plans for longer term investments proceed. The following were summarized in MEMO (Middle East Money), August 3, 1974.

- (1) In the first seven months of 1974 Iran committed \$110 billion in loans to foreign countries;
- (2) Iran has agreed to buy \$1.2 billion in bonds from the British government and \$1.0 billion from the French;
- (3) Saudi Arabia will buy \$12.0 billion in bonds from the U.S. government;
- (4) Kuwait will buy \$1.0 billion in bonds from the U.S. government and \$1.8 billion from the British;
- (5) Egypt is entering into a \$700 million trade agreement with Iraq, involving autos, tractors, ferries, and housing construction. It is working on a \$1 billion loan from Saudi Arabia. It has received a \$100 million loan from a Western and Arab consortium and a \$25 million trade loan from Japan. An early goal will be increased nuclear power electric generating capacity.

2. Undocumented Reports

- (1) The Mellon Family will sell a block of Gulf Oil Stock to Saudi Arabia;
- (2) The Shah of Iran has bought Ashland Oil;

- (3) Kuwait and other Middle Eastern groups will invest in U.S. real estate placing \$50 million in equities and \$200 million in loans through Encie Hollingworth and Reveaux, Agents, Louisville, Kentucky. \$200 million through Wooten and Assoc. Agents, Dallas; and \$1 billion through Easdil Reality ((Blyth, Eastern Dillion, New York) (New York Times, April 25, 1974).
- (4) Saudi Arabia is investing in Japanese securities starting with \$34 million in Nippon Telegraphy and Telephone Public Corp. bonds (Wall Street Journal, August 5, 1974).

We conclude that the large amounts of foreign investment excluding the short-term investments by the Middle East Oil producing nations are recycled into the developed countries through long-term financial loans and to a lesser degree to underdeveloped and neighboring countries. Smaller investments of other types, such as purchases of real estate and hotels. This reflects the Kuwait policy of foreign investment over the past three years. The number of such investments has been relatively large but the dollar amounts have not been substantial. In short the true picture of the long-term strategy for investing the large sums primarily by Saudi Arabia and Iran has not yet been evolved or at least has not yet been revealed. It will undoubtedly be some time before this strategy becomes apparent.

Chapter IX

ECONOMIC IMPLICATIONS

The purpose of this chapter is to discuss the possible effects of an increase in oil prices on the world economy, both in the short run and long run. This subject has recently been widely discussed in current literature, where a wide range of different views among experts is detected. Our objective is to put some order in the analysis, simplify it somewhat, and thereby explain the source of the differences among experts. On this basis we shall be able to indicate some possible alternative economic outcomes.

We will start by presenting three "pure" processes which constitute the basic elements of the complex economic scene. We shall discuss each of these elements separately and then we shall show that the actual economic scene (in an analytical sense) is a certain combination of these three.

We first discuss the above under a very simplified assumption--that there is no friction in the adjustment process. That means we shall compare the initial and final equilibrium points (comparative statics). Later we will introduce the probable frictions that are expected to disturb the adjustment process, and try to evaluate their implication.

A. The Pure Economic Elements

The analysis of the effects of the increased oil prices and revenues on the world economy can be based on the following three pure elements:

- (1) The pure financial (and monetary) effect;
- (2) The pure real economic effect in the importing countries;
- (3) The pure real economic effect on the oil exporting countries.

1. The Pure Financial Effect

In order to deal exclusively with the pure financial effect, we make the working assumption (which will be dropped in the later stage) that the outcome of the increase in oil revenues will be limited to a transfer of funds with perfect recycling. We thus assume here that there will be no change in the total consumption and investments, either in the importing countries or in the exporting countries. Therefore, there will be no change in world trade.

As a result, the only change that will take place is in ownership of assets located in the importing countries. The oil exporting countries will replace the oil importing countries as owners of some of these assets. Thus the payment for the oil is made simply by transfer of ownership of certain assets.

2. Pure Real Effect in the Importing Countries

The second pure element is a real change in consumption and investment of the oil importing countries. The common argument is as follows: An importing country pays a greater price for the same oil import. Therefore the real income available to consumers and population as a whole is smaller by the additional oil bill. As a result the total consumption in the economy declines by the marginal propensity to consume. In order to prevent unemployment (at a rate determined by the Keynesian multiplier) fiscal and monetary action will be undertaken.

Under the "no frictions" assumption, a new equilibrium will be reached at a lower consumption level. This will be partly compensated for by either a greater investment level or a greater level of government expenditure. The real level of the GNP thus falls by an amount equal to

the increased oil bill, but full employment is retained. For example,* suppose the increase in the oil bill is \$1 billion per year and the marginal propensity to consume is 0.80. Consumption will thus fall by \$800 million and domestic investment (or government expenditure) will increase by the same sum. However, the balance of payments deficit increases by \$1 billion, which by definition means that investment abroad falls by \$1 billion. Thus total national investments fall by \$200 million. Savings also fall by \$200 million (since real income falls by \$1 billion and consumption falls by \$800 million). The increase in the current account deficit in the balance of payments of \$1 billion is financed by perfect recycling. As a result, the oil exporting countries own \$1 billion assets in the importing countries. Since total domestic real assets increased by \$800 million due to increased investments, the net decline in asset ownership by local citizens is \$200 million, that is, it exactly equals the decline in their savings.

In summary there will be no change in international trade and oil exporting countries becoming holders of assets like in the pure financial case. However, there is a real change in the importing countries toward lower consumption level and greater investment levels. In order to be in equilibrium this requires a decline in interest rates.

3. Pure Real Effect in the Oil Producing Countries

The third pure element is a real change in the consumption and investment of the oil producing countries combined with a perfect real adjustment in the economies of the oil importing countries. More specifically, increases in oil revenues raise the GNP of the oil exporting countries.

*See Appendix 3 for a detailed example.

This will cause an increase in the consumption of the oil exporting countries and in their domestic investment. Assuming that they were at full employment, the total increase of their consumption and investment is made possible by an increase of their imports from the oil consuming countries.

For example,* suppose again that a certain oil producing country has an increase of \$1 billion per year from oil revenue which is fully spent on increased domestic consumption and investment and is therefore reflected by an increase in its net imports of \$1 billion. This means that the oil consuming countries increased their exports by the same \$1 billion. To make this possible in a new equilibrium, the oil consuming countries must have reduced their consumption and investment by \$1 billion (assuming they were at full employment). This reduction results from the decline in the real national income due to the oil price increase as well as from complementary fiscal and monetary measures to close the gaps between total domestic demand and supply for consumption and investment.

It is not expected that this last pure process will take place at a size equal to the total oil bill. On the other hand, some increase in investment and consumption of the oil producing countries is expected to take place. Some estimates are summarized in Chapter 7. In the case of high revenues, increased imports will reach \$28 billion in 1975 when oil revenues increase by \$80 billion. In the case of low revenues the increased import will be \$18 billion when oil revenues increase by \$40 billion.

*See Appendix 3.

4. Integrating the Pure Elements--No Frictions

The above three pure elements help to simplify the complexity of the actual economic scene. We conceive this complexity as a simple combination of the three pure elements. The no-friction assumption makes it possible to clarify this concept. We shall assume that the increased oil revenues are divided into two parts. One part is used to finance the increased imports by the oil producing countries (element 3) and the balance is invested abroad. In addition we conceive of the decline in the real gross national income of the oil importing countries (which is exactly equal to the increased revenues of the oil producing countries) as being divided into two parts. The first is a decline in aggregate domestic spending (element 2). The second is the balance. By assuming that the value of increased imports of the oil producing countries is equal to the value of the increased exports of the oil consuming countries we can combine the two processes into one system. The emerging net increase in the current account deficit of the balance of payments of the oil consuming countries is that part of the system which is subject to the pure financial effect (element 3).

By inserting certain proportions of the increased oil revenues to element 3 (i.e., increased imports by the oil producing countries as a proportion of increased oil revenues) as well as to element 2 (i.e., reduced spending in the oil importing countries as a proportion of the increased oil costs), we can solve for the new equilibrium and find the implications to changes in consumption, investment, the deficit in balance of payments, and the magnitude of financial recycling.

The following example aims to clarify this process. Using Appendix 3, let us assume that the marginal propensity to consume is 0.80, and let us "trace" the "pure" effects of a \$1 billion increase in oil revenues in the following three cases:

- (1) A \$1 billion increase in oil revenues finances increased exports from the oil consuming to the oil producing countries.
- (2) \$1 billion of increased oil costs leads to increased domestic investments by \$800 billion to compensate for the reduced consumption, and to retain full employment.
- (3) \$1 billion of increased oil costs leads to increased government spending on public consumption by \$800 billion to compensate for the reduced consumption and employment.

These three cases are summarized in the following table (taken from Appendix 3).

TABLE 44
NET CHANGES IN REAL ECONOMIC MAGNITUDES
"PURE" CASES
(Per \$1 bill. of Oil Bill)

	(1) EXPORT	(2) INVESTMENT	(3) GOVERNMENT CONSUMPTION
Real National Income	-1.0	-1.0	-1.0
Import	+1.0	+1.0	+1.0
Export	+ .8	0	0
Consumption	- .8	- .8	0
Domestic Investments	0	+ .8	0
Foreign Investment*	- .2	-1.0	-1.0
Total Investments	- .2	- .2	-1.0
National Savings	- .2	- .2	-1.0

*This is the increased deficit (or reduced surplus) in the current account of the balance of payments. This amount is subject to the financial recycling.

The actual economic scene is a simple combination of these three cases, weighted by their relative magnitudes. In the following table we summarize the overall economic outcomes for the oil importing countries using three selected weights, where the total increase in the oil costs is low. The weights as a fraction of the total oil bill are as follows:

	<u>Increased Exports</u>	<u>Increased Domestic Investment</u>	<u>Increased Public Consumption</u>
A	1/3	1/3	1/3
B	1/2	1/4	1/4
C	1/3	1/2	1/6

These weights give the following results:

TABLE 45
SUMMARY OF ECONOMIC IMPLICATIONS OF INCREASED OIL PRICE
NO FRICTIONS CASE

	A	B	C
Real GNI (increase of oil bill)	-100	-100	-100
Imports	+100	+100	+100
Exports	+26-2/3	+40	+26-2/3
Consumption	-53-1/3	-60	-66-2/3
Domestic Investments	+26-2/3	+20	+40
Foreign Investments	-73-1/3	-60	-73-1/3
Total National Investments	-46-2/3	-40	-33-1/3
Total National Savings	-46-2/3	-40	-33-1/3

From the table we see the following outcomes for the oil consuming countries:

- (1) Real gross national income falls by the total amount of the increase in the oil bill.
- (2) Imports rise by the same amount.
- (3) Consumption and total national savings fall by an amount equal to the increased oil bill.
- (4) Domestic investment rises, but foreign investment (i.e., increase of deficit in the current account of the balance of payments or a decline in its surplus) falls by a greater amount.

- (5) The amount of the required financial recycling is equal to the decline in foreign investments.

Case B indicates quite a reasonable case for the new equilibrium that may be reached in two or three years. In this case exports rise by 40 percent of the oil bill, domestic investments by 20 percent, consumption by 60 percent, and the magnitude of required recycling is 60 percent of the required increase in oil revenues.

The outcomes are net changes resulting merely from the increased oil bills. Other simultaneous economic developments such as increased productivity, unemployment, real growth, inflation, and resulting nominal changes in the economic magnitudes will make it difficult to detect empirically direct effects of the increased oil revenues.*

Moreover, these effects are derived under the "no friction" assumption. Such frictions will distort the simplicity of the results. Finally, the parameters assumed in the above illustration will be different for the various countries. Thus the direct impact on each country will differ in magnitude, even in the "no friction" case.

In the next section of this chapter we shall discuss some expected frictions which may disturb the economic development in its movement toward the new equilibrium.

B. Frictions in the Adjustment Process

We divide the discussions on the possible frictions in the adjustment process into two main sections: the frictions in the financial sector and

* In fact, whenever we say that a certain factor (x) will decline (or increase) we actually mean that "the level of (the x factor) will be lower (or higher) than it would have been in case the oil prices remained low," or that "this (factor x) does not grow as it would have at low oil prices."

and the frictions in the real sector.

I. Frictions in the Financial System

a) Frictions within One Country

The pure recycling process involves a transfer of ownership of financial assets from owners residing in the oil importing countries to the hands of the oil exporting countries. The specific payment process can be described by the following steps.

- (1) An importer pays to the exporter for the oil and the exporter retains the payment as a demand deposit in the same bank from which it was drawn. (The importer does not pay on a bank outside its country.)
- (2) The importer sells the oil to customers in his country. His deposit is restored to the original level (plus profits). The customers' deposits decline by the amount of the purchase.
- (3) The foreign exporter transfers the deposits to another local bank with which he works.

Up to this point the country has not lost foreign exchange but its total foreign exchange credit increased by the amount of the import. Public demand deposits declined and foreigners' deposits increased by the same amount.

Assuming (at this stage only) that no transfer of capital outside the country takes place, the principal effect will be the transfers from the consumers' banks to the exporters' local banks. The oil exporters deal essentially only with money market banks while consumers deal with these and also with other, smaller, banks. The latter group of banks will lose deposits to the larger banks reducing the reserves available to make loans to their customers. The larger banks will increase reserves but may be unable to usefully employ them if they are viewed as unstable

deposits, that is, if the banks do not feel they can estimate the time they will have the deposits.

This, of course, is not the end of the process. On the one hand the public seeks to replenish its demand deposits needed for transactions and on the other hand the foreign holders of the deposits will seek to put a substantial part of their new deposits into some financial assets which provide return. Both processes can take place in various ways, but in the case of perfect recycling within the country they will end as follows:

(A) The foreign holders will increase their holdings of financial assets while their demand deposits will go down.

(B) The increased oil bill is paid partly by the business sector (corporations) and partly by the household sector. The households bear that part that is shifted on them by increase of prices. Assuming no change in real consumption and investment (which is the case under discussion here), the household sector will finance its greater nominal expenses (resulting from the increased prices) by reducing its holding of assets. The balance of the oil bill, which is carried by the business sector (by reduced profits), causes a reduction in the sector's net cash flow resulting in an increase in its total liabilities. The total of the reduced assets of the household sector and the increased liabilities of the business sector exactly equals the increase in the oil bill. (The proportion of each represents the relative distribution of the burden between the two sectors.)

Thus, if the foreign oil exporters put all of their increased oil revenues in local financial assets it will exactly equal the sum of

the household financial assets sold and corporate liabilities created. Given this process, the following frictions are expected to occur within one country.

(1) While the total increase in assets held by foreigners is equal to the total sales of assets and increased liabilities of domestic sectors, the composition of each does not necessarily match. The result is an excess demand of some forms of assets and an excess supply of other assets. The excess demand and excess supply will change the return structure of the various financial assets in the market. The return on assets with excess demand will go down and the return on those in excess supply will go up. The reallocation of returns may create problems as some sectors of the local economy no longer can raise capital at traditional costs. Requests for government regulation of returns may result in interventions that will distort the rate structure, create erratic interest rate fluctuations, and increase uncertainty and instability of the financial markets.

(2) Transfer of reserves from a wide range of banks to a small number of big banks will increase concentration in the banking system. It may also create scarcity of credit in regions and sectors relying on smaller and medium size banks, resulting in increased borrowing rates for these sectors. On the other hand it will create an excess supply of liquidity at the big banks, which will not be used to its full capacity to replenish credits, due to the risk that large deposits might be withdrawn on too short a notice. Thus the banking credit system may be bound to instability which will have disturbing implications for business production and trade.

(3) Faced with such disturbances the central monetary authorities (the central banks) will feel obliged to intervene in order to adjust the banks' reserves and assure the required credit capacity. However, it is unlikely that the central banks will be able to make a perfect adjustment at all times. This may show itself in relatively more erratic shifts from excess supply of credit to tight money and back.

b) Friction Among Countries

What is perhaps the most serious financial friction may occur when the exporters transfer their deposits from one importing country to another, thus distributing their holdings of deposits and financial assets among the countries in proportions which do not correspond with the increased imports of oil in those countries. This process adds to the above mentioned "one country" frictions a "set" of other, possibly serious frictions. The implications of these shifts in deposits on the importing country that loses the deposits (say, Italy) differ from the implications for the country that receives the deposits (say, the U.S.).

Italy loses foreign exchange reserves, and bank reserves and total demand deposits also, decline by the same amount. In order to replenish the money supply, the central bank has to provide reserves to the commercial banks, which in turn increase their loans to the public thereby replenishing the demand deposits. Thus total liabilities of the public sector (including both businesses and households) increase by the amount transferred from the country and total money supply remains as it was before the transaction took place. Yet the central bank loses the foreign exchange reserve and in order to continue international transactions, the country must increase its borrowing from foreign countries.

In the U.S. foreign deposits with the domestic banks increase as do their reserves. Foreign exchange reserves with the Federal Reserve also increase. In order to neutralize the expansionary monetary effect, the Federal Reserve has to take steps to reduce bank reserves to their original level.

Assuming that this takes place, there is still an excess demand for financial assets created by the foreign capital that was transferred to the U.S. This will affect the structure of interest rates on the financial assets of the U.S. to an even greater extent than happens in Italy, because the public does not reduce its demand for assets nor does it increase its supply of liabilities, since this shift of capital (from Italy) did not involve the burden of increased oil expenditures.

The U.S. domestic public deposits decrease and the public must look for other sources to replenish its deposits. At the same time the foreign depositors look for opportunities to invest their money in earning assets. The sum of domestic and foreign owned deposits is the same as before; the difference is that foreigners hold a greater amount of local assets while the public reduces its holdings of assets in order to replenish its demand deposits that were first cut down due to the action of the Federal Reserve.

Thus the difference between the case of an importing country and the case of a deposit receiving country is as follows: In the importing country the public had to pay a greater bill for the oil by reducing its holding of assets and increasing its liabilities. The total is equal to the increased assets held by the oil exporters. In the receiving countries the public does not pay for the oil and in order to cause a decrease its asset holdings and an increase in its liabilities in order to match the

foreign investments, the central bank reduces bank reserves, thus forcing the banks to reduce their loans to the public. This process adds to the instability of the financial system.

Another net effect is that the importing country (Italy) loses foreign exchange reserves and the receiving country (U.S.) gains foreign exchange reserves. Perfect recycling requires that the receiving country lends these gained foreign exchange reserves to the importing country that has lost it. This results in another form of international credit. If this is done among central banks it has no further effect on the banking system and the process should repeat itself as long as the importing country loses reserves.

To believe that such recycling among countries takes place smoothly is, however, a heroic assumption. If it does not take place, serious frictions will appear because certain countries lose their international creditworthiness. This is apt to be particularly true in underdeveloped countries and may very well apply to some developed countries. If this friction occurs, it will cause changes in interest rates and exchange rates. Interest rates in an importing country will rise in order to attract international credit. Its exchange rate will decline in order to reduce its imports, increase its exports and thereby replenish its net supply of foreign exchange. (The exporting country will see also interest rates and exchange rates move in the opposite direction.) Moreover, the importing countries will be forced to take special monetary and fiscal measures that may have a recessionary effect on their economy.

The international recycling process, however, would work much more perfectly if international monetary reforms are made which increase the

liquidity available to the depressed countries. The essence of such a reform is the pooling of all of the surpluses of the receiving countries into an international fund which would be used to finance the needs of the other importing countries.

This improves the recycling process for the following reasons. First, it stabilizes the process of recycling and assures its more complete implementation. Second, the international fund can create loans to depressed countries, thereby adjusting for the required international liquidity. And third, this fund pools together the default risk of the international credit (especially to developing countries), and thereby it shares the burden with the financing countries at a predetermined proportion, thus reducing their uncertainty.

It is highly improbable that such a reform will take place in the near future, though some partial reform may occur gradually. Thus the international recycling problem seems to be a real one.

It is expected that the exporting countries will shift their holdings to countries that have the following characteristics:

- (1) a relatively more stable economy;
- (2) relatively slight prospects for high rates of inflation;
- (3) a relatively small probability of devaluation;
- (4) a relatively small unfavorable effect of increased oil revenues on the economy;
- (5) developed money and capital markets that can absorb large investments.

Given these criteria, the U.S. rates the highest profile and is expected therefore to receive a relatively large share in the flow of money.

Because they are oil importing countries that are bound to lose reserves,

France, Germany, Japan and the U.K. are second in the rating. They may receive deposits approximately equal to the sum required to finance their increased oil bill, though deviations from this "equilibrium" may easily occur. Other European countries may fall in this category or in the third category which is the one that loses deposits and suffers from imperfect recycling. Most of the developing countries certainly fall into this third category.

In conclusion, frictions in the financial sector are bound to occur in various forms. They will be reflected in size and concentration of financial institutions, in the level and structure of borrowing interest rates, in excess demand and supply of various financial assets, and of course in creditworthiness of some countries. Perfect recycling among countries is not enough to avoid such frictions, and as we have seen in the "one country" case international recycling may not occur perfectly due to the lack of an efficient international monetary system. This may have implications reaching beyond the financial sector, into the real sector: employment, trade, and economic growth. We shall refer to the real sector in the following section.

2. Real Economic Frictions in the Oil Importing Countries

We shall deal with real economic frictions in two sub-sections: first, with regard to that part of the increased oil bill that is not used to increase imports to the oil producing countries (OPC) and second, with regard to the other part that finances such an increase of imports.

a) No Increase in Import by Oil Producing Countries

In a frictionless world discussed in the preceding chapter, we have concluded that in order to achieve a new full employment economic equilibrium, at the lower real national income, the oil importing countries should increase their domestic investments by 80 percent of their increased oil bill. (Eighty percent is just an example. Actually it is the marginal propensity to consume and spend.) This closes the deflationary gap created by the reduced domestic consumption and spending which results from the decline in the real national income. The friction arises from the simple fact that there are no indigenous incentives to increase the domestic investment at such a high rate. With the gloomy expectations, investment may well go down rather than increase. As a result, the deflationary gap will create greater unemployment and further reduction of output.

In order to prevent this serious unfavorable development, the aggregate demand of the economy should be increased. This is achieved in two ways.

(1) A decline in the interest rates which may encourage investment and private consumption. However, historical experience shows that in periods of gloomy expectations, declining interest rates have a limited effect (if any) on aggregate demand.

(2) An increase of government expenditures on investment and on public consumption to make up for the deflationary gap (a case which we investigated in Appendix 3, and incorporated into Table 45). This can be accompanied also by a reduction of taxes.

Taking vigorous steps by the governments to reduce the deflationary gap and prevent an increase of unemployment is a very difficult political problem in a period of cost-push inflation that persists today in many countries. We have here an unfortunate combination of unemployment with inflation which is enhanced by the increased deflationary gap. If the government follows an expansionary fiscal and monetary policy in order to reduce the inflationary gap they may succeed in preventing a significant increase in unemployment but much increase the rate of inflation. While the increased inflation will be easily detected to the government expansionary policy, the success in preventing a further increase in unemployment will not be politically appreciated simply because this avoidance does not become obvious. Moreover, when some unemployment already exists for other reasons the governments may be incorrectly blamed for crediting inflation while not succeeding in reducing unemployment while in fact they might have succeeded in preventing a further increase in unemployment. But this is not recognized. On the other hand, lack of vigorous steps against the inflationary gap may result in increased unemployment, which again, will be held against the government policies. Being caught in such a "flation trap," governments may switch quite erratically from one policy to its reverse, neutralizing its own actions and contributing merely to increase economic instability. Meanwhile the economies will face a combination of inflation and unemployment. Thus, the net effect of the increased oil bill will be split between some upward push of inflation and some downward push of employment. One should also note that these problems are bound to develop under the assumption that the process of recycling the capital will work perfectly. If it does not, it will add further frictions to the real economic sectors as discussed above.

b) Increased Imports by the Oil Producing Countries

The increase in consumption and investment in the oil exporting countries means an increase in the imports from the rest of the world, which entails an increase in the exports of the oil exporting countries. As we have seen, in this case the decline in domestic consumption and spending in the oil importing countries releases reserves for export to the oil producing countries. In a frictionless world this is the most favorable case because it will exactly neutralize the frictions of aggregate imbalance we have seen above in the real sectors of the importing countries. However, even this case is subject to frictions which result mainly from the following factors:

(a) The commodity composition of the increased demand of the oil producing countries is not identical to that of the reduced demand to the oil importing countries (OIC). Thus in order to match it, structural changes in the economy of the OIC are required before a stable equilibrium is received.

(b) The distribution of the increased demand for imports to the oil producing countries from the OIC does not necessarily match the decline in demand within the OIC on a country by country basis. This is shown in the following table:

<u>Country</u>	<u>#1</u>	<u>#2</u>	<u>#3</u>	<u>TOTAL</u>
Reduced domestic aggregate demand	-1	-2	-3	-6
Increased export	+3	+1	+2	+6
Net change in aggregate demand	+2	-1	-1	0

The first row shows by how much the aggregate demand in the OIC is reduced. The second row shows the distribution of demand for OPC imports from the OIC, which in total match the first row. Thus there is an aggregate balance. However, the results do not match by individual oil importing countries. Thus country #1 faces an increase in exports greater than a decline of its domestic aggregate demand while countries #2 and #3 face net declines. This creates a demand inflationary gap in country #1 and a deflation gap in countries #2 and #3. The latter countries thus face the same kind of real frictions discussed in the preceding sub-section, and this is despite the total aggregate demand for all the countries is balanced. At the same time country #1 faces a new problem which has not appeared before, i.e., a demand inflation. In order to reduce it, restrictive fiscal and monetary policies must be implemented in order to reduce the domestic aggregate demand for consumption and investment. Whether governments are able to follow such a policy with correct timing is a big question, despite the fact that with full employment it is easier politically to implement this policy as compared to the case where deflationary forces existed.

Stable equilibrium among these countries will be reached only if the OIC themselves neutralize these balances, i.e., that country #1 imports from country #2 and #3. In order for this to happen, changes in exchange rates must take place so that in country #1 the currency is revalued and in #2 and #3 devalued. While this development may very well happen, the period involves painful costs of adjustment.

C. Conclusions:

(1) Accumulation of capital in excess of domestic uses will continue to take place even if prices decline. At low prices capital accumulation will be concentrated mainly in the hands of Saudi Arabia and the other Arab sheikdoms. Net surpluses, i.e., positive accumulation at any price level will continue well into the future despite the economic growth and the increasing absorption capacity of the oil producing countries. However, the magnitude of the accumulation depends on the price level. Thus, the recycling process will take place over a long period of time.

(2) Perfect recycling by transfer of asset ownership and creation of financial liabilities will not solve the whole economic problem. The decline in real income will reduce aggregate consumption and spending and create a deflationary gap. Rather than helping to cut the inflation (cost push inflation) it will increase unemployment.

(3) Perfect recycling among countries may not work well because of the inefficient monetary system.

(4) Even if the perfect recycling among countries does work well, internal financial frictions are expected.

- (a) Due to movement of funds from small to large financial institutions;
- (b) Due to erratic changes in the borrowing rate structure;
- (c) Due to rapid changes in the demand structure for financial assets.

(5) Combining imperfect recycling among nations and financial frictions within countries, it is not improbable that the financial system will face dramatic problems, such as bank failures and deterioration of the system's credibility.

(6) A prudent monetary and financial policy under international cooperation can technically prevent this crisis. It is questionable, however, whether such cooperation will be achieved.

(7) Governments face "flation traps" where cost inflation and unemployment simultaneously exist. Flation traps are compounded by increased oil prices. It is questionable whether governments will succeed in dealing successfully with this dilemma.

(8) Due to the increased imports to the oil producing countries, there will be an increase in the volume of international trade that will constitute in the next 2-3 years some 35 percent of their oil revenues, while this development facilitates the recycling process, it creates problems of adjustment in the real sectors. Some countries may face excess demand for exports, and the recycling among the oil importing countries will be required in increasing magnitudes.

(9) The process of international adjustment will require changes in exchange rates (devaluation and revaluation). The system of floating exchange rates is more efficient than some system of fixed rates in dealing with this process.

(10) There will be a trend toward a decline in the real interest rates, but due to inflation the nominal rates may remain high.

It should be emphasized that these problems are objective implications of the increased oil prices. They are expected to develop even if the oil producing countries cooperate with the western world by smoothing the recycling process and avoiding the use of financial power to threaten the economic world.

APPENDICES

Appendix 1

THE PRICE ELASTICITY OF SUPPLY IN THE NORMAL 48

In recent years several attempts have been made to estimate the price elasticity of supply in oil and gas.

A. Fisher's Estimates

The first extensive study was made by Franklin M. Fisher. *

1. Oil

Oil supply elasticity is the sum of three partial elasticities:

- A. The price elasticity of wildcat drilling.
- B. The price elasticity of the success ratio.
- C. The price elasticity of the average size of discovery.

Since total discovery is a product of the rate of wildcat drilling, the rate of success ratio and the average size of discovery, the overall supply elasticity is the sum total of these three partial effects. Fisher's estimates are given below.

SUPPLY OF RESERVES: OIL AND GAS

	Estimate	Estimate	Estimate
	1	2	3
A. Price elasticity of wildcat drilling:	+2.85	+2.45	+2.27
B. Price elasticity of success ratios:	-.36	-.39	
C. Price elasticity of average size in productive discoveries:	-2.16	-1.63	

The resulting price elasticity of supply is:

Highest estimate: $n_s^H = 2.85 - .36 - 1.63 = .86$

Lowest estimate: $n_s^L = 2.27 - .39 - 2.16 = -.32$

*F. M. Fisher, Supply and Costs in the U.S. Petroleum Industry, Resources for the Future, Baltimore, Md., John Hopkins Press, 1964, p. 35.

The negative estimate is inconceivable. Therefore, the estimate is between 0 and +.86.

2. Natural Gas

Natural gas is a joint product, with oil, of drilling and discovery. Therefore, the price elasticities of wildcat drilling and success ratio mentioned above refer also to gas. The price elasticity of the average size of gas discovery per productive wildcat drilling was estimated.

Estimate 1: -2.01
Estimate 2: -1.55

Accordingly, the highest and the lowest elasticities of gas supply were:

$$\begin{aligned} \text{Highest: } n_s^H &= 2.85 - .36 - 1.55 = .94 \\ n_s^H &= 2.27 - .39 - 2.01 = -.13 \end{aligned}$$

Hence, the range is: 0 - +.94.

3. Fisher's Conclusion

Fisher concludes that the best estimates are:

Oil: +.3
Gas: +.3

Since these findings refer to the 1950s, the estimates should be adjusted downward to reflect the 1970s and 1980s.

B. Erickson and Spann's Estimates

Another study was made by Erickson^{*} on the basis of Fisher's findings, whose results were re-evaluated and adjusted accordingly.

^{*} Erickson, E. W., Economic Incentives, Industrial Structure and the Supply of Crude Oil Discoveries in the U.S., 1946-58/59. Unpublished Ph.D. Dissertation, Vanderbilt University, 1968.

Erickson revised Fisher's elasticity of supply from an estimate of +.3 to an estimate of +.91.

Further elaboration of these analyses were made by Erickson and Spann,^{*} whose own estimates were as follows:

1. Oil

- A. Wildcat Drilling: +1.48
- B. Success Ratio: -.23
- C. Average Discovery Size: -.42

$$n_{s(\text{oil})} = 1.48 - .23 - .42 = +.83$$

2. Gas

- A. Wildcat Drilling: +.35
- B. Success Ratio: +.01
- C. Average Discovery Size: +.33

$$n_{s(\text{gas})} = +.69$$

With respect to gas, Erickson and Spann modified their estimates of elasticities from +.69 to .5 (p. 117 ibid.).

3. Cross Elasticities

Erickson and Spann also calculated cross-elasticities as follows:

Cross-elasticity of oil supply with respect to natural gas price: +1.07. Thus a one percent increase in the price of gas was found to be associated with a 1.07 percent increase in oil discovery. However, gas cross-elasticity of supply with respect to oil price was found to be negative (-.25). Thus a one percent increase in the price of oil was associated with a .25 percent decline in gas discovery.

^{*}Erickson, E. W., and Spann, R. M., "Price, Regulations and the Supply of Natural Gas in the U.S.," in Resources for the Future, Keith Brown, ed.

C. Mancke's Estimates

A study by Mancke^{*} presented another method of estimating the price elasticity of supply. This method, however, provides results which are very sensitive to certain strong assumptions. Mancke found that the price elasticity of supply in the 48 must be far greater than +1.0. In particular, he concludes that the expected long-run real cost of oil was:

- (1) Some unknown quantity of "lower 48" oil: \$2.51/bbl.
- (2) Off-shore: \$1.42/bbl.
- (3) The remaining oil: less than \$2.51/bbl.

To reflect 1974 prices, the above must be increased by 50 percent.

D. Conclusion

While these studies leave a wide range of estimated price elasticities of supply for oil and natural gas, all indicate a greater-than-zero elasticity. From these estimates, the most reasonable conclusions are:

- For oil: between .3 and .8
 For gas: .5

However, these data refer to normal sources of oil in the 48 states during the 1950s and therefore are based on price fluctuations in the low range (i.e., between \$1 and \$3 per barrel of oil). Had these findings been applied indiscriminately to the 1970s and 1980s, a reduction of the elasticity estimates would have been required. But at prices higher than \$4/bbl., there is a greater incentive for exploration, so that the above estimates may be relevant to the higher price levels. Consequently

* Mancke, R. M., "The Long-Run Supply Curve of Crude Oil Produced in the U.S.," Antitrust Bulletin, Winter 1970, pp. 727-56.

the following conclusion is made:

At a price of \$3/bbl., output declines by 2 percent of the 1973 output. At higher prices, output increases from the lower base, reflecting price elasticity of +.3.

Appendix 2

THE METHODOLOGY OF ESTIMATING THE ENERGY DEMAND FUNCTION FOR 1980

A. Price Effect and Income Effect

In order to project energy consumption in 1980, estimates of the following variables are required: (1) the change in income from 1973 to 1980; (2) the change in prices during that period; and, (3) price and income elasticities of the demand for energy.

The sum total of energy consumption in 1973 is defined by C_{73} . Consumption in 1980 (C_{80}^1) at constant prices is defined as the sum of consumption in 1970 plus the change in 1980 consumption attributable to changes in income, ΔC_y . Thus

$$(1) \quad C_{80}^1 = C_{73} + \Delta C_y$$

Consumption in 1980 at actual prices (C_{80}^2) is defined as the sum of C_{80}^1 and the change in 1980 consumption attributable to changes in prices, ΔC_p .

Hence:

$$(2) \quad C_{80}^2 = C_{80}^1 + \Delta C_p = C_{73} + \Delta C_y + \Delta C_p$$

Therefore:

$$(3) \quad C_{80}^2 - C_{80}^1 = \Delta C_p$$

The price effect, C_p , comprises two components, respectively

ΔC_{P1} : the price effect of the consumption level of 1973.

and ΔC_{P2} : the price effect on the increase in consumption resulting from the increase in income over the period. Thus, ΔC_{P2} is the price effect on ΔC_y . Therefore,

ΔC_{P1} is independent of income elasticity, while ΔC_{P2} is a function of the income elasticity.

B. Alternative Demand Models

The elasticities of income and price which were estimated from empirical studies refer to past fluctuations in prices. They are all based, therefore, on relatively low and declining prices, and reflect only that section of the demand curve. Estimating the demand at higher prices requires certain assumptions, notably the manner in which the price-elasticity changes along the demand curve. Two methods were applied in the investigation of price elasticity. One assumed that the arc-elasticity in the section between the low and high prices is equal to the empirically derived elasticity estimates. The second assumes that the demand curve is a combination of a fixed, minimum demand and a quantity that does depend on prices, whose elasticity is constant and equal to the empirical estimates. We shall investigate in detail these two demand models.

1. The Arc-Elasticity Demand Model

Arc elasticity is defined as:

$$N_p = \frac{\frac{Q_1 - Q_0}{Q_1 + Q_0}}{\frac{P_1 - P_0}{P_1 + P_0}}$$

where P = price and Q = amount demanded.

This formulation provides a measure of the elasticity, for a change in the price from P_0 to P_1 associated with a change in the consumption from Q_0 to Q_1 ; thus it is a measure of the average elasticity for the section of the demand curve between point 0 and point 1. Applying this formula to the consumption of energy in 1980, we have

$$(4) \quad N_p = \frac{\frac{\Delta C_p}{C_{80}^1 + C_{80}^2}}{\frac{\Delta p}{P_0 + P_1}}$$

This can be rewritten to yield

$$N_p = \frac{\Delta C_p}{C_{73} + \Delta C_y + C_{73} + \Delta C_y + \Delta C_p} \cdot \frac{P_{80} + 3}{P_{80} - 3}$$

Where $p_0 = 3$ and $p_2 = p_{80}$.

Finally,

$$(5) \quad N_p = \frac{\Delta C_p}{2C_{73} + 2\Delta C_y + \Delta C_p} \cdot \frac{p_{80} + 3}{p_{80} - 3}$$

If it is assumed that income grows at a rate of 4 percent per year, then income in 1980 will equal $(1.04)^7$, or 1.316 more than the income in 1973, i.e., $y_{80} = 1.316y_{73}$.

The income elasticity of the demand for energy is defined as

$$(6) \quad N_y = \frac{\frac{\Delta C_y}{C_{73}}}{\frac{\Delta y}{y_{73}}} = \frac{\frac{\Delta C_y}{C_{73}}}{.316}$$

This last equation becomes

$$(7) \quad \Delta C_y = .316 \cdot N_y \cdot C_{73}$$

Substituting in equation (5) and assigning a base of 100 to C_{73} , yields:

$$(8) \quad N_p = \frac{\Delta C_p}{200 + 2(31.6)N_y + \Delta C_p} \cdot \frac{P_{80} + 3}{P_{80} - 3}$$

Solving for the price effect, we obtain the expression:

$$(9) \quad \Delta C_p = \frac{N_p(200 + 63.2N_y)}{\left(\frac{P_{80} + 3}{P_{80} - 3}\right) - N_p}$$

Assuming $p_{80} = 9$, $N_p = -.2$ and $M_y = 1.25$, the percentage increase in 1980 consumption can be calculated by adding the income and price effects together. From equation (7), the income effect (in percentage terms) is:

$$\Delta C_y = .316(1.25)100 = 39.5$$

The price effect (equation (9)) in percentage terms is:

$$\Delta C_p = \frac{-.2(200 + 63.2(1.25))}{\left(\frac{9+3}{9-3}\right) - (-.2)} = \frac{-.2(279)}{2.2} = -25.4$$

Summing the combined price and income effects on consumption yields a 14.1 percent increase in consumption in 1980.

Furthermore, the price effect can be subdivided into its two components as follows:

$$\text{From } \Delta C_p = \frac{N_p(200 + 63.2N_y)}{\left(\frac{P_{80} + 3}{P_{80} - 3}\right) - N_p}$$

Obtain

$$\begin{aligned} \Delta C_p &= \frac{200N_p}{\left(\frac{P_{80} + 3}{P_{80} - 3}\right) - N_p} + \frac{63.2 \cdot N_y \cdot N_p}{\left(\frac{P_{80} + 3}{P_{80} - 3}\right) - N_p} \\ &= \Delta C_{p_1} + \Delta C_{p_2} \end{aligned}$$

In the above example

$$\Delta C_{p_1} = \frac{200(-.2)}{2.2} = -18.2$$

$$\text{and } \Delta C_{p_2} = \frac{63.2(1.25)(-.2)}{2 - (-.2)} = 7.2$$

Confirming that $\Delta C_p = \Delta C_{p_1} + \Delta C_{p_2}$

$$\text{by } -25.4 = (-18.2) + (-7.2)$$

Percentage changes in 1980 consumption, divided into its price and income effect components, were calculated for the following combinations

of N_y , N_p , and 1980 prices.

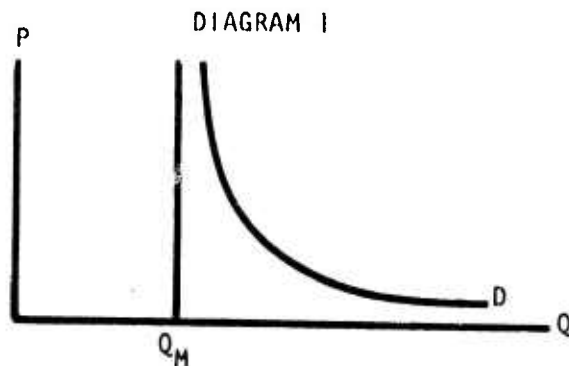
$$N_y = .5, .75, 1, 1.25, 1.5$$

$$N_p = -.1, -.2, 0.35, -.5$$

$$P_{80} = 3, 6, 9, 12$$

2. The Fixed Minimum Demand Model

Now assume that the demand curve for energy is as follows:



It is assumed here that a minimum demand of Q_M is essential to any given economy. It is further assumed that such a minimum demand is independent of the level and movement of prices. Even if prices reach extraordinarily high levels, demand will not fall below Q_M . However, should prices decline the consumption will increase from Q_M up, in such a manner that the elasticity of the demand curve in the section to the right of Q_M is constant and equal to the empirically derived estimates of elasticity.

This demand function can then be rewritten as follows:

$$(10) P = \frac{K}{Q - Q_M}$$

In order to specify the function, estimates of the parameters Q_M and K need to be obtained. For this purpose, empirical estimates of the price elasticity, N_p , are used.

The price elasticity of this function is:

$$(11) N_p = -\left(1 - \frac{Q_M}{Q}\right)^*$$

It follows that

$$(12) Q_M = (1 - N_p)Q$$

Letting

$$Q = C_{73} = 100, \text{ then}$$

$$Q_M = (1 - N_p)100$$

Hence Q_M is a percentage of the actual consumption, which is determined by the elasticity, N_p . If, for example, $N_p = -.2$, then Q_M is 80 percent of the total consumption level. After defining Q_M , it is a simple matter to specify K from the empirical data and the demand function.

Since

$$P = \frac{K}{Q - Q_M},$$

$$(13) K = P(Q - Q_M) = PQN_p$$

For 1973 P is equal to \$3. Suppose $N_p = -.2$, it follows that $K = 60$. Hence, for this example the demand function is specified,

$$P = \frac{60}{Q - 80}$$

We can therefore plot points along the demand curve and calculate the price elasticity at each point, rather than settle for a constant arc-elasticity for the entire range.

Continuing the above example, $Q = \frac{60}{P} + 80$, and we derive a demand schedule which is shown in the following table.

$$\begin{aligned} * N_p &= \frac{\partial Q}{\partial P} \cdot \frac{P}{Q} = \frac{-K}{P^2} \cdot \frac{P}{Q} = \frac{-K}{PQ} = -\frac{K}{\left(\frac{K}{Q - Q_M}\right)Q} \\ &= \frac{-Q - Q_M}{Q} = -\left(1 - \frac{Q_M}{Q}\right) \end{aligned}$$

TABLE 1

PRICE, P	QUANTITY	PRICE ELASTICITY
3	100	-.2
4	95	-.157895
5	92	-.130435
6	90	-.111111
7	88-4/7	-.096774
8	87.5	-.0857143
9	86-2/3	-.076923
10	86	-.0697675
11	85-5/11	-.0638298
12	85	-.0588236

As can be noted in this example, the price elasticity which was estimated empirically at low prices, falls gradually with the increase in prices. In fact, it approaches zero as demand, Q , approaches the indispensable demand, Q_M (80 in this example). This demand model was applied to the same combinations of income and price elasticities described above.

C. Selecting the Demand Models

On the basis of the above models, twenty different demand curves were simulated, each represent one of twenty combinations of four price elasticities and five income elasticities. Each of the twenty demand curves from the first model was compared with its counterpart from the second model. The typical relationship is illustrated in the following table.

TABLE 2

P	Q_1	Q_2
3	131.6	131.6
6	115.1	118.4
9	107.1	114.1
12	103.4	111.9

In this table, the two demand schedules are predicated on a price elasticity of $-.2$ and an income elasticity of 1 . Consumption in 1973 is set at 100 , and the rate of growth of Income is assumed to be 4 percent per year.

The difference between these two demand schedules lies in the interpretation of the price elasticities as found in empirical studies. For the Q_1 schedule, this elasticity was applied to the whole range of prices using the arc-elasticity formula. In the Q_2 schedule, this elasticity was applied only to the lower price point ($P=\$3$), from which the price elasticity declines gradually as price increases, reaching $-.06$ at the highest price point of $P = \$12$ (and reaching zero at very high prices).

Our analysis in this study proceeds on the basis of the second demand model, especially since the empirical estimates of the price elasticities unanimously refer to the low price only. It is eminently reasonable to expect that higher prices will lower consumption levels, due to the price effect; it is however to be expected that once prices reach high levels and consumption was already cut down, further reduction of energy consumption at the margin will be increasingly unresponsive to additional price increases. Hence, the price elasticity of demand is expected to decrease as the price increases.

D. The Demand Function: Schematic Estimates

The following five tables present selected points on the twenty estimated demand schedules. They are followed by five diagrams of these twenty demand curves (note again that the tables and the diagrams are expressed in percentage where the consumption in 1973 at price $\$3=100$.) They therefore constitute a basis to derive actual demand schedules by proportionate adjustment of the quantities on the basis of 1973.

TABLE 3

SCHEMATIC DEMAND SCHEDULES

2.1 Income Elasticity = .50

Price	Quantity			
	np= -.10	np= -.20	np= -.35	np = -.50
3	115.8	115.8	115.8	115.8
6	110.0	104.2	95.5	86.9
9	108.1	100.4	88.8	77.2
12	107.1	98.4	85.4	72.4
Highest (Q _M)	104.2	92.6	75.3	57.9

2.2 Income Elasticity = .75

Price	np = -.1	np= -.2	np= -.35	np= -.5
3	123.7	123.7	123.7	123.7
6	117.5	111.3	102.1	92.8
9	115.5	107.2	94.8	82.5
12	114.4	105.2	91.2	77.3
Highest (Q _M)	111.3	99.0	80.4	61.8

2.3 Income Elasticity = 1.0

Price	$\eta_p = -.10$	$\eta_p = -.20$	$\eta_p = -.35$	$\eta_p = -.50$
3	131.6	131.6	131.6	131.6
6	125.0	118.4	108.6	98.7
9	122.8	114.1	100.9	87.7
12	121.7	111.9	97.1	82.3
Highest (Q_M)	118.4	105.3	85.5	65.8

2.4 Income Elasticity = 1.25

Price	$\eta_p = -.10$	$\eta_p = -.20$	$\eta_p = -.35$	$\eta_p = -.50$
3	139.5	139.5	139.5	139.5
6	132.5	125.6	115.1	104.6
9	130.2	120.9	107.0	93.0
12	129.0	118.6	102.9	87.2
Highest (Q_M)	125.5	111.6	90.7	69.7

2.5 Income Elasticity = 1.5

Price	$\eta_p = -.10$	$\eta_p = -.20$	$\eta_p = -.35$	$\eta_p = -.50$
3	147.4	147.4	147.4	147.4
6	140.0	132.7	121.6	110.6
9	137.6	127.8	113.0	98.3
12	136.4	125.3	108.7	92.1
Highest (Q_M)	132.7	117.9	95.8	73.7

DIAGRAM 2

DEMAND CURVES: INCOME ELASTICITY = .5

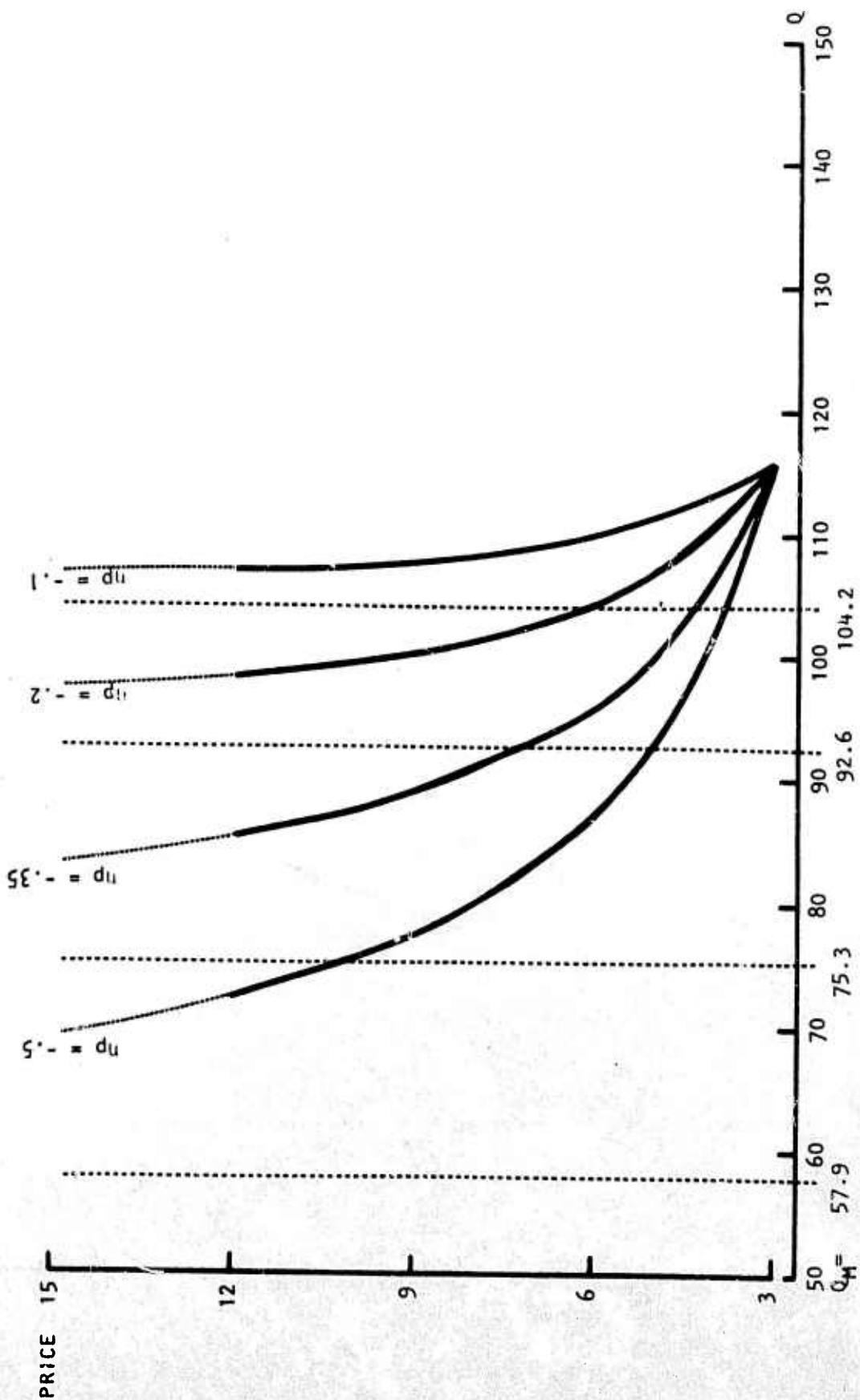


DIAGRAM 3

DEMAND CURVES: INCOME ELASTICITY = .75

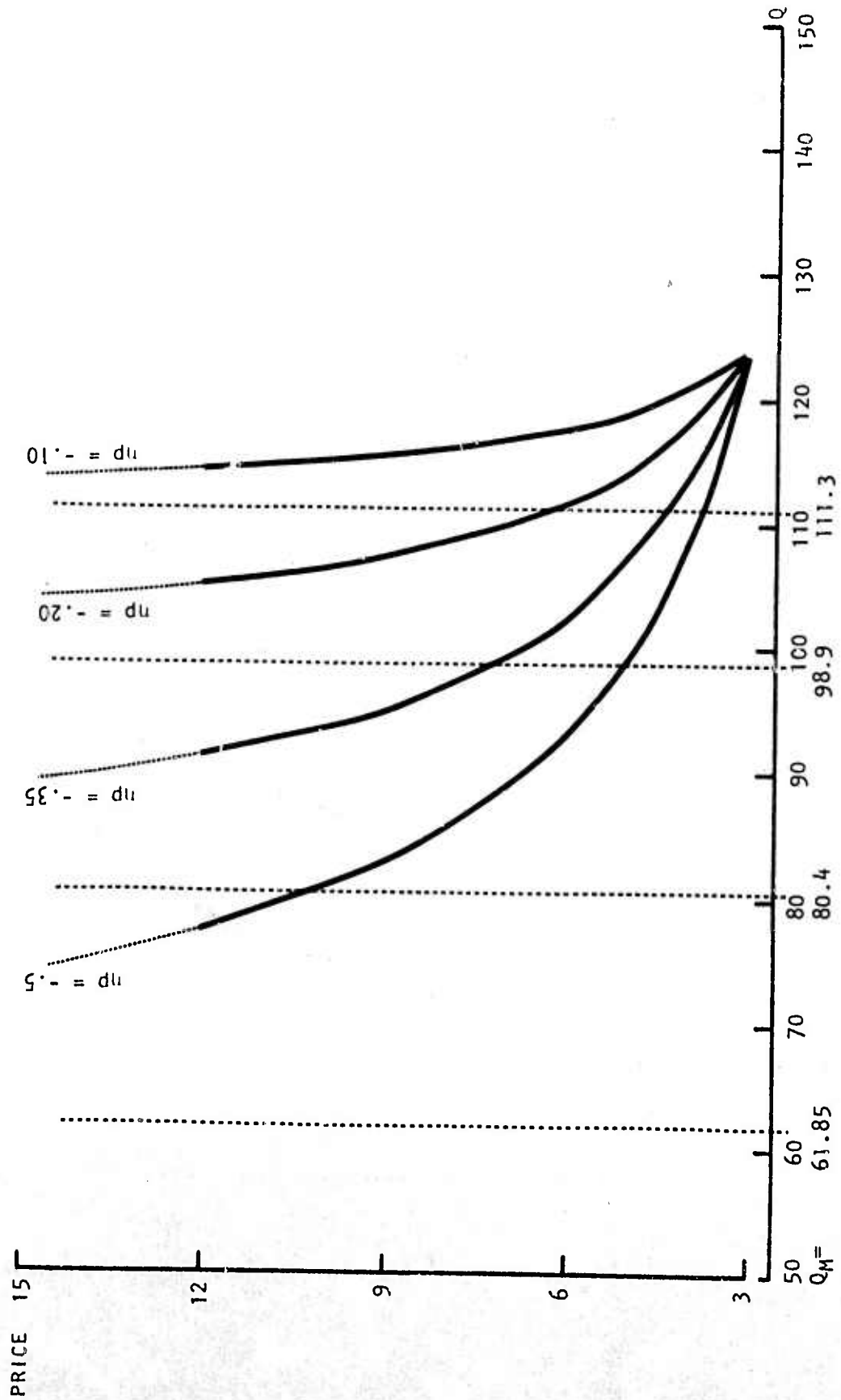


DIAGRAM 4
DEMAND CURVES: INCOME ELASTICITY = 1

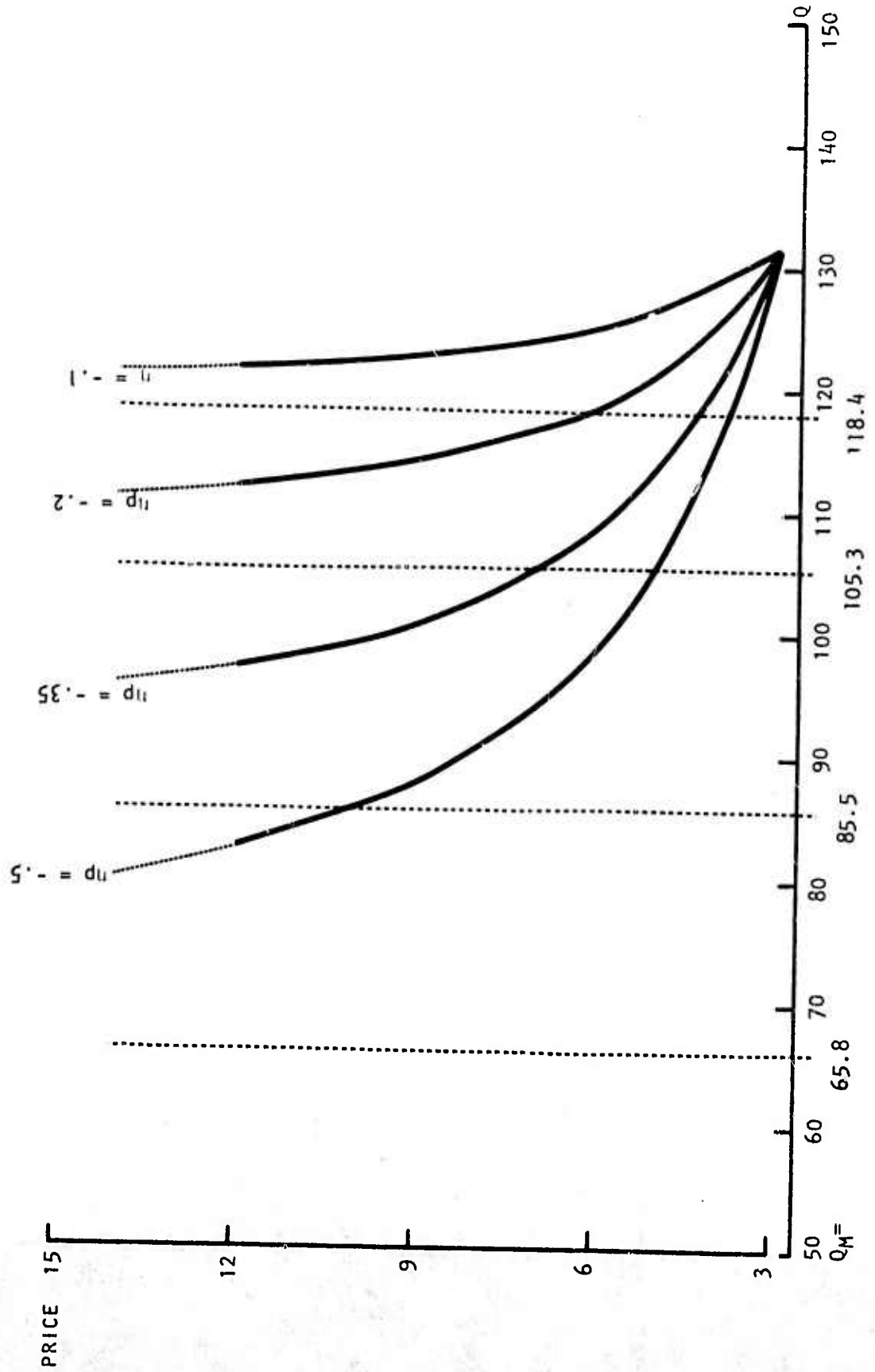


DIAGRAM 5

DEMAND CURVES: INCOME ELASTICITY = 1.25

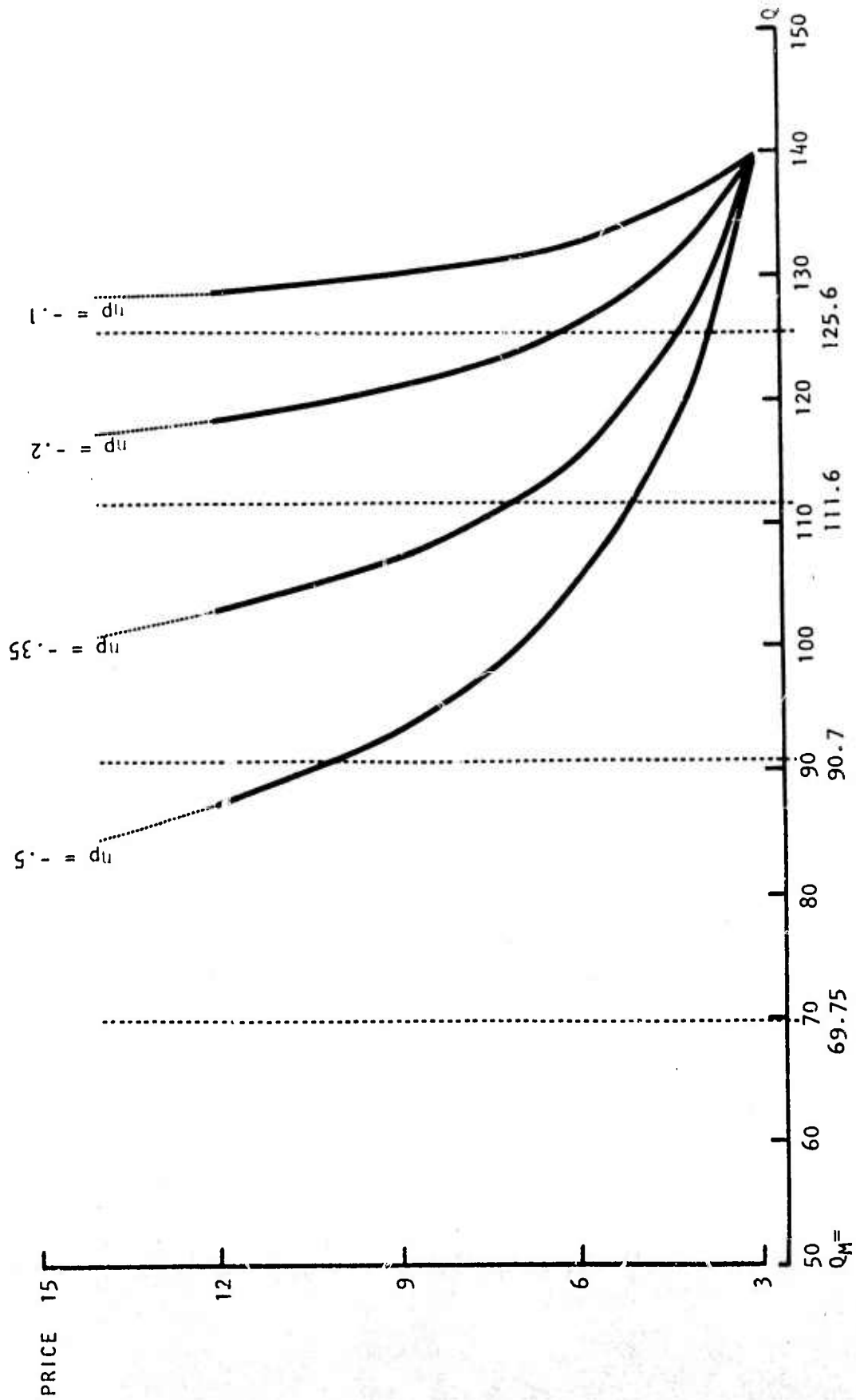
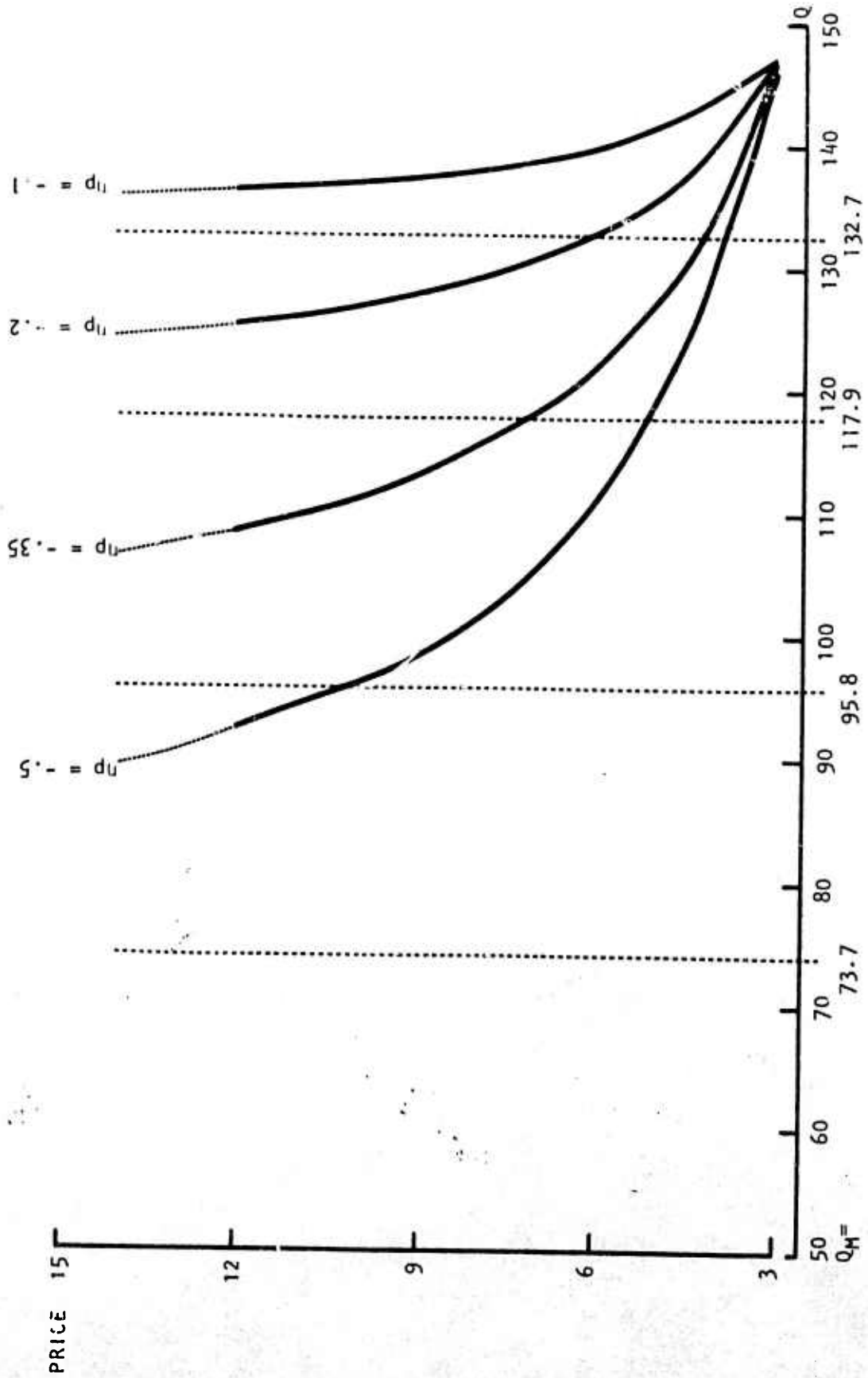


DIAGRAM 6

DEMAND CURVES: INCOME ELASTICITY = 1.5



The preceding tables and diagrams illustrate expected consumption in 1980 (1973=100), given certain elasticity assumptions. Notably, even with a low price elasticity, consumption in 1980 will not rise significantly if the income elasticity is small. Furthermore, if the price remains at \$9 and if the income and price elasticities are at the medium range of the current estimates, then total consumption in 1980 will be between 10 and 20 percent higher than in 1973.

The three following graphs show, for three different price levels (\$6, \$9 and \$12), the expected demand for 1980 at all combinations of income and price elasticity. The upper line (for $\eta_p = 0$) actually represents the expected demand for 1980 at the original price level of \$3. The diagrams show, for example, that at $P=\$9$, 1980 consumption will remain at the 1973 level if the price elasticity is $-.2$ and the income elasticity is about 0.7 ; or it shows that if the price elasticity is $-.35$, then the income elasticity is about 1.3 ; and so on for any other combination of this type. The diagram shows further that at $P=\$12$, 1980 consumption will not be greater than 1973 consumption, as long as the income elasticity is not greater than one, and the price elasticity is not smaller than $-.2$. Thus we need to have a high income elasticity combined with a low price elasticity to see any substantial increase in demand, at high prices.

DIAGRAM 7

P = \$6

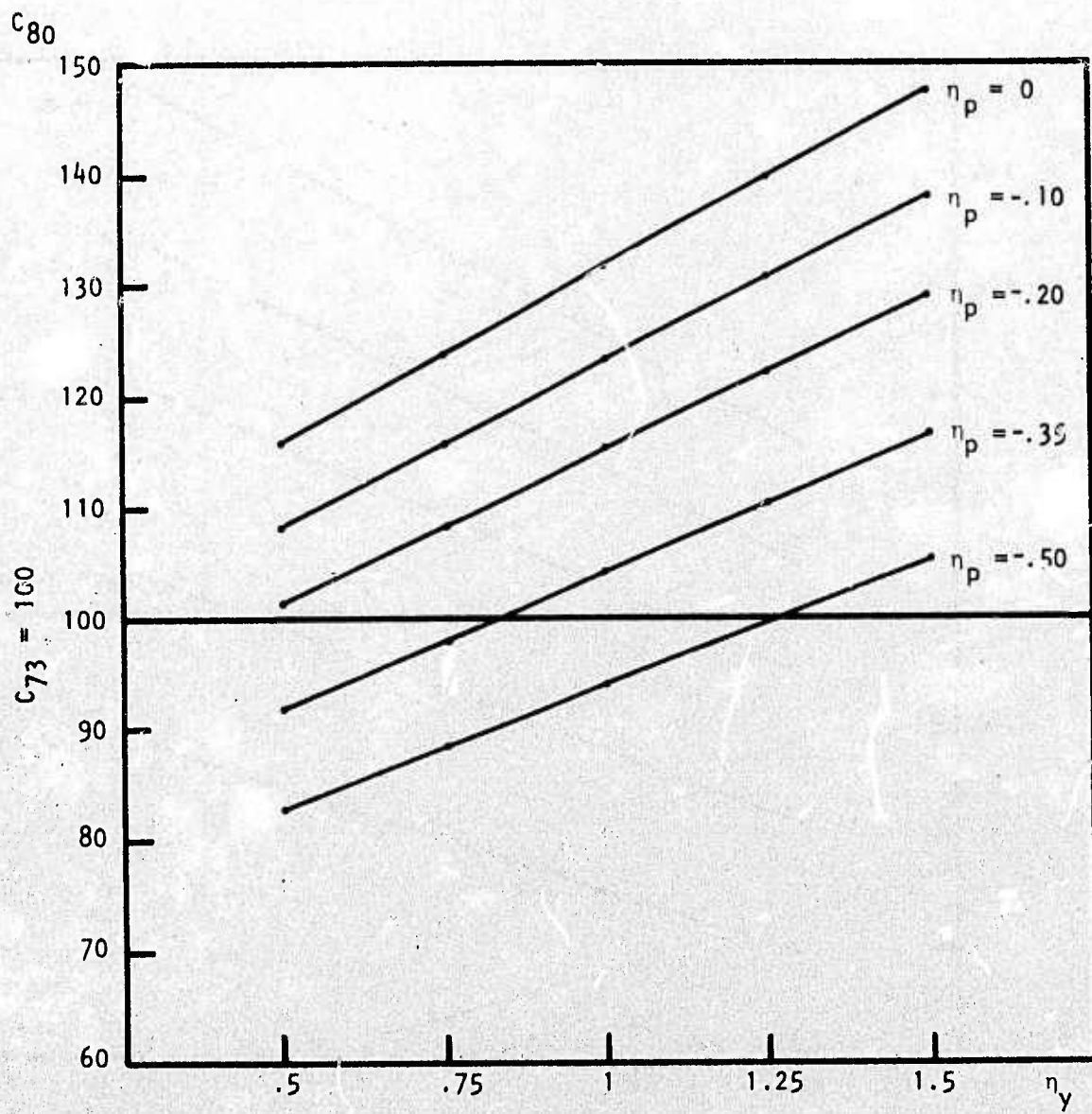


DIAGRAM 8

P = \$6

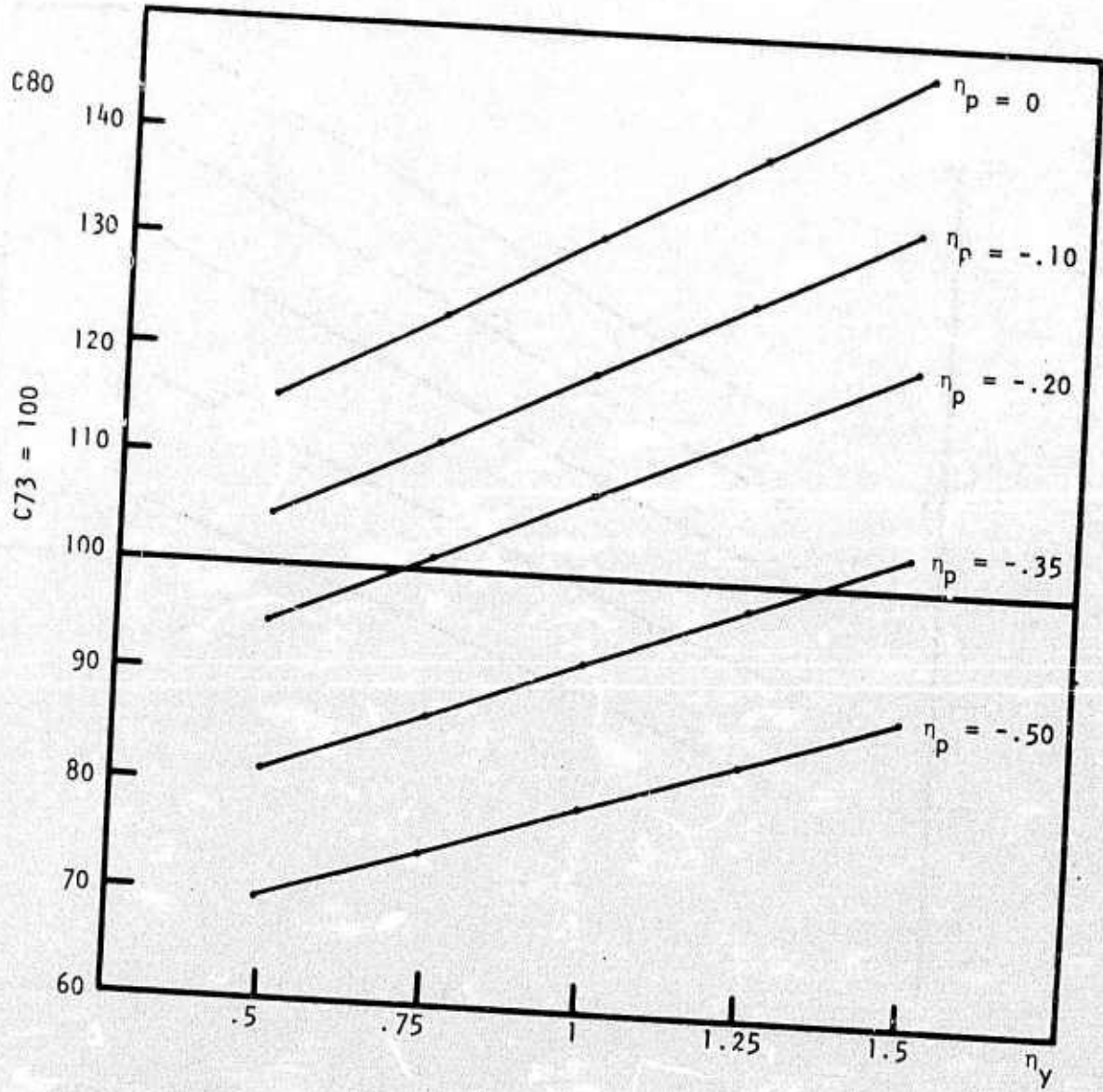
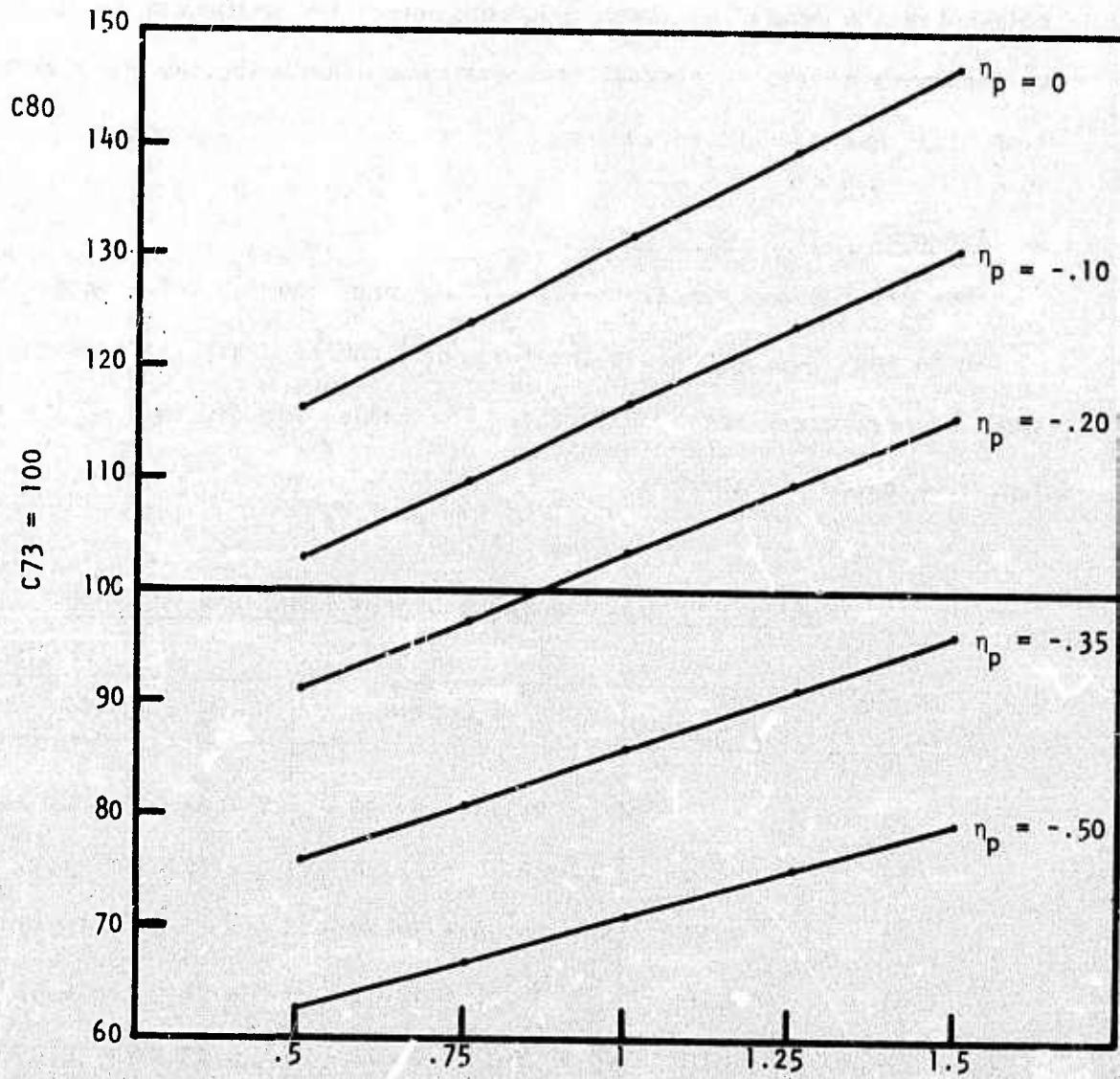


DIAGRAM 9

P = \$6



Some of the preceding 20 demand curves are based on two extreme values of elasticities. Thus in the study we eliminate the 8 demand functions where income elasticities are .50 and 1.50. In addition we eliminated the remaining three functions where the price elasticity = -.50. We incorporated into the study the remaining nine functions where $N_y=0.75, 1.00, 1.25$ and $N_p=-.10, -.20, \text{ and } -.35$.

5. The Empirical Demand Functions

The nine demand functions for world energy and for U.S. energy that we use in the study appear in the following table. This includes the specific parameters for 1980 demand. The tables and diagrams of these functions appear in the text.

TABLE AP2-4

WORLD AND U.S. ESTIMATED DEMAND FUNCTIONS FOR 1980

Income Elasticity	Price Elasticity	World Demand	U.S. Demand
.75	-.10	$Q = 34.17 + 11.39 \frac{1}{p}$	$Q = 14.03 + 4.67 \frac{1}{p}$
.75	-.20	$Q = 30.38 + 22.78 \frac{1}{p}$	$Q = 12.47 + 9.35 \frac{1}{p}$
.75	-.35	$Q = 24.68 + 39.87 \frac{1}{p}$	$Q = 10.13 + 16.37 \frac{1}{p}$
1.00	-.10	$Q = 36.36 + 12.12 \frac{1}{p}$	$Q = 14.92 + 4.97 \frac{1}{p}$
1.00	-.20	$Q = 32.32 + 24.24 \frac{1}{p}$	$Q = 13.27 + 9.95 \frac{1}{p}$
1.00	-.35	$Q = 26.26 + 42.42 \frac{1}{p}$	$Q = 10.78 + 17.41 \frac{1}{p}$
1.25	-.10	$Q = 38.54 + 12.85 \frac{1}{p}$	$Q = 15.82 + 5.27 \frac{1}{p}$
1.25	-.20	$Q = 34.26 + 25.70 \frac{1}{p}$	$Q = 14.06 + 10.55 \frac{1}{p}$
1.25	-.35	$Q = 28.84 + 44.97 \frac{1}{p}$	$Q = 11.43 + 18.46 \frac{1}{p}$

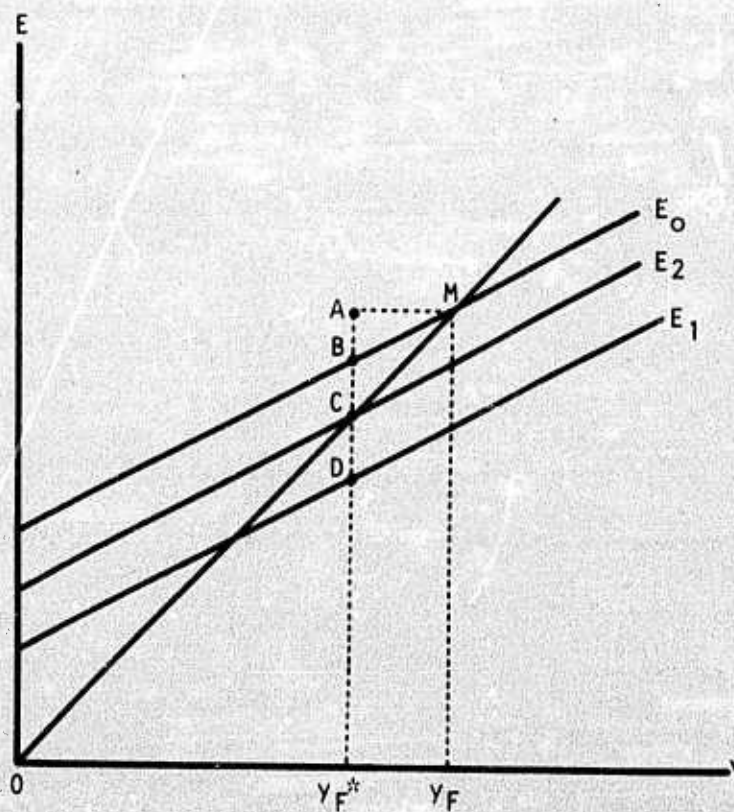
APPENDIX 3

REAL ECONOMIC EFFECT ON OIL IMPORTING COUNTRIES
(No Frictions)

Take an economy under equilibrium with full employment before the oil price rise. Its aggregate demand (E) as a function of the GNP (y) is shown by the E_0 line. The marginal propensity to consume (mpc) is given by the slope of the E line. (For simplicity, all other marginal propensities to spend are assumed to be zero). The full employment real national income is y_F (point M).

Assume the increase of oil price entails a greater burden of payments abroad of \$1 billion. This means that the real domestic national income of full employment declines by \$1 billion, from y_F to y_F^* .

DIAGRAM 1



3-2

If $mpc = .80$, then at y_F^* , E is smaller by \$.8 billion (\overline{AB}). Imports have increased by \$1 billion. This shifts the E_0 line downwards by \$1 billion to E_1 .

Thus, the net result in the first place is a deflationary gap of \$.8 billion (\overline{CD}).

In order to close the gap E_1 has to be increased to E_2 . This can occur through either one of, or a combination of, the following three actions:

1. Increase in export to the oil exporting countries, by \$.8 billion.

In this case we shall have the following end results:

Imports increased by \$1 billion.

Exports increased by \$.8 billion.

Deficit in the balance of payments increased by \$.2 b.

Real domestic GNP declined by \$.8 b.

Total investment declined by \$.2 b (domestic investment did not change but foreign investments went down).

National savings declined by \$.2 b.

If there is a perfect recycle, the balance of payments deficit will be financed by transfer of OPEC funds of \$.2 b. to the importing country and purchases of assets there at this amount.

2. Increase in domestic investment by \$.8 billion.

The results will be:

Import: + 1

Export: no change

Balance of payment deficit: + 1

Real Domestic GNP: -1

Consumption: -.8

Total investment: -.2

(Domestic investment: + .8, Foreign investment: -1.0).

National savings: -.2

In a perfect recycling, the balance of payments deficit will be financed by a transfer of OPEC funds of \$1 b. to the importing country, and purchase of assets there at this amount.

3. Increase in government spending: similar to case 2. However, any dollar spent on public consumption rather than investment, will result in a \$1 less increase of domestic investment and \$1 further decline of national savings.

These three possible outcomes are summarized in the following table.

TABLE I
NET CHANGES IN REAL ECONOMIC MAGNITUDES
"PURE" CASES
(Per \$1 bill. of Oil Bill)

	(1) EXPORT	(2) INVESTMENT	(3) GOVERNMENT CONSUMPTION
Real National Income	-1.0	-1.0	-1.0
Import	+1.0	+1.0	+1.0
Export	+ .8	0	0
Consumption	- .8	- .8	0
Domestic Investments	0	+ .8	0
Foreign Investment*	- .2	-1.0	-1.0
Total Investments	- .2	- .2	-1.0
National Savings	- .2	- .2	-1.0

*This is the increased deficit (or reduced surplus) in the current account of the balance of payments. This amount is subject to the financial recycling.

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY (Corporate author)

Hudson Institute, Inc.
Quaker Ridge Road
Croton-on-Hudson, New York 10520

2a REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b GROUP

3 REPORT TITLE

AMERICAN SECURITY AND THE INTERNATIONAL ENERGY SITUATION

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

5 AUTHOR(S) (Last name, first name, initial)

Arad, Uzi B. and Smernoff, Barry J.

6 REPORT DATE

15 April 1975

7a TOTAL NO OF PAGES

950

7b NO OF REFS

8a CONTRACT OR GRANT NO

MDA903 74 C 0286

b PROJECT NO

c

d

9a ORIGINATOR'S REPORT NUMBER(S)

HI-2239-RR

9b OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10 AVAILABILITY/LIMITATION NOTICES

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

11 SUPPLEMENTARY NOTES

12 SPONSORING MILITARY ACTIVITY

Defense Advanced Research Projects Agency
1400 Wilson Blvd.
Arlington, Virginia 22209

13 ABSTRACT

This report sets down the results of research on some of the significant problems relating to energy and national security. The relationship of the security of oil supplies to market conditions in the past and in the future is examined. An analysis is made of the scope of oil revenues for domestic and foreign investment and of the patterns of economic development and investment in Middle East oil producing countries. The general questions of access to non-oil global resources and the relationship of energy and American economic security are addressed.

DD FORM 1473
1 JAN 64

UNCLASSIFIED
Security Classification

PRECEDING PAGE BLANK - NOT FILMED

14

KEY WORDS

LINK A		LINK B		LINK C	
ROLE	WT	ROLE	WT	ROLE	WT

INSTRUCTIONS

1. **ORIGINATING ACTIVITY:** Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (*Corporate author*) issuing the report.

2a. **REPORT SECURITY CLASSIFICATION:** Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. **GROUP:** Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. **REPORT TITLE:** Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. **DESCRIPTIVE NOTES:** If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. **AUTHOR(S):** Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. **REPORT DATE:** Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.

7a. **TOTAL NUMBER OF PAGES:** The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. **NUMBER OF REFERENCES:** Enter the total number of references cited in the report.

8a. **CONTRACT OR GRANT NUMBER:** If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. **PROJECT NUMBER:** Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. **ORIGINATOR'S REPORT NUMBER(S):** Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. **OTHER REPORT NUMBER(S):** If the report has been assigned any other report numbers (*either by the originator or by the sponsor*), also enter this number(s).

10. **AVAILABILITY LIMITATION NOTICES:** Enter any limitations on further dissemination of the report, other than those imposed by security classification, using standard statements such as:

- (1) "Qualified requesters may obtain copies of this report from DDC."
- (2) "Foreign announcement and dissemination of this report by DDC is not authorized."
- (3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through _____."
- (4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through _____."
- (5) "All distribution of this report is controlled. Qualified DDC users shall request through _____."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. **SUPPLEMENTARY NOTES:** Use for additional explanatory notes.

12. **SPONSORING MILITARY ACTIVITY:** Enter the name of the departmental project office or laboratory sponsoring (*paying for*) the research and development. Include address.

13. **ABSTRACT:** Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (TS), (S), (C), or (U).

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. **KEY WORDS:** Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.