The Effect of OPEC Oil Pricing On Output, Prices, and Exchange Rates In the United States and Other Industrialized Countries

A CBO Study
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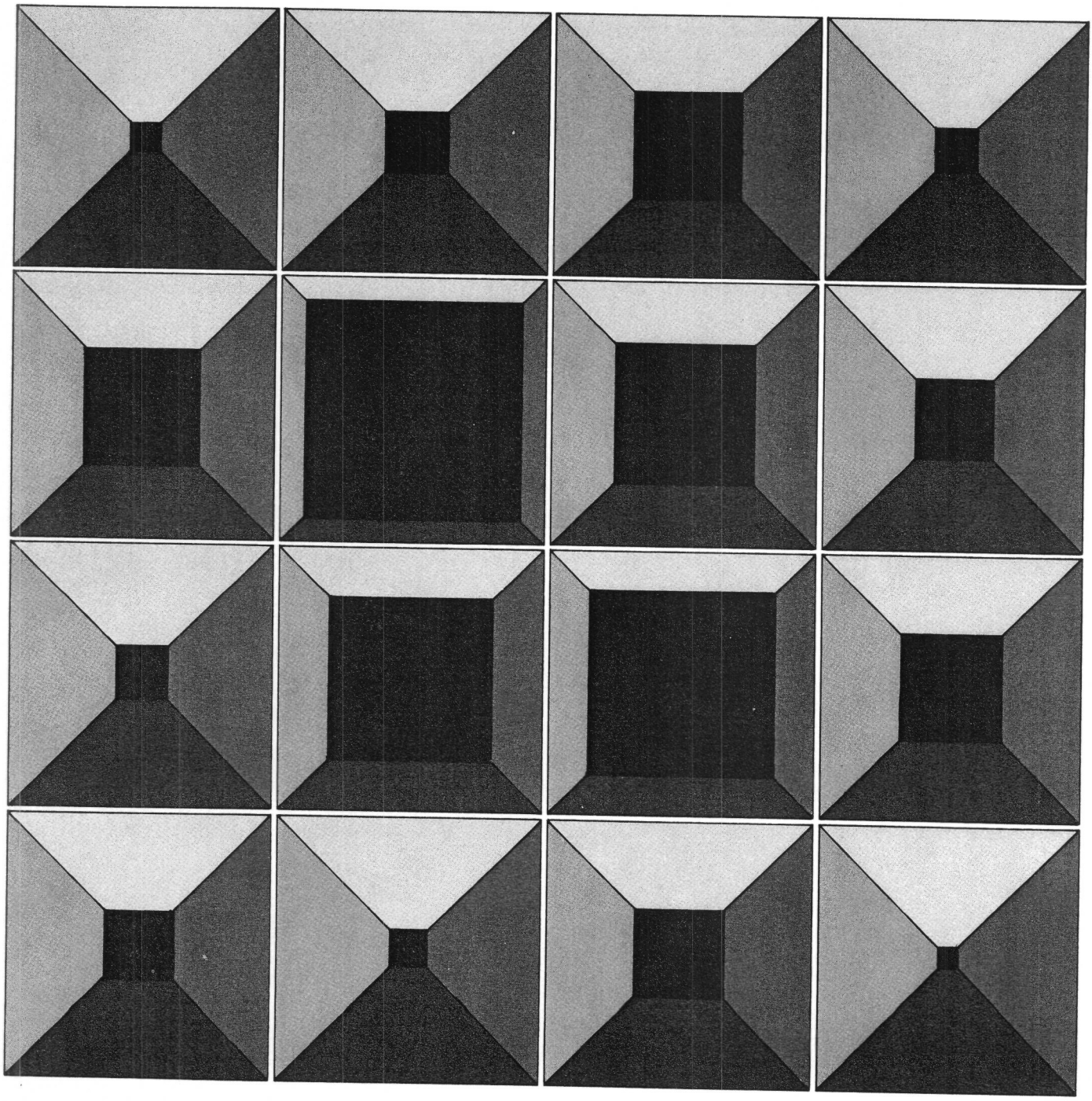
Congress of the United States
Congressional Budget Office



THE EFFECT OF OPEC OIL PRICING ON OUTPUT, PRICES, AND EXCHANGE RATES IN THE UNITED STATES AND OTHER INDUSTRIAL COUNTRIES

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PREFACE

Since 1973, high and rising oil prices have seriously aggravated the management of macroeconomic policy. This report assesses the consequences of oil price rises for the general price level, employment, the trade balance, domestic and international credit markets, and the exchange rate in the United States and other major industrial countries. Based on earlier work undertaken for the Joint Economic Committee, this report was requested by the Subcommittee on Revenue Sharing, Intergovernmental Revenue Impact, and Economic Problems of the Senate Finance Committee. In accordance with CBO's mandate to provide objective and nonpartisan analysis, the report makes no recommendations.

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Alice M. Rivlin
Director

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SUMMARY

The high and rising price of oil burdens industrial oil-importing countries in two ways. First, it lowers the standard of living below what it would otherwise be. Second, it affects the economy in ways that are difficult for policymakers to manage: on the one hand, the rising oil price spurs general inflation; on the other, it depresses domestic demand and employment. Policymakers typically do not fully offset the effect on employment because they simultaneously try to hold down the rate of inflation.

Price levels in the United States rise more with oil price increases than do price levels in other industrial oil-importing countries. The U.S. Consumer Price Index rises more than consumer price indexes in other countries mainly because energy bulks larger in U.S. consumption. The GNP deflator, often consulted as a broader measure of price performance, also rises more in the United States than in other countries. The deflator measures the price of domestically produced output; its increase reflects larger U.S. domestic oil production relative to total GNP--a consequence of greater U.S. energy self-sufficiency.

When they are not offset by policy actions, oil price increases will depress economic activity in oil-importing countries. The greater the share of oil in total consumption, the greater the depressing effect of an oil price rise, since the greater will be the fall in domestic demand for domestically produced goods. Larger domestic oil production relative to GNP, and increases in exports to oil-exporting countries, can offset part of these effects. But, on net, for typical major oil-importing countries today, oil price increases depress demand. Studies based on simple economic models indicate that the depressing effect of an oil price rise is somewhat greater in Japan and Europe than in the United States.

The U.S. trade balance against OPEC is more volatile than the trade balances of other industrial countries. The larger swings in the U.S. trade balance do not reflect U.S. export performance, but rather the greater responsiveness of U.S. oil imports to income changes. This greater responsiveness comes about because imports comprise a smaller part of total U.S. oil consumption.

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Thus, a rise in income and oil consumption will increase U.S. oil import volume by a relatively larger percentage than it will that of other major oil-importing countries.

Even though oil price increases raise the U.S. price level and trade deficit relative to those of other countries, they also initially raise the value of the dollar. The dollar appreciates because:

- The stimulus to inflation increases the domestic demand for credit and attracts foreign capital;
- OPEC members invest the proceeds of their trade surpluses in dollar-denominated assets; and
- Other oil-importing countries increase their holdings of dollar-denominated international reserves.

The actions of the Federal Reserve probably reinforce this initial dollar appreciation. The Federal Reserve has typically pursued relatively restrictive policies immediately after oil price increases, easing up only later when unemployment rises.

The dollar does not rise permanently, though; as inflation eases, domestic credit demand and interest rates fall in U.S. credit markets. At the same time, OPEC members draw down their dollar assets to buy foreign goods. But they do not spend all of their dollar-denominated assets on imports from the United States. The drop in domestic and foreign demand for dollar assets depresses the dollar exchange rate.

Whatever the proper level of the oil price, its increase imposes a burden on industrial countries: unemployment and inflation rise in a combination that policymakers cannot fully offset. In dealing with those problems, they have several policy options. They could:

- Design a monetary policy path that minimizes the combined costs of short- and long-term unemployment and inflation produced by the oil price shock. In such a strategy, monetary policy is used to control the inflationary effects of an oil price rise; fiscal policy, to offset its demand-reducing effect;

- o Coordinate national trade policies to permit a better choice of macroeconomic policies by improving the distribution of the non-OPEC deficit;

- o Use income policies and oil price controls to minimize the initial impact of the oil price rise;

- o Use tax and transfer policies to maintain real disposable income in the short run;

- o Improve labor market programs to offset the initial unemployment effects of the oil price rise; or

- o Under some circumstances, undertake policies that would lead OPEC countries to reduce the oil price.

What lessons can the United States draw from the experience of other countries? Germany and Switzerland, on examination, provide little guidance for the United States. Their apparent achievement of low rates of inflation and unemployment rests largely on their acceptance of higher unemployment rates, relative to their own typical experience, over long periods of time; the exit of women from their labor forces; and the emigration of their foreign workers. Whether Japan provides a good lesson for the United States is less clear. The United States could not have relied as heavily as Japan on expanding its trade surplus without seriously disrupting existing trading patterns. If, as some evidence indicates, Japanese success rests on superior economic organization, the United States obviously should emulate that where possible. But to the extent that Japan's success rests on restricting imports and subsidizing exports, then the United States may have to seek other policy alternatives.

A high oil price, even when it is not increasing, imposes a burden on oil-importing countries. The OPEC oil price is a cartel price, believed by some to be far higher than the price that should be charged to ration the world's scarce energy resources into the next century. This pricing policy causes a drop in living standards among oil-importing countries of between $50 billion and $100 billion per year. Oil-importing countries cannot erase this burden simply by balancing their trade accounts.

The high OPEC price can best be reduced by raising world—not necessarily U.S.--energy production and by lowering world energy consumption so as to reduce the amount of oil that Saudi

Arabia can sell at the current price. Only the Saudis are vulnerable to a shrinkage of the world oil market, and only the threat of such a market shrinkage is likely to induce them to produce quantities of oil that maintain Saudi Arabia's market share by moderating the OPEC price.

CHAPTER I. INTRODUCTION

Following each major oil price increase, real gross national product (GNP) has fallen, unemployment and inflation have risen, and exchange rates have moved erratically. But how do oil price increases produce these effects? This paper discusses some of the macroeconomic consequences of too high and rising oil prices, and some of the policy options that might control these effects.

It finds that the high and rising price of oil imports from the Organization of Petroleum Exporting Countries (OPEC) burdens the industrial oil-importing countries in two ways. First, because total expenditures on oil rise relative to income, the potential real standard of living in oil-importing countries falls. Together, the countries of the Organization for Economic Cooperation and Development (OECD), for example, may have paid as much as $150 billion more for oil in 1979 than they would have paid in a competitive oil market. Second, the rising oil price increases unemployment and inflation in ways that are difficult for policymakers in oil-importing countries to manage; on the one hand, the rising oil price produces general inflation, and on the other hand, it depresses domestic demand and employment. Policymakers attempt to control part of the inflation, at the cost of increasing unemployment. The total loss in output from the 1974-1975 recession, though part of it may have followed from factors unrelated to oil, was about $350 billion.

Chapter II shows why OPEC price increases raise the Consumer Price Index (CPI) and GNP deflator more in the United States than in other industrial countries. Chapter III discusses the ways in which oil price increases also reduce real GNP, employment, and real disposable income. Chapter IV shows how the U.S. trade balance has grown more responsive to OPEC price rises, and also why U.S. oil imports are more sensitive to U.S. income changes than are the oil imports of other industrial countries. Chapter V combines the preceding information to show how oil price increases raise the demand for dollar-denominated assets relative to assets denominated in other currencies. Chapter VI relates this to exchange rate changes, to show why oil price increases first lead the dollar to appreciate above the level it would otherwise have attained and then to depreciate below that level. Chapter VII shows how the oil price rise produces two distinguishable

problems: the short-term decline in real GNP and employment, and the longer-term drop in real disposable income and standards of living among industrial countries. It enumerates a number of policy options.

CHAPTER II. HOW OPEC OIL PRICE INCREASES INITIALLY RAISE THE GNP DEFLATOR AND THE CONSUMER PRICE LEVEL

GREATER U.S. ENERGY PRODUCTION INCREASES OIL PRICE IMPACT ON U.S. GNP DEFLATOR

An OPEC price increase will raise the U.S. general price level, as measured by the GNP deflator, more than the price levels of other large oil-importing countries because energy production is a larger fraction of total U.S. production. An OPEC price increase causes prices of domestically produced energy products to rise. Consequently, oil price rises will increase the GNP deflator in the same proportion that domestic energy production occupies in total output. Oil price increases have little direct impact on the GNP deflators of countries with little domestic energy production, even when those countries import large amounts of oil.

An OPEC price increase does not directly raise the GNP deflator of an oil-importing country. Gross national product measures the goods produced by nationally owned productive factors. Imports are not so produced and thus are excluded from GNP. For the same reason, the GNP deflator—the "price of GNP"—excludes the prices of imported goods. A rise in the price of imported oil, therefore, cannot, by itself, increase the GNP deflator. For example, when a gallon of gasoline is imported and consumed, it will be added to GNP in the consumption account and subtracted from GNP in the import account. That procedure prevents counting the gallon of gasoline as a domestically produced commodity. If the price of that gallon doubles, then it doubles when added to consumption and when subtracted from imports: it has no net effect on GNP or on the GNP deflator. For any rise in the oil price, the U.S. GNP deflator will increase about three times more than will the German GNP deflator, and 12 times more than will the Japanese GNP deflator (Table 1).

GREATER U.S. ENERGY CONSUMPTION INCREASES OIL PRICE IMPACT ON U.S. CONSUMER PRICE INDEX

Any oil price rise will also increase the U.S. CPI more than the consumer price indexes in other countries. This occurs

TABLE 1. DOMESTIC ENERGY PRODUCTION, GROSS DOMESTIC PRODUCT, AND WEIGHT IN GDP DEFLATOR IN SELECTED OECD COUNTRIES RELATIVE TO THE UNITED STATES, 1977

Country or Country Group	Domestic Energy Production (million tons oil-equivalent)	Domestic Energy Production as a Percentage of Total OECD Energy Production	Gross Domestic Product (current dollars and current exchange rates)	Gross Domestic Product as a Percentage of Total OECD Gross Domestic Product	Weight of Energy in U.S. GDP Deflator Relative to Foreign Countries (U.S. = 100) a/
United States	1,432.4	61.1	1,878.8	38.1	100
OECD, Total	2,342.9	100.0	4,925.7	100.0	160
OECD, Europe	555.5	23.7	2,041.1	41.4	280
European Economic Community	433.5	18.7	1,581.0	32.1	279
Japan	43.9	1.9	694.4	14.1	1,207
Germany	116.7	5.0	516.2	10.5	337
United Kingdom	155.8	6.6	244.3	5.0	120

SOURCES: Domestic energy production in million tons oil-equivalent taken from Organization for Economic Cooperation and Development (OECD), Energy Balances of OECD Countries, 1975/1977 (Paris, 1979). GDP of selected countries taken from OECD, Main Economic Indicators (December 1979), p. 152.

a/ Calculation of weights assumes a constant energy price across countries. (See Appendix A for further details.)

partly because, relative to total consumption, U.S. consumers use more energy than do consumers in other countries. U.S. energy consumption, relative to total consumption expenditure, is 50 to 100 percent greater than that of the European OECD countries and 100 to 200 percent greater than that of Japan (Table 2). Excluding gasoline, U.S. aggregate expenditure on residential energy, relative to total consumption, is about 50 percent greater than that of the European OECD countries and about twice that of Japan. When total gasoline consumption is added to residential energy consumption, their combined weight in the United States relative to total consumption expenditures is twice that of the European OECD countries and three times that of Japan. 1/

LOWER U.S. ENERGY TAXES INCREASE OIL PRICE IMPACT ON U.S. CONSUMER PRICE INDEX

For any oil price rise, the gasoline price will rise by a larger percentage amount in the United States than in other countries. Lower U.S. gasoline taxes result in a lower U.S. gasoline retail price. Oil price rises, however, present each country with the same absolute increase in gasoline prices, so that, measured against a lower base, this means a larger percentage increase in the U.S. price. Based on tax differences existing in October 1973, any given OPEC oil price increase would have raised U.S. gasoline prices by about twice the percentage amount it would have raised foreign gasoline prices (Table 3).

Had taxes remained unchanged, subsequent increases in OPEC oil prices between 1973 and 1979 would have reduced the relative importance of national tax differences. Instead, European countries increased their taxes, while the United States kept the

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1/ All gasoline consumption has been added to residential energy consumption because data separating private and commercial gasoline consumption could not be obtained. This certainly overestimates true residential energy consumption because some gasoline is consumed by commercial enterprises. It may overestimate U.S. residental demand relative to that of other countries, moreover, if commercial vehicles use gasoline more intensively in the United States than in Europe, where diesel fuel might be more common. Gasoline is included, nonetheless, because its exclusion probably would produce larger errors in measuring relative private energy consumption.

TABLE 2. DIRECT RESIDENTIAL ENERGY CONSUMPTION RELATIVE TO TOTAL PRIVATE CONSUMPTION EXPENDITURES IN THE UNITED STATES AND IN SELECTED FOREIGN COUNTRIES AND REGIONS, 1977

Country or Country Group	Estimated Residential Consumption (million tons oil-equivalent) a/		Private Consumption Expenditures (billions of dollars)	Weight of Energy in Total Consumption Expenditures: U.S. Relative to Foreign (U.S. = 100) c/	
	Excluding Gasoline	Including Gasoline b/		Excluding Gasoline	Including Gasoline b/
United States	397.5	706.6	1,213.6	100	100
OECD, Total	753.4	1,220.4	3,016.5	131	144
OECD, Europe	268.6	362.0	1,225.7	149	197
European Economic Community	217.0	292.7	938.6	142	187
Japan	56.8	79.8	399.1	196	291
Germany	63.3	84.6	288.0	149	198
United Kingdom	46.5	59.2	144.5	102	142

SOURCES: Data on total residential energy consumption originally appeared in OECD, Energy Balances of OECD Countries, 1975/1977 (Paris, 1979). Data for national gasoline consumption were taken from OECD, Energy Statistics, 1975/1977 (Paris, 1979). Private consumption expenditures in current prices at current exchange rates expressed in dollars were taken from OECD, National Accounts of OECD Countries, 1952-1977 (Paris, 1979), Volume I, p. 134.

a/ The table adjusts residential electricity consumption to reflect only the fossil fuel used in generating that electricity. The adjustment first divides total fossil fuel used in electricity generation by the total electricity generated, in order to derive the average use of fossil fuel per unit of electricity. It then multiplies the fossil fuel per unit of electricity by the total amount of electricity consumed in the residential sector. (These data were taken from the same source.) Such a correction assumes that fossil fuel prices are passed through into electricity prices in the same proportion as that of fossil fuel to total electrical-generating fuel.

b/ Separate data are not apparently available for private and commercial gasoline consumption. The data add total gasoline consumption to household residential energy consumption, overstating direct household expenditures on energy. The two weights shown are the boundaries of the actual value.

c/ Relative weights are derived from the first three columns by assuming that all countries pay the same pre-tax energy price.

TABLE 3. RELATIVE EFFECT OF A CHANGE IN THE OIL PRICE ON THE PRICES OF GASOLINE IN SELECTED WESTERN COUNTRIES (U.S. cents per gallon)

Country	October 1973 a/			June 1979 b/		
	Price, Including Tax c/	Tax	Percentage Rise in Gasoline Price Relative to Percentage Rise in the U.S. Gasoline Price d/	Price, Including Tax c/	Tax	Predicted Percentage Rise in Gasoline Price Relative to Percentage Rise in the U.S. Gasoline Price d/
United States	40	12	1.00	86	13	1.00
France	100	68	0.40	241	156	0.36
Italy	108	81	0.37	216	156	0.40
United Kingdom	69	43	0.58	184	79	0.47
West Germany	99	71	0.40	198	110	0.43

SOURCE: Prices and taxes for regular gasoline taken from Central Intelligence Agency, National Foreign Assessment Center, International Energy Review (June 24, 1980), p. 20.

a/ Converted to end-of-1973 exchange rates, using IMF, International Financial Statistics (April 1980), p. 10 and (July 1980), passim.

b/ March 1979 exchange rates.

c/ Data shown in Table 4 correct for the changes in home currency gasoline prices that occur because of exchange rate fluctuations. Such fluctuations alter home currency gasoline prices because the OPEC oil price is set in dollars. (See Appendix B for a discussion of how the correction is made.)

d/ Relative price impact is calculated as follows: The gasoline price in any foreign country (P_f) is the sum of the underlying oil price (P) and the tax (T_f), or $P_f = (P + T_f)$; the percentage rise in the price in a foreign country will be $dP_f/P_f = (dP)/(P + T_f)$. The rise in the U.S. gasoline price may be expressed in the same way, substituting U.S. for the "f" subscript. Dividing the foreign percentage price increase by the U.S. percentage price increase, and noting that each country faces the same increase in the OPEC price (dP), produces the percentage increase in the foreign price relative to the percentage increase in the U.S. price, or $(P + T_{US})/(P + T_f)$.

federal tax unchanged. Hence, the expected relative percentage impact of an oil price rise on U.S. gasoline prices in 1979 remained more than twice that for European countries (Table 3). The actual differences during this period were about as expected, except, inexplicably, for the United Kingdom (Table 4). Table 4 shows price data corrected for the changes in home currency gasoline prices that occur because of exchange rate fluctuations. Such fluctuations alter home currency gasoline prices because the OPEC oil price is set in dollars. (Appendix B discusses this correction.)

TABLE 4. HOME CURRENCY PRICE CHANGES OF REGULAR GASOLINE IN THE UNITED STATES AND SELECTED EUROPEAN COUNTRIES (Constant excise taxes and exchange rates) a/

	Percentage Change, January 1976 Over October 1973	Percentage Change, June 1979 Over October 1973
United States	45	115
France	26	39
Italy	23	27
United Kingdom	50	110
Germany	20	50

SOURCE: Central Intelligence Agency, National Foreign Assessment Center, International Energy Review (June 24, 1980), p. 20.

a/ These calculations hold excise taxes at their 1973 levels. Since the OPEC oil price is denominated in dollars, the home currency price of gasoline in foreign countries will vary with the dollar exchange rate. To calculate the home currency price change that would have occurred in the absence of exchange rate changes, it is necessary to make an appropriate deduction from the home currency price change when that currency depreciates against the dollar, and to make an appropriate addition to the home currency price change when that currency appreciates against the dollar. (These calculations are presented in detail in Appendix B.)

OIL PRICE INCREASES INDIRECTLY RAISE NONENERGY PRICES BY INCREASING INPUT AND SUBSTITUTE PRICES

Effects on Input Prices

An oil price increase will raise the prices of goods whose production requires significant inputs of energy. 2/ Not only do the prices of oil and direct oil substitutes rise, but so do the prices of products that use energy-intensive inputs. For example, the price of garbage bags will rise because of the rise in the price of input fuels, as will the price of energy-intensive but nonfuel commodities such as steel or aluminum.

Based on the 1967 U.S. input-output table, $366.3 billion of such nonenergy consumption required $18.3 billion in energy inputs (Table 5). If this sample typifies the $466.5 billion of all nonenergy consumption in 1967, then 1/20 of any given percentage oil price increase would show up in the average price paid for nonenergy consumer goods. For example, a 100 percent rise in oil prices would, in this way, increase the average price of nonenergy consumer goods by 5 percent. 3/

Consumers devote about 4.9 percent of their expenditures directly to energy (Table 5), where 100 percent of any oil price increase shows up in the average price. Therefore, the total of direct and "input" effects of an oil price rise on consumer prices is just under 10 percent, nearly twice the size of the more easily measured direct effects.

2/ Increases in oil input prices do not seriously affect the GNP deflator. Because GNP is a measure based on value added in production, the GNP deflator will rise by the same amount when firms use a fixed absolute markup over cost, whether domestically produced oil is an intermediate or a final good. When firms use a fixed percentage markup over costs, then oil used as an intermediate good will have some additional inflationary effect on the GNP deflator. But the Consumer Price Index is not based on value added in production, so irrespective of whether oil is an intermediate or a final product, rises in its price indirectly raise the consumer price level.

3/ This assumes energy cost increases are passed along in an identical absolute markup; a fixed percentage markup over cost would increase the impact on the final product price.

TABLE 5. DIRECT AND ESTIMATED INDIRECT WEIGHTS OF EXPENDITURES ON ENERGY CONSUMPTION IN TOTAL EXPENDITURES ON CONSUMPTION, 1967

Expenditure Category	Billions of Dollars or Percentage
Total Personal Consumption Expenditures	490.7
Direct Expenditures	
Coal	0.1
Crude oil	0.0
Refined petroleum products	10.7
Electricity, gas, water, sanitary services a/	13.9
Total direct expenditures on above products	24.7
As a percentage of total consumption	(4.9)
Inputs of Above Industries to Other Sampled Consumer Expenditures b/	
Total sampled c/	366.3
Coal input	0.7
Crude oil input	3.2
Refined petroleum input	5.6
Electricity, gas input	8.8
Total of inputs	18.3
As a percentage of total sampled	(5.0)
Total Direct Consumption of Energy Industries	24.2
Total Estimated Indirect Consumption of Energy Industries d/	23.3
Total Direct and Indirect Consumption	47.5
Total Energy Consumption as a Percentage of Total Final Consumption	(9.7)
Ratio of Total Energy Weight to Direct Energy Weight	1.98

(continued)

TABLE 5. (continued)

SOURCE: Calculated from data in U.S. Department of Commerce, Interindustry Economics Division, "The Input-Output Structure of the U.S. Economy: 1967," Survey of Current Business (February 1974), pp. 24-56. Personal consumption data were taken from Table 1, p. 43; total direct and indirect requirements for the sampled sectors of personal consumption were taken from Table 3, pp. 52-55.

a/ Water and sanitary services are included with gas and electric in the 85-industry table shown in the Survey of Current Business. In 1970, 59 percent of the personal consumption expenditure of the total output of this group was produced by electric utilities, 30 percent was produced by gas utilities, and 11 percent was produced by water and sanitary services. With the subsequent rise in energy prices, the share of water and sanitary services has probably fallen even further, so treating the entire industry as being in the energy sector produces no important error. U.S. Department of Labor, Bureau of Labor Statistics, "The Structure of the U.S. Economy in 1980 and 1985," Bulletin 1831 (1975).

b/ These figures were derived by multiplying the direct and indirect requirements per dollar of delivery to final demand for the four energy-related industries, taken from Table 3 of the reference cited, by final consumption of each of the sampled industries taken from Table 1.

c/ The individual nonenergy components of personal consumption included in the sample, chosen because they were large, were food and kindred products ($60.9 billion), apparel ($16.2 billion), motor vehicles and equipment ($15.8 billion), transportation and warehousing ($11.4 billion), wholesale and retail trade ($109.4 billion), finance and insurance ($25.3 billion), real estate and rental ($70.9 billion), hotels and personal and repair services ($15.5 billion), and medical, educational services, and non-profit institutions ($41.1 billion).

d/ The product of the 5 percent energy use found in the sample of indirect energy consumption times total consumption of non-energy items ($490.7 - $24.2).

The Substitution Effect

An energy price rise can also increase the prices of non-energy-intensive substitutes for energy. So, for example, bicycle prices might rise because of a sudden increase in demand for substitutes for fuel-intensive forms of transportation; or the price of natural-fiber clothes might rise as demand shifted to them because of energy-related increases in synthetic fiber prices. Some substitute price increases would be offset by declines in the prices of products that are "complements" to fuel-intensive energy uses: the prices of less fuel-efficient used cars, for example, might fall, as might rental rates at distant resorts. Broadly, however, most commodities are probably substitutes, not complements: an oil price rise will increase the average price of nonenergy substitutes.

Prices of nonenergy substitutes would not, typically, rise more than the original oil price increase, for then the relative oil price would have fallen. But they could rise by any amount up to the original oil price increase. The ensuing range of estimates is large: considering only the direct substitute and input effects, a 100 percent oil price rise would increase consumer prices by 5 to 10 percent; but including the wider possible substitution of nonenergy products for energy products, consumer prices could rise more. The direct substitute and input effects provide a minimum estimate of the direct impact of an oil price rise on the general price level.

Feedback Into Wages and Prices

Where labor or industrial units have sufficient bargaining power, they may attempt to raise wages and prices to restore their previous real incomes or profits. Including these wage and price effects would raise the estimated final impact of an oil price rise on the general price level.

MONETARY POLICY CONSTRAINS THE OVERALL PRICE INCREASE

The foregoing arithmetic assumes that the price effects are left free to work themselves out. But in practice the final inflationary effect of an oil price rise is limited by the supply of money. The monetary authorities, in their effort to restrain inflation, limit the increase in the general price level at the cost of an increase in unemployment.

Policy decisions by the central bank are critical in this, because an increase in the total value of transactions can only take place if the bank provides a sufficient volume of credit to sustain it. The precise amount of money that the bank must provide depends upon structural features of the economy (such as billing and collection procedures), the presence of close substitutes for money (such as credit cards), and other features of the economy that change only slowly. To keep oil-related price increases from permanently raising the price level, the central bank would have to hold the credit supply constant. If it did, the oil price increases would not lead to an increase in the total value of transactions. Instead, consumption and investment would fall, choked off by interest rate increases and credit restrictions. Eventually, rising unemployment and excess capacity would reduce non-oil prices. The price level, capacity utilization, and unemployment would ultimately return toward the levels that existed before the price rise.

Any central bank would face great political obstacles to pursuing such a policy: the short-term rise in unemployment and excess capacity would be too great. Central banks will typically increase the amount of credit by enough to accommodate part of the oil price rise.

The part of the oil price rise that the central bank chooses to accommodate appears as a rise in the general price level; the part it does not choose to accommodate produces a rise in unemployment and excess capacity. The central bank's choice is unpleasant and difficult (as will be discussed further in Chapters III, VI, and VII), because no known combination of monetary and other policies can avoid both unemployment and inflation after an oil price rise. Nonetheless, it is essential to recognize that the central bank does choose a response to OPEC pricing policies, because changes in that response, and in the domestic environment in which central bank policy is made, can reduce the costs of unemployment and inflation that follow an oil price increase. These costs could be reduced even while leaving unchanged the loss of purchasing power that occurs with the higher oil price.

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CHAPTER III. HOW OPEC OIL PRICE INCREASES REDUCE REAL DISPOSABLE INCOME, REAL GNP, AND EMPLOYMENT

When OPEC raises the oil price, policymakers in oil-importing countries have no domestic policy tool that can prevent the increased payments to OPEC and the corresponding decline in real disposable income. Living standards, relative to what they would have been, must decline. Policymakers could use tax and transfer policy to raise the after-tax disposable income of the present generation of citizens. But such a program would only pass on its costs to future generations (see below and Chapter VII). The living standard attainable at full employment in oil-importing countries falls by an amount equal to the difference in the cost of oil when priced by the OPEC cartel and the cost when priced in a competitive market. For the OECD countries, that difference amounted to between $65 billion and $150 billion in 1979 (Chapter VII).

Policymakers in oil-importing countries do have tools that would prevent the declines in economic activity that generally follow OPEC price rises; they typically choose not to use these tools fully, however, because they fear inflation. Thus, OPEC price rises not only cause the permanent loss of purchasing power discussed above; they also produce short-term unemployment. The recession of 1974-1975, in part attributable to the oil price hike, cost the OECD countries about $350 billion, as measured by the deviation of real GNP from its trend value (Chapter VII).

This chapter begins with a discussion of the channels through which OPEC price increases reduce real disposable income in oil-importing countries, and goes on to show how those price increases, combined with policymakers' reluctance to offset their effects, produce unemployment and declines in real GNP.

POLICYMAKERS CANNOT OFFSET THE DECLINE IN POTENTIAL REAL DISPOSABLE INCOME IN OIL-IMPORTING COUNTRIES

Even when policymakers take steps to ensure that unemployment does not rise, real disposable income in oil-importing countries must fall. For most oil-importing countries, oil

consumption is larger relative to total consumption than is oil production relative to total domestic production, so that increases in the price of oil typically raise the cost of those goods that citizens prefer to consume relative to the value of the goods and services that they produce. 1/ With no change in taxes or in government transfers, consequently, a rise in the oil price will reduce real disposable income (see Appendix C).

Certain government policies could shield citizens from an immediate reduction in real disposable income, but only at the expense of future generations. The government could reduce taxes, for example, to push real income back up to its level prior to the oil price rise. By doing this, the government could ensure that consumers were able to maintain their real purchasing power and savings levels. But more of the oil-importing country's unchanged GNP (its own real production) must be exchanged for OPEC oil. If other consumption doesn't change, then a larger fraction of GNP must be devoted to consumption and less, therefore, to domestic and foreign investment. If consumption is maintained at the expense of domestic investment, then a smaller capital stock and a lower potential GNP will be passed on to future generations of citizens. If both real consumption and real investment are maintained at their preceding levels, then the extra resources must be obtained from overseas: the current account will decline and fewer foreign assets (or a larger foreign debt) will be passed on to future generations. (Sometimes this ability to redistribute the burden among generations produces better macroeconomic policy choices, a point discussed in Chapter VII.)

No domestic policy can raise the real disposable income of all generations to what it was before an oil price increase. Policymakers can restore the previous potential real disposable income only if OPEC is induced to lower its oil price (Chapter VII).

1/ For all oil-importing countries, domestic consumption of oil must exceed domestic production. But for those same countries, domestic consumption of all goods will typically be less than domestic production of all goods (GDP). Therefore, oil consumption will be larger relative to total consumption than will be oil production relative to total production.

POLICYMAKERS DO NOT FULLY OFFSET THE DECLINE IN ECONOMIC ACTIVITY IN OIL-IMPORTING COUNTRIES

When an oil price rise reduces real disposable income in oil-importing countries, it also reduces consumer demand. Consumers, who must pay for more expensive oil products, now find they cannot purchase the same quantities of other goods as before.

This drop in consumer demand could be offset by fiscal and monetary measures. Policymakers typically choose not to offset it fully, however, because they are concerned with the inflationary consequences of oil price increases on general domestic price levels. Policymakers typically choose to combat this inflation to some extent, so they cannot at the same time offset all of the depressing effects of oil price increases on GNP and employment.

Oil Price Increases Reduce GNP in Oil-Importing Countries by Depressing Demand

Oil price increases reduce GNP in oil-importing countries when offsetting policies are absent because oil imports do not fall sufficiently in response. If, for example, a price rise triggered an expansion of domestic oil production, GNP (that is, nationally produced real output) would rise. Similarly, if an oil price rise shifted demand to non-oil products, and domestic economic slack was available to produce those products, GNP might also rise. But in the short run, consumers cannot avoid spending more for imported oil and, therefore, less on domestically produced goods. Thus, an oil price rise functions like a tax, depressing GNP. 2/

This drop in real GNP and domestic employment will be greater when:

- oil-exporting countries run large trade surpluses, thereby failing to substitute their own demand for the slack left by the fall in domestic demand in oil-importing countries;
- domestic oil and energy production does not rise in response to price increases;

2/ They differ in that, where legal compulsion leads consumers to pay increased personal taxes, inelastic or intense demand leads consumers to pay an increased total oil bill.

- o domestic energy production is small relative to consumption, so that the rise in price redistributes income primarily to foreigners rather than to domestic residents; or

- o oil consumption is a large fraction of total consumption and is relatively insensitive to price changes.

Aside from these aggregate demand and oil supply effects, a rise in the price of oil, by itself, would not raise the real GNP of an oil-exporting country; nor would it lower the GNP of an oil-importing country. Attention to real GNP is essential, for if real GNP does not change, neither will employment. As discussed above, an oil price rise must reduce real disposable income; but it need not reduce real GNP and raise unemployment (discussed further in Appendix C).

Real gross national product measures the quantity of goods produced by the productive factors owned by the nationals of a country. If an oil price increase does not raise oil production in an oil-exporting country, and if the economy is otherwise fully employed so that the increase in real disposable income does not raise domestic production of other goods or services, then real GNP cannot rise. Without an increase in real GNP, domestic employment cannot rise. 3/ Similarly, an oil price rise would reduce real disposable income in an oil-importing country, but policymakers could offset that drop in disposable income, thereby preventing real GNP from falling; were they to do that, unemployment would not rise. Real GNP measures the volume of output, not its price; and employment depends upon the volume of output.

Fearing Inflation, Policymakers Do Not Fully Offset OPEC-Caused Demand Reductions

Oil-importing countries could use monetary and fiscal policies to offset the depressing effect of an oil price rise.

3/ For example, Saudi Arabian oil exports rose in value by a factor of five between 1973 and 1977, while nominal GNP rose by a factor of six. But real GNP rose over the same period by only 45 percent; and about one-half of that rise, or 20 percentage points, reflected a rise in oil production. International Monetary Fund, International Financial Statistics (December 1980), p. 332.

Indeed, such tools could eliminate the drop in real GNP and employment. But because an oil price rise has its depressing effect in combination with an inflationary effect (see Chapter II), policymakers will not combat the unemployment alone. The declines in GNP and employment follow from the inability of policymakers in oil-importing countries to achieve both inflation and unemployment rate targets after an oil price rise, not directly from the price rise itself.

Oil Price Increases May Reduce Full-Employment GNP

An oil price rise may also reduce GNP from the supply side by making it less profitable to maintain former production levels with the existing capital stock and labor force. This may occur when a rise in the oil price makes the existing set of factors of production less productive.

For any single (non-oil-owning) business firm, a rise in the price of oil will reduce that firm's profit and its demand for labor and capital. But the economy-wide effects of an oil price rise could accentuate or offset this. A rise in the oil price changes the demand for capital and labor. An oil price rise, for example, may reduce both the demand for and the cost of labor, so that a firm's total costs actually are unchanged relative to its total revenues. Or, the demand for capital may fall at the same time that a rise in demand for labor increases a firm's costs by even more than the increase in its fuel bill.

What happens, on average, over an entire economy that possesses industries with quite different characteristics is a difficult empirical question. There is some evidence that a rise in the OPEC oil price leads, at least in the short run, to simultaneous economizing on both energy and capital. Capital and energy, by that account, are complements in the short run, while labor is a substitute for both. 4/

4/ Robert H. Rasche and John A. Tatom, "The Effects of the New Energy Regime on Economic Capacity, Production, and Prices," Federal Reserve Bank of St. Louis Review (October 1979); Savas Ozatalay, Stephen Grubaugh, and Thomas Veach Long II, "Energy Substitution and National Energy Policy," American Economic Review (May 1979); E.R. Berndt and D.O. Wood, "Technology, Prices, and the Derived Demand for Energy,"

If this is correct, a rise in the price of oil simultaneously reduces the value of the existing capital stock, the output that it can profitably produce, and (temporarily) the incentive to add to that capital stock by investing.

Policymakers may not be able to remedy such a fall in potential GNP and investment incentives with monetary and fiscal tools. Obviously, the government can use monetary and fiscal policies to lower investment costs and raise the after-tax return on investment to offset the effects of an oil price increase. But this may not be socially efficient. Private companies desire a lower capital stock at the higher energy price because they can produce output more efficiently with the new combination of capital, energy, and labor. Subsidizing capital, in such an environment, would increase its rate of formation. But by adding to the capital stock projects that do not cover interest costs, such policies lower productive efficiency.

This problem is potentially very serious. But the empirical evidence for the size and the direction of the effect is still tentative, and the analysis presented in this paper will not make further use of this finding.

Review of Economics and Statistics (August 1975); J.M. Griffin and P.R. Gregory, "An Intercountry Translog Model of Energy Substitution Responses," American Economic Review (December 1976); E.A. Hudson and D.W. Jorgenson, "U.S. Energy Policy and Economic Growth, 1975-2000," Bell Journal of Economics (Autumn 1974).

CHAPTER IV. HOW OPEC OIL PRICE INCREASES AFFECT TRADE BALANCES WITH OIL-IMPORTING COUNTRIES

OPEC oil price increases markedly change trade balances with oil-importing countries. Immediately after OPEC raises the oil price, its members typically run a trade surplus: they cannot increase their expenditures quickly enough. If OPEC collectively runs a surplus, then non-OPEC countries must, collectively, run a deficit.

Aside from the trade policies adopted by oil-importing countries (discussed in Chapter VII), several factors determine the distribution of the non-OPEC deficit. An oil-importing country's trade deficit will rise more with an OPEC price rise, the greater the volume of its oil imports relative to total imports. U.S. oil imports have risen relative to total imports since 1973, so the U.S. trade balance is now more sensitive to oil price increases (see Appendix D).

An oil-importing country's trade deficit will rise more when GNP rises, the smaller the volume of oil imports relative to total oil consumption. Since the United States is more self-sufficient in oil production than most industrial countries, any increase in total oil demand will cause a larger percentage increase in oil imports in the United States than it will in another, less self-sufficient country. Compared with those of other industrial countries, the U.S. trade balance with OPEC fluctuates more during recession and recovery. For this reason, as its GNP grew between 1973 and 1978, U.S. oil imports rose at a faster percentage rate than did oil imports of other industrial countries. This relatively sharp rise in U.S. imports followed from greater initial U.S. self-sufficiency, not from a smaller U.S. response to rising oil prices.

UNABLE TO ADJUST SPENDING TO REVENUES QUICKLY, OPEC RUNS A CURRENT ACCOUNT SURPLUS

For OPEC members as a group, total expenditures on imported goods and services lag behind their oil export revenues. The lag in expenditures produces surpluses on OPEC's goods and services account.

The OPEC surplus is produced by a few major oil producers who fail to spend all their revenues. There are many reasons for this: their governments may believe that bottlenecks or expected social instability will reduce the returns expected from additional investment; private citizens may desire to save current oil-related payments because they expect superior investment opportunities in the future, because they desire to hold overseas assets as precautions against domestic instability, or because they are sated; their governments may believe that additional military equipment will not buy additional security; or their major suppliers may not sell them the weapons they want.

Why Does the OPEC Surplus Matter?

If OPEC members run a collective surplus, the rest of the world must run a collective deficit. This feature of the oil price rise must create disharmony, since policymakers in oil-importing countries cannot collectively succeed in eliminating their deficits if OPEC has a surplus. The struggle to eliminate deficits must frustrate at least some policymakers.

The fact that OPEC runs a collective surplus, however, does permit more oil-importing nations to defer the burden of reducing domestic consumption and investment because of the higher OPEC oil price. The surplus allows oil-importing countries to maintain domestic consumption and investment by borrowing from OPEC. When the OPEC surplus is gone, oil-importing countries will have to deliver goods and services to pay for oil; perforce, they will no longer be able to consume and invest those goods and services themselves.

Finally, the OPEC surplus has an important bearing on what happens to the dollar exchange rate as a result of an oil price increase. For reasons discussed in Chapter V, much of the OPEC surplus is invested in dollar-denominated assets. In the exchange rate response, OPEC's demand for dollar assets helps outweigh the increases in trade deficits discussed in this chapter. This asset demand for dollars contributes to the result, discussed in Chapter VI, that oil price increases initially cause the dollar to rise.

What is the Regional Distribution of the OPEC Surplus?

While non-OPEC countries must collectively have a deficit, that deficit can be distributed in many ways among them. More-

over, the distribution itself can change over time. In 1973, for example, the U.S. deficit with OPEC countries was $2.1 billion, considerably smaller than the "other industrial countries'" $12.1 billion combined deficit with OPEC and less than half the "rest of the world's" $5.1 billion combined deficit (Table 6). By 1978, that had changed. The U.S. deficit with OPEC had reached $12.9 billion, about the same as the $13.2 billion deficit that other industrial countries had with OPEC and more than half the rest of the world's deficit with OPEC (Table 6).

The swing in U.S. deficits with OPEC occurred mainly because of the greater sensitivity of U.S. oil imports to income changes. In order to see the importance of income changes, the first of the following two sections discusses the likely evolution of trade balances assuming that oil-importing countries undertake policies to hold GNP and current disposable income constant; the second section discusses the evolution of trade balances when oil-importing countries' incomes vary.

THE U.S. TRADE BALANCE HAS BECOME MORE SENSITIVE TO OPEC PRICE INCREASES

To isolate the effects of price changes, this section assumes that oil-importing countries use macroeconomic policies to maintain GNP and employment, and tax and transfer policy to maintain disposable income. (There is, of course, no way to maintain the real disposable income of this generation of U.S. citizens without reducing that of future generations of U.S. citizens. 1/)

If income does not change, and if the short-term response of oil demand and supply to a price change is zero, then the volume of oil imports will not change. Under these assumptions, the

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1/ To raise real disposable income to the level citizens enjoyed before the OPEC price rise, the government could reduce taxes or increase transfer payments. The consequent rise in the budget deficit would require an offset. If the offset took the form of a fall in investment, then the present generation would maintain its consumption by passing on a smaller capital stock to future generations. If the offset took the form of a drop in the current account, the present generation would maintain its consumption by passing on smaller foreign assets (or larger foreign debts) to the next generation.

TABLE 6. OPEC TRADE WITH THE UNITED STATES AND SELECTED REGIONS, 1973-1978

	Trade (billions of dollars)			Percentage Change		
	1973	1975	1978	1975 over 1973	1978 over 1975	1978 over 1973
United States						
Exports to OPEC	3.4	10.4	16.0	206	54	371
Imports from OPEC a/	5.5	18.4	28.9	235	57	425
Trade Balance	-2.1	-8.0	-12.9	--	--	--
Other Industrial Countries b/						
Exports to OPEC	11.8	33.6	58.4	185	74	395
Imports from OPEC	23.9	60.3	71.6	152	19	200
Trade Balance	-12.1	-26.7	-13.2	--	--	--
Rest of the World c/						
Exports to OPEC	4.2	10.7	17.9	155	67	326
Imports from OPEC	9.3	29.9	39.2	222	31	322
Trade Balance	-5.1	-19.2	-21.3	—	—	—

SOURCE: Regional trade flows taken from International Monetary Fund, Direction of Trade Yearbook, 1979. To avoid problems of inconsistency between export and import data, only export data were used to construct the trade tables.

a/ Replaces IMF data on U.S. imports from OPEC (of $4.6 billion, $13.3 billion, and $28.9 billion for 1973 to 1978) with larger figures representing about 77 percent of total U.S. imports of petroleum and petroleum products. U.S. net imports of petroleum and petroleum products amounted to $7.1 billion, $23.9 billion, and $37.5 billion in 1973, 1975, and 1978, respectively. (See U.S. Department of Commerce, Survey of Current Business (March 1979), p. S-23; U.S. Department of Commerce, Business Statistics, 1977, pp. 111, 115.) A great deal of imported refined petroleum comes indirectly from OPEC through offshore refining centers and is not reported as an import from OPEC. But when OPEC raises the oil price, the United States would pay, and OPEC would receive, the bulk of increased revenue; the intermediate refiner would retain little of the increase. This table makes a rough correction for this problem by attributing to OPEC member countries all oil imports from those countries in Central America and the Caribbean where oil production is zero. Such imports amounted to about 10 percent of total U.S. imports in 1979 and raised total imports from OPEC to 77 percent of total U.S. imports of petroleum and petroleum products. (See U.S. Department of Energy, "Supply, Disposition, and Stocks of All Oils by P.A.D. Districts and Imports in the United States, by Country" (December 1979), p. 8; U.S. Department of Energy, International Petroleum Annual, 1978, p. 16.)

b/ Includes Austria, Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Norway, Sweden, Switzerland, and the United Kingdom.

c/ Excludes the United States, other industrial countries, and OPEC member countries; includes the developing countries, some smaller European countries, Australia, New Zealand, and South Africa.

total value of oil imports will rise in step with oil price increases.

The change in exports to OPEC will depend on how much of its increased disposable income OPEC will spend. Between 1973 and 1978, OPEC spent about 72 percent of its increased oil revenues on imports. If the oil-importing nations' shares of exports to OPEC remain unchanged, as they did between 1973 and 1978, then the value of their exports to OPEC will also rise in step with oil price increases.

The effects of a hypothetical 100 percent oil price increase under 1973 conditions are shown in Table 7. The deficits of all oil-importing countries would have increased, but the increase in the U.S. trade deficit would have been smaller than those of other country groups. This would be because the United States imported relatively little oil.

By 1978, because of the rise in U.S. oil imports, this would no longer have been the case. By that time, a hypothetical 100 percent oil price increase would have raised the U.S. deficit by $11.4 billion, while increasing the deficit of other industrial countries by only $7.8 billion. The U.S. trade balance became more sensitive to oil price increases, as will be discussed below, because U.S. income growth raised U.S. oil imports more.

THE U.S. TRADE BALANCE WITH OPEC CHANGES MORE WITH INCOME THAN DO THE TRADE BALANCES OF OTHER COUNTRIES

The U.S. trade deficit with OPEC rose, relative to those of other industrial countries, because of the relatively sharp rise in U.S. oil imports. U.S. exports to OPEC, by contrast, increased by about the same amount as other industrial countries' exports to OPEC.

U.S. oil imports have been more sensitive to income changes primarily because of the initially greater U.S. self-sufficiency in oil. Of secondary importance was the drop in U.S. oil production that occurred while production in other OECD countries was rising. Differences in "conservation" behavior explain only a minor part of differences in increases in oil imports.

The greater sensitivity of U.S. imports to income growth is important for two reasons:

TABLE 7. EFFECTS OF A HYPOTHETICAL 100 PERCENT OPEC PRICE INCREASE ON TRADE BALANCES WITH OPEC (Billions of dollars)

	Forecast Based on 1973 Trade Balances			Forecast Based on 1978 Trade Balances		
	Base	Predicted	Change a/	Base	Predicted	Change a/
United States						
Exports to OPEC	3.4	8.3	--	16.0	33.5	--
Imports from OPEC	5.5	11.0	--	28.9	57.8	--
Trade Balance	-2.1	-2.7	-0.6	-12.9	-24.3	-11.4
Other Industrial Countries						
Exports to OPEC	11.8	28.8	--	58.4	122.2	--
Imports from OPEC	23.9	47.8	--	71.6	143.2	--
Trade Balance	-12.1	-19.0	-6.9	-13.2	-21.0	-7.8
Rest of the World						
Exports to OPEC	4.2	10.2	--	17.9	37.5	--
Imports from OPEC	9.3	18.6	--	39.2	78.4	--
Trade Balance	-5.1	-8.4	-3.3	-21.3	-40.9	-20.4
Memo						
OPEC Exports	38.7	77.4	--	139.7	279.4	--
OPEC Imports	19.4	47.3	--	92.3	193.2	--
OPEC Trade Balance	19.3	30.1	10.8	47.4	86.2	38.8

SOURCE: Actual data are from Table 6. If oil-importing countries keep disposable income and GNP unchanged, and if the short-term elasticity of demand for OPEC (oil) exports (X) with respect to the oil price (P) is zero, then the projected export increase, dX/X, equals dP/P. The projected rise in OPEC oil exports would equal, by definition, the projected rise in non-OPEC oil imports. To predict the change in OPEC imports, assume that the change in OPEC imports (dM) is fixed relative to the change in exports (dX), so that $dM = m\,dX$. Divide through by X to obtain $dM/X = m(dX/X) = m(dP/P)$, and rearrange to get $dM/M = m(X/M)(dP/P)$. The value of "m" is calculated from the memo item in this table; over the period 1973 to 1978, "m" was approximately equal to $[(92.3 - 19.4)/(139.7 - 38.7)]$, or about 0.72. The value of M/X is also shown in the memorandum to this table. Assuming constant shares in the OPEC market, the predicted percentage increase in each oil-importing country's exports to OPEC equals the percentage increase in total OPEC imports.

a/ Negative numbers indicate an increase in deficit or a decrease in surplus; positive numbers, a decrease in deficit or an increase in surplus.

- o When an oil price increase leads to a recession, the U.S. trade balance with OPEC will improve much more than will the trade balances of other industrial countries;

- o But during the recovery, and during periods of normal economic growth, the U.S. trade balance with OPEC will worsen much more than will those of other industrial countries.

Industrial Country Exports to OPEC Have Changed Similarly

U.S. export performance does not explain the rise in the U.S. deficit with OPEC relative to the rise in the deficits of other industrial countries. U.S. exports to OPEC rose by 371 percent between 1973 and 1978, while exports of other industrial countries to OPEC rose by 395 percent (Table 6). Had U.S. exports risen by the same amount as those of other industrial countries, the U.S. deficit would not have been much different: $15.1 billion instead of $16 billion. In sharp contrast to the $10.8 billion increase in the U.S. deficit against OPEC, the deficits vis-a-vis OPEC of other industrial countries rose by only $1.1 billion: differences in export performance obviously explain little of the different evolution of deficits.

U.S. Imports from OPEC Are More Sensitive to Income Change Than Are Imports of Other Countries

Because the United States is more self-sufficient in oil production than Japan and most European countries, U.S. income growth will produce larger percentage increases in oil import volumes. U.S. import growth will be greater even when total oil demand responds to price and income changes identically in the United States and in foreign countries.

Suppose, for example, that of two identical countries, one produces half the oil it consumes while the other produces none. Suppose further that each country consumes a total of 10 million barrels per day and that income rises enough to increase oil consumption by 10 percent, to 11 million barrels per day. Imports would then increase by 10 percent in the country that imports all its oil, but they would increase by 20 percent in the relatively "self-sufficient" country.

U.S. oil import volume rose 34.2 percent between 1973 and 1977; the rise in domestic U.S. demand for petroleum accounted for

15.7 percentage points of this increase, while the fall in domestic energy production accounted for 18.6 percentage points (Table 8). But had the United States in 1973 imported the same proportion of its energy as did OECD-Europe, the percentage increase in U.S. imports would have been much smaller: using OECD-Europe weights, U.S. oil imports would have increased by only 6.1 percent from an initially larger base. 2/ Of the 45.8 percentage-point difference between the import changes of the United States (34.2 percent) and of OECD-Europe (-11.6 percent), about 28.1 percentage points, or more than half the difference, followed from the initially higher degree of U.S. energy self-sufficiency.

U.S. Oil Production Fell Relative to OECD-Europe. Of the remaining 17.7 percentage-point difference, about 16.3 percentage points existed because OECD-Europe increased its oil supplies by developing the North Sea oil field; in contrast, U.S. gas and oil production declined. OECD-Europe imports fell by 14.2 percentage points because of increases in domestic energy production. About three-quarters of this import decline resulted from increased gas and oil production. U.S. imports, on the other hand, rose by 2.1 percentage points because of reduced production. Declines in domestic oil and gas production would have increased U.S. imports by 2.3 percent, but were offset by increases in other energy production.

Differences in Adjustment of Demand to Higher Oil Prices Were Not Large. Contrary to popular opinion, differences in adjustment of demand to price and income accounted for only 1.4 percentage points of the total 45.8 percentage-point difference in oil import growth. Demand factors in OECD-Europe explained a 2.6 percentage-point increase in imports, while demand factors in the United States accounted for a 4.0 percentage-point increase in imports (with the United States adjusted to the OECD-Europe base). GNP/GDP growth was the same in the United States and in OECD-Europe during this period, so differences in the evolution of oil demand probably followed from non-income factors, including response to price changes and "conservation" behavior. These non-income demand factors are least important in explaining the different development of U.S. and OECD-Europe oil imports. Contrary to popular accounts that focus on price differences, even

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2/ See Appendix E for a discussion of how weights are used to decompose imports into consumption and production components.

the total absence of such differences would not have prevented the emergence of substantially larger oil imports in the United States. 3/

The memorandum columns of Table 8 show the estimated change in national energy demand produced by non-income factors. A rise in U.S. GNP/GDP of 8 percent between 1973 and 1977 would, by itself, have increased energy demand by an estimated 8 percent. U.S. energy demand actually rose by only 3.2 percent, so non-income factors offset part of the income effect, reducing demand by 4.8 percent. By the same reckoning, non-income factors may have reduced energy demand by 6.4 percent in OECD-Europe and by 6.8 to 8.4 percent in Japan and selected European countries. Yet, for all the attention that has been focused on relative levels of petroleum consumption, the differences in adjustment to higher prices since 1973 are strikingly small.

3/ It is possible, of course, that higher initial U.S. energy consumption meant that the United States could have reduced energy consumption faster than did other countries. If this were the case, data showing similar responses by the United States and other countries to oil price increases might still be consistent with a much lower U.S. response, relative to the potential U.S. response, than occurred in other countries. This paper does not treat this question. It is useful to note, though, that it is not obvious that the United States should have adjusted faster. Automobiles are most commonly cited to support the view that Americans could have adjusted energy consumption more than did Europeans or Japanese. Although the average foreign car gets more miles per gallon than the average American car, it does not follow that U.S. citizens should adjust the composition of their car stock faster. When the gasoline price rises, the prices of the majority of U.S. cars--already manufactured and on the road--simply fall to compensate. The scrapping rate does not rise, older-model cars continue to be used and traded (albeit at lower prices), and, consequently, gasoline consumption does not change significantly.

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TABLE 8. COMPONENTS OF CHANGE IN QUANTITIES OF ENERGY IMPORTS FOR THE UNITED STATES AND SELECTED OECD COUNTRIES, 1973-1977

Country or Country Group	Percentage Change in Import Volume a/	Contribution to Import Change of Percentage Change in Demand		
		Total	Income Component b/	Other Demand Change
1973 to 1977				
United States	34.2	15.7	51.5	-35.9
Japan	3.1	4.7	15.1	-10.3
Germany	-1.0	-3.3	12.4	-15.7
United Kingdom	-50.1	-11.0	2.3	-13.3
OECD-Europe	-11.6	2.6	13.0	-10.4
United States with OECD-Europe weights	6.1	4.0	13.0	-9.1
1973 to 1975				
United States	-9.8	-32.7	-14.4	-18.3
Japan	-3.1	-1.5	1.1	-2.6
Germany	-15.3	-16.1	-2.9	-13.2
United Kingdom	-22.6	-18.5	-7.0	-11.6
OECD-Europe	-13.9	-8.6	1.6	-10.2
United States with OECD-Europe weights	-9.8	-8.3	-3.7	-4.6
1975 to 1977				
United States	48.7	53.6	71.0	-17.3
Japan	6.4	6.4	14.1	-7.6
Germany	16.9	15.1	16.7	-1.6
United Kingdom	-35.5	9.7	11.3	-1.6
OECD-Europe	2.6	12.9	12.3	0.6
United States with OECD-Europe weights	13.5	14.2	18.8	-4.6

(continued)

SOURCES: Imports are derived from energy demand and production data taken from OECD, Energy Balances of OECD Countries, 1960/1974 (Paris, 1976) and Energy Balances of OECD Countries, 1975/1977 (Paris, 1979). Income data are GDP data taken from OECD, Main Economic Indicators (October 1979). See Appendix D for derivation. Detail may not add to totals because of rounding.

a/ Total energy imports, converted to million tons of oil equivalent, and expressed as percentage change over the base period.

TABLE 8. (Continued)

Contribution to Import Change of Percentage Change in Production			Memorandum		
	Oil and		Gross Domestic Product (percentage	Total Energy Demand (percentage	Percentage Demand Change Not Attributed
Total	Gas	Other	change)	change)	to Income Change
18.6	45.5	-26.9	8.0	3.3	-4.8
-1.6	0.1	-1.7	12.1	3.7	-8.4
2.3	1.1	1.2	6.8	-1.5	-8.3
-39.1	-42.7	3.7	1.2	-5.6	-6.8
-14.2	-10.6	-3.6	8.0	1.6	-6.4
2.1	2.3	-0.1	--	--	--
23.0	39.5	-16.5	-2.3	-4.4	-2.1
-1.6	0.1	-1.7	1.0	-1.8	-2.8
0.8	1.0	-0.3	-1.6	-8.5	-6.9
-4.0	-6.5	2.5	-3.5	-9.3	-5.8
-5.3	-3.7	-1.6	1.0	-5.3	-6.3
2.6	2.0	0.7	--	--	--
-4.9	6.6	-11.5	10.5	7.9	-2.6
0.0	0.0	0.0	11.0	5.6	-5.4
1.9	0.1	1.8	8.5	7.7	-0.8
-45.3	-46.8	1.5	4.8	4.1	-0.7
-10.3	-7.9	-2.4	6.9	7.2	0.3
-0.7	0.5	-1.1	--	--	--

b/ Appendix D discusses the separation of the total demand change into its income and non-income components. The income component assumes an income elasticity of demand of 1. This is about the historical value of the income elasticity assumed in the OECD energy projections. (See OECD, Energy Policies and Programmes of IEA Countries, 1978 Review (Paris, 1979), pp. 74, 97, 139, 147.) Any adjustment of demand beyond this is attributable, broadly, to other factors, including adjustment to past and current price changes, excise taxes, and special government programs.

CHAPTER V. HOW OPEC OIL PRICE INCREASES AFFECT DOMESTIC AND INTERNATIONAL CREDIT MARKETS

Oil price increases first affect credit markets by raising nominal GNPs, nominal disposable incomes, and nominal domestic expenditures. The demand for credit rises in all the oil-importing countries, but most of all in the United States.

DEMAND FOR CREDIT INCREASES BY MORE WITHIN THE UNITED STATES THAN WITHIN OTHER COUNTRIES

Oil price increases raise short-term credit demand by increasing the total value of transactions. Oil price increases simultaneously reduce real economic activity and raise the general price level. For the United States, the rise in the price level more than offsets the fall in real activity, so that both nominal transactions and demand for credit rise. 1/

Economists disagree about the best indicator of a change in the demand for credit. Suggested indicators include changes in nominal disposable income, nominal gross national product, and nominal domestic expenditure. But by any of these measures, the predicted rise in U.S. credit demand will exceed that of its major trading partners. U.S. credit demand will rise because an oil price rise increases the general price level more than it reduces real economic activity. U.S. credit demand will rise relative to that in foreign countries because the rise in the U.S. general price level is greater than that in foreign countries (Chapter II), while the drop in economic activity is about the same (Chapter III). 2/

Whatever the correct indicator of the demand for credit, then, U.S. domestic credit markets should tighten relative to

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1/ Appendix F further discusses the effect of oil price increases on nominal GNP and disposable income.

2/ See Appendix F.

those of other major oil-importing countries. (This assumes no change in central bank credit supplies, an assumption relaxed in Chapter VI.) The rise in the demand for credit within the United States will increase interest rates relative to those in other countries. That, in turn, will contribute to dollar exchange rate appreciation.

OPEC MEMBERS DEMAND DOLLAR-DENOMINATED ASSETS TO STORE THEIR SURPLUSES

When OPEC members demand dollar-denominated assets to store their financial surpluses, they hold the dollar exchange rate higher than it would otherwise be. The first of the following sections presents data indicating that, in the short run, OPEC members keep more than 75 percent of increased international reserves in dollars. The second section estimates that more than 60 percent of OPEC's nonreserve investment assets are denominated in dollars. The next two sections discuss the plausibility of major OPEC shifts into and out of dollars in view of the large share of dollar denominations in the world stock of public and private financial assets.

Currency Composition of Oil-Exporting Countries' Reserve Assets

Reserves are customarily defined as highly liquid assets that countries can use to finance current account deficits while they adjust their domestic economies. In practice, however, the definition of reserves is not very precise; the fraction of total assets comprising foreign currency reserves is whatever a country claims it to be. (The distinction is relevant here only insofar as it is possible to piece together better data on the currency denomination of reserves. Some of the problems in doing so are discussed in the notes to Table 9. 3/)

3/ The U.S. government and some international agencies have more complete and precise information than is shown here concerning oil-exporting countries' holdings of reserve and investment assets, together with the geographic location and the currency denomination of those investments. Those entities include the U.S. Departments of Treasury and Commerce, the Central Intelligence Agency, the Federal Reserve Board, the International Monetary Fund, and the Bank for International Settlements.

TABLE 9. OIL-EXPORTING COUNTRIES' HOLDINGS OF RESERVE ASSETS, DOLLAR-DENOMINATED AND OTHER, 1973-1978 (Billions of dollars)

	1973	1974	1975	1976	1977	1978
1. Cumulative OPEC Surplus Since 1973 a/	7.0	75.0	110.0	151.0	186.0	206.0
2. Total OPEC Reserves, End-of-Year Data b/	14.5	47.0	56.6	65.2	75.5	65.8
3. OPEC Reserves Held in Dollars						
a. In United States c/	3.4	15.3	23.2	34.2	41.6	42.0
b. In Eurodollars d/	4.8	19.1	24.2	27.5	31.4	19.4
c. Total	8.2	34.4	47.4	61.8	72.9	61.5
4. Percentage of Reserves Held in Dollars (4 = 3c/2)	57	73	84	95	97	93
5. Change in Dollar Reserves as Percentage of Change in Total Reserves (5 = Change in 3c/Change in 2)	—	81	135	167	108	118

NOTE: Detail may not add to totals due to rounding.

a/ Derived from data presented in International Monetary Fund, Annual Report, 1979, p. 18.

b/ Data for 1973-1977 from International Monetary Fund, Annual Report, 1978, Table 14, p. 51; data for 1978 from Annual Report, 1979, Table 18, p. 57. Original data in SDRs were converted to dollars using the SDR/dollar exchange rate for the end of year from various issues of International Financial Statistics. To make the series consistent, SDR 4.3 billion ($5.6 billion) has been added to the 1978 value, representing the estimated foreign exchange cover against the Saudi Arabian note issue.

c/ See testimony of C. Fred Bergsten, Assistant Secretary of the Treasury for International Affairs, in The Operations of Federal Agencies in Monitoring, Reporting On, and Analyzing Foreign Investments in the United States, Hearings before the Subcommittee on Commerce, Consumer, and Monetary Affairs, House Committee on Government Operations, 96:1 (July 1979), Part 2, Table 3, p. 221. All OPEC holdings of U.S. Treasury debt were treated as official holdings, an assumption broadly supported by the aggregate data on identities of foreign holders of U.S. Treasury debt.

d/ International Monetary Fund, Annual Report, 1979, Table 20, p. 59. Original data in SDRs converted to dollars as described in note b.

Allowing for these difficulties, OPEC appears to have held more than 70 percent of its reserves in dollars since 1974 (Table 9). When OPEC members reduced their reserves in 1978, more than 100 percent of the reduction was in dollars, implying some shift out of dollars. When OPEC members added reserves between 1975 and 1977, they replaced nondollar assets with dollar assets, so the table shows for those years that more than 100 percent of reserve additions were in dollars.

Currency Denomination of Oil-Exporting Countries' Total Assets

By 1978, OPEC's total foreign assets (the cumulative OPEC surplus) represented more than twice the value of its reserve assets (Table 9). Unfortunately, little information exists on the currency denomination of nonreserve assets. The following section begins by presenting data on the currency denomination of newly issued international assets. It then estimates the currency denomination of all OPEC assets by assuming that OPEC nonreserve assets have the average currency denomination of new issues. Finally, it discusses the plausibility of this estimate in light of the currency denomination of combined newly issued and existing government and private assets.

Currency Composition of New Issues and Bank Assets. Dollars accounted for about 60 to 70 percent of the currency denomination of international bonds and publicly offered Eurocurrency credits between 1976 and 1978 (Table 10). The deutsche mark occupied a distant second place, with 6 to 9 percent of the offerings.

Dollar-denominated assets also represented about 70 percent of the external assets of European banks (Table 10). Moreover, most of the decline in the dollar's share of these assets between 1976 and 1978 followed from valuation effects: dollar depreciation raises the dollar value of foreign currencies held by banks. The decline was not the result of fund movements. 4/

Various government officials have discussed the justification for not releasing these data. (See The Adequacy of the Federal Response to Foreign Investment in the United States, H. Rept. 1216, 96:2 (August 1980), pp. 119-29.)

4/ Bank for International Settlements, Annual Report, 1978/1979, p. 119.

TABLE 10. CURRENCY DENOMINATION OF SOME IMPORTANT LONG- AND SHORT-TERM FINANCIAL INSTRUMENTS (Percent of total)

	Currency Denomination of International Bond and Eurocurrency Credit Offerings			Currency Denomination of External Assets of European Banks Reporting to the Bank for International Settlements			
	1976	1977	1978	1976	1977 a/	1977 b/	1978
Canada (Canadian Dollar)	2.3	0.9	-	-	-	c/	c/
Germany (Deutsche Mark)	6.0	8.7	7.3	16.0	18.1	18.3	19.4
Japan (Yen)	-	0.4	0.5	c/	c/	c/	c/
Switzerland (Franc)	0.1	0.2	-	5.9	6.0	6.1	5.6
United Kingdom (Sterling)	0.9	0.5	1.0	0.7	1.2	1.4	1.5
United States (Dollar)	58.5	64.1	69.9	73.4	70.2	69.8	67.6
Other Currencies d/	32.2	25.2	21.3	4.0	4.5	4.4	5.9

SOURCES: Currency composition of international and Eurocurrency bond offerings derived from data presented in World Bank, Borrowing in International Capital Markets, Fourth Quarter, 1978, EC-181/784 (March 1979), Tables 6, 7, and 12, pp. 85-86, 158. The currency composition of assets in European banks was derived from data presented in Bank for International Settlements, Annual Report, 1978/79, p. 118.

a/ Compare these 1977 data with 1976 data.

b/ Compare these 1977 data with 1978 data.

c/ Grouped with "other currencies."

d/ National borrowings were assigned to the "other currency" category, so the dollar denomination of these bonds is somewhat underestimated.

Estimated Currency Denomination of Total OPEC Assets. Large sums like the OPEC surplus could probably not be invested in international financial instruments without purchases of something close to the average currency denomination of that market. One estimate of the currency denomination of OPEC's reserve and nonreserve financial assets might assume that when oil-exporting countries purchase nonreserve assets they obtain the market's average currency denomination of new issues. The resulting estimate (Table 11, Estimate A) suggests that the average dollar-denominated content of the OPEC portfolio was 68 percent in 1974 and ranged between 72 and 77 percent for the balance of the

TABLE 11. ESTIMATED DOLLAR DENOMINATION OF OPEC RESERVE AND NONRESERVE FOREIGN ASSETS, 1974-1978 (In percent)

	1974	1975	1976	1977	1978
Estimate A					
OPEC dollar assets as percentage of total OPEC foreign assets (cumulative OPEC current account surplus) a/	68	72	74	77	77
Change in OPEC dollar assets as percentage of change in total OPEC foreign assets a/	63	81	79	91	79
Estimate B					
OPEC dollar assets as percentage of total OPEC foreign assets (cumulative OPEC current account surplus) b/	46	43	41	39	30
Change in OPEC dollar assets as percentage of change in total OPEC foreign assets b/	38	38	35	32	-57

a/ Total OPEC dollar-denominated reserve assets taken from Table 9. Balance of OPEC cumulative surplus (also shown in Table 9, line 1) is assumed to be divided into dollar and nondollar assets in the same proportion that dollar bonds represented in that year's international bond and Euromarket credit offerings. That distribution is shown in Table 10 for the years 1976 to 1978 and is assumed to be 0.6 for previous years.

b/ Assumes no OPEC nonreserve assets are invested in dollar-denominated assets.

period. Under such an assumption, the increase in dollar assets held as a fraction of each additional dollar of OPEC surplus would have ranged between 63 and 91 percent (line 2).

In addition to this "reasonable" estimate of the currency denomination of the OPEC portfolio, Table 11 shows an "extreme" estimate that assumes that none of the funds held by OPEC members as nonreserve assets are invested in dollar-denominated assets (line 3). Even under this assumption, which the following two sections will indicate is highly improbable, the dollar content of a rise in OPEC assets would still have ranged between 32 and 38 percent, except in 1978, when this assumption is indeed consistent with a substantial absolute drop in dollar-denominated holdings. The table does not show the other extreme assumption: that OPEC's nonreserve assets are entirely denominated in dollars. This would, of course, imply that the dollar denomination of total OPEC reserve and nonreserve assets (the cumulative OPEC surplus) exceeds the 70 to 90 percent found for reserves alone (Table 9).

Currency Denomination of Outstanding Government Debt as a Check on the Estimate of OPEC Asset Denomination. Sizes of outstanding public debt show why OPEC could not move much of its assets out of dollars into government debt of major financial center countries without massively disrupting world financial markets (Table 12). OPEC nonreserve assets of $150 billion exceed the entire national debts of Germany, Switzerland, or the United Kingdom. Even in countries where outstanding debt exceeds OPEC assets, the debt is already held somewhere; attempts to purchase only a fraction of that debt might have enormously disruptive effects in their financial markets. For an investor, such a purchase attempt would certainly drive down yields and might raise the exchange rate. Most of these countries, furthermore, have restrictions on who may hold their national debt and on the purposes for which the national debt may be held.

Transactions in the U.S. national debt, in contrast, are considerably less trammeled than in others. A larger amount is traded actively. U.S. government bonds, moreover, are available at many different maturities, ranging between a few weeks and almost 30 years. Such spacing is valuable to investors manipulating large portfolios.

Currency Denomination of Private Instruments as a Check on the Estimate of OPEC Asset Composition. Dollar denominations also predominate among private market instruments: U.S. equities

TABLE 12. NATIONAL DEBT OF MAJOR COUNTRIES, 1979 (Billions of dollars)

Country	Amount
Switzerland a/	7.1
Germany	117.0
United Kingdom b/	136.8
Japan	241.0
United States	658.0

SOURCES: International Monetary Fund, International Financial Statistics (July 1980). Figure for United Kingdom from International Monetary Fund, Government Finance Statistics Yearbook, 1979, p. 370.

a/ End of 1977.

b/ As of March 31, 1978.

account for about 75 percent of all equities outstanding among major Western countries; U.S. private bonds account for about 50 percent of all private bonds outstanding (Table 13).

In the United States, negotiable financial instruments are relatively plentiful because public stock and bond issues have financed private capital. Other countries have fewer financial certificates relative to their capital stocks because banks and governments have, more than in the United States, financed industry directly.

Potential investors must consider the riskiness of assets, too. The United States possesses about one-third of the OECD's capital stock, 5/ but probably more than one-third of the capital stock that most investors consider secure. A variety of

5/ At current prices and exchange rates, the United States had 34.5 percent of OECD GDP in 1979; see OECD, Main Economic Indicators (December 1980), p. 169. Assuming equal capital output ratios, it would have had about the same share of the capital stock.

TABLE 13. TOTAL DOLLAR VALUE OF OUTSTANDING DOMESTIC PRIVATE BONDS AND STOCKS IN MAJOR WESTERN COUNTRIES, 1977 a/

	In Billions of Dollars		As Percentage of Total	
	Private Bonds	Private Stocks	Private Bonds	Private Stocks
Austria	6.5	3.6	0.8	0.3
Belgium	18.3	15.5	2.2	1.2
Canada	30.6	68.6	3.7	5.1
Denmark	30.2	11.7	3.7	0.9
Finland	2.3	7.2	0.3	0.5
France	17.3	27.9	2.1	2.1
Germany	144.5	37.3	17.6	2.8
Italy	51.6	22.8	6.3	1.7
Japan	116.1	69.9	14.1	5.2
Norway	5.0	3.2	0.6	0.2
United Kingdom	7.9	73.1	1.0	5.5
Subtotal	528.4	340.2	52.4	25.5
United States	390.7	996.7	47.6	74.5
Total	919.1	1,336.9	100.0	100.0

SOURCE: Organization for Economic Cooperation and Development, OECD Financial Statistics, Volume I (October 1978).

a/ End-of-period data converted from national currencies with end-of-period exchange rates. Period ending in 1977 for Canada, France, Germany, Italy, Japan, and the United States; period ending in 1976 for Belgium, Finland, Norway, and United Kingdom; period ending in 1975 for Denmark.

geographical, military, and historical factors contribute to this in obvious ways. Moreover, the United States, itself possessing large foreign assets, has a relatively strong interest in guaranteeing all investors' rights.

Because of this omnipresence of U.S. instruments in private and public portfolios, a sum as great as the cumulative OPEC

TABLE 14. CURRENCY DENOMINATION OF FOREIGN EXCHANGE RESERVES, 1973-1978 (Billions of dollars and percentages)

	1973	1974	1975	1976	1977	1978
All Countries						
Total foreign exchange reserves, measured in dollars a/	122.6	154.8	160.8	186.3	243.3	288.1
Total reserves held in dollars b/	89.1	115.7	125.2	145.0	191.2	218.8
Dollars as a percentage of total foreign exchange reserves c/	72.7	74.7	77.9	77.8	78.6	75.9
Oil-Exporting Countries						
Total foreign exchange reserves, measured in dollars a/	12.3	42.8	49.7	57.0	67.1	52.2
Saudi Arabian Monetary Authority (SAMA), other assets d/	0.0	0.0	15.4	22.6	25.1	N.A.
Total foreign exchange reserves held in dollars e/	8.2	34.4	47.4	61.8	72.9	61.5
Dollars as a percentage of total foreign exchange reserves and other SAMA holdings f/	66.7	80.4	72.8	77.6	79.1	--
Oil-Importing Countries						
Total foreign exchange reserves measured in dollars a/	110.3	112.0	111.1	129.3	176.2	235.9
Total foreign exchange reserves held in dollars g/	73.5	78.0	78.4	83.3	114.2	146.2
Dollars as a percentage of total foreign exchange reserves	66.6	69.7	70.6	64.4	64.8	62.0

a/ Total foreign exchange reserves are taken from International Monetary Fund, International Financial Statistics (June 1980) and converted with the end-of-period dollar/SDR exchange rate given in that source.

(continued)

surplus probably has a currency denomination closer to that of Estimate A than to that of Estimate B in Table 11.

OTHER OIL-IMPORTING COUNTRIES DEMAND MORE DOLLAR-DENOMINATED RESERVES

Other oil-importing countries did not draw down their reserves to finance their deficits; instead, they increased their reserves. They did not, therefore, offset OPEC demands for reserve assets--they increased them. These oil-importing countries may have increased their reserve holdings because of increased uncertainty about the effects of the OPEC price increases on their trade balances.

TABLE 14. (continued)

b/ Total reserves held in dollars is the sum of official claims on the United States and official assets held in Eurodollars. See International Monetary Fund, Annual Report, 1979, Table 20, p. 59.

c/ Note that Table 9, line 4, shows dollar-denominated reserves as a fraction of total reserves, comprising gold, SDRs, and foreign exchange.

d/ International Monetary Fund, International Financial Statistics (June 1980); latest 1977 data for SAMA are end of first quarter.

e/ Official Eurodollar holdings of oil-exporting countries are taken from IMF, Annual Report, 1979, Table 20. OPEC holdings of U.S. government debt are taken from the testimony of C. Fred Bergsten, Assistant Secretary of the Treasury for International Affairs, in The Operations of Federal Agencies in Monitoring, Reporting On, and Analyzing Foreign Investments in the United States, Hearings before the Subcommittee on Commerce, Consumer, and Monetary Affairs, House Committee on Government Operations, 96:1 (July 1979), Part 2, Table 3, p. 221.

f/ The figures reported by the U.S. Treasury as official OPEC holdings of dollars exceed the figures reported by the IMF as total OPEC holdings of reserves. It is likely that SAMA's other assets are treated as official holdings by the United States even though SAMA does not report them as "reserves" to the IMF. Since there is apparently no important difference in the financial instruments in which reserves and SAMA's other assets are embodied, and since no other official estimate of dollar-denominated OPEC holdings is available, SAMA's other assets were grouped with the IMF-defined reserves to compute this ratio.

g/ Non-OPEC official holdings of Eurodollars were taken from IMF, Annual Report, 1979, Table 20, p. 59. Non-OPEC official holdings within the United States were estimated by summing U.S. liabilities to official institutions of foreign countries outside Asia; see Department of the Treasury, Treasury Bulletin (May 1980), Table IFS-3, p. 91. This underestimates non-OPEC official holdings, since it excludes the non-OPEC countries of Asia, including Japan. Estimated total holdings of dollars are the sum of Eurodollar holdings and holdings within the United States.

Non-OPEC countries held 60 to 70 percent of their foreign exchange reserves in dollar-denominated assets between 1973 and 1978, while OPEC member countries held 70 to 80 percent in dollars during the same period (Table 14). Had other oil-importing countries drawn down their reserves to finance their deficits, they would have sold assets representing, on average, 65 percent dollars at the same time that OPEC members were buying assets representing, on average, 75 percent dollars. Had that happened, the reserve-associated increase in dollar-asset demand would have been only 10 percent of the OPEC surplus.

Other oil-importing countries did not, however, draw down their reserves during the period of OPEC asset accumulation. Despite their current account deficits, they increased reserve

holdings by borrowing in international capital markets. All major country regional groups increased their foreign exchange reserves between 1973 and 1978 (Table 15, column 3). Even when current account surpluses and deficits were developing and shifting rapidly, between 1973 and 1975 or 1976, 6/ industrial countries and (non-oil) less-developed countries accumulated reserves; only "Other Europe" drew down reserves during this period (Table 15, columns 1 and 2). During the period of world economic recovery, from 1975 or 1976 to 1978, all regional groups except the oil-exporting countries accumulated reserves rapidly.

TABLE 15. PERCENTAGE CHANGE IN DOLLAR EQUIVALENT OF FOREIGN EXCHANGE RESERVES HELD BY MAJOR NATIONAL ECONOMIC GROUPINGS

	Percentage Change Over 1973		Percentage Change 1978 Over		
	1975	1976	1973	1975	1976
All Countries	31	52	135	79	55
Industrial Countries	2	8	109	106	94
Other Europe	-37	-17	3	63	24
Oil-Exporting Countries	304	364	324	5	-8
Other LDCs	8	55	163	143	69

SOURCE: International Monetary Fund, International Financial Statistics (July 1980), pp. 32-34.

Oil-importing countries may have increased reserve holdings because they expected the average deficit to be larger. The oil price rise directly increased the expected size of the deficit of oil-importing countries taken as a group, as it was the counterpart of the oil-exporting countries' surplus.

6/ This discussion compares both 1975 and 1976 with 1973 and 1978 to show that the argument does not depend critically on the choice of the mid-point year.

Oil-importing countries may also have increased reserve holdings because they were more uncertain about the likely size of the deficit. After the first OPEC price increases, national governments were unsure about the response of energy supply and demand to the oil price rise. They were also uncertain about the pattern of deficits that would emerge as different national governments used different policy mixes to secure different policy goals. The inflation induced by the oil price rise added to the uncertainty surrounding the likely changes in international trade.

Oil-importing countries did not, however, accumulate many reserves in the course of intervening in support of the dollar. 7/ When the dollar depreciated between 1975 or 1976 and 1978, reserves of those industrial countries that did intervene grew somewhat faster than those of other European countries but more slowly than the reserves of the non-oil LDCs; neither of the latter two groups intervened substantially to support the dollar.

7/ Combined foreign currency reserves of Germany, Japan, and Switzerland rose by $36.9 billion from their value of $44.5 billion (the average of 1975 and 1976) and their 1978 value of $81.3 billion. World foreign exchange reserves rose by about $114.6 billion over the same period; if all foreign exchange acquisition by these countries was motivated by intervention in support of the dollar, then such intervention would account for at most 32 percent of the increase in reserves. Total world reserves, including gold valued at a constant price of SDR 35 per ounce, rose by $121.8 billion over the same period; the assumed amount of intervention would have accounted for no more than 30 percent of the increase in total reserves. Valuing gold at world market prices would further reduce the share of intervention in explaining total reserve accumulation. Indeed, the foreign exchange holdings of the intervening countries increased by about 83 percent over this period (measuring reserves in dollars), less than the 119 percent rise in foreign exchange holdings of other, typically non-intervening, industrial countries. Since even countries that intervene accumulate reserves for other reasons as well, attributing all their reserve increases to intervention overestimates true intervention; less than 30 percent of reserve accumulation followed from intervention. Holdings of reserves by country and by type of reserve, and SDR exchange rates, were taken from International Monetary Fund, International Financial Statistics (June 1980), pp. 10, 32-35.

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There is no reason to associate total industrial country foreign exchange accumulation with dollar support operations in the period between 1973 and 1975 or 1976. Within the industrial countries, only Germany, Japan, and Switzerland have been important intervenors in support of the dollar. Were all of their reserve accumulations between 1975 or 1976 and 1978 obtained by intervening in support of the dollar—surely an overestimate—then intervention would still explain no more than 30 percent of world reserve accumulation.

CHAPTER VI. HOW OPEC OIL PRICE INCREASES AFFECT THE DOLLAR EXCHANGE RATE

The dollar exchange rate--the price of a dollar measured in foreign currency--depends on the supply of and demand for dollars and dollar-denominated financial assets.

This chapter first discusses why, when central banks hold credit unchanged, an increase in the oil price will first raise, and later lower, the dollar exchange rate relative to the rate that would have existed without the oil price increase. Holding central bank reaction constant permits focusing on the structural, nonpolicy reaction to an oil price increase: the relatively large increase in credit demand in the United States, the rise in the demand for dollar-denominated international reserves, and the insufficiency of the rise in the U.S. deficit as a way of supplying the dollar assets demanded. It then shows why speculators can dampen, but not eliminate, these exchange rate fluctuations.

The chapter then discusses how choices of monetary and fiscal policy will change this predicted exchange rate path.

WHY THE DOLLAR WILL APPRECIATE IF CENTRAL BANKS DO NOT CHANGE CREDIT SUPPLIES

An oil price increase will first raise the value of the dollar because it:

- increases credit demand and tightens credit markets in the United States relative to other countries;
- increases the OPEC surplus and OPEC's demand for dollar-denominated international reserve assets;
- increases other oil-importing countries' uncertainty about the size of their deficits and increases their demand for reserves; and
- only partly offsets the above by increasing the U.S. trade deficit.

In the second phase of the adjustment period, the dollar will depreciate relative to what it would have been because:

- o credit markets will slacken as non-oil prices drop in response to unchanged central bank credit policies;
- o OPEC will stop accumulating reserves and will increase imports of goods and services;
- o other oil-importing countries will become more certain about the evolution of their deficits and will demand fewer dollar-denominated reserves; and
- o the foregoing will be only partly offset by the drop in the U.S. trade deficit.

For Any Oil Price Increase, U.S. Domestic Credit Demand Will Rise Relative to That of Other Countries

An oil price rise reduces U.S. and foreign real output by about the same amount, but it increases the U.S. GNP deflator and the consumer expenditures deflator by much more. Therefore, nominal GNP and disposable income will rise in the United States relative to other countries. Accordingly, relative to other countries, credit demand within the United States will also rise.

Assuming unchanged central bank credit supply policies, the rise in U.S. credit demand will reduce domestic loan availability and increase U.S. interest rates. Foreign capital will flow into the United States, and the exchange rate will rise. This exchange rate movement is roughly sketched in Panel A of Figure 1.

If, as time passes, however, the central bank continues to hold credit unchanged, the aggregate price level will fall back toward its old level. The U.S. demand for credit will fall, and the exchange rate will return toward its old level.

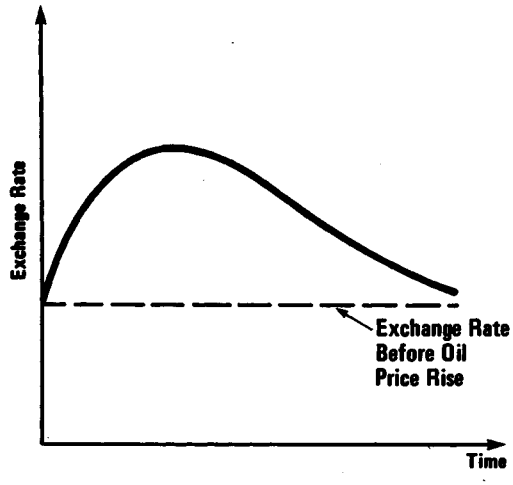
The Oil Price Rise Will Increase Foreign Demand for Dollar-Denominated Assets

While OPEC runs a surplus, its demand for dollar-denominated assets will raise the dollar exchange rate above the level that otherwise would have prevailed. This period of "high" exchange rates is labeled "Phase I" in Panel B of Figure 1.

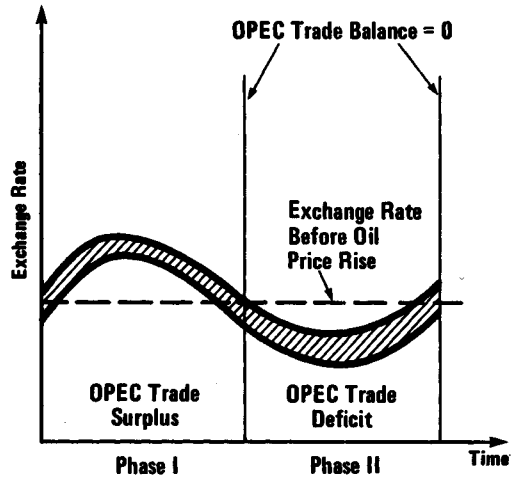
Figure 1.

Components of the Exchange-Rate Effect of Oil-Price-Related Changes in Demand for Dollars and Other Dollar-Denominated Financial Assets

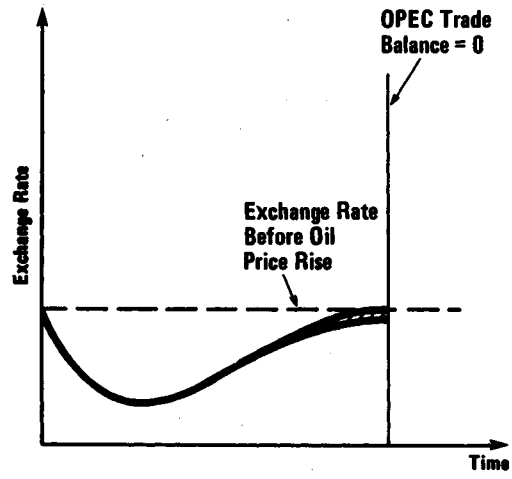
Panel A. Effect of Changes in the U.S. Transactions Demand for Money



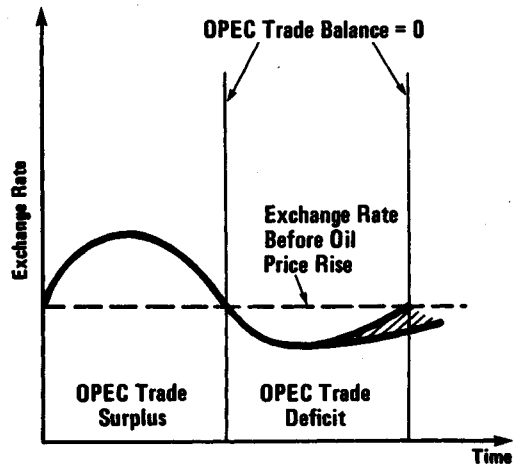
Panel B. Effect of OPEC and Foreign Demand for Reserve Assets



Panel C. Effect of Changes in the U.S. Trade Balance



Panel D. Combined Effect



At the same time, other oil-importing countries will either draw down their reserves to finance their deficits or borrow to increase their reserves because of greater uncertainty about their deficits. Depending on whether their demand rises (as it did between 1973 and 1976) or falls, the exchange rate will rise more or less. The uncertainty about combined OPEC and non-U.S. oil-importing country reserve demand is indicated by the shaded zone in Panel B.

Should OPEC imports eventually rise enough to eliminate its trade surplus, OPEC's demand for dollar assets will fall to zero. The exchange rate will return to the level that would have prevailed without an oil price increase. This point is the dividing line between Phase I and Phase II (Figure 1, Panel B).

OPEC may increase imports enough to create a trade deficit, financing it by spending accumulated dollar-denominated assets. Because of OPEC's asset reductions, the dollar will fall below the value that otherwise would have prevailed. The dollar will remain depressed until OPEC stops drawing down those reserves, either because it once again has no trade deficit (shown in Figure 1) or because it borrows to finance the deficit.

Changes in the U.S. Trade Balance Only Partly Offset the Above

The U.S. trade balance with OPEC will move into deficit when the oil price is first increased; it will then move back toward zero as OPEC imports rise (Panel C). Should OPEC eventually run a deficit, the United States might have a counterpart surplus.

If, ultimately, OPEC maintains its current market share of U.S. exports and there are no offsetting changes elsewhere, then a U.S. trade deficit will appear at the old exchange rate. This deficit must be erased with permanent "real" depreciation of the dollar relative to the level that prevailed before the oil price rise. Such real depreciation would occur either by reducing the general price level (relative to foreign price levels) at the old exchange rate or by depreciating the exchange rate while maintaining the U.S. general price level (shown as the shaded area in Panel C).

The U.S. trade deficit will not, however, supply all the dollars that OPEC members demand. The hypothetical 100 percent oil price increase discussed in Chapter IV (Table 7) would, with

1973 trade balances, increase the U.S. trade deficit with OPEC by $0.6 billion. At the same time, it would increase the OPEC surplus by $10.8 billion. Since, as Chapter V discussed (Table 11), OPEC will put 60 percent or more of that surplus in dollar assets, OPEC demand for dollar-denominated assets will probably rise by more than $6 billion. This rise in demand exceeds the increase in dollar assets supplied by the U.S. trade deficit, so the exchange rate will rise.

Even in 1978, when the U.S. trade balance had grown more sensitive to oil price increases, such price increases would still increase OPEC demand for dollar assets by more than the rise in the U.S. deficit. The 100 percent oil price increase would raise the 1978 U.S. deficit by $11.4 billion. But the OPEC surplus would rise by $38.8 billion, of which more than $23 billion would be placed in dollars.

Conversely, when OPEC later draws down its reserve assets to finance its trade deficit, its demand for dollars will fall. This demand decline will exceed the drop in dollar assets supplied when the U.S. trade deficit falls. When OPEC sells a dollar's worth of foreign assets, more than 60 cents is actually denominated in dollars. When OPEC buys a dollar's worth of imports, only about 18 cents actually comes from the United States. 1/ So when OPEC draws down reserves to buy imports, the demand for dollars falls.

The Combined Effect First Raises, then Reduces, the Value of the Dollar

The combined effect of the increase in domestic credit demand, demand for international dollar reserves, and rise in the U.S. trade deficit is first to raise the value of the dollar relative to what it would have been, and then to decrease it. The combined effect is roughly shown in Panel D of Figure 1. (The shaded area shows the possibility of permanent real depreciation of the dollar.)

Speculators May Partly Dampen These Price Movements

Speculators will limit the dollar's rise and fall. If they foresee the price pattern, they will sell the dollar short when it

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1/ Total OPEC imports rose by $71.6 billion between 1973 and 1978, while OPEC imports from the United States rose by $12.6 billion over the same period (Table 7).

first rises and later cover their positions by purchasing when the dollar has fallen. These purchases and sales will reduce the dollar's fluctuation.

They will not, however, completely damp out the fluctuation. Speculators' expected profits must exceed their interest costs. A speculator who borrowed to short the dollar would have to expect the dollar to depreciate by at least as much as the interest rate; any less and the speculator would lose money. Even with stabilizing speculation, exchange rate swings as great as the annualized interest rate are possible; greater swings would occur when speculators required reasonable risk premiums over the interest rate.

U.S. AND FOREIGN CENTRAL BANK REACTION MAY PRODUCE A DIFFERENT DOLLAR EXCHANGE RATE

The preceding discussion assumed that central banks hold credit supplies unchanged; obviously, they will not do this. Rather, they will change credit supplies according to a variety of policy goals; they may even place prime emphasis on changing the exchange rate.

Historically, the Federal Reserve has met oil price increases with relatively restrictive credit policies. This reaction may follow from its perception that U.S. prices rise more than foreign prices, or that they rise by a great deal relative to other inflationary episodes within the United States. This reaction accentuates the dollar exchange rate appreciation: at the same time that the demand for dollars and dollar-denominated assets rises more than demand for foreign currencies and foreign-currency assets, the Federal Reserve Board increases dollar-denominated credit by less than foreign central banks expand their foreign-currency-denominated credit.

Monetary policies of other industrialized nations are equally central. The initial steadiness and subsequent rapid appreciation of the deutsche mark and Swiss franc followed from relatively restrictive credit policies in Germany and Switzerland. Those policies were possible, as will be discussed in Chapter VII, because of a greater willingness to tolerate unemployment and because of the exit of women from the labor force and of "guest workers" from the countries.

Trade policies are also relevant: Japan's huge current account surplus reduced the supply of yen-denominated assets (or,

equivalently, reduced the Japanese demand for non-yen assets) and contributed to yen appreciation (discussed further in Chapter VII).

Different central bank and government policy responses are as important as the initial differences in economic structures in determining how oil price increases affect dollar exchange rates.

CHAPTER VII. POLICY PROBLEMS AND OPTIONS

OPEC oil price increases create two different problems for oil-importing countries:

- o inflation and unemployment;
- o a permanent loss in real income.

The first of the following two sections discusses the inflation and unemployment created by any rise in the price of oil, and surveys some possible policy responses. The subsequent section discusses the long-term problems arising from an oil price that some people consider excessively high; it presents a possible remedy to that problem. Since many of the policy options discussed here have been treated extensively elsewhere, this chapter will often limit itself to commenting on how the change in the oil price affects the desirability of a particular option.

The problems of rising oil prices and too high oil prices are linked. If the oil price is too high, reducing it would help to solve the macroeconomic problems caused by its increase without creating natural-resource management problems. But if the oil price is not too high, and if it will continue to rise, then other policies ought to address the macroeconomic consequences of its increase.

THE MACROECONOMIC COSTS OF A RISING OIL PRICE

The social cost of a rising oil price is the consequent unemployment, inflation, and decline in GNP. Policymakers in oil-importing countries cannot fully offset the twin effects of oil price increases: a general price increase and a decline in economic activity. These costs can be immense. In 1974 and 1975, for reasons partly following from the oil price rise, the output of the OECD countries fell below its previous growth path by about $350 billion. In the same years, U.S. output fell over $100 billion below its previous path. 1/

1/ The average annual growth rate of OECD output was 4.2 percent between 1966-1967 and 1976-1977. (See OECD Economic Outlook

Monetary Policy Options

Fearing increased inflation, central banks typically do not fully offset the demand-reducing effects of an oil price increase.

Figure 2 illustrates the central bank's problem. The rise in the aggregate price level depends upon credit policy: an accommodating policy might, over time, produce a price path like P_1, while a tighter monetary policy could produce a lower price path, like P_2.

But society pays for tighter central bank control over the aggregate price level with increased short-run unemployment: the credit policy that produced the lower price path, P_2, would also produce a higher path for the unemployment rate, like U_2. A draconian central bank policy that held credit supplies unchanged in the face of an oil price increase might eventually restore the former price level (as in path P_3), but would also produce the greatest transitional unemployment (U_3).

Choices among price levels correspond to choices among inflation rates. The more accommodating central bank policy associated with price path P_1 (Figure 2) implies higher and longer-lasting inflation rates like $\dot{P}_1$ (Figure 3). That more accommodating credit policy also secures a lower rate and a shorter period of unemployment. The tighter central bank policy

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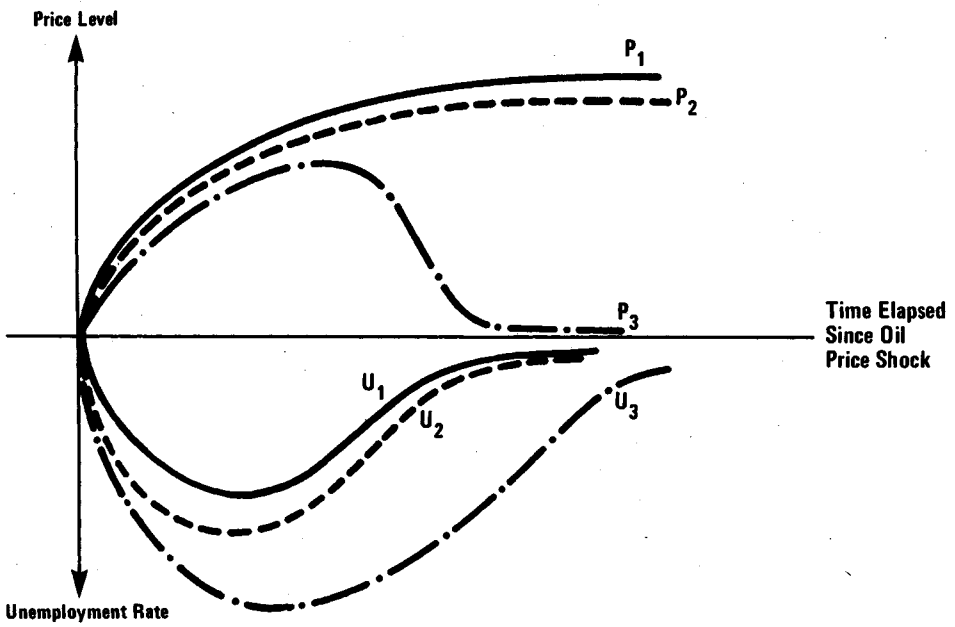
(December 1979), Table 1, p. 13.) The actual rates of growth of output in 1974 and 1975 were 0.5 percent and -0.4 percent, respectively. (Ibid., p. 130.) The deviation of actual growth from trend growth was, therefore, 3.8 percent in 1974 and 4.6 percent in 1975. For the OECD countries taken as a group, gross domestic product in 1974 was $4,063.92 billion, measured in 1975 prices and 1975 exchange rates. (OECD, Main Economic Indicators (August 1980), p. 169.) The deviation from trend in absolute terms was, therefore, about $150.4 billion in 1974 and $186.9 billion in 1975. Trend growth for the United States was 2.8 percent annually over the same period, while 1974 GDP was $1,541.42 billion. Actual U.S. growth was -1.3 percent in 1974 and -1.0 percent in 1975, so the deviation from trend growth in those two years was -4.1 and -3.8 percent, respectively. The loss in absolute terms in 1974 was $63.2 billion; in 1975, $58.6 billion.

Figure 2.
Illustrative Sketch of Price Level and Unemployment Rate After Oil Price Increase



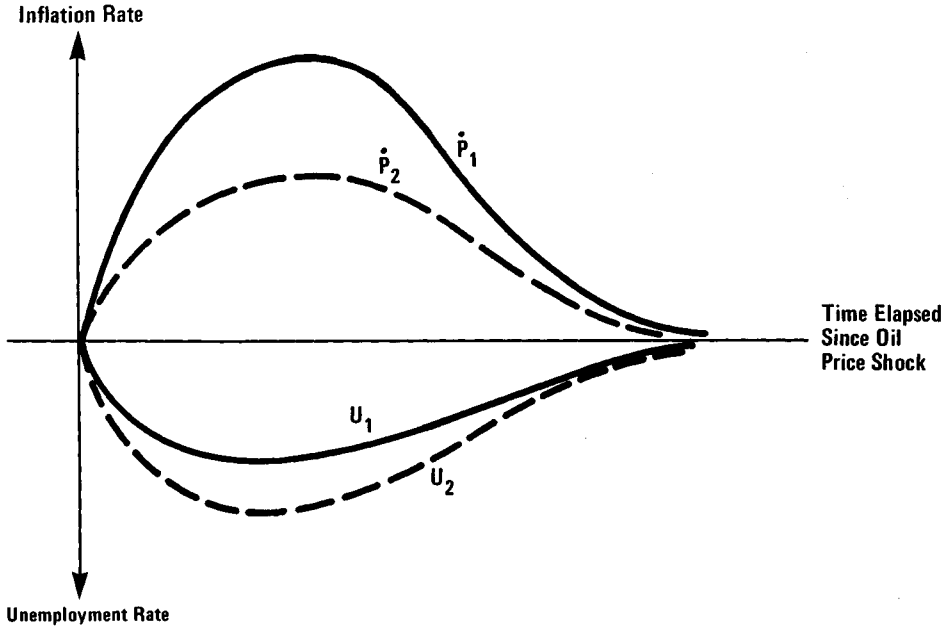
associated with price path P_2 (Figure 2) implies lower inflation rates lasting a shorter period, as in $\dot{P}_2$ (Figure 3), but, in contrast to the more accommodating policy, it also implies higher unemployment rates of longer duration. Had the inflation path associated with price level P_3 been drawn, it would have shown a period of inflation followed by a deflation until the original price level had been restored. This improbable policy is not illustrated in Figure 3.

Reducing the general inflation caused by an oil price rise will increase unemployment in the short run. Little comfort can be derived from knowing that eventually the unemployment rate will return to its former level, for the costs of the short-run unemployment are immense.

The central bank must solve the policy problem of choosing the socially best combination of unemployment and inflation

Figure 3.

Illustrative Sketch of Inflation Rate and Unemployment Rate After Oil Price Increase



in responding to the oil price shock. Each policy incurs costs from both unemployment and inflation; the central bank must weigh each against the other. (The numerous problems associated with measuring these costs are discussed elsewhere and need not be reviewed here.) Once the costs are known, the central bank must take proper account of their different time patterns: a cost incurred now hurts more than the same cost incurred later.

The choice facing a central bank is vexatious. The bank cannot know its technical options with precision; it cannot know the precise effect of the price shock on the aggregate price level; and it must be concerned that wage- and price-setting behavior elsewhere in the economy depends, in part, on the policies that observers expect of the bank.

Nonetheless, most technical examinations of this issue have concluded that the central bank should accommodate most of the oil

price rise. If accommodation is the best policy, then the sharp rises in unemployment following past OPEC price increases indicate that the Federal Reserve's policy has been too tight. 2/

Macroeconomic Policy in Germany and Switzerland: Few Lessons for the United States. It is often asked why Germany and Switzerland have fared better than the United States even though they rely almost entirely on OPEC for their energy needs. Both have had exchange rates rising against the dollar, and both have experienced lower unemployment and inflation rates than the United States.

Swiss and German monetary authorities were able to control inflation and raise the value of the franc and the deutsche mark by pursuing very restrictive credit policies. These policies reduced employment in Switzerland and Germany just as they would have in the United States. But the rise in measured unemployment was small, because unemployed women left the labor force and unemployed "guest workers" left the country. Had officially measured unemployment included those workers, the statistics would have shown more clearly the employment consequences of restrictive credit policies: the measured unemployment rate would have tripled.

2/ Gramlich, Phelps, and Solow conclude that the best macroeconomic policy would partially or completely accommodate an oil price rise. ("Complete accommodation" implies monetary or fiscal expansion sufficient to keep unemployment from rising.) Gordon argues for accommodation when wages and prices are not flexible. Problems arising from macroeconomic accommodation are discussed by Fellner (in his response following the Gramlich article) and by Feldstein and Poole (in their discussion of the Gordon article). Edward Gramlich, "Macro Policy Response to Price Shocks," Brookings Papers on Economic Activity (1979:1), pp. 125-166, especially p. 166; Edmund S. Phelps, "Commodity Supply Shock and Full-Employment Monetary Policy," Journal of Money, Credit, and Banking (May 1978), pp. 206-221, especially p. 215; Robert Solow, "What to Do (Macro-economically) When OPEC Comes" (Department of Economics, Massachusetts Institute of Technology, July 1978; processed), pp. 19-21; Robert J. Gordon, "Alternative Responses of Policy to External Supply Shocks," Brookings Papers on Economic Activity (1975:1), pp. 183-206.

In Germany, restrictive credit policies permitted the deutsche mark to remain steady relative to the dollar between 1973 and 1975 and then to appreciate between 1975 and 1978. These policies also achieved a relatively low increase of 15.1 percent in the consumer price index (Table 16) in the face of a rise in unemployment to 4.5 percent, still a relatively low rate among Western countries.

The German unemployment rate rose from 2.6 percent to 4.5 percent between 1974 and 1977. Had 450,000 "guest workers" not left the country, though, the unemployment rate would have been about 6.4 percent (Table 16), which would have exceeded the previously recorded cyclical peak of 4.9 percent in 1955. 3/ Such a rise in unemployment can only reflect a restrictive policy unprecedented in the recorded history of postwar Germany.

In addition, in contrast to a rise in the U.S. labor force participation rate, labor force participation in Germany declined from 54.4 percent to 52.8 percent. Had those 768,000 workers been unemployed, as opposed to dropping out of the labor force, the German unemployment rate would have been nearly 10 percent. 4/

Most of the Swiss experience is inapplicable for similar reasons. Between 1974 and 1977, the Swiss franc appreciated relative to the dollar, while the Swiss consumer price index

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3/ OECD Economic Outlook (December 1978), p. 12. The peak rate for each country was calculated over the period 1955 to 1973.

4/ Labor force participation rates taken from Joyanna Moy, "Recent Labor Market Trends in Nine Industrial Nations," U.S. Department of Labor, Monthly Labor Review (May 1979), pp. 8-16. The same source gives a total German labor force of 25.34 million in 1977, with a participation rate of 0.528; had the participation rate been 0.544, as it was in 1973, the labor force would have been 26.11 million, or 0.77 million more than it was. The drop in labor force participation plus the guest-worker emigration total about 1.2 million workers, compared with a 1.0 million total unemployment count. Germany had the largest decline in its labor force participation rate of nine Western countries studied. In contrast, the labor force participation rate in the United States rose from 61.2 percent to 62.3 percent in the same period.

TABLE 16. CHANGES IN UNEMPLOYMENT RATES AND CONSUMER PRICES IN THE UNITED STATES, GERMANY, AND SWITZERLAND

	United States		Germany		Switzerland	
	1974	1977	1974	1977	1974	1977
Guest Workers (thousands)	--	--	2,331.6	1,888.6	598.5	492.8
Registered Unemployed (thousands)	--	--	583.0	1,030.0	0.2	12.0
Unemployment Rate (percent)	5.6	7.1	2.6	4.5	0.001	0.4
Unemployment Rate Including Emigrated Guest Workers (percent)	5.6	7.1	2.6	6.4	0.001	3.5
Consumer Price Index (percentage change from 1974)	--	22.9	--	15.1	--	9.9
Industrial Production (1975 = 100)	110	116	106	110	114	106
Percentage change from 1974	--	5.4		3.8	--	-7.1
Employment (1975 = 100)	101	107	104	99	109	96
Percentage change from 1974	--	5.9	--	-4.8	--	-11.9
GDP, 1975 Prices and Exchange Rates (percentage change from 1974)	--	9.9	--	5.5	--	-5.6

SOURCES: Consumer prices taken from OECD Economic Outlook (December 1978), p. 127. Unemployment and unemployment rate, industrial production, employment, and real GDP data taken from OECD, Main Economic Indicators (December 1978), pp. 18-19, 152. Swiss unemployment rate for 1977 taken from Le Department Federal de L'Economie Publique, La Vie Economique (November 1980), p. 2*; the rate for 1974 computed from Swiss unemployment (221) and total labor force size (2,943,000) given in OECD Economic Survey: Switzerland (March 1976), pp. 1, 17; total unemployment for 1977 taken from Banque Nationale Suisse, Bulletin Mensuel (February 1978). Guest-worker data taken from "Foreign Workers: A Current Inventory," OECD Observer (March 1979), pp. 33-34.

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rose only 9.9 percent. At the same time, however, the Swiss unemployment rate rose from about 0.001 percent to about 0.4 percent. While the total number of unemployed in Switzerland in 1977 was only 12,000, that was historically high by Swiss standards. Over the same period, however, the number of "guest workers" fell by 105,700. Had those workers been counted among the Swiss unemployed, the unemployment rate would have been about 3.5 percent, extraordinarily high by Swiss standards.

In the absence of guest-worker emigration and declines in labor force participation rates, unemployment rates would probably not have risen by as much as is indicated above, since some of the "guest workers" and some of the other workers who dropped out of the labor force undoubtedly could have had jobs. It does, nevertheless, serve to give some notion of how much restrictive policies reduce output.

It is unlikely that the German or Swiss policies would have been politically feasible without the emigration of foreign workers and declines in labor force participation. Had policies in the United States been restrictive enough to reduce total employment by 4.8 percent, as they did in Germany, then the U.S. unemployment rate would have risen to 10.1 percent. Had U.S. policies been restrictive enough to reduce employment by 11.9 percent, as they did in Switzerland, the U.S. unemployment rate would have risen to 16.8 percent. 5/ In the United States, such unemployment

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5/ The comparison between U.S. and foreign unemployment rates is made as follows: If N equals the number of employed workers and L equals the total labor force, then the number of unemployed workers (U) equals L - N, and the unemployment rate is U/L = (L-N)/L. For a given labor force (constant L), the elasticity of the unemployment rate with respect to employment (N) is -[N/(L-N)], or [(U/L)-1]/(U/L). Given an initial unemployment rate of 5.6 percent in the United States, a 1 percent drop in the number of employed workers would produce a 16.8 percent rise in the unemployment rate, increasing the unemployment rate from 5.6 percent to 6.5 percent. For an employment decline of 4.8 percent, like that experienced in Germany, the U.S. unemployment rate would have risen by 80.9 percent, to 10.1 percent; for a decline of 11.9 percent, like that experienced by Switzerland, the U.S. unemployment rate would have risen to 16.8 percent.

rates would present political and economic problems unseen since the 1930s.

There are, finally, many other differences between the economic structures of the United States, on the one hand, and of Germany and Switzerland on the other. 6/ Such differences may explain different levels of unemployment and even different apparent short-term trade-offs between inflation and unemployment. In other ways, not discussed here, Swiss and German practices may suggest improvements for U.S. policy formulation. All this notwithstanding, the United States could have had a lower inflation rate had it been prepared to sustain a fall in employment such as occurred in Germany and Switzerland. But this fact is made less germane by the past ability of Germany and Switzerland to avoid much of the political and economic cost of unemployment by exporting it.

Commercial Policy Options

Oil-importing countries can also offset the demand-reducing effects of an oil price rise by expanding their trade surpluses. The trade surplus increase, moreover, would contribute to exchange rate appreciation, and would partially offset the original inflationary effect of the oil price rise.

International Cooperation Required. But non-OPEC countries cannot all simultaneously increase their trade balances unless OPEC reduces its surplus. Otherwise, when one oil-importing country solves its stagflation problem with an increased trade balance and exchange rate appreciation, another oil-importing country's problems become worse because its trade balance shrinks and its currency depreciates.

6/ A recent study, for example, found greater real wage rigidity in Japan and Europe than in the United States. This suggests that, had the United States pursued as contractionary a monetary policy as did Germany, the drop in U.S. inflation would have been greater, because declines in the real wage would have prevented some of the unemployment in the United States. Jeffrey D. Sachs, "Wages, Profits, and Macroeconomic Adjustment: A Comparative Study," Brookings Papers on Economic Activity (1979:2), p. 271. Sachs also cites other comparative studies (p. 269).

Different national policy approaches and different domestic economic structures, not direct trade with OPEC, explain most of the trade balance changes of the United States and other oil-importing countries between 1973 and 1978. The U.S. trade balance fell by $26.5 billion over this period; only about $10.8 billion of that drop occurred in trade with OPEC (Table 17). The combined trade balance of the other industrialized countries rose by $44.9 billion, while their balance with OPEC fell by $1.1 billion. The trade balance of the rest of the world, excluding OPEC, fell by $45.4 billion; about $29.2 billion of this decline occurred in trade with OPEC.

Despite massive changes in trade balances outside of trade with OPEC, and despite the prior knowledge that all oil-importing countries cannot simultaneously solve their macroeconomic problems with trade promotion, such external policies are coordinated in only a rudimentary way. Nor is it clear that existing international institutions could do much more to coordinate such policies, or that there would be agreement on the economic effects of different patterns of trade balances. It is unlikely, though, that the United States could address its oil-related macroeconomic problems with a trade balance growth like that of Japan. Were the United States to attempt this, its trading partners would require such strong measures to insulate their domestic economies that they would probably undo the Western free trade system.

Is Japan a Good Example? Between 1973 and 1978, the yen rose 54.7 percent against the dollar, while the Japanese unemployment rate rose from 1.3 percent to 2.3 percent--not especially high by Japanese standards. 7/ The increase in the Japanese trade balance of over $20 billion 8/ during that period produced these effects.

Three explanations of Japan's achievement are offered: superior products, marketing, and domestic economic organization; export subsidies and dumping; and import barriers and discrimination.

7/ End-of-year exchange rates taken from IMF, International Financial Statistics (January 1980), p. 220. Japanese unemployment rate taken from Moy, "Recent Labor Market Trends in Nine Industrial Nations," p. 12.

8/ U.S. Department of Commerce, International Economic Indicators (September 1979), p. 46.

TABLE 17. EVOLUTION OF TRADE BALANCES, 1973-1978 (Billions of dollars)

	Trade Balance			Changes in Trade Balance		
	1973	1975	1978	1975 Over 1973	1978 Over 1975	1978 Over 1973
Total Trade						
United States a/	3.2	16.7	-23.3	13.5	-40.0	-26.5
Other industrial countries b/	12.1	18.1	55.9	6.0	37.8	43.8
OPEC	19.3	53.9	47.4	34.6	-6.5	28.1
Rest of the world c/	-34.6	-88.7	-80.0	-54.1	8.7	-45.4
Trade with OPEC						
United States	-2.1	-8.0	-12.9	-5.9	-4.9	-10.8
Other industrial countries	-12.1	-26.7	-13.2	-14.6	13.5	-1.1
Rest of the world	-5.1	-19.2	-21.3	-14.1	-2.1	-16.2
Trade Excluding OPEC						
United States	5.3	24.7	-10.4	19.4	-35.1	-15.7
Other industrial countries	24.2	44.8	69.1	20.6	24.3	44.9
Rest of the world	-29.5	-69.5	-58.7	-40.0	10.8	-29.2

SOURCE: Regional trade flows are taken from International Monetary Fund, Direction of Trade Yearbook, 1979. To avoid problems of inconsistency between export and import data, only export data were used to construct the trade tables.

a/ Replaces IMF data on U.S. imports from OPEC (of $4.6 billion, $13.3 billion, and $28.9 billion for 1973 to 1978) with larger figures representing about 77 percent of total U.S. imports of petroleum and petroleum products. U.S. net imports of petroleum and petroleum products amounted to $7.1 billion, $23.9 billion, and $37.5 billion in 1973, 1975, and 1978, respectively. (See U.S. Department of Commerce, Survey of Current Business (March 1979), p. S-23; U.S. Department of Commerce, Business Statistics, 1977, pp. 111, 115.) A great deal of imported refined petroleum comes indirectly from OPEC through offshore refining centers and is not reported as an import from OPEC. But when OPEC raises the oil price, the United States would pay, and OPEC would receive, the bulk of increased revenue; the intermediate refiner would retain little of the increase. This table makes a rough correction for this problem by attributing to OPEC member countries all oil imports from those countries in Central America and the Caribbean where oil production is zero. Such imports amounted to about 10 percent of total U.S. imports in 1979 and raised total imports from OPEC to 77 percent of total U.S. imports of petroleum and petroleum products. (See U.S. Department of Energy, "Supply, Disposition, and Stocks of All Oils by P.A.D. Districts and Imports in the United States, by Country" (December 1979), p. 8; U.S. Department of Energy, International Petroleum Annual, 1978, p. 16.)

b/ Includes Austria, Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Norway, Sweden, Switzerland, and the United Kingdom.

c/ Excludes the United States, other industrial countries, and OPEC member countries; includes the developing countries, some smaller European countries, Australia, New Zealand, and South Africa.

Much qualitative evidence supports the view that superior products, marketing, and trading organizations explain the rapid growth of the Japanese surplus. If Japanese companies perform better with techniques that U.S. companies could profitably use, then U.S. citizens would be better off if U.S. companies adopted them. In some cases, there might be social gains if the U.S. government accelerated adoption of these techniques.

But the drop in Japanese real imports gives some support to the view that trade restrictions may explain the rise of the Japanese surplus. Quite unusually, Japanese real imports fell despite a rise in Japanese GNP and a fall in import prices. If trade restriction explains Japan's trade surplus, then adopting Japanese production methods will not help the United States--but negotiation and retaliation might.

The rise in the Japanese share of world exports, despite the worsening of most indicators of Japanese international competitiveness, is also perplexing. The increase in share of world exports is consistent with superior products and marketing, but it is also consistent with the use of credit and merchandise subsidies and with dumping.

Because the U.S. economy is so much larger than Japan's, intensive reliance on trade policy to achieve U.S. macroeconomic goals would disrupt world trade. With respect to other commercial issues, only better explanations of Japan's trading success can determine whether the United States should emulate the Japanese or take issue with them.

Fiscal Policy Coordinated with Monetary Policy

When inflation is caused by an external shock, such as an oil price increase, the social costs of the adjustment could be lessened by aiming monetary policy at reducing inflation while aiming fiscal policy at maintaining output and employment. The result would be lower inflation and less unemployment than would otherwise be obtained.

A full treatment of such a coordinated fiscal and monetary policy cannot be presented here, but one example serves to illustrate the case. A combination of an expansionary fiscal policy and a restrictive monetary policy could simultaneously expand GNP while restricting credit markets and raising interest rates and exchange rates. The exchange rate appreciation might offset part

of the inflationary effect of the oil price rise by reducing the dollar prices of U.S. imports and exports. The obverse policy--easing monetary policy to expand output while tightening fiscal policy to reduce inflation--would slacken credit markets, resulting in falling interest and exchange rates. The exchange rate depreciation might aggravate the inflationary impact of the oil price rise.

Some economists believe it would be ineffective to address monetary and fiscal policies to different objectives, such as inflation and unemployment. They argue that economic slack governs the rate of inflation, and that monetary and fiscal policy both act on the inflation rate solely by changing the amount of slack. In such an environment, monetary and fiscal policy would not have different effects on employment and inflation.

Oil Price Controls

Unless OPEC lowers its price, no oil-importing country can improve the economic well-being of all its citizens by holding the domestic price below the OPEC price. Obviously, if it were possible to do so, then oil-importing countries should just reduce oil prices to zero. Oil price controls cannot permanently increase the economic well-being of all citizens of a country because taxpayers, as a group, must pay the difference between the controlled price and OPEC's price.

But a price control program that permitted the domestic oil price to rise to the new OPEC price more slowly than the rate at which the OPEC price increases might improve short-term macroeconomic choices. Thus, although OPEC might raise the oil price over the course of a few weeks, macroeconomic policy might be better served if the domestic price rose to the new OPEC price more slowly, over a longer period. (This could be achieved by subsidizing all oil imports, letting the subsidy shrink at the rate necessary to achieve the desired rate of domestic price increase.)

Several studies have explored the best monetary and fiscal policy response to a one-time, permanent rise in the oil price. 9/

9/ Gordon, "Alternative Responses of Policy to External Supply Shocks"; Gramlich, "Macro Policy Response to Price Shocks"; Phelps, "Commodity Supply Shock and Full-Employment Monetary Policy"; and Solow, "What to Do (Macroeconomically) When OPEC Comes."

But none seems to have considered the most appropriate monetary and fiscal policy when oil price controls slow the rate at which the domestic oil price reaches the OPEC price. If a gradually rising oil price reduced the costs of unemployment and inflation, the macroeconomic gains might outweigh the costs of the subsidy.

Wage and Price Controls

Wage and price controls cannot succeed in the face of overly expansive monetary or fiscal policies. But such controls might help dampen the spread of inflation caused by a clearly external shock such as an OPEC price increase. One appropriate response might be for labor and industry groups with market power to attempt to maintain their real wages and profits at the expense of those groups without such power. Moreover, since oil price increases raise the U.S. general price level more than the price levels of other major oil-importing countries, the importance of external pressures on costs has increased more in the United States than it has in other countries. For this reason, the attractiveness of wage and price controls, aimed directly at containing such cost increases, may have increased relative to other policy options more in the United States than in other countries.

Use of Tax and Transfer Policy to Maintain Real Income

Where wage settlements reflect workers' attempts to maintain real wages, policymakers might secure lower nominal wage increases by cutting taxes (or increasing transfer payments) in order to offset the drop in real after-tax income that follows from the OPEC price rise. As explained above, the full-employment real after-tax income of the present generation cannot be maintained without reducing the full-employment after-tax disposable income of future generations. If the government undertook such tax or transfer policies, the rise in the government budget deficit would also appear either as a drop in savings and investment (passing on a smaller domestic capital stock to future generations) or as a drop in the current account (passing on a smaller foreign asset position or a larger foreign debt).

But some policies might increase the potential real income of both generations. For example, suppose that adjusting the current generation's after-tax income to the full OPEC price rise produced higher wage demands and additional inflationary pressure, and that policymakers combated this higher inflation with more

restrictive policies that created higher unemployment. Suppose further that tax cuts would have moderated these wage demands. Then policymakers would have to weigh the effect of the tax cut in passing on a reduced net worth to future generations against the effect of unemployment, which reduces current output below potential levels, thereby also reducing savings, investment, and the net worth passed on to future generations. Proper policies might call, therefore, for deferring some reduction of real after-tax income when oil prices rise. Moreover, so long as OPEC maintains a surplus, all industrial countries could pursue such policies simultaneously. 10/

Labor Market Programs

When periodic OPEC price increases are added to the other factors that spur inflation, a macroeconomic policy aimed at maintaining the same inflation target will produce a larger amount of unemployment if the effectiveness of labor markets does not improve. If, however, there are economies of scale in changing labor market regulations 11/ or in operating programs aimed at improving labor market efficiency, the social rates of return on such programs will rise, relative to what they were before, as a result of OPEC price increases. Such programs might, then, merit enlargement. Moreover, since the U.S. general price level rises more with oil price increases than do the general price levels in other major industrial countries, the returns on such programs may have risen in the United States relative to the returns in other countries. Such programs might then warrant more rapid development in the United States relative to other countries.

Lowering the OPEC Oil Price

If OPEC were to stop raising the world oil price, or to reduce it relative to other prices, the problems discussed above

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10/ For a discussion of the macroeconomic implications of attempts by workers to maintain real wages, see Solow, "What to Do (Macroeconomically) When OPEC Comes," and Sachs, "Wages, Profits, and Macroeconomic Adjustment."

11/ Since regulations typically affect classes of unemployed workers, and since the cost of changing a regulation generally does not vary with the number of affected people, there will usually be economies of scale in changing regulations.

would be alleviated. Whether this is desirable, or possible, is the subject of the following section.

THE MACROECONOMIC COSTS OF A HIGH OIL PRICE

Were the oil price to stop rising, its effects on inflation and real GNP would abate. GNP would return to full-employment levels, and oil-related increases in aggregate price indexes would cease. But even without these costs, the burden of high oil prices would remain.

In what sense can it be said that the price of oil is too high? The price is too high if it leads consumers to reduce inefficiently their present consumption of oil in favor of consumption by future generations. The price of oil should reflect its natural scarcity rather than the market power of the producing countries. Too low an oil price would permit the world to deplete its oil reserves before oil substitutes had been developed and energy demand had fallen. Too high an oil price, on the other hand, would leave substantial amounts of oil in the ground long after the high oil price had promoted the development of oil substitutes and reduced energy demand.

Were OPEC charging a price that properly rationed oil for future generations in oil-consuming countries, then reducing that price would not appropriately solve the foregoing macroeconomic problems. The rise in the oil price would reflect an unfortunate but unavoidable constraint in economic growth resulting from fixed available natural resources.

But most estimates indicate that OPEC charges a price far greater than is warranted by the underlying scarcity of oil, far higher than necessary to move efficiently to the energy base of the 21st century. OPEC is a cartel. As such, it can charge a price designed to maximize the wealth of its members at the expense of the rest of the world. Estimates of the competitive price of oil--the price warranted by oil's underlying scarcity--ranged between $5 and $16 per barrel in 1979. 12/ Given

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12/ Nordhaus sets the 1979 competitive price at about $3.50, expressed in 1975 dollars. CBO estimates that the price in 1979 dollars is 35 percent higher based on the rise in the Consumer Price Index between 1975 and 1979. (William

the 1979 cartel price of $24 per barrel, the excessive price charged by OPEC was $8 to $19 per barrel. The total transfer to OPEC unjustified by oil's scarcity ranged between $65 billion and $150 billion in 1979 for the OECD countries; for the United States alone, the unjustified transfer was $25 billion to $75 billion. 13/

Why is the OPEC Price a Burden?

Excessively high OPEC prices reduce the real standard of living that oil consumers may purchase with their current levels of real production, or GNP. That decline in consumption is the burden of high OPEC prices.

As was discussed in Chapter III, an individual wishing to avoid this decline in his consumption could choose to save less in order to maintain his consumption at its former level. That individual would pass the burden of the oil price increase on to himself in later years, or on to his children through a smaller bequeathed estate. A country can make the same choice. It can

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Nordhaus, The Efficient Use of Energy Resources (New Haven: Yale University Press, 1979), Figure 6.2 and Table 6.5, pp. 108-109.) Marshalla estimates, under a variety of assumptions, that the competitive price between 1986 and 1990 will range between $5 and $12, measured in 1975 dollars. These prices measured in 1979 dollars are also 35 percent higher. (Robert Marshalla, "An Efficient World Price for Oil," Federal Energy Administration, International Analysis Division, Office of Energy Systems Modeling and Forecasting, Office of Data and Analysis (May 24, 1976; processed), p. 2.)

13/ OECD net imports of crude oil and refined petroleum were 1.1 billion metric tons in 1979. (OECD, Quarterly Oil Statistics, Fourth Quarter 1979 (1980: 1), pp. 284-285.) The above text converts data in metric tons to barrels using 7.4 barrels per ton, the average for the United States (p. VIII). The United States imported 8.4 million barrels of crude and refined petroleum per day in 1979. (Central Intelligence Agency, International Energy Statistical Review (August 26, 1980), p. 4.) The above text uses a cartel price of $24.00, the official sales price for Saudi Arabian light crude in December 1979 (p. 21).

borrow from OPEC members to maintain current consumption; its borrowings would appear in the balance of payments as a current account deficit. In later years, the country would either have to repay the debt or have a smaller net foreign asset position: the burden would be passed on to future generations.

The burden of the high oil price cannot be reduced by reducing the trade deficit with OPEC. When a country reduces its imports or increases its exports to pay for more expensive oil, fewer goods remain available for domestic consumption and investment. The present generation then bears the burden of the high oil price; the burden is not erased. If the present generation fails to reduce the trade deficit, then it passes the burden on to future generations; again, the burden is not erased.

Policy Implications

If, as some argue, the oil price is too high, and since it imposes a burden on all oil-consuming countries whether they have trade surpluses or deficits, the oil-consuming countries have a common interest in reducing the OPEC oil price. 14/

One way to reduce the OPEC oil price would be to reduce the demand for Saudi Arabian oil.

The world energy market uses approximately 80 million barrels of oil equivalent per day, of which about nine million are supplied by Saudi Arabia. Because of its huge exports, controlled by a single state seller, Saudi Arabia is the "swing producer" of the OPEC cartel. Other OPEC members need never sell below the Saudi price because they know that Saudi Arabia will refuse to sell below that price and that, without Saudi Arabia, world production would fall far short of world demand. Normally, the process is symmetric: other OPEC members cannot raise their prices much above the Saudi price without risking the loss of their sales to Saudi Arabia. In 1979 and early 1980, Saudi Arabia did not increase its production enough to hold the world oil price at the Saudi price after Iran withdrew from the world market. Saudi Arabian authorities predicted, however, that their production

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14/ They also have an interest in more reliable oil supplies, but this is a separate issue. It is easy to imagine cheap oil supplied unreliably, just as it is easy to imagine excessively expensive oil supplied with great reliability.

level of 9.5 million barrels per day would suffice to bring the spot market price down to the Saudi price by the end of 1980; that appeared to be happening before the Iran/Iraq war. But regardless of what Saudi Arabia does when unforeseen circumstances drive the price above its minimum selling price (and maximum production limits), it will, under present arrangements, always prevent the price from falling below its minimum selling price. In short, Saudi Arabia has acted as the guarantor of the OPEC price.

But suppose, hypothetically, that nine million additional barrels of oil were to arrive on the world market at the current price. Saudi Arabian sales would then fall to zero, as would their revenues; while other OPEC members could maintain sales volume by selling just under the Saudi market price, Saudi Arabia could not do so without, perforce, lowering the cartel price. Therefore, if Saudi Arabia continued to guarantee the cartel price under these circumstances, it would sell nothing. Clearly, Saudi Arabia could not raise its revenues by raising the oil price.

OPEC might try to distribute production cuts among its members in order to guarantee the cartel price, but such production-cutting agreements are difficult to police and typically collapse. Ultimately, Saudi Arabia would have to lower the price to increase its market share, either by driving other suppliers out of the market or by increasing total demand.

The goal of reducing the demand for Saudi oil can be pursued in various ways. Some policies presently in force—conservation, demand reduction policies, and expansion of non-oil energy sources--will reduce the demand for Saudi oil. To the extent that these policies are successful, they all will eventually cut into the Saudi market and moderate the Saudi price.

But other policies, not presently emphasized, may more effectively moderate Saudi pricing. Any barrel of oil produced (or not consumed) outside Saudi Arabia, no matter where, has the same dampening effect on Saudi pricing policy. The expanded production of oil and oil substitutes, or a reduction in energy demand anywhere outside Saudi Arabia, even within OPEC, will reduce the size of the Saudi market at the current price. Even if a reduction in energy demand or an increase in energy supply had no effect on U.S. demand or production, it would still provide incentives for price reduction.

A widely publicized Central Intelligence Agency report, for example, predicted a supply shortfall of 3.2 to 7.7 million barrels of oil per day in 1982 (at mid-1979 prices). This estimate rests on a range of assumptions about OECD income growth and the response of OECD energy demand to price changes. The CIA shortfall estimate assumes Saudi Arabia's preferred production level is 8.5 million barrels per day. In the framework outlined above, maintenance of mid-1979 prices through 1982 would require a rise in Saudi production to between 11.7 and 16.2 million barrels per day, given all the other CIA assumptions. 15/

But there is great uncertainty in these assumptions, more than is reflected in the range of OECD income growth and energy demand assumptions. Uncertainty also exists about energy production and consumption among other blocs of countries, including the other OPEC members. If one applies the same degree of uncertainty to these other countries' production and consumption levels as the CIA applies to those of the OECD, the range of uncertainty around the CIA's shortfall estimate widens. Indeed, at the lower extreme, consistent application of the CIA's own uncertainty intervals implies that the market for Saudi crude would be less than 1 million barrels per day in 1982. Moreover, as the forecast moves further into the future, the interval of uncertainty increases. 16/

Should the market for Saudi oil shrink dramatically, Saudi Arabia could not continue to serve as the swing producer in the cartel. It would have to secure production agreements among OPEC members to widen its market. If such agreements broke down, as they typically have in the past, Saudi Arabia would have to lower its price in order to increase its market share and raise its revenues.

Market conditions consistent with dramatic declines in the OPEC price are within the present error of the forecast. Policies aimed more directly at reducing the Saudi market would increase the probability of such a price reduction.

15/ Central Intelligence Agency, National Foreign Assessment Center, The World Oil Market in the Years Ahead, ER 79-10327U (August 1979), Table 10, p. 12. The shortfall estimate comes from Table 10, page 12; the estimate of desired Saudi production is shown in Table 5, p. 5.

16/ See Appendix F for the details underlying this calculation.

APPENDIXES

APPENDIX A. MEASURING THE RELATIVE IMPACT OF OIL PRICE CHANGES ON U.S. AND FOREIGN GNP DEFLATORS AND CONSUMPTION EXPENDITURES DEFLATORS

EFFECT OF OIL PRICE INCREASES ON THE GNP DEFLATOR

To understand essentially how oil price changes affect the GNP deflator, unobscured by the complexities of actual index numbers, consider a simple geometrically weighted price index. If "P_o" is the price of oil, "P_{no}" is the price of non-oil products, and "A" is the value of oil production relative to GNP in the base period, then the GNP deflator in the United States would be

$$(1) \qquad P_G = P_o^{A} P_{no}^{(1-A)}$$

Denoting percentage change with a dot, the rise in the GNP deflator would be

$$(2) \qquad \dot{P}_G = A\dot{P}_o + (1-A)\dot{P}_{no}$$

Representing the elasticity of nonenergy prices with respect to energy prices as "K," so that $\dot{P}_{no} = K\dot{P}_o$, expression (2) can be rewritten as

$$(3) \qquad \dot{P}_G = [A + (1-A)K]\dot{P}_o$$

The value of "K" will not fall below zero when energy is a gross substitute for other products; it will not exceed one if the relative price of energy is to rise. Given these bounds on "K," the change in the U.S. GNP deflator will range between

$$(4) \qquad A\dot{P}_o < \dot{P}_G < \dot{P}_o$$

Where passthrough of oil prices into non-oil prices is zero, the relative responsiveness of GNP deflators to oil price changes in two countries will depend entirely on relative shares of oil in production. The deflator for a foreign country is derived the same way as shown in expression (3). Denoting the foreign country

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with a lower-case "g," "a," and "k," the ratio of the percentage change in the U.S. GNP deflator to the foreign GNP deflator, when K = k = 0, is

$$(5) \qquad \frac{\dot{P}_G}{\dot{P}_g} = \frac{A}{a}$$

For several tables in the text, it is more informative to express weights in terms of their components of quantity of oil (Q) and real GNP (Y). The price of oil drops out because it is assumed to be set in the world market and be equal across countries, net of tax. 1/

$$(6) \qquad \frac{\dot{P}_G}{\dot{P}_g} = \left[\frac{\dot{P}_o Q_A}{Y_A}\right]\left[\frac{Y_a}{\dot{P}_o Q_a}\right] = \left[\frac{Q_A}{Q_a}\right]\left[\frac{Y_a}{Y_A}\right]$$

If the passthrough of oil prices into non-oil prices in country "A" equals that in country "a," but is not zero, then an

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1/ This assumes away the effect of the U.S. crude oil and natural gas price control programs. These calculations ignore the effects because they are complex; because, to a great degree, they will not affect the application of this analysis to future periods when controls are relaxed; and because substantial evidence indicates that the U.S. price control program affected crude oil prices, not the petroleum product prices that enter the deflators. Moreover, control programs have ambiguous effects on the rate of inflation: while they depress the price below the price that would otherwise have existed, they may permit the price to rise more rapidly than it would have over some periods of time within the control program. C.E. Phelps and R.T. Smith, "Why Decontrol Will Not Raise Petroleum Prices" (Santa Monica: The Rand Corporation, December 1975); C.T. Rousch, Jr., "Effects of Federal Price and Allocation Regulations on the Petroleum Industry," Federal Trade Commission Staff Report R-6-15-33 (December 1976), pp. 38-44; "An Interview with Economist Kenneth Arrow," Forbes (February 4, 1980), p. 49.

oil price rise will still have a greater effect on the deflator in the country in which domestic production is larger relative to GNP. The effects will no longer be in strict proportion to the two countries' weights of oil in GNP, however.

From (3), the ratio of the two prices will be

$$(7) \qquad \frac{\dot{P}_G}{\dot{P}_g} = \frac{A + (1-A)K}{a + (1-a)k}$$

If $K = k$, and $A > a$, then

$$(8) \qquad \dot{P}_G > \dot{P}_g$$

Where passthrough is the same, then, the ratio of increase in the GNP deflator of country "A" to that of foreign country "a" will fall in the range

$$(9) \qquad \frac{A}{a} \geq \frac{\dot{P}_G}{\dot{P}_g} \geq 1$$

EFFECT OF OIL PRICE INCREASES ON THE PERSONAL CONSUMPTION EXPENDITURES (PCE) DEFLATOR

Constructing the PCE deflator involves the same general procedure as with the GNP deflator, but the weights differ. The weight, "B," for the United States would be the value of total oil consumption in total consumption during the base year. The passthrough of an oil price change into the prices of other consumer goods could be "C," where $P_{no} = CP_o$. Then, as in (1),

$$(10) \qquad P_C = P_o^B P_{no}^{(1-B)}$$

As in (7), the percentage change in the consumption expenditures deflators of country "A" relative to country "a" would be

$$(11) \qquad \frac{\dot{P}_C}{\dot{P}_c} = \frac{B + (1-B)C}{b + (1-b)c}$$

As in (9), where passthrough is the same in the two countries, and where $B > b$, the change in the consumption expenditures deflator after an oil price rise will lie in the range

$$(12) \qquad \frac{B}{b} \geq \frac{\dot{P}_C}{\dot{P}_c} \geq 1$$

Where passthrough is zero, it is sometimes useful to express the relative impact in terms of the components of the weights--the quantity of oil consumed (Q) and real consumption (C_B and C_b).

$$(13) \qquad \frac{\dot{P}_C}{\dot{P}_c} = \frac{B}{b} = \left[\frac{\dot{P}_o Q_B}{C_B}\right]\left[\frac{C_b}{\dot{P}_o Q_b}\right] = \left[\frac{Q_B}{Q_b}\right]\left[\frac{C_b}{C_B}\right]$$

Expression (13) assumes that retail oil product prices are equal across countries. That assumption, in turn, ignores the effects of differences in energy taxes. Differences in energy taxes reinforce the finding of this section: OPEC price increases have a greater effect on the U.S. consumer price level.

The expression also ignores differences in petroleum product prices (excluding taxes). The expression does this for the same reasons as were given for ignoring differences in producer prices in the GNP deflator comparisons: the price control program has effects on inflation that are not within the purview of this paper; these effects will decline as the price control programs are phased out; and while there is wide agreement that the control program led to lower prices for crude oil, some observers argue

that the absence of effective retail product price controls permitted refiners to charge world market prices to U.S. consumers. In their view, controlling crude oil prices lowered profits of oil extractors and raised profits of refiners, leaving consumer prices about where they would have been without a price control program. 2/

2/ Ibid.

APPENDIX B. HOW EXCHANGE RATE CHANGES AFFECT DOMESTIC OIL PRICES

The text argues that higher taxes on oil products in European countries force any given OPEC price increase to produce a smaller percentage increase in product prices than would occur in a country with a lower energy tax. This discussion seeks to compare actual price rises in the United States and Europe, but the comparison is blurred by three problems: the price data are expressed in dollars, converted at a constant exchange rate; the OPEC oil price is denominated in dollars, so changes in exchange rates produce changes in non-U.S. domestic oil prices; and finally, the level of taxes has changed over this period. The following paragraphs describe how to control for these differences, in order to isolate the effect of OPEC price rises on the home currency prices for petroleum products.

Let "P" be the oil price measured in dollars, let "r" be the exchange rate measuring dollars per unit of foreign currency (so that a rise in "r" would be a dollar depreciation from the point of view of the United States), and let "t" be the home-currency-denominated tax levied on the oil product in the foreign country. Then the oil price in non-dollar terms may be written as:

$$(1) \qquad P_f = \frac{P}{r} + t$$

The percentage increase in the non-dollar retail oil price is

$$(2) \qquad \dot{P}_f = \frac{P}{(P + tr)}\left[\dot{P} - \dot{r}\right] + \frac{tr}{(P + tr)}\left[\dot{t}\right]$$

Expression (2) measures the relation between the observed rate of increase of the non-dollar foreign price of oil and the rates of increase of the OPEC oil price, the domestic tax, and the dollar exchange rate.

As expression (2) indicates, the effects of exchange rate changes can be removed from the data on the observed non-dollar oil product price by adding the percentage exchange rate change times [P/(P + tr)].

The underlying CIA price data do not make this correction, however. Rather, CIA tables convert several years' data on foreign home currency oil prices into dollars at a single dollar exchange rate. But, as expression (2) indicates, converting at a single exchange rate is tantamount to assuming that the exchange rate did not change over the period. Since the exchange rate did in fact change, the CIA procedure does not actually control for the effect of exchange rate change on the foreign home currency oil price.

Tables 3 and 4 in the text first convert the original CIA dollar-equivalent foreign oil prices back into the foreign currency prices using the CIA conversion exchange rate. Table 4 is derived by using expression (2): the effect of the OPEC oil price rise is isolated by adding the (weighted) exchange rate change and subtracting the weighted tax change.

APPENDIX C. HOW OIL PRICE INCREASES AFFECT REAL GNP AND REAL DISPOSABLE INCOME

HOW OIL PRICE INCREASES AFFECT POTENTIAL REAL GNP

Potential real GNP depends upon the availability of nationally owned labor, capital, and natural resources. A rise in the price of imported oil can affect potential real GNP only by affecting one or more of these factors; it cannot, by itself, directly alter GNP.

As Chapter III discusses in greater detail, an oil price rise could increase potential GNP if it made it profitable to produce more oil or oil substitutes from the existing set of resources. The rise in the oil price may also, however, make some existing capital and labor resources unprofitable to employ at their current prices. If the real prices of these factors do not fall enough, then excess capacity and unemployment will rise. Potential output under these circumstances will fall. Potential output can also fall, though not by as much, even if real wages and rents on capital adjust fully.

This appendix considers none of these effects, but rather concentrates on the effects of an oil price rise on real GNP through its effect on aggregate demand. That exercise permits focusing on the policy actions that policymakers in oil-importing countries may take in order to counter the unemployment effects, rather than on the question of how they may undo the effects of the oil price rise itself, a question considered in Chapter VII.

Under these assumptions, real GNP is related to the productive factors capital (K), labor (L), and land (T) through the production function

$$Y = y(K,L,T) \tag{1}$$

Assuming that technology and the economically usable quantities of the factors of production do not change, an oil price rise does not change potential output.

HOW OIL PRICE INCREASES AFFECT ACTUAL REAL GNP

Oil price increases reduce real GNP in oil-importing countries by reducing consumers' real disposable income. Because their demand is inelastic, consumers do not switch away from oil consumption; instead, they reduce their consumption of other goods, including imported and domestically produced non-oil goods and services. The drop in domestic consumption is not offset by a rise in exports, on net, because OPEC runs a trade surplus. Either monetary policy or fiscal policy could offset the depressing effect of the rise in the oil price, but policymakers typically will not take completely offsetting measures because they fear aggravating the inflationary effects of the OPEC price rise.

Treating real consumption (C) as a function of disposable income (Y_d); investment (I) and government expenditure (G) as exogenous; exports (X) as a function of foreign disposable income (Y_d^*) and of relative non-oil export prices (P_G relative to dollar foreign export prices, $\$P_g$); real non-oil imports (M_{no}) as a function of disposable income and the relative price of foreign non-oil products (P_{no}); and real oil imports as a function of disposable income and the price of oil relative to the price of domestically produced goods (P_o/P_G), then real GNP (Y) is

$$Y = \overset{+}{C}(Y_d) + \overset{+}{I} + \overset{+}{G}$$

$$(2) \qquad + \overset{+}{X}(Y_d^*, \overset{-}{P_G/P_g}) - \overset{-}{M_{no}}(Y_d, \overset{-}{P_G/P_g}) - \overset{-}{M_o}(Y_d, \overset{+}{P_o/P_G})$$

The sign of the effect of each variable on GNP, when GNP is less than potential, is shown above the expression. An increase in disposable income operates on real consumption to raise domestic demand and real GNP; but it also raises imports of foreign goods and oil, thereby reducing U.S. GNP. In stable economic systems, however, a rise in disposable income will, on net, increase real GNP.

Increases in investment, government expenditure, and exports raise home demand for domestically produced goods and, thereby, real GNP. U.S. exports will rise with increases in foreign real disposable income. A rise in U.S. prices (P_G) relative to foreign prices (P_g), however, that is not offset by a depreciation of the dollar exchange rate (a rise in "r," where r = \$/foreign currency) will tend to reduce U.S. exports.

Similarly, a rise in foreign prices (P_g) relative to U.S. prices (P_G) that is not offset by dollar appreciation (a fall in "r") will reduce U.S. imports and raise GNP. A rise in the real oil price (P_o/P_G) will reduce oil imports, by itself increasing real GNP. The change in real GNP is

$$(3) \qquad dY = c'dY_d + dI + dG + x_Y dY_d^* + x_p dP - m_Y dY_d - mpdP - m_{o,Y} dY_d - m_{o,p} dP_o$$

The Y and P subscripts indicate the partial derivative of the expression with respect to the income or price variable within the expression, whatever the precise definition of that income or price variable.

Several assumptions simplify the analysis. To investigate the size of the decline in GNP when monetary and government expenditure policies are unaltered, set "dI" and "dG" equal to zero. To focus on the interaction of income effects between one oil-importing country and the oil-exporting countries, assume that governments of other non-oil-exporting countries stabilize real disposable income and that the short-term responsiveness of oil and non-oil imports and exports to price is zero. These simplifying assumptions permit writing

$$(4) \qquad dY = c'dY_d + x_Y dY_d^* - m_Y dY_d - m_{o,Y} dY_d$$

or

$$(5) \qquad dY = (c' - m_Y - m_{o,Y})dY_d + x_Y dY_d^*$$

In order to solve expression (5), the next two sections derive expressions for dY_d, dY_d^*, and x_Y.

The Effect of an Oil Price Increase on Real Disposable Income

To obtain real disposable income, the national income accounts deflate nominal disposable income by the personal consumption expenditures (PCE) deflator. To obtain real GNP, they deflate nominal GNP by the GNP deflator (P_G). Real taxes may be computed by deflating nominal taxes with either the GNP deflator

or the personal consumption expenditures deflator; it is convenient here to use the personal consumption expenditures deflator.

$$(6) \qquad Y_d = \frac{YP_G - TP_C}{P_C} = Y\left[\frac{P_G}{P_C}\right] - T$$

The GNP and PCE deflators are represented with geometric indexes, as in expressions (1) and (11) from Appendix A. Substituting these in (6) yields

$$(7) \qquad Yd = Y\left[\frac{P_o}{P_{no}}\right]^{A-B} - T$$

The change in disposable income then becomes

$$(8) \qquad dY_d = \frac{P_G}{P_C}\left[Y(A - B)(\dot{P}_o - \dot{P}_{no}) + dY\right] - dT$$

If any given percentage rise in the oil price leads to a K percent rise in non-oil prices, and if the GNP deflator and the PCE deflator are each equal to one in the base period, then disposable income becomes

$$(9) \qquad dY_d = Y(A - B)(1-K)\dot{P}_o + dY - dT$$

The Effect of an Oil Price Increase on Foreign Real Disposable Income

The change in foreign real disposable income largely determines the rise in exports that might offset the drop in domestic demand. Other oil-importing countries, by assumption, take measures, discussed below, to maintain real GNP and disposable income. This section discusses the rise in oil-exporting countries' real disposable income.

The rise in oil-exporting countries' real disposable income can be developed in this simple model in several ways. While for several countries the rise in oil export revenues operates directly on imports through government expenditures on imported products, this section assumes that governments of oil-exporting countries distribute the proceeds of the rise in oil revenues to their citizens through reductions in taxes or increases in transfer payments. That permits developing the rise in oil-exporting countries' disposable income symmetrically with the fall in oil-importing countries' disposable income. Further detail on oil-exporting countries' government expenditures is not germane to the problem treated here.

For simplicity, real disposable income of oil-exporting countries is treated as the total value of oil produced deflated by the price of imported goods. The price of goods imported by oil-exporting countries is assumed here to be P_G, the U.S. GNP deflator. A more elaborate deflator would weight both the U.S. GNP and non-U.S. GNP deflators (P_G and P_g of Appendix A), but deflating with the U.S. price index alone does capture the spirit of the problem without the algebraic complexity that would accompany a finer rendition. Real disposable income for the OPEC countries is, then,

$$Y_d^* = \frac{P_o X_o}{P_G} \tag{10}$$

Assume again that oil and GNP are defined in units such that their prices equal one in the base period. Assume, further, that the quantity of oil exports does not change because of the price rise. In part, this is consistent with the earlier assumption that the short-term responsiveness of oil demand to price change is zero. But here this assumption also involves ignoring the depressing effect of an oil price increase on OPEC oil exports through its effect in reducing the oil-importing countries' disposable income and real GNP. These secondary effects are also ignored for simplicity. The change in OPEC real disposable income under these assumptions will be

$$dY_d^* = X_o(1-A)(1-K)\dot{P}_o \tag{11}$$

An Expression for the U.S. Marginal Propensity to Export to OPEC

To show the direction of trade simply, commas used in the subscripts of export and import numbers separate the sending country from the recipient country; so, for example, U.S. exports to OPEC are denoted as "$X_{US,O}$". A blank entry indicates all regions, so that world exports to OPEC are "$X_{,O}$"; these would be the same as total OPEC imports, "$M_{,O}$".

If, by assumption, the U.S. share in world exports to OPEC does not change, then the marginal propensity of the United States to export to OPEC, equivalently the marginal propensity of OPEC to import from the United States, $m_{US,O}$, given an overall OPEC marginal propensity to import of m*, will be

$$x_Y = m_{US,O} = m^* \left[\frac{X_{US,O}}{M_{,O}} \right] \tag{12}$$

The Change in U.S. Exports to OPEC

Under these assumptions, expressions (11) and (12) define the change in total U.S. exports to OPEC:

$$x_Y dY_d^* = m^* \left[\frac{X_{US,O}}{M_{,O}} \right] X_{O,}[(1-A)(1-K)]\dot{P}_O \tag{13}$$

The Effect of an Oil Price Increase on Real GNP and Real Disposable Income

Substituting expressions (9) and (13) in expression (5) permits estimating the effect on GNP of an oil price rise:

$$dY = (c' - m_Y - m_{O,Y})[Y(A-B)(1-K)\dot{P}_O + dY - dT] \tag{14}$$

$$+ m^* X_{US,O} \frac{X_{O,}}{M_{,O}} (1-A)(1-K)\dot{P}o$$

Note in expression (14) that the effect of an oil price rise on GNP can be completely offset by the tax cut (dT) that makes dY equal zero. This section, however, concerns the effect on GNP of an oil price rise that is not offset, so the argument proceeds holding dT equal to zero. Expressing the result in terms of the percentage change in GNP implies

$$(15) \qquad \dot{Y} = \frac{(1-K)}{V}\left[(A-B)V' + m^* \frac{X_{US,O}}{Y}\frac{X_{O,}}{M_{,O}}(1-A)\right]\dot{P}_O$$

$$V = 1 - c' + m_Y + m_{O,Y} \quad \text{and} \quad V' = c' - m_Y - m_{O,Y}$$

Several features should be noted about this expression. First, if passthrough is complete (K = 1), then real GNP does not change: a 100 percent passthrough implies no change in the relative oil price, neutralizing the real effects of the price rise. Second, if the share of oil in GNP (A) is the same as the share of oil in consumption (B), then the only effect on the economy of an oil price rise follows from its effect on exports to OPEC. Third, symmetrically, if OPEC's marginal propensity to import is zero, or if U.S. exports to OPEC are small relative to GNP, then the entire effect of an OPEC price rise occurs through the relative shares of energy in production (A) and consumption (B), not in the trade with OPEC.

Numerically, the second term in expression (15) is probably not very important. OPEC's marginal propensity to import out of nominal exports is about 0.7 and the ratio of its nominal exports to nominal imports is about 1.5; their product is about one, so the second term amounts to the ratio of exports to OPEC relative to GNP. 1/ OPEC imports from the OECD countries in 1979 amounted to about $63 billion, 2/ while OECD GNP amounted to about $6.8 trillion, 3/ so the size of this ratio will be about 1 percent. The balance of this section sets this term equal to zero.

Consider now a foreign country with passthrough of oil prices into non-oil prices of "k," with weight "a" of oil in GNP (y),

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1/ Chapter IV, Table 7, p. 29.

2/ OECD Economic Outlook (July 1980), p. 136.

3/ OECD, Main Economic Indicators (June 1980), p. 169.

and a weight "b" of oil in total consumption (c). Then the percentage change in U.S. GNP relative to the percentage change in foreign GNP will be

$$(16) \qquad \frac{\dot{Y}}{\dot{y}} = \frac{\frac{V'}{V}(1-K)(A-B)\dot{P}o}{\frac{v'}{v}(1-k)(a-b)\dot{P}o}$$

It is difficult to evaluate expression (16). Everyone would concede, of course, that differences in passthrough (K versus k), differences in the underlying structure of the economies (V and v versus V' and v'), and different oil price control programs ($\dot{P}_O$ versus $\dot{p}_O$) will lead to different effects on GNP.

These differences, however, can be held constant in order to show how GNP would vary when only production and consumption patterns of oil differ. To do that, assume $\dot{P}_O = \dot{p}_O$, K = k, V = v, and V' = v', so that the relative changes in GNP produced by differences in patterns of energy production and consumption are

$$(17) \qquad \frac{\dot{Y}}{\dot{y}} = \frac{(A-B)}{(a-b)}$$

Table C-1 derives values for expression (17) to determine the relative sizes of the percentage declines in GNP that oil price increases produce among major industrial countries and country blocs. Estimate 2 indicates that oil price increases, when not offset by other policies, produce larger declines in foreign GNP than in U.S. GNP; estimate 1 indicates that GNP in OECD/Europe would fall by marginally less than in the United States. Either result is consistent, however, with the argument made below that nominal GNP and disposable income will rise more in the United States than in major foreign countries (Appendix E); it is that finding that underlies the result that oil price increases first raise U.S. interest rates and appreciate the dollar. Because of the great simplicity of the model used, and the assumption of identical economic structures across countries, the actual percentage differences in impact are probably unreliable; it is,

TABLE C-1. ESTIMATED PERCENTAGE DECLINE IN GNP FROM AN OPEC OIL PRICE INCREASE (U.S. = 100)

	United States	OECD	OECD/ Europe	Japan	Germany	United Kingdom
Weight of Energy Output in GDP (Divided by Energy Price, (A or a)/P_o) a/	0.76	0.48	0.27	0.06	0.23	0.64
Weight of Energy Consumption in Total Consumption (Divided by Energy Price, (B or b)/P_o), Estimate 1 b/	1.48	1.20	0.98	1.03	0.91	1.46
Weight of Energy Consumption in Total Consumption (Divided by Energy Price, (B or b)/P_o), Estimate 2 c/	0.96	0.74	0.59	0.50	0.51	0.87
Percentage Decline in GDP, Estimate 1 (U.S. = 100) d/	100	101	98	135	95	115
Percentage Decline in GDP, Estimate 2 (U.S. = 100) e/	100	134	161	226	144	117

a/ Energy production data, in million tons oil-equivalent, divided by Gross Domestic Product (GDP) in current dollars and current exchange rates (Table 1). The weight of energy production in total output, "A", would be (quantity of home energy production times price, "P_o") divided by nominal GDP. Without specifying the energy price, line 1 shows the weight, "A" (or "a" outside the United States) divided by the energy price, "P_o".

b/ Total real energy requirement divided by total nominal domestic consumption (C), or (B or b)/P_o. Total energy requirement taken from OECD, Energy Balances of OECD Countries, 1975/1977 (Paris, 1979). This estimate of B (or b) assumes that all energy is used to produce consumption goods.

c/ Total energy requirement divided by total private domestic consumption, or (B or b)/P_o. This estimate assumes that the proportion of the total energy requirement used to produce consumption goods is the same as the proportion of total consumption to total output.

d/ Estimates the size of expression (17), using the first estimate of B.

e/ Estimates the size of expression (17), using the second estimate of B.

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however, the direction and ranking of the impacts that is of concern here.

Relation of Previous Results to Oil-Importing Country/Oil-Exporting Country Status. Expression (17) is consistent with the finding that any oil-importing country will face a drop in real domestic demand and GNP when no offsetting domestic policy action is taken. To see this, note that a net oil-importing country must have oil production (Q_o^P) less than oil consumption (Q_o^C). If that same oil-importing country has positive savings so that consumption (C) is less than GNP (Y), then

$$\frac{Q_o^P}{Y} < \frac{Q_o^C}{C} \quad \text{or} \quad A < B \tag{18}$$

Being an oil-exporting country, however, is insufficient in this framework to guarantee that an oil price rise will increase domestic demand. The boundary condition for a rise in aggregate demand and real GNP is

$$\dot{Y} \gtrless 0 \text{ for } A \gtrless B \text{ or } \frac{Q_o^P}{Y} \gtrless \frac{Q_o^C}{C} \tag{19}$$

For GNP to rise, therefore, an oil-exporting country must have production in excess of domestic consumption in the same proportion as total GNP exceeds total consumption:

$$\frac{Q_o^P}{Q_o^C} \gtrless \frac{Y}{C} \tag{20}$$

Therefore, for a country that imports oil and has positive savings ($A < B$, $A - B < 0$), real GNP will fall when the oil price rises (expression 17). For any given tax rate, real disposable income must also fall (expression 9).

APPENDIX D. DECOMPOSING THE PERCENTAGE CHANGE IN OIL IMPORTS INTO ITS COMPONENTS

THE DEMAND AND SUPPLY COMPONENTS OF AN IMPORT CHANGE

Assuming, for simplicity, that domestically produced and imported energy are homogeneous products, then imports (M) are the difference between domestic demand (D) and domestic supply (S):

$$M = D - S \tag{1}$$

Representing the percentage change with a dot, the change in imports is the weighted sum of the percentage change in demand and supply:

$$\dot{M} = \dot{D}\left[\frac{D}{M}\right] - \dot{S}\left[\frac{S}{M}\right], \quad M > 0 \tag{2}$$

Expression (2) shows the derivation of columns 2 and 5 in Table 8. The bracketed terms (D/M and S/M) are the weights referred to in the text.

FURTHER DECOMPOSITION OF THE COMPONENTS OF THE CHANGE IN ENERGY DEMAND AND SUPPLY

Treating the demand for oil as a function of domestic income (Y) and of price and non-price factors (a), and the domestic supply of oil and gas (S_o) and of domestic substitutes for oil and gas (S_{no}) as predetermined, imports may be written as

$$M = D(Y,a) - S_o - S_{no} \tag{3}$$

Differentiating totally produces

$$dM = D_Y dY + D_a da - dS_o - dS_{no} \tag{4}$$

The first term in expression (4) can be written as the elasticity of energy demand with respect to income [E(D.wrt.Y)]:

$$(5) \qquad D_Y dY = E(D.wrt.Y)\dot{DY}$$

Substituting (5) into (4), dividing through by imports (M), and denoting percentage change with a dot, results in

$$(6) \qquad \dot{M} = E(D.wrt.Y)\left[\frac{D}{M}\right]\dot{Y} + E(D.wrt.a)\left[\frac{a}{M}\right]\dot{a}$$

$$-\left[\frac{S_o}{M}\right]\dot{S}_o - \left[\frac{S_{no}}{M}\right]\dot{S}_{no}$$

The first term in expression (6) gives the percentage change in total import demand attributable to the change in domestic income. Given the income elasticity of demand for energy (a value of 1.0 is assumed here), the numerical value of the first term may be calculated. The sum of the first and second terms is the total effect of demand change shown in the first term of expression (2). Since the sum of the first two terms of expression (6) is the actual change in demand, the estimated value of the first term in (6) (income factors determining demand) determines the estimate of the size of the second term (non-income factors).

The third term in expression (6) shows the percentage change in total imports attributable to changes in the domestic supply of gas and oil. Its numerical value, as well as the numerical value of the fourth term, the supply of non-oil energy, can be derived from data shown in the sources indicated in the notes to Table 8.

The items in the memorandum columns of Table 8 are derived as follows. From the first two terms of expression (4), substituting (5), the change in demand becomes

$$(7) \qquad dD = D_Y dY + D_a da = E(D.wrt.Y)DY + D_a da$$

Substituting, as before, the elasticity of demand for oil for the first term in the expression, the percentage change in total demand can be written as

$$\dot{D} = E(D.wrt.Y)\dot{Y} + D_a\left[\frac{a}{D}\right]\dot{a} \tag{8}$$

Again, assuming that the elasticity of domestic energy demand with respect to GDP is 1.0 permits determining the effect of GDP changes on total demand. Subtracting that effect from the total percentage change in demand gives the estimate of changes in demand attributable to non-income factors.

APPENDIX E. EFFECT OF OIL PRICE INCREASES ON NOMINAL GNP AND NOMINAL DISPOSABLE INCOME IN THE UNITED STATES AND IN OTHER INDUSTRIAL COUNTRIES

NOMINAL GNP

Writing nominal GNP [NOM(Y)] as the product of real GNP (Y) and the GNP deflator (P_G), the percentage change in nominal GNP is

$$\dot{NOM}(Y) = \dot{Y} + \dot{P}_G \tag{1}$$

Appendix C showed that an oil price rise not offset by government policies would reduce real GNP in any oil-importing country. But such a price rise would reduce U.S. GNP (Y) less than GNP (y) in other major industrial oil-importing countries, so

$$\dot{Y} > \dot{y} \tag{2}$$

Appendix A showed that the U.S. GNP deflator would rise more than GNP deflators in other industrial countries, or

$$\dot{P}_G > \dot{P}_g \tag{3}$$

Substituting (2) and (3) in expression (1) shows that nominal U.S. GNP [NOM(Y)] will fall less or rise more than nominal foreign GNP [nom(y)]:

$$\dot{P}_G + \dot{Y} > \dot{P}_g + \dot{y}, \text{ or } \dot{NOM}(Y) > \dot{nom}(y) \tag{4}$$

NOMINAL DISPOSABLE INCOME

Writing disposable income (Y_d) as GNP (Y) less net taxes and transfer payments (T), and holding net taxes and transfers

unchanged, deflating disposable income with the PCE deflator, the percentage change in nominal disposable income is

$$\dot{NOM}(Y_d) = \dot{Y}\left[\frac{Y}{Y_d}\right] + \dot{P}_c \tag{5}$$

In 1978 the ratio Y/Y_d was 1.45 for the United States, 1.39 for Japan, and 1.35 for the average of Germany, Italy, and the United Kingdom. 1/

Given this and expression (2), then

$$\dot{Y}\left[\frac{Y}{Y_d}\right] > \dot{y}\left[\frac{y}{y_d}\right] \tag{6}$$

Appendix A showed that

$$\dot{P}_C > \dot{p}_c \tag{7}$$

Thus the sum of (6) and (7) indicates that nominal U.S. disposable income falls by less or rises by more than nominal disposable income in other major oil-importing countries:

$$\dot{NOM}(Y_d) > \dot{nom}(y_d) \tag{8}$$

1/ Disposable income figures taken from OECD Economic Outlook (July 1980), p. 131; GNP data taken from OECD, Main Economic Indicators (August 1980), pp. 17-18.

APPENDIX F. ESTABLISHING PLAUSIBLE RANGES FOR ESTIMATES OF THE DEMAND FOR SAUDI ARABIAN OIL

Even a relatively pessimistic outlook on the world oil market, such as the August 1979 study by the Central Intelligence Agency, "The World Oil Market in the Years Ahead," 1/ may still be consistent with the possibility of a substantial drop in the demand for Saudi oil and a substantial drop in the OPEC oil price. The CIA report concluded that prices would rise because, at then-current prices, an oil supply gap of 3.2 to 7.7 million barrels per day would develop by 1982; that finding was not based on the anticipation of the supply interruptions that occurred as a result of the Iranian revolution or the Iran-Iraq war.

This appendix examines the CIA report because it is unusually complete and permits one to derive the estimates needed to show that some of the possible outcomes in the world oil market of the 1980s differ substantially from what many might consider the most likely single outcome. Understanding the full range of possible outcomes is crucial to evaluating different policy options.

DERIVING THE CIA POINT ESTIMATES

Table F-1 reproduces the essential CIA findings. Total energy demand by the OECD countries was expected to rise from 75.2 million barrels of oil-equivalent per day in 1978 to between 82.5 and 87 million barrels in 1982 (line 1). The CIA's low-demand estimate assumed a 3 percent annual GNP growth rate and a 1 percent annual fall in demand as a result of "conservation"; the high-demand estimate assumed a 4 percent annual GNP growth rate and a 0.5 percent annual fall in demand from conservation.

The CIA forecast that OECD energy supply would rise from 49.2 million barrels of oil-equivalent per day to 56.2 million barrels per day in both the high- and low-demand cases (line 2). These

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1/ U.S. Central Intelligence Agency, National Foreign Assessment Center, The World Oil Market in the Years Ahead (August 1979).

TABLE F-1. THE IMPLIED CIA FORECAST OF 1982 DEMAND FOR SAUDI ARABIAN OIL (In millions of barrels per day of oil-equivalent)

	1978	1982 Low Demand	1982 High Demand
Demand for Imported OPEC Oil			
1. OECD energy demand a/	75.2	82.5	87.0
2. OECD domestic energy supply b/	49.2	56.2	56.2
3. OECD demand for oil imports c/	25.7	26.3	30.8
4. Non-OECD demand for imported oil d/	2.5	4.2	4.2
5. Total demand for imported OPEC oil e/	28.2	30.5	35.0
Supply of Imported OPEC Oil			
6. Total OPEC oil exports f/	28.2	27.3	27.3
7. Non-Saudi OPEC supply g/	20.1	18.8	18.8
The "Gap"			
8. Demand for Saudi Arabian oil h/	8.1	11.7	16.2
9. Saudi Arabian desired exports g/	8.1	8.5	8.5
10. "Gap" i/	0.0	3.2	7.7

SOURCE: Derived from data presented in Central Intelligence Agency, National Foreign Assessment Center, The World Oil Market in the Years Ahead (August 1979). References in the footnotes to this table refer to this source as "CIA."

a/ Data for 1978 taken from Table 8, representing total amount supplied to the OECD countries plus stock drawdown. High and low forecast for 1982 taken from CIA, Table 10, p. 12. Low forecast assumes 1 percent annual conservation and 3 percent annual GNP growth; high forecast assumes 5 percent annual conservation and 4 percent annual GNP growth.

b/ CIA, Table 6, p. 7.

c/ The entry for 1978 is taken from CIA, Table 8, p. 8. The entries for 1982 are derived by subtracting OECD domestic supply (line 2) from OECD domestic demand (line 1).

d/ The sum of net imports of non-OPEC less developed countries, other developed countries, and communist countries; taken from CIA, Table 7, p. 8.

e/ The sum of lines 3 and 4.

f/ CIA, Table 5, p. 5.

g/ Derived from CIA, Table 5, p. 5.

h/ Total non-OPEC demand for imported oil (line 5) less non-Saudi OPEC oil exports (line 7).

i/ Demand for Saudi oil (line 8) less Saudi desired output (line 9).

projections imply a 1982 oil import demand of 26.3 to 30.8 million barrels per day (line 3), compared with 25.7 million barrels in 1978. It projected that non-OPEC countries outside the OECD would import 4.2 million barrels per day in 1982, rising from 2.5 million barrels per day in 1978 (line 4). Total demand for oil from OPEC would rise, therefore, from 28.2 million barrels per day in 1978 to between 30.5 and 35.0 million barrels in 1982 (line 5).

In meeting this demand, the CIA projected that non-Saudi Arabia OPEC members would be willing to supply 18.8 million barrels per day in 1982, compared with 20.1 million barrels per day in 1978 (line 7). Therefore, the demand for Saudi oil would rise from 8.1 million barrels per day in 1978 to between 11.7 and 16.2 million barrels per day in 1982 (line 8). But the CIA posited that the Saudis would be willing to supply only 8.5 million barrels per day (line 9). Therefore, at a constant oil price, a gap would develop of 3.2 to 7.7 million barrels per day (line 10). To close this gap, the oil price would have to rise.

WHAT IS THE RANGE AROUND THE CIA POINT ESTIMATE?

The foregoing represents the CIA's best (1979) guess about the oil shortfall in 1982. Each element of that estimate, however, is subject to some error, and the combined effect of the uncertainty is sufficiently large to permit a very wide range of possible values for the residual demand for Saudi Arabian oil. Table F-2 follows the lines of Table F-1, but marks off a plausible range of possible outcomes around the CIA mean estimate. As line 8 shows, one possible outcome is a substantial fall in demand for Saudi oil.

Table F-2 derives one set of ranges of high and low forecasts of demand for Saudi Arabian oil exports. The left column combines the low-demand growth forecast with the high-supply growth forecast to produce a low estimate of the demand for Saudi exports in 1982. The right column reverses this procedure: it combines the highest estimate of the demand for Saudi oil exports with the lowest estimate of non-Saudi supply. In each case, measures of "plausibility" are based on findings within the CIA study; these are discussed further below and in the notes to Table F-2.

Line 1 of Table F-2 shows an estimated range of demand for OPEC oil based on the CIA's own reported standard error of estimate of 1.2 percent. Line 1a reports an alternative estimate of

TABLE F-2. ESTIMATED RANGE OF VALUES FOR THE CIA FORECAST OF 1982 DEMAND FOR SAUDI ARABIAN OIL

	Extreme Low Demand High Supply	Extreme High Demand Low Supply
Demand for Imported OPEC Oil		
1. Range of OECD demand within standard error of 1.2 percent a/	81.5	88.0
1a. Alternative estimate of OECD demand b/	77.8	87.3
2. Range of OECD domestic supply within range of U.S. oil production c/	62.3	51.9
3. OECD oil import demand d/	16.8	35.4
4. Non-OECD oil import demand e/	4.2	4.2
5. Total demand for imported OPEC oil f/	21.0	39.6
Supply of Imported OPEC Oil		
6. Total OPEC oil exports g/	21.0	25.9
7. Range of non-Saudi OPEC oil exports c/	20.8	17.4
The "Gap"		
8. Demand for Saudi Arabian oil exports h/	0.2	22.2
9. Saudi Arabian desired oil exports i/	8.5	8.5
10. "Gap" j/	0.0	13.7

SOURCE: Derived from data in U.S. Central Intelligence Agency, National Foreign Assessment Center, The World Oil Market in the Years Ahead (August 1979). References in the footnotes to this table refer to this source as "CIA."

a/ The ranges of the demand forecast use the standard error of 1.2 percent shown in the CIA report, Table F-8, p. 61. It applies that standard error to the "high"- and "low"-demand outcomes in Table F-1, line 1.

b/ Over the four years between 1973 and 1977, OECD real GNP rose by 8.4 percent (CIA, p. 60), while OECD energy consumption rose by 3.2 percent (CIA, p. 61). For each 1 percent rise in OECD GNP, therefore, energy demand rose by 0.38 percent; the change in demand also reflects, of course, the rise in the oil price. The same calculation for the 1975-1977 period, using data from the same sources, shows that each 1 percent rise in GNP was accompanied by a rise in energy demand of 0.86 percent.

The CIA's low-growth scenario assumes that OECD income grows at 3 percent per year in 1979-1982. Actual growth in 1978 was 3.9 percent (OECD, Main Economic Indicators (December 1980), p. 169), so total GNP growth in

(continued)

TABLE F-2 (continued)

1979-1982 would be $(1.039)(1.03)^4 = 1.169$. Actual 1977 energy demand was 74.3 million barrels per day (CIA, Table F-9, p. 61), so if energy demand responded to income and past price changes as it did in 1973-1977, a rise in income of 16.9 percent would produce an increase in energy demand of (16.9)(0.38), or 6.4 percent, thereby increasing energy demand to 77.8 million barrels per day (which is entered as the low forecast). On the other hand, the higher rate of income growth in the high-demand scenario amounts to $(1.039)(1.03)(1.04)^3$, or 20.4 percent over the period (CIA, Table 10 and footnote c, p. 12). With the larger response of energy demand to a GNP rise of 0.86, energy demand would rise by 17.5 percent, to 87.3 million barrels per day.

c/ The CIA sets the range of oil production in the United States at 8.5 to 10.2 million barrels per day in the early 1980s (CIA, pp. 18-19), and adopts 9.2 million barrels per day as the point estimate for the United States (CIA, Table 6, p. 7). In percentage terms, that range lies between -7.6 percent and 10.9 percent of the CIA's most probable forecast. While this is admittedly limited evidence, there is no obvious reason to believe that non-U.S. production prospects should be any more certain than U.S. production prospects or that non-oil production prospects should be more certain than oil production prospects. The same range of uncertainty, therefore, is used for OECD domestic energy supply (line 2) and for non-Saudi OPEC oil supply (line 7).

d/ Line 1a minus line 2.

e/ See Table F-1, line 4. The CIA does not supply total energy demand and supply figures for non-OPEC less developed countries, other developed countries, and communist countries. The point estimates used here, therefore, underestimate the actual variance of those estimates. Mexico alone, by CIA estimates, has the capacity to produce between 2.5 and 3.0 million barrels per day between 1982 and 1985, with "higher rates . . . technically feasible" (CIA, p. 28). An error of 0.5 million barrels per day would, by itself, represent more than 10 percent of the value of the entry for non-OPEC oil demand; similar ranges in estimates for other countries would further increase the interval.

f/ Sum of lines 3 and 4.

g/ Equals total demand (line 5) or the sum of non-Saudi output (line 7) and Saudi output (line 9), whichever is smaller.

h/ Equals zero or total demand for imported OPEC oil (line 5) less non-Saudi OPEC oil exports (line 7), whichever is larger.

i/ CIA, Table 5, p. 5.

j/ Demand for Saudi exports (line 8) less desired supply of Saudi oil exports (line 9) or zero, whichever is greater.

demand growth based on the evolution of energy demand and GNP growth shown in the CIA study. (See Table F-2, note b/, for further discussion.)

Line 2 uses the CIA's own interval of error around its forecast of U.S. oil production to estimate the range of possible OECD domestic energy supply projections. This procedure assumes, reasonably, that expectations about non-oil energy production should be at least as uncertain as those about oil production, and that expectations about non-U.S. production should be at least as uncertain as those about U.S. production (see Table F-2, note c/).

The estimates of OECD demand from line 1a and of OECD supply from line 2 imply a range of OECD demand for imported oil of 16.8 to 35.4 million barrels per day (line 3).

For non-OECD oil import demand, the table gives the CIA point estimate of 4.2 million barrels per day (line 4), but only because the CIA report did not contain data on total energy demand and supply for the non-OPEC less developed countries, the non-OECD developed countries, and the communist bloc. Had such data been presented, the same technique as before could have been employed to mark off an estimated range for non-OECD oil import demand.

Combined OECD and non-OECD demand for OPEC oil exports appears in line 5, ranging from 21.0 to 39.6 million barrels per day.

To determine the Saudi share of the market, the table first estimates non-Saudi production (line 7). It makes this estimate by using the same range of uncertainty for non-Saudi OPEC members as the CIA applies to U.S. oil production. The range of non-Saudi output so derived is 17.4 to 20.8 million barrels per day. For the higher rate of output, in combination with the low total demand estimate, the demand for Saudi oil would fall to 0.2 million barrels per day. Under such circumstances, the Saudis would try to restore their share of the market by establishing prorating agreements among OPEC members. Should these agreements fail, as they typically do, the Saudis would be forced to cut prices to regain their share of the market. (Should the opposite conjunction of demand and supply outcomes occur, of course, a substantial rise in prices would be required to close the gap.)

Each line of the table suggests policies that ultimately reduce the demand for Saudi Arabian oil and increase the pressure

for OPEC price reductions. An energy policy that aims only at increasing domestic supply or reducing domestic demand, focusing on only one component of lines (1a) and (2), misses many potentially important energy strategies.