SERI/TR-51-170D
UC CATEGORY: UC-13

POTENTIAL EFFECTS ON THE U.S. ECONOMY AND SOCIETY RESULTING FROM A DEPENDENCE ON FOREIGN PETROLEUM SOURCES AND POSSIBLE SOLAR ENERGY RESPONSE

PETER DELEON
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FEBRUARY 1979

Solar Energy Research Institute

1536 Cole Boulevard
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A Division of Midwest Research Institute

Prepared for the
U.S. Department of Energy
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FOREWORD

This report documents work performed in compliance with Contract No. EG-77-C-01-4042, Task No. 5326.30. The report was prepared by Peter deLeon of the Policy Analysis Branch of the Solar Energy Research Institute and Robert F. McNown, Associate Professor, Department of Economics, University of Colorado, Boulder. The authors appreciate the valuable comments made on an early draft by John Ashworth and Byron Jackson, both of SERI's Policy Analysis Branch.

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TABLE OF CONTENTS

LIST OF TABLES

SECTION 1.0

INTRODUCTION

Close to 40% of American oil supplies are currently imported from the Middle East; almost as much is imported by the United States from continental Africa.* There is no indication that this amount will decline within the near future [1], even given the recent rise in prices set by the Organization of Petroleum Exporting Countries (OPEC) and the prospects of major oil finds in the Western Hemisphere [2,3]. Therefore, it is worthwhile to examine the possible socioeconomic implications which might be ascribed to the American dependence on foreign petroleum. In most cases, empirical evidence is lacking or, where available, is often inconclusive. (Those areas which are most susceptible to empirical validation will be designated.) The purpose of this paper, then, is to identify the possible social, political, and economic issues relating to U.S. dependence on foreign petroleum sources as a preliminary to later arguments supporting solar energy alternatives as a means of reducing the balance of payments deficits and relieving American dependence on foreign -- especially Middle East -- petroleum.

This analysis examines three issues of particular relevance to the Department of Energy and especially the Energy Technology Division. First, it offers some evidence to calibrate assumed but untested "conventional wisdom" that balance of payment deficits have a harmful effect on the American economy and body politic. It analyzes a number of specific policy issues in which oil dependence and trade deficits potentially could have a significant, dangerous impact. Where possible, these relationships are empirically supported. Taken in sum, this paper can be seen as a first approximation of the social and economic costs accrued by the United States because of its dependence on foreign sources of petroleum. It therefore represents substantive political and economic underpinnings for proposing and developing new energy technologies and policies which can ameliorate that condition. Second, in presenting these social and economic issues as a function of oil imports, this paper provides substance and example to the current practice of describing oil imports in terms both of dollar flow and energy consumption (or quads). Finally, it offers a set of specific issues that later research can substantiate empirically, thus giving more precise estimates of the magnitude of the problem and the effects of policies designed to resolve those problems; for example, what would be the effect of a certain number of quads provided by solar energy on the amount of oil imported, the total U.S. balance of trade, and the domestic rate of inflation? This last set of questions sets the stage for subsequent analysis of the amount of foreign oil which solar energy technologies could be expected to replace, and the economic and social ramifications accorded that level of displacement.

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*In 1977, 37.9% and 37.7% of the petroleum imported by the United States originated in the Middle East and Africa, respectively; by a wide margin, the two largest suppliers were Saudi Arabia (499.8 million barrels) and Nigeria (409.8 million barrels). Source: DOE Energy Information Agency.

The following analysis is presented in two parts. The first part examines the general issue of balance of payments deficits from the perspective of economic theory, specifically, the relevant areas from macroeconomics and international economics. This discussion introduces the general theoretic and accounting concepts as they structure the analysis of the effects of trade deficits on the domestic and international economic system. Although the arguments are valid for any commodity or asset exchanged across national borders, the emphasis and examples deal with petroleum. The second part is much more issue oriented. It details some specific policy situations and problems that might result from a growing national balance of payments deficit or a dependence upon a limited number of suppliers of a strategic material. This section examines possible political and social implications, as well as the economic costs. A concluding section links the present analysis to the overall SERI oil displacement study.

SECTION 2.0

ECONOMIC PRINCIPLES

As a point of departure, the costs of petroleum imports are examined using the balance of payments framework. From this analysis, it is clear that a large volume of oil imports imposes economic costs in the form of reduced levels of other imports, increased United States exports of goods and services, and/or reduced net capital flows from the United States (i.e., reduced investment by U.S. nationals and corporations in the rest of the world or increased foreign investment in the U.S.). Balance of payments deficits can also lead to a depreciation of the dollar, a greater reliance on restrictions of capital flows and international trade, and the elevation of balance of payments considerations over domestic economic conditions in macroeconomic stabilization policy.

The examination of the economic costs of oil imports is a function of the framework adopted for balance of payments analysis and the interpretation of the relevant balance of payments concepts. It is therefore useful to define the accounting framework and the determinants of a balance of payments deficit in both the accounting and theoretical senses. Contrary schools of thought are examined later.

BALANCE OF PAYMENTS ACCOUNTING

Table 2-1 presents the U.S. balance of payments statement for 1977 and categorizes the accounts into three major headings: current account, capital account, and official transactions. Entries under the current account primarily include merchandise trade, payments for travel and transportation, and net returns from foreign investment. Oil imports manifest themselves as debits to the U.S. balance on merchandise trade. To the extent that these imports are financed by increased U.S. exports or reduced U.S. imports of other goods, the negative contribution of oil imports to the merchandise trade balance is neutralized.

The balance on current account adds payments for travel and transportation, government and private transfers to and from foreign nationals, net military payments, and the net return from foreign investment to the merchandise trade. Because the United States has large investments abroad, there is presently a large flow of income from these investments into this country. As foreign investment in the United States grows, it will ultimately lead to a growing flow of income out of the country and an increasing debit to the balance on current account.

Any deficit on current account must be offset by some combination of capital flows and official transactions. The capital account summarizes all capital flows into and out of the United States (other than official transactions between government and international agencies) including direct investments by corporations, transactions in corporate stocks and bonds, purchases and sales of government securities by private firms and individuals, and changes in holdings of bank deposits. Any such investment by an American citizen or firm

TABLE 2-1

U.S. BALANCE OF PAYMENTS, 1977

Payment Category	Amount - Billions of Dollars	
Current Account		
Exports of Merchandise	120.6	
Imports of Merchandise	-151.6	
Merchandise Trade Balance	-31.1	
Travel and Transportation (net)	1.7	
Net Military Transfers and Sales	1.3	
Income on U.S. Investments Abroad	32.1	
Payments on Foreign Investments in U.S.	-14.6	
Net Govt. and Private Transfers	-4.7	
Balance on Current Account	-15.2	
Capital Account		
Statistical Discrepancy	-1.0	
U.S. Investment Abroad	-34.4	
Foreign Investment in U.S.	13.7	
Official Transactions Balance		-36.9
Official Transactions		
Changes in U.S. Liabilities to Foreign Official Agencies	36.9	
Changes in Gold and other Reserve Assets	0.0	

Source: Survey of Current Business, S-3, July 1978.

abroad entails a flow of funds out of the country and thus becomes a debit to the U.S. capital account balance. Any such investment by foreign nationals or firms in the United States involves a flow of funds into the country and is a credit to the balance on capital account. For example, when OPEC nations invest their oil revenues in U.S. corporations or assets, this appears as a positive entry under the capital account which offsets the deficit incurred in current accounts.

Finally, any cumulative deficit from the current and capital accounts must be financed by official settlements between the U.S. government and foreign governments or international agencies such as the International Monetary Fund, and generally is referred to as the Official Settlements or Transaction Balance. This entry is a measure of official actions taken to compensate any imbalance resulting from the current and capital account transactions of private firms and individuals. It is generally assumed that any deficit in the Official Settlements Balance tends to exert downward pressure on the value of the dollar [4]. For the purposes of this paper, a balance of payments deficit is taken to mean a deficit on the Official Transactions Balance.

To the extent that the U.S. government wishes to prevent a balance of payments deficit from resulting in a depreciation of the dollar, it must obtain foreign exchange from other governments or sell gold to purchase the surplus American dollars. In the past, the United States could rely to a large degree on other governments to perform this stabilization function. It was in their best interests to avoid a depreciation of the dollar because of its pivotal role in the international economic system. Recent events and policy actions, including President Carter's decisions to issue financial securities denominated in foreign currency terms and to commit a portion of American gold stock to the stabilization of the dollar, indicate that the United States will have to rely increasingly on its own resources to stabilize the dollar. Because such resources are limited, it is clear that the United States cannot indefinitely sustain a balance of payments deficit while simultaneously avoiding any further depreciation in the dollar.

ECONOMIC THEORY AND TRADE DEFICITS

The preceding paragraphs delineate the basic accounting conventions in the balance of payments statement. However, accounting relations say little about the causes and effects of balance of payments deficits. Most current discussions of the U.S. balance of payments problem focus on the large volume of oil imports as the key source of the present problems, citing the simple fact that oil imports account for the single largest import item by dollar value -- $45 billion in 1977 -- and amount to 30% of all U.S. merchandise imports [5]. Hence, it is not difficult to argue that oil imports have been a primary and growing factor in the recent and continuing U.S. balance of payments deficit.

Some macroeconomists argue that a country's balance of trade or balance of payments position is determined more by natural macroeconomic activity than by changes in particular items on the balance sheet [6,7]. This view denies the relevance of any particular item in the trade accounts, regardless of size, and instead concentrates on other macroeconomic indicators--such as the growth

in the money supply, size of the government deficit, relative rates of inflation, and relative rates of economic growth--as the important determinants of the balance of payments position. However, this school of thought is valid only if extreme assumptions are made concerning which economic variables are autonomous and which are dependent. For example, an empirical relationship can be established between large government deficits and large current account deficits [7]. The issue remains, however, as to which of these two deficits is causal in regards to the other, if either. Similar objections can be raised with respect to the other macroeconomic variables considered to be the driving factors in the U.S. balance of payments problem.*

Various domestic macroeconomic policies and variables will have an effect on the directions and magnitudes of the individual components of the balance of payments statement. Certainly imports and exports are affected by relative prices of foreign versus domestic goods and by relative rates of growth in aggregate demand in various countries. However, this should not preclude the possibility that exogenous factors can also have an impact on the signs and magnitudes of individual entries; the quadrupling of oil prices in 1974 clearly had an impact on oil imports, and hence total imports, which dominated the effects of the internal macroeconomic policies. Unless there are balancing tradeoffs from one item in the accounts to others, the effect of the change in one balance of payments item on the overall deficit would be additive.**

A second reason for considering individual components in the balance of payments accounts is that some individual items may have significance beyond their contribution to the overall balance of payments position. For example, it is often pointed out that a large fraction of the U.S. oil import bill returns as payments to the U.S. by petroleum exporters. From this point of view, the net impact of oil imports on the American balance of payments position is considerably less than $45 billion. However, the "petrodollar" method of financing American petroleum imports does entail real economic costs to the United States. Valuable domestic resources are sacrificed in the production of U.S. exports and heavy investment in the United States by foreigners will entail large flows of investment income out of the country in future years. This argument is not meant to suggest a policy of no trade between nations. Oil imports clearly provide significant benefits to the U.S. economy. Rather, the main point here is to emphasize that the trade deficits partially created by oil imports but currently offset by foreign investments in the U.S. domestic economy can impose significant costs in terms of future U.S. balance of payments.

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*See, in particular, the literature on the monetary approach in which domestic rates of inflation and rates of monetary growth become determined by corresponding variables in the rest of the world. This approach also reserves the direction of the effect of changes in real GNP on the balance of payments from that hypothesized by the Keynesian view.

**One important feedback in this case is the increase in OPEC investments in and imports from the United States.

Theories of automatic adjustment to equilibrium or flexible exchange rates in balance of payments accounting similarly deny the importance of particular items. Under flexible exchange rates, given the appropriate import and export price elasticities, a balance of payment surplus or deficit will automatically be corrected through currency appreciation or depreciation [8]. Such adjustments, however, are hardly costless, for currency depreciation can fuel domestic price inflation to the extent that an economy is open [9,10]. In correcting the initial trade deficit, currency depreciation will necessarily lead to an increase in exports and a reduction in other imports, and hence impose real economic costs. To the extent that the U.S. oil imports are financed by a reduction in other imports, this entails a reduced availability of goods consumable by Americans. Likewise, if the oil imports are paid for by increased U.S. exports of good and services, these also would be less available for domestic consumption.

The oil price increases have resulted in a transfer of real income from the oil importing countries to OPEC [11, p. 102]. This transfer of real income to OPEC provides the exporters with greater command over real goods and services produced in the United States and causes a corresponding reduction in the quantity of goods and services available to U.S. nationals.

Fixed exchange rate theories of balance of payments adjustment likewise involve real costs of adjustment [12]. Any movement from an initial position of trade deficit to a balance of payments equilibrium must entail corrective movements of capital or other trade items. In the case of adjustments in other trade items, the costs are the same as under flexible exchange rate regimes. If a trade deficit is compensated through reduced U.S. investment abroad and/or increased foreign investment in the United States, such capital flows will have long run effects on the current account through their effect on net income from foreign investment.* Increased investment by foreigners in the United States increases the future payments made by American corporations or governments to foreign agents; similarly, reduced U.S. investment abroad decreases the future income from investments which U.S. firms and individuals may expect to receive. Both of these changes will cause a reduction in the current account entry, "net income from foreign investment." Historically, America has relied on a large net inflow from the return on foreign investment to finance other deficit items; in 1977, American investments abroad returned $32.1 billion. If this figure were reduced substantially as an indirect result of heavy oil imports, the ability of American investors to finance a high level of net imports, foreign aid, and/or foreign investment in the future would be severely weakened.

This discussion does not reject the validity of either the macroeconomic view or the automatic adjustment approaches. Rather, it goes beyond these arguments to consider explicitly the costs of adjustment or of allowing domestic

*See Current Account, Table 2-1.

macroeconomic policies to be affected by balance of payments considerations. In fact, these approaches attempt to estimate the social cost of oil imports, namely, the summation of the compensating changes in the other balance of payments items and the costs of allowing domestic stabilization policies to become dependent upon balance of payments considerations.

An initial estimate of the social and economic costs of oil imports is simply the dollar value of such imports (say, $45 billion for 1977). To achieve equilibrium in the balance of payments, this oil import bill must be balanced by $45 billion in compensating changes in other items in the balance of payments. To the extent that oil imports are financed by increased U.S. exports or reduced imports of other products, the economic cost of the oil imports would be the $45 billion in goods and services forgone by American nationals. Likewise, to the degree that the oil import bill is financed through changes in the capital account, investment by foreigners in the U.S. must increase by $45 billion and/or U.S. investment abroad must decline by $45 billion. The ultimate cost of such changes in the capital account is the reduced net income from foreign investment accruing in the future, a loss which can be discounted to an equivalent present value.

The dollar value of oil imports would be only a first and most conservative approximation to the total economic and social cost of petroleum imports. Recent balance of payments disequilibria indicate that adjustments do not occur easily or without cost. Under fixed exchange rates, balance of payments deficits have led to restrictions in trade and capital flows and accommodating deflationary macroeconomic policies. In the United States during the late 1960s, a policy restricting capital flows from the United States was adopted. This three-pronged program called for annual limits on new direct foreign investment by U.S. corporations, repatriation of a specified fraction of total foreign earnings, and restriction of holdings of short term foreign securities [11, p. 173]. Americans were urged to buy domestically and discouraged from foreign travel; the allowance on duty free goods brought in by U.S. tourists was reduced from $500 to $100 per person. Similarly, Great Britain restricted the amount of pounds British tourists were permitted to take out of the country during the sterling crisis. More importantly, the Labour government imposed severe restraints on the British economy to correct the balance of payments problem.

Even under a system of flexible exchange rates, adjustment has not always been as smooth as economists have expected. Relatively low short-run import and export price elasticities can exacerbate the problem of balance of payments adjustment [9]. Some economists argue that recent exchange rate fluctuations have been wider than would be predicted by economic theory and that these fluctuations have been a significant contribution to the current worldwide inflation [13,14,15].

In summary, the balance of payments framework can be used as a starting point in evaluating the cost of oil imports. Within this framework, it has generally been argued that costs of petroleum imports are the value of other imports forgone, of increased U.S. exports, of increased foreign investment in the United States, and of reduced U.S. investment abroad. Compensatory changes for each of these balance of payments entries must take place to finance the oil import bill, and each of these changes imposes its own cost on

the U.S domestic economy. The total cost of all these changes is the total value of the oil import bill which necessitated these offsetting changes. In addition to these basic costs, there are additional economic costs in the form of corrective governmental balance of payments and domestic stabilization policies as well as adjustment costs incurred because of exchange rate fluctuations. Finally, there are a number of less quantitative, more social costs incurred that fall beyond the ken of economic theory. The following section deals more specifically with the potential effects of some of these economic and social costs of oil dependence and balance of payments deficits on the American and international social and economic infrastructure.

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SECTION 3.0

POSSIBLE IMPLICATIONS OF BALANCE OF PAYMENTS DEFICITS AND OIL DEPENDENCY

The possible domestic and international ramifications of U.S. dependency on foreign petroleum supplies and the resulting balance of payments deficits are presented here as possible, plausible extensions or results of the present international economic conditions. As such, they are a basis for discussion rather than pressing issues for immediate policy attention. For convenience's sake, the issues are categorized into four topics -- Strategic and Foreign Policy, International Economics, Domestic Economics, and Social and Environmental -- although in actuality, the different issues are not nearly so distinct.

STRATEGIC AND FOREIGN POLICY

1. There is concern that American national security could be adversely affected by its dependence on foreign petroleum [16]. The argument can be approached in two ways. First, to rely on foreign nations to supply strategic materials to the United States would place American national interest and military operations at the caprice of the supplier nation. Department of Defense officials have consistently warned that Middle East oil is particularly susceptible to interdiction. Second, American imperatives to protect the accessibility of strategic materials might force the United States to engage in a conflict it might otherwise wish to avoid (for example, a confrontation with the Soviet Union over the control of the Saudi oil fields). Although the United States has sufficient domestic oil supplies to fulfill all its military requirements, the necessary displacement of petroleum from the civilian sector would cause severe disruptions in the domestic economy.

2. The international competition for oil has created serious strains within the American system of alliances, especially among the OECD member nations. The intra-alliance tensions among NATO members during the Middle East crisis demonstrated this political cost [17]; U.S. supplies being airlifted to Israel were not permitted to use European airfields for refueling. There is some sentiment in Europe that the U.S. State Department deliberately urged the Arab OPEC members to raise their oil prices because State Department officials reasoned that the American economy would be less hurt than other OECD economies and thereby gain an advantage for the United States in the international trade competition [18]. The validity of these charges is suspect, but the fact that they are expressed and U.S. oil import policies are cited as supporting evidence means that they must be considered as a possible cost of U.S. dependence on Middle East oil. Similar perceptions could trigger a trade war between the United States and its major trading partners which would have a detrimental effect on the domestic economy and alliance politics in general.

3. The influence of the Arab oil states on U.S. government policy as a result of U.S. dependence on their petroleum could undermine traditional U.S. political and military commitments (for example, to Israel) which would

effectively constrain American freedom of action in the conduct of its foreign policy. In the specific case of Middle East diplomacy, such limitations could create major domestic policy debates with repercussions spilling beyond the foreign policy arena; witness the domestic recriminations when President Ford and Secretary of State Kissinger announced their decision to "reassess" the American relationship to Israel. However, as some observers have taken pains to point out, the Arab members of OPEC hardly represent a monolithic organization; increasingly they are faced with growing socioeconomic problems of their own [19]. They must consider their own internal vulnerabilities and American strengths before attempting to dictate or compel American foreign policy decisions [20,21,22]. Another area of concern would be Africa, with the continuing struggle between the black nations and South Africa setting the stage for possible pressures upon the United States to terminate all support of the apartheid regime brought to bear by the African oil exporting nations.

4. A dependence on Middle East oil could conceivably make it more difficult for the United States to refuse Arab requests to purchase U.S. nuclear power reactors or even reprocessing facilities. The sale of nuclear reactors, especially to regions as volatile as the Middle East or sub-Saharan Africa, would be contradictory to the declared U.S. policy of nuclear non-proliferation and the problems inherent in that issue [23,24].

5. The effects of high oil prices on the lesser developed countries (LDCs) could be especially disastrous because they have few exports, monetary reserves, and/or investment opportunities to make up the growing trade deficit, and lack the facilities or capabilities for recycling petrodollars [25,26,27]. They are therefore forced to fall back on international organizations and, more often than not, the United States for increased assistance. Under such conditions of growing debt and deprivation in the Third and Fourth worlds, the U.S. government might find it extremely difficult to ignore the requests for foreign aid and be forced to raise its levels of foreign assistance (either in terms of money or commodities, the latter acting to keep domestic prices at a slightly higher level) and commercial banks would be pressured to reschedule LDC debt repayments [28]. Another possibility is that to meet higher oil prices, the LDCs would attempt to raise the price of whatever commodities they were able to export; their success, of course, would be situationally dependent and problematic, at best. Finally, the high level of LDC loans and their inability to meet repayment schedules could tie up U.S. bank reserves which would contribute to a possible loss of liquidity within commercial banking circles and resulting higher domestic interest rates.

INTERNATIONAL ECONOMICS

6. The unprecedented transfer of such large amounts of money from one group of nations to another could severely strain the fabric of the international monetary system and its component institutions, even given the system of free floating exchange rates [29]. The disruption of the international monetary system could reflect back on a number of domestic economies and recreate either inflationary or recessionary pressures. For example, during 1978 when the dollar came under very heavy attack by

foreign speculators, the Federal Reserve set its domestic policy considerations aside and began raising interests rates by selling some of its holdings of U.S. Treasury bills. This action attracted more foreign-held dollars into the U.S. money market and helped to offset the heavy dollar sales by speculators and the dollar outflow to pay for continuing trade deficit. The domestic effect, of course, was to make the cost of borrowing money more expensive. With future large deficits in the U.S. trade account, chances are good that domestic monetary policy objectives will again have to be set aside so that the dollar can be defended, which for Americans means slower income growth and lessened employment opportunities.

7. American dependence on oil imports at world prices could conceivably weaken the dollar relative to other national currencies to such an extent that a world depression could result. Secretary of State Kissinger warned the U.N. General Assembly (23 September 1974) that "Strains on the fabric and institutions of the world economy threaten to engulf us all in a general depression." Although some argue that a world depression of the magnitude experienced in the 1930s is not presently feasible [30] and that the pressures on the world economic system are grossly overrated [26], still the specter of world depression brought about by the instability of the U.S. dollar and its resulting effects on the internal U.S. economy (both due, at least in part, to the high price of oil and the U.S. dependence upon world oil) cannot comfortably be dismissed.

DOMESTIC ECONOMIC

8. The fear of oil embargo has resulted in a program to build up a strategic oil reserve that, in case of another embargo, would supply the American economy with six months' supply of petroleum [31]. In the process of stocking this strategic reserve, the government keeps the short term petroleum demand artifically high in a competitive market, thereby retaining the price of oil at a premium which directly affects the individual consumer in a myriad of ways (e.g., higher cost for fuel oil, gasoline, and agricultural products).

9. The large and growing influx of petrodollars into the U.S. economy could have adverse affects on the internal investment patterns or place critical sectors of the U.S. industry and resources into foreign hands. These possibilities are discounted in some quarters [32] but the potential is nevertheless believed to exist, and investment is a conspicuous example of an area in which perceptions are as important as reality. There are examples in which petrodollars have already had an impact upon domestic U.S. interest rates and economic activity. The relatively low interest rates experienced during the business recovery from the 1974 recession is partly attributable to the purchase of short term securities by the OPEC nations. This influx of petrodollars improved the liquidity of the nation's money markets, resulting in a lower interest rate than otherwise would have prevailed. The recycling of petrodollars into short-term U.S. securities, however, does create a potentially serious problem. OPEC nations have accumulated very large holdings of these highly liquid assets. If, for whatever reason, these investors were suddenly to sell

their securities in the domestic money market, the result would be a sharp increase in short-term interest rates that could easily disrupt the domestic economy.

10. An increase in energy costs (partially attributable to paying the high price of imported oil) drives up the cost of production. If labor and capital costs are fixed (or themselves increasing), a decline in real output must occur. There appears to be little opportunity to substitute capital for energy or for labor (at least in the short run). Pindyck asserts that the total cost of output is increased almost as much as the percentage increase in the cost of energy multiplied by energy's share in the total costs [33, p. 48]. For example, he cites econometric projections in which a doubling of the total cost of all energy in the United States would cause a 3% increase in the cost of U.S. manufacturing output [34].

11. Watt claims that oil imports drive up the price of food to the U.S. consumer because of the need to export food as a means to ameliorate the oil-induced balance of payments deficit [34]. Pindyck seconds this by suggesting that the increased demand for exporting wheat and other foodstuffs added 1.5 to 2 percentage points to the U.S. rate of inflation in 1974 [35]. Similar logic would apply to any commodities or assets that the United States might export to balance its trade deficit.

12. The fact that the United States imports a figure approaching one-half of its domestic oil consumption clearly contributes to the U.S. balance of payments deficit, even with the recycled petrodollars [36]. The balance of payments deficits contribute, in turn, to the general U.S. rate of inflation. Although a causal relationship between balance of payment deficits and inflation has not been empirically verified, economists have suggested that half the 11% U.S. rate of inflation in 1974 was due to the fourfold increase in foreign oil prices and the U.S. need to import large quantities of that oil [36]. Enders attributes 25% of the 14% average rate of inflation among OECD nations in 1974 to the same set of conditions [37]. The recently announced 14.5% price increase in OPEC oil costs scheduled for 1979 is projected to add 0.5 to 0.75 of a percentage point to the U.S. rate of inflation for that year [38], although slightly lower estimates are projected by the CEA [39] and other Administration economists [40]. The general effects of inflation are well enough documented so that they need not be repeated here.

13. In attempting to counter inflation, the government may adopt contractionary macroeconomic measures, such as reduced government expenditures and a restricted money supply, which could lead to a domestic recession and higher unemployment than otherwise might be expected [41]. Pindyck claims that the government adopted such policies to counter the 1974 inflation, not realizing that they were appropriate for ordinary demand-pull inflation, but relatively ineffective against inflationary tendencies generated from outside the United States, thereby contributing to the recession of 1975 [35]. The result, of course, is a reduction in economic growth, higher unemployment, and loss of certain production opportunities.

14. The American balance of payments deficit directly undermines the value of the U.S. dollar on the international money market. This has two adverse effects. First, because of the U.S. dollar's central role, its instability seemingly threatens the integrity of the international monetary system (see No. 7 above). Evidence of this danger was apparent in the concern expressed by the world leaders during the 1978 Bonn economic summit conference and President Carter's pledge to address the instability of the dollar. Second, the balance of payments gap reduces the value of the U.S. dollar, thereby making imported goods more expensive for U.S. consumers. This condition is generally thought to be inflationary (at least in the short run) because consumers and their utility preference patterns are notoriously reluctant to readjust. Short term efforts to support and stabilize the dollar, such as borrowing foreign currencies, could lead to a longer-run, much more serious financial crisis should the current economic conditions which led to these measures continue to prevail [42].

15. The inflationary elements referenced above (Nos. 12 and 14) only add to the on-going inflationary spiral. As inflation undermines the value of the U.S. dollar relative to other national currencies, other nations see the real price of their exports to the United States declining because of the inflated dollar and the central position of the U.S. dollar in the world economy (e.g., OPEC oil prices are priced in terms of U.S. dollars). In the case of the OPEC nations, they also see U.S. inflation diminishing the value of their investments in American financial bonds or Treasury notes [43]. This condition leads to yet another series of price increases [29], especially as the OPEC nations face greater internal demands for Western goods and public services.* Thus, the balance of payments and domestic inflation feed upon and fuel one another. (There are, of course, other causes for domestic inflation and balance of payment deficits--e.g., deficit spending and lack of comparative advantage on the world market--which contribute to this cycle. It is not meant to suggest that balance of payment gaps are the fundamental or most important cause of inflation, nor that the oil import problem is the only commodity driving the trade deficit [45].)

SOCIAL AND ENVIRONMENTAL

16. The role of American oil companies in the OPEC negotiations and policies has created a great deal of controversy and open distrust of these companies by the American public.** Repeated public opinion surveys show that nearly half the American people believe that the energy crisis was

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*Moran [44] suggests that internal development policies will force the OPEC nations to institute an annual price increase of "10 per cent to 15 per cent per year above the OECD inflation ...." (p. 74; emphasis in original). Smithies [19] argues that by 1985, Saudi Arabia will experience a balance of payments deficit.

**The debate is joined by Church [46] and Chandler [47].

contrived for the economic benefit of the oil companies [48]. Talk of "ill-gained, windfall" profits and "uncontrolled multinational corporations" directed against a major U.S. industrial sector and the suspicion these charges engender might result in debilitating regulatory actions which could undermine the industry. Thus this could also be counted as a social cost of American corporate involvement in the Middle East oil production.

17. The decline of purchasing power of the U.S. dollar creates severe hardships for U.S. citizens living abroad who are paid in U.S. currency. The plight of the American soldiers stationed in Europe (especially West Germany) is often cited as an example, particularly in the case of the low-ranking soldiers who do not have access to on-base housing [49]. Automatic cost of living escalation factors for American military personnel living abroad could raise the cost of maintaining U.S. installations so high as to warrant a reduction in American overseas commitments. Problems encountered by the American tourist who is, of course, not required to travel abroad are less severe manifestations of the decline in the dollar's purchasing power.

18. There are a number of environmental issues that a reduced dependence upon oil as a source of energy would address, such as reduced air pollution and the preservation of scarce and non-renewable resources [50,24]. This would apply to the reduced use of any fossil fuels, of course, not just foreign sources, so there is no reason to elaborate except to note the relevance of these issues in the overall social cost-benefit calculus of regarding U.S. dependence on foreign oil supplies. As a point of illustration, the burning of fuel oil to heat homes in the northeastern United States has a harmful effect on the air quality standards regardless of the source (i.e., domestic or foreign) of the oil.

19. Even a marginal reduction in the U.S. supply of petroleum could have magnified effects on the American society. For example, the recent interruption in Iranian oil exports to the United States, which contributed approximately 10% of U.S. oil imports (or less than 5% of the total U.S. energy supplies), has raised the specter of gasoline rationing by the spring of 1979 [51,52]. Although the effect and duration of the Iranian curtailment of oil are uncertain [53,54], it is clear that the potential impact could have detrimental effects on the American society [55,56]. The Iranian shortage has revived memories of the long waits and short tempers American motorists experienced waiting for gasoline in 1974.* Such conditions could adversely affect business patterns and recreational patterns of American citizens.

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*For different national perspectives on the effect of the Iranian oil cutoff, see [57,58].

SECTION 4.0

CONCLUSION

In sum, from both the theoretical and policy perspectives, it is clear that the present and growing American dependency on foreign supplies of petroleum and the resulting imbalance in U.S. trade ledgers can have adverse effects on the domestic and international economies and societies. One possible strategy for ameliorating the oil dependency and trade deficit problems is the displacement of oil by solar energy alternatives (such as residential space and water heating, industrial process heating, and biomass applications). Given this option as a means of offsetting the potentially adverse effects, the remainder of the SERI task will be to determine the amount of foreign oil that can be displaced in solar energy applications and the impact of the released oil on the American petroleum imports and balance of payments. Specifically, this entails the following tasks: determining the amount of petroleum the United States currently imports, the projected totals for future years if present rates should continue, the geographic regions to which the foreign petroleum is shipped, and the estimated percentages of the oil accorded to specified end uses. Using these baseline projections, computer simulation models will be used to estimate the displacement of foreign oil given specified levels of solar energy utilizations according to region and end use. This can then be translated in terms of foreign oil replaced by solar energy alternatives with the consequent positive effects on American balance of payment deficits and the concomitant reduction of U.S. dependence upon foreign suppliers of petroleum.

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REFERENCES

1. Tanner, James. "Barreling In: Oil Imports are Rising after First Half Drop; Record '79 Total Likely." Wall Street Journal. pp. 1; August 9, 1978.

2. For example, see: Metz, William D. "Mexico: The Premier Oil Discovery in the Western Hemisphere." Science. vol. 207 (no. 4374): pp. 1261-1265; December 22, 1978.

3. Also see: Corrigan, Richard. "An Optimistic Look at Mexico's Oil, Gas Riches." National Journal. vol. 10 (no. 51-52): p. 2080; December 30, 1978.

4. Kemp, Donald S. "Balance of Payment Concepts - What Do They Really Mean." Federal Reserve Bank of St. Louis Review. vol. 57: pp. 14-23; July 1975.

5. Mudd, Douglas R. and Wood, Geoffrey E. "Oil Imports and the Fall of the Dollar." Federal Reserve Bank of St. Louis Review. vol. 60: pp. 2-6; August 1978.

6. See also the literature on the monetary approach to the balance of payments, in particular: Frenkel, Jacob A., and Johnson, Harry G. (eds.). The Monetary Approach to the Balance of Payments. London: George Allen & Unwin, Ltd.; 1976.

7. For a somewhat different approach to the macroeconomic view see: Yang, Jai-Hoon. "Budget Deficits and Trade Deficits: Is there a Link?." Federal Reserve Bank of St. Louis Review. vol. 60: pp. 9-15; October 1978.

8. For a persuasive argument of this position see: Friedman, Milton. "The Case for Flexible Exchange Rates." Essays in Positive Economics. Chicago: University of Chicago; 1953. pp. 157-203.

9. Estimates of this effect indicate that a 10% depreciation of the dollar would lead to a 1.4 to 2.0% increase in the U.S. price level. See: Dornbusch, Rudiger, and Krugman, Paul. "Flexible Exchange Rates in the Short Run." Brookings Papers on Economic Activity. pp. 537-584; 1976.

10. See: McNown, Robert F. "The Impact of Currency Depreciation and International Markets on U.S. Inflation." Quarterly Review of Economics and Business. vol. 15: pp. 7-14; Winter 1975.

11. The Economic Report of the President, 1978.

12. Mundell, Robert A. "Capital Mobility and Stabilization Policy Under Fixed and Flexible Exchange Rates." Canadian Journal of Economics and Political Science. vol 29: pp. 475-485; November 1963.

13. Witeveen, H. Johannes. "Inflation and the International Monetary Situation." American Economic Review. vol 65: pp. 108-114; May 1975.

14. Whitman, Marina v.N. "The Payments Adjustment Process and the Exchange Rate Regime: What Have We Learned?" American Economic Review. vol. 65: pp. 115-146; May 1975.

15. Laffer, Arthur B. "The Bitter Fruits of Devaluation." Wall Street Journal. January 10, 1974.

16. Aikens, James E. "The Oil Crisis: This Time the Wolf is Here." Foreign Affairs. vol. 51 (no. 3): pp. 462-490; April 1973.

17. For a sample of European perceptions of U.S. actions during the 1973 Middle East crisis, see: Simonet,Henri. "Energy and the Future of Europe." Foreign Affairs. vol. 53 (no. 3): pp. 450-463; April 1975.

18. Reported in: Oppenheim, V.H. "Why Oil Prices Go Up: The Past: We Pushed Them Up." Foreign Policy. no. 25: pp. 24-57; Winter 1976-77.

19. Smithies, Arthur. The Economic Potential of the Arab Countries. Santa Monica, California: The Rand Corporation, R-2250-NA; November 1978. This elaborates on economic problems facing the Arab nations.

20. Levy, Walter J. "The Years that the Locust Hath Eaten: Oil Policy and OPEC Development Prospects." Foreign Affairs. vol. 57 (no. 2): pp. 287-305; Winter 1978/79.

21. Campbell, John C. "Oil Power in the Middle East." Foreign Affairs. vol. 56 (no. 1): pp. 89-110; October 1977.

22. Singer, S. Fred. "Limits to Arab Oil Power." Foreign Policy. no. 30: pp. 53-67; Spring 1978.

23. Nye, Joseph S. "Nonproliferation: A Long-Term Strategy." Foreign Affairs. vol. 56 (no. 3): pp. 601-623; April 1978.

24. Lovins, Amory. Soft Energy Paths: Towards a Durable Peace. chapt. 11. Cambridge, Mass: Ballinger for Friends of the Earth; 1977.

25. Farmanfarmaian, Khodadad, et al., "How Can the World Afford OPEC Oil?" Foreign Affairs. vol. 53 (no. 2): pp. 201-222; January 1975.

26. Chenery, Hollis B. "Restructuring the World Economy." Foreign Affairs. vol. 53 (no. 2): pp. 242-263; January 1975.

27. Pollack, Gerald A. The Economic Consequences of the Energy Crisis." Foreign Affairs, vol. 52 (no. 3): pp. 452-471; April 1974.

28. Beim, David O., "Rescuing the LDCs." Foreign Affairs. vol. 55 (no. 4): pp. 717-731; July 1977.

29. Triffin, Robert. "The International Role and Fate of the Dollar." Foreign Affairs. vol. 57 (no. 2): pp. 269-286; Winter 1978/79.

30. Cleveland, Harold v.B. and Brittain, W.H. Bruce. "A World Depression?" Foreign Affairs. vol. 53 (no. 2): pp. 223-241; January 1975.

31. Tolley, George S. and Wilman, John D. "The Foreign Dependence Question." Journal of Political Economy. vol. 85 (no. 2); April 1977.

32. Amuzegar, Jahangir. "The Oil Story: Facts, Fiction, and Fair Play." Foreign Affairs. vol. 51 (no. 4); July 1973.

33. Pindyck, Robert S. "Interfuel Substitution and the Industrial Demand for Energy: An International Comparison." Review of Economics & Statistics. May 1979 (forthcoming). Also published as MIT Energy Laboratory Working Paper #77-026WP, August 1977.

34. Watt, Kenneth E.F., "Why Energy Prices Should be Deregulated." House of Representatives Subcommittee on Energy and Power, Committee on Interstate and Foreign Commerce. Washington, D.C.: Government Printing Office; 1978.

35. Pindyck, Robert S. "OPEC's Threat to the West." Foreign Policy. no. 30: p. 48; Spring 1978.

36. Bach, Christopher L., "OPEC Transactions in the U.S. International Accounts." Survey of Current Business. vol. 58 (no. 4): pp. 21-32; April 1978.

37. Enders, Thomas O. "OPEC and the Industrial Countries: The Next Ten Years." Foreign Affairs. vol. 53 (no. 4): p. 625; July 1975.

38. Hillery, Victor J. "Stocks Staggered by Shock of OPEC Oil-Price Boost; Industrials Tumble 17.84 to 787.51 in Heavy Trading." Wall Street Journal. p. 2; December 19, 1978.

39. Rattner, Steven. "Fight on Inflation: Outlook is Bleaker." New York Times. p. D3; December 21, 1978.

40. Farnsworth, Clyde H. "U.S. Conceding Inflation in '79 Will Exceed 7%." New York Times. pp. A1, D14; December 20, 1978.

41. Silk, Leonard. "Economic Scene: Can U.S. Cope with Oil Rise?" New York Times. p. 2; December 20, 1978.

42. Samuelson, Robert J. "The Turning Point." National Journal. vol. 10 (no. 45): p. 1829; November 11, 1978.

43. Amuzegar, Jahangir, "OPEC and the Dollar Dilemma." Foreign Affairs. vol. 56 (no. 4): pp. 740-750; July 1978.

44. Moran, Thomas H. "Why Oil Prices Go Up: The Future: OPEC Wants Them." Foreign Policy. no. 25: pp. 58-77; Winter 1976/77.

45. Lawrence, Robert Z. "An Analysis of the 1977 U.S. Trade Deficit," Brookings Occasional Papers, 1978.

46. Church, Frank. The Impotence of Oil Companies." Foreign Policy. no. 27: pp. 27-51; Summer 1977.

47. Chandler, Geoffrey. "The Innocence of Oil Companies." Foreign Policy. no. 27: pp. 52-70; Summer 1977.

48. Roper Reports 78-10 Section D.

49. For example, see: "Some Reasons to Worry." Time. p. 39; January 16, 1978.

50. See: Hayes, Dennis. Rays of Hope. New York: Norton; 1977.

51. "U.S. Mandatory Curb on Oil, Gasoline Use Is Possible by April Due to Strike in Iran." Wall Street Journal, p. 2; February 1, 1979.

52. Halloran, Richard. "Oil Curb Ruling Set for April 1: Iran Cutoff Cited by Schlesinger." New York Times. pp. D1, D2; February 1, 1979.

53. Berry, John M. "Mandatory Fuel Conservation Urged: Iran Impact Seen Limited." Washington Post. pp. A1, A18; February 16, 1979.

54. Halloran, Richard. "Iranians Said to Hint Oil Resumption in '79." New York Times. p. D16; February 15, 1979.

55. Smith, J.P. "Mandatory Fuel Conservation Urged: Schlesinger Spurs Debate." Washington Post, pp. A1, A18; February 16, 1979.

56. Halloran, Richard. "Schlesinger Issues Renewed Warning on Iran's Oil Flow." New York Times. pp. A1, D2; February 14, 1979.

57. Andelman, David A. "East Bloc Seeks New Oil Sources: Russians Unable to Help Much in Iranian Cutoff." New York Times. pp. D1, 04; February 20, 1979.

58. Revzin, Philip. "Western Europe Frets About Iranian Oil Cutoff But Shows No Panic." Wall Street Journal. pp. 1, 35; February 20, 1979.

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