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ABSORPTIVE CAPACITY, THE DEMAND FOR REVENUE, AND THE SUPPLY OF PETROLEUM

*Salah El Serafy**

Misconceptions about Production

With growing attention focused on the issue of absorptive capacity, there is a need to examine the "production" policies of the petroleum-exporting countries from their own perspective, under the usual assumptions of rational economic behavior. Much concern, understandably, has been expressed on behalf of the petroleum buyers and importers: over their current accounts deficits, the depressive effect on their economies of their worsened terms of trade, the inflationary impact of energy prices on their prices, and the various related problems bearing on recycling the financial surpluses, the plight of individual poorer countries, the burden of international debt, and similar issues. The supply side of the petroleum market, in my view, has remained underanalyzed or, worse, misrepresented and misunderstood, having been considered mainly through demand-side spectacles.

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The view seems too uncritically held that a small group of nations, members of the Organization of the Petroleum Exporting Countries (OPEC), has clubbed together to form a powerful cartel to exploit the rest of the world, meeting periodically in order to tighten the screw, raising prices all the time. Consistent with this view is a set of misconceptions, enjoying a variable range of popularity, to the effect that petroleum is plentiful and is being artificially monopolized; that "production" is being maintained below capacity to "produce"; that the price charged for petroleum is higher than its marginal cost of production; and that the petroleum exporters are undeservedly rich countries that should do more to solve the problems they have created. The persistence of such misconceptions delays adjustment, misdirects policies and enhances conflict rather than fostering interdependence between sellers and buyers, whereas oil-producer cooperation should be promoted for the benefit of world prosperity. Moreover, there are special problems of this petroleum-exporter group of fundamentally poor and developing countries that are liquidating a nonrenewable resource and are attempting to build up alternative sources of income in conditions of enormous difficulty, albeit with the advantage of temporarily abundant finance; these problems should engage the attention and professional interest of all who claim that their concern is the economic and social development of the less-developed world.

It should now be clear, at least to the professionals, that: petroleum cannot be produced but is merely extracted; its extraction cost cannot be treated as if it were the same as production cost; petroleum price should contain a scarcity rent, derived from the price of substitutes, and this price should increase over time as its scarcity increases; "production" capacity has no meaning as usually defined in terms of the transient facilities that happen to be in place, since it is perfectly variable downward, and to a large extent also upward, depending on the owner's decision on the rate at which his petroleum reserves should be liquidated; the surpluses generated in the balance of payments of these countries are not current account surpluses; and the receipts from petroleum sales are well in excess of the petroleum income of these countries.¹ Further attention will be directed toward some of these issues here.

¹This author has touched on some of these issues previously, e.g., "The Oil Price Revolution of 1973-1974," in *OPEC: Twenty Years and Beyond*; the Arabic version of that article appeared in the bulletin of the Organization of the Arab Petroleum Exporting Countries, *Oil and Arab Cooperation*, vol. 5 no. 2 (1979). The English version of that study was reissued in the World Bank Reprint Services as no. 119.

Absorptive Capacity: A Definition

Discussion of the absorptive capacity of the petroleum exporters appears to gain popularity *pari passu* with the size of their financial surpluses. When these surpluses gradually receded in the latter half of the 1970s, so did interest in discussing absorptive capacity. In the wake of the Iranian revolution and the new wave of price explosions to which it gave rise in 1979 and early 1980, the subject is being revived as the financial surpluses have emerged once more.

This popular view of absorptive capacity has more to do with absorption than with absorptive capacity. According to this view, if a petroleum-exporting country shows no surplus in its external balance, its absorptive capacity is adequate. Better still, if a current deficit is realized, the nation's absorptive capacity is in excess of its earning ability and there is a presumption that all is well with its absorptive capacity. In this sense, absorptive capacity is called into question only if surpluses develop. And we discuss absorptive capacity in order to see if it can be raised so that the surpluses are reduced or eliminated. Thus, the only countries whose absorptive capacity appears to attract attention is that coterie of so-called capital surplus states within OPEC, essentially Saudi Arabia, Kuwait, the United Arab Emirates, Libya, and Qatar. The others, it may be argued, sell their petroleum because they need its proceeds to finance clearly defined objectives that are running ahead of their ability to generate revenue.

A working definition of absorptive capacity in this sense is the ability of the country concerned to dispose of its petroleum earnings so as to preclude the emergence of any surplus. Here there is no probing of the level of the earnings and whether they could be reduced, and no questions are raised about how indiscriminate the spending. The definition avoids all consideration of the utility — to the petroleum exporters — of the various things they can buy with their revenue. It abstracts from the problem of optimal allocation of expenditures between capital formation and consumption. It ignores the productivity of domestic investment. It avoids considerations of optimal extraction rates either to maximize short-term revenue or long-term returns. It focuses only on a practical aspect of the problem, namely, whether or not imports by these countries can be expanded until the financial surplus is eliminated.

Despite the conceptual poverty of this approach, it can be rationalized, for it is consistent with the set of popular misconceptions about the petroleum market enumerated above. In this view, the oil earnings of the sellers are at a maximum anyway since the principal "producers" continue to set a monopoly price for it. With no foreseeable substitutes developing, short of breaking the "cartel" to depress prices and eliminate the surplus, the best interests of the petroleum buyers seem to lie in inducing the ex-

porters to spend as much as possible of their earnings on imports. In this way the oil exporters would help redress the imbalances in external payments they created in the first place and restore to the global income stream the purchasing power they had withdrawn from it through their monopoly power. Consistent with this view also lies the aversion of many deficit countries to the conversion of financial deposits into foreign ownership of domestic stock and real estate which would lay claim to future income. In other words, the buyers of petroleum would prefer that equilibrium in international payments were restored on current rather than on capital account.

Taking absorption to mean expenditure in this way and given their petroleum earnings, how can the oil exporters with financial surpluses increase their expenditure? They obviously can increase their consumption, domestic investment, and foreign aid. Let us take these in turn.

Consumption, in the normal sense, traditionally is considered in economic theory as being fairly inelastic to income, especially at the high levels of "income" enjoyed by the countries with financial surpluses. "Imprudent" and "conspicuous" consumption, on the other hand, knows no bounds. In practice, its manifestations have been great and publicized as part of the new style of life to which some of the nationals of the surplus nations have become accustomed. Yet another category of consumption, of infinitely greater size and absorption potential, is public expenditure on defense. This also has been constantly creeping into the utility functions of the same countries, claiming increasing quantities of capital and scarce labor resources. With their newly acquired affluence the defense requirements of the petroleum states truly may have risen. But this is an area where fear and insecurity can translate quickly, and to a certain extent rationally, into very high levels of expenditure. Heightened expenditure on defense, though good for absorption, may ultimately jeopardize the petroleum resources themselves; it would be shortsighted, therefore, for the petroleum-importing countries to think of greater expenditure on defense by the oil-exporting nations (though quite efficacious in eliminating the surpluses) as an unqualifiedly desirable objective.

As for domestic capital formation, it is perhaps the one item of expenditure which lends itself most easily to evaluation on the basis of rational criteria. Before it is undertaken, every investment (in the normal course of events) should be subjected to comparative analysis in terms of the opportunity cost of capital and in juxtaposition with other investments. But such criteria can be tempered in practice by considerations of autarky or national security and also of pride to promote one's country as an industrial power. For the petroleum-exporting nations with financial surpluses the lowering of investment criteria in this way has been most noticeable in expenditure on infrastructure, which has often been pushed far beyond what

is necessary to support economic activity. But it has been evident as well in the pursuit of uneconomic ventures in agriculture and industry.

Foreign aid, in the sense of unrequited donations and grant elements contained in concessionary lending, is inherently a worthy cause, and expenditure on this could expand and provide a convenient outlet for the petroleum-generated financial surpluses. Moreover, by redressing the harm done through higher oil prices to the economies of the aid recipients, economic assistance would restore these countries' ability to pursue economic growth and would promote their demand for the exports of the trading nations, whether developing or industrialized. From this aspect, the nations with financial surpluses, though already providing in relation to their "incomes" more than ten times the amount of aid given by the industrialized countries,² could and should, it is argued, give still more, as they seem to be both rich and liquid. This will be examined in greater detail later in this article.

Expanding Absorptive Capacity: Why and How?

The above portrayal of the situation of petroleum-exporting countries that generate financial surpluses, including the desirability to promote their absorptive capacity, was undertaken almost entirely from the perspective of the rest of the world and not from their own point of view. Emphasis was placed primarily on the elimination of their surpluses and not on the rational management of their scarce resources in pursuit of social and economic development. It may be helpful to apply a better definition of the concept of absorptive capacity in the consideration of these issues.

Properly defined, the absorptive capacity of an economy relates to its ability to absorb capital productively. The concept has been used in development literature to highlight the constraints imposed on development by factors other than capital. Even if funds for investment were available, lack of complementary resources, local skills, manpower, work habits, entrepreneurship, or markets could depress the returns to investment and inhibit capital formation. This in turn could stunt income growth and the promotion of imports. If we seek the expansion of imports, we must therefore attempt to remove those constraints on development usually summed up under the umbrella of a limited absorptive capacity. In their different ways the petroleum-exporting economies have been striving to

²According to the Development Assistance Committee of the Organization for Economic Cooperation and Development (OECD). OECD, *Development Co-operation* (Paris: OECD, November 1979), in particular, tables VI-II p. 76, and tables G1 and G2, p. 269.

develop, and if they make progress along this path their absorptive capacity will expand and their imports grow. Expanding absorptive capacity in this sense, however, is a complex and time-consuming process whose impact on eliminating the surplus must be expected to be smaller and slower than increasing expenditure on consumption or foreign aid — hence, the dominance in this context of the popular version of absorptive capacity over this analytically more acceptable one.

Yet once we begin to focus on the productivity of domestic capital formation as a legitimate concern of the petroleum-exporting countries, we lose credibility if we do not apply the same economic calculus to the whole gamut of decisions taken by these states. Clearly the elimination of their petroleum-generated financial surpluses through indiscriminate imports and foreign aid may not be in their best interest. Equally, we would be remiss if we should exclude from economic scrutiny their major decisions on the quantity of petroleum they sell and the price they sell it at. In other words, we should attempt to link, under assumptions of rationality, their demand for the various goods and services they purchase (in exchange for the revenue from their petroleum sales) with the supply of petroleum itself, treating these nations as we treat others in economic analysis as optimizers, pursuing their legitimate self-interest.

The members of OPEC are all less-developed countries which have found themselves in peculiar and difficult circumstances. The petroleum resources in their possession are limited and nonrenewable. These nations cannot produce petroleum; they can only extract it from the ground. If they extract more today, they have less to extract tomorrow. How much should they extract and sell today? Before addressing this question two fundamental implications of this last point should be stressed. Once we realize that petroleum is not produced, we cannot be justified in reckoning as income the value derived from its sale. Such a value is the product of selling an asset. Thus, if its owner decided to consume it, he would be disinvesting. Certainly he would not be able to maintain his assets intact if he did so, and his ability to continue to live in the same style would be impaired.³

It is conceptually wrong to inflate the petroleum-exporting countries' incomes by the value of assets that are diminishing through sale. Equally it is wrong to consider the proceeds from oil exports as providing surpluses on current account in the balance of payments of the petroleum exporters, though it is perfectly correct to consider the counterpart import bills as contributing to the current account deficits of the importers. To the oil exporters the sale of petroleum represents an irrevocable act of liquidating an asset. Considering it otherwise moves one back into the set of inadequate

³See appendix A.

perceptions with which this article began and which inevitably distorts one's understanding of the rational behavior of the petroleum exporters. One could term as "poor" then the major oil-exporting states which, while having financial surpluses today, remain overwhelmingly dependent on the exploitation of a diminishing and nonrenewable asset.

Once this premise is accepted, it follows that these poor countries probably cannot afford to spend so much on consumption or to approach domestic capital investment with anything but the strictest economic criteria. The idea that they should be attaching priority to the interest of others over their own interests, providing assistance to countries that are more prosperous than they, appear unfair and indefensible. We should not expect the poor to liquidate their assets and subsidize the rich, even if the latter appear to be genuinely suffering from liquidity problems.⁴ As they draw their valuable and diminishing resource out of the ground, they should be considering the return they will be earning on turning this asset into other forms of wealth. And they would be foolish if they accepted lower returns on the new investments than they would earn by leaving their petroleum under the ground where it would appreciate as its scarcity increases over time. Looking back on the course of petroleum prices since 1973, few investments undertaken anywhere during this period would be able to match, in terms of yield, the solid investment in petroleum left undisturbed in the ground.⁵ Certainly domestic investments in the petroleum-exporting countries themselves, owing to the limitation of absorptive capacity, could not approach this level of yield.

Factors in Output Decisions

How much oil should the nations with financial surpluses extract and sell if they were focusing on their own self-interest? We can expect them to sell some petroleum in order to provide for their consumption needs. Considering the argument, advanced above, as to their relative poverty such needs should be quite modest. But once these needs have been attained, they

⁴In 1977, the last year for which complete figures were available to the author, the "income" of all the members of OPEC, gross of any allowance for the depletion of petroleum, was in the neighborhood of \$320 billion, with a per capita "income" level of just over \$1,000 — about half the world average. See *The World Bank Atlas, 1979* (Washington, D.C.: The World Bank, 1979), which, however, contains no estimate for Iran. Gross national product data for Iran were taken from the International Monetary Fund, *International Financial Statistics*.

⁵A barrel of oil worth \$3 in 1973 left in the ground for seven years to be sold at \$30 in 1980 indicates a yield on this investment of 39 percent per annum in nominal terms and about 30 percent in real terms.

should be comparing carefully between their expectations that petroleum prices would continue to rise in the foreseeable future and the yield they can realize on alternative investments. As maximizers, they should not show bias for domestic investment over lending abroad. However, there should be no sales beyond those necessary to provide for consumption, unless there existed a clear yield advantage in doing so. If we consider that such a clear yield advantage is not present, then it is inevitable to conclude that the oil exporters are selling too much petroleum.⁶

The conclusion that the sellers of petroleum are selling too much for their own good can be reinforced from another direction. One can refer to the structure of the oil market and whether OPEC is in fact a maximizing monopoly. To this author, there is little doubt that the present price of oil, high as it is, is not a monopoly price.

The argument is clearly false that the price of oil would be equal to its marginal cost of production if the market were purely competitive. If we accept the notion that petroleum cannot be produced, then it is clearly untenable to expect price to equal its cost of extraction. Leaving extraction costs aside, we can rest assured that if OPEC charged a monopoly price, it would choose one on its long-term sales curve that maximized total revenue to the group. At this price, the price elasticity of demand would, by definition, be equal to -1. Below it, the elasticity would be numerically smaller and the quantity sold greater than the monopoly quantity. Above it, the elasticity would be numerically higher and the quantity smaller. What has been amply demonstrated is that the long-term elasticity of demand for OPEC's oil is numerically well below unity.⁷ It follows therefore that the current OPEC price is lower and the quantity sold greater than the price/quantity combination that would maximize total revenue. If OPEC, acting as the monopolist it is supposed to be, should reduce its sales, not only would it have more petroleum to sell in future, but it would obtain greater revenue now.⁸

⁶They should extract less oil still if they were to optimize their total receipts from oil and associated gas.

⁷See, for example, United States, Energy Information Administration, *Annual Report to Congress*, vol. 3 (Washington, D.C.: Government Printing Office, 1979), p. 32, where the 1985 "medium- to long-term" price elasticity for OPEC exports is given as -0.78. Both this source and Merih Celasun and Frank Pinto, "Energy Prospects in OECD Countries and Possible Demand for OPEC Exports to 1980," World Bank Staff Working Paper no. 221, September 1975, show an elasticity of petroleum demand by the OECD of -0.35. From this estimate an elasticity of demand for OPEC exports numerically below -0.7 can be estimated (see appendix B).

⁸In an article in the *Lloyds Bank Review* (London), July 1980, Lord Balogh, former Minister of State for Energy of Great Britain, suggested that OPEC's monopoly price might be in the neighborhood of \$90-\$100 a barrel, but that OPEC is perhaps restrained by political considerations from charging the full monopoly price.

Not only is OPEC capable of increasing its total revenue by a reduction of sales, but it is possible that certain individual members, acting separately, could conceivably increase their revenues by reducing sales. This derives from the small magnitudes of the market elasticities and can be proved, using the formula in appendix B, if we assume backward-rising supply curves, i.e., negative elasticities of supply.

Attitudes and Policies Toward OPEC

The gist of the above is that we should appreciate the fact that OPEC members — both individually and as a group — though they appear periodically to fight for higher prices, do in fact extract and sell more petroleum and charge lower prices than would maximize their revenues, generating more revenues than they can profitably invest either in their economies (limited as they are by absorptive capacity) or in the hitherto largely unreceptive world outside. They continue to do so partly out of their perceived responsibility to the world at large, and partly, perhaps, to mollify forces that may otherwise become hostile. Until substitutes have been developed for petroleum OPEC states are willing to continue to supply greater quantities than is consistent with maximum revenue, and they are even eager to finance energy development elsewhere. In return for this, the world should treat them as the developing countries they are, provide them with assistance to develop their economies, and above all recycle their surpluses into good investments everywhere. Such surpluses should be viewed as valuable savings capable of being channeled for productive investment, not as a manifestation of disequilibrium to be dissipated through wasteful expenditure. Understanding and sympathy are necessary for the recycling problems of the nations with financial surpluses as they could always eliminate the surplus by a sufficient reduction of petroleum sales. The industrialized countries themselves should be more hospitable to the investment of OPEC surpluses within their economies (which can benefit greatly from increased investment) and should help in devising mechanisms for a large-scale redirection of the petroleum surpluses to the less-developed world through both existing and new international channels. These funds should be regarded primarily as investments for the petroleum nations, intended to generate income for them after their petroleum reserves had been depleted.

For the atmosphere to improve so that cooperation can prevail rather than conflict, it would be useful to stop treating oil prices as if they were the beginning and the end of all the world's economic problems and to cease to view the difficulties of the developing world (whose imports of food and manufactures are more than four times their energy imports) as stemming largely from the policies of OPEC. Several developing countries outside OPEC are net petroleum exporters rather than importers. As a

group the developing nations vary greatly among themselves in terms of their dependency on imported petroleum; they vary greatly in terms of the benefits they derive from the petroleum boom either through workers' remittances or increased exports. Higher prices for imported manufactures and services such as shipping and banking have been crippling to their economies; so has been the mounting burden of their foreign debt, overwhelmingly owed to the industrialized countries. As Gottfried Haberler has warned, "oil related deficits and nonoil deficits, petrodollars, and other dollars are hopelessly intermingled..." and "even if they could be separated statistically there is no good reason why they should be treated differently."⁹ If some very poor countries need special help, they should be so helped, with funds from OPEC if need be.

But there is no rational economic or "ethical" reason why such aid or charity should be tied to the oil price rise. A country that has been hit by the rise of the oil price is not more deserving than another one that received a blow from high food prices, a string of crop failures, or some other calamity.¹⁰

Without wishing to underestimate the damage inflicted by higher energy prices on the economies of many a developing nation, it can be argued that a more general cause of the deterioration of the developing countries' terms of trade is the rise of prices of manufactures and services imported by them from the industrialized states that have tended to inflate rather than face the major structural adjustments necessary for coping with the effects of higher energy prices. But to emphasize the price of manufactures in this way would earn the strictures of Professor Haberler on the same grounds as singling out high oil prices as the major cause of the world economic ills. A much more constructive approach is to look for areas of potential cooperation between the nations with financial surpluses and the industrialized market economies, for through such cooperation much benefit to the world would result.

Recycling the surplus is one area for such cooperation. Once it is acknowledged that these surpluses are created (at least partly) for the benefit of the oil consumers, the responsibility for recycling ceases to be that of the oil-exporting countries alone. If these OPEC states are to be induced to continue to convert their petroleum into funds, they should be assisted in finding productive outlets for investing these funds and given assurances that their investments will not be frozen or appropriated.

Since the developing world will remain hungry for investment in the foreseeable future, and since the commercial banks in Europe and America

⁹Gottfried Haberler, "Oil, Inflation, Recession, and the International Monetary System," *Journal of Energy and Development*, spring 1976, p. 189.

¹⁰Ibid.

understandably appear apprehensive about the creditworthiness of many of their borrowers in view of the rapid rise of their foreign indebtedness; the great international development institutions, particularly the International Monetary Fund and the World Bank, should take up the task and foster new facilities if need be. Already the World Bank has announced its plans for a new energy affiliate that would lend for the development of energy sources in the less-developed countries on a large scale.¹¹ It is significant that the petroleum-surplus countries themselves appear to regard this as a worthy cause. (What monopolists, we might ask, would encourage the development of substitutes for their product?) But there is room for more affiliates as well as new institutions to recycle annually at least \$50 billion a year in addition to the current lending by the existing institutions. The countries with financial surpluses should be induced to associate themselves more with the existing organizations, as, for example, by giving them a greater voice in institutional councils. The returns that can be offered to these nations as lenders of funds (though they are likely to be lower than what they would expect to earn if they did not extract the petroleum) should represent for them yields on safe investments, immune from nationalization, confiscation, or freezing by host countries, beside being made available on favorable conditions and in association with technical advice to the developing countries with which they sympathize and have much in common.

Coming back to absorptive capacity, any suggestion that the so-called capital-surplus countries should be encouraged to dissipate their surplus through indiscriminate spending for the sake of the world's financial balance should be dismissed as a waste of resources. As argued earlier, the surpluses can be eliminated at the source by adjusting down the rates of petroleum extraction. Financial balance can be achieved with minimal waste if it is addressed directly as a problem of financial intermediation. It would be helpful to refrain from trying to influence the expenditure preferences of the countries with financial surpluses in a wasteful direction. In as much as returns on investment in their domestic economies are depressed by a low absorptive capacity, they deserve to be aided with advice to expand this capacity and raise returns to levels comparable with those offered to them on good investment abroad. Nevertheless, such domestic capacity is likely to remain low. The OPEC states that have financial surpluses should be encouraged to look as well upon the regions in which they exist and the whole of the developing world as providing the investment outlets so desperately needed to provide for the day when their petroleum resources run out.

¹¹The notion of an energy affiliate has since met with opposition, but the Bank is currently lending actively for energy development.

Appendix A

HOW MUCH OF PETROLEUM RECEIPTS CAN BE
RECKONED TO INCOME?

Present practice is to treat the value of petroleum sales accruing to the oil-exporting countries (after small deductions for cost of inputs that do not directly generate value added) as if they were all income. I have maintained in this article that this practice is conceptually wrong and that it results in the overestimation of the income of these nations. Such an income overestimation has implications of the gravest consequence.

In a straightforward sense the petroleum reserves available to an economy at the beginning of every year represent a stock of capital which, by the end of the year, is diminished precisely by the quantity extracted from it during the year. Receipts from petroleum sales reflect the liquidation of this quantity of stock and do not represent creation of value added. To treat such receipts as income, capable of being allocated to consumption, is therefore wrong, since capital would be left diminished. The acid test of income, both to accountants and to economists, is whether or not it would leave capital intact were it devoted entirely to consumption.¹

Accountants in particular tend to be on their guard, eliminating all traces of capital (including used-up inventories) which may have contaminated receipts. In certifying a certain amount out of these receipts as income, they give their sanction to the earners to dispose of this amount in any way desired. When in doubt, they would rather err on the side of caution by underestimating rather than overestimating income in order to ensure that capital be left intact.

When a nonrenewable resource is progressively diminished as it is sold, it would be imprudent on the part of its owners to regard their sales receipts as income available for consumption. As Sir John Hicks has put it,

If a person's receipts are derived from the exploitation of a wasting asset, liable to give out at some future date, we should say that his receipts are in excess of his income....²

Is there a practical way to arrive at an estimate of income out of the receipts from the sale of a wasting asset like petroleum? Professor Hicks provides a clue for such an estimate in stating that the owner of a wasting asset, if he is to consume no more than his income, must relend some part of his receipts in order for the interest on it to make up for the expected failure of receipts from his wasting asset in the future; also that it should be possible to convert any stream of expected receipts into another "standard" or income stream having the same capitalized value as the first stream.³

Out of a time series of an expected annual petroleum receipts R which, on account of depletable, is expected to come to an end in a future year n , the owner should consider

¹Cf. Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations*, Cannan ed (New York: Modern Library, 1937), book 2, chapter 2, p. 271, and J. R. Hicks, *Value and Capital*, 2nd ed. (Oxford: Oxford University Press, 1946), chapter 14.

²J.R. Hicks, op. cit., p. 187.

³Ibid., pp. 187 and 184.

that his income is only X (where $X < R$), such that if he were to relend $R - X$ in each year he would build up a stock of investments which would yield him the same annual income X after his wasting asset had become extinct. In this way he could withdraw X annually from his petroleum receipts, devoting this to consumption if he so wished, in the expectation that he could go on relying on the same income even after his petroleum had been exhausted.

In order to determine X out of R (or X/R , i.e., the ratio of petroleum receipts that can be considered as income), we need to convert the finite series of Rs into a perpetual series of Xs. To do so, and following the suggestion of Hicks, we should find the capitalized value of the Rs and equate this with the capitalized value of the Xs. Clearly both the life expectancy of the petroleum resources and the interest rate used for the capitalization affect the outcome.

At an interest rate r, the capitalized value of a constant and finite stream of receipts R that has a life expectancy of n years is given by the quantity:

$$\sum_0^n R^* = \frac{R \left[1 - \frac{1}{(1+r)^{n+1}} \right]}{1 - \frac{1}{1+r}} \dots \dots \dots \tag{1}$$

and the capitalized value of a constant and perpetual stream of income X has a value of:

$$\sum_0^\infty X^* = \frac{X}{1 - \frac{1}{1+r}} \dots \dots \dots \tag{2}$$

If we set $\sum_0^n R^* = \sum_0^\infty X^*$ to equate the two capitalized values, and multiplying by the denominator in equations (1) and (2), we get

$$X = R \left[1 - \frac{1}{(1+r)^{n+1}} \right] \dots \dots \dots \tag{3}$$

$$\text{and } X/R = 1 - \frac{1}{(1+r)^{n+1}} \dots \dots \dots \tag{4}$$

Using equation (4) we can calculate the proportion of annual receipts to be reckoned to income, depending on the life expectancy of the petroleum reserves and the interest rate. Thus, X/R will be higher the longer the life expectancy of the petroleum reserves and the higher the interest rate and conversely will be lower the shorter the life expectancy of the petroleum reserves and the lower the interest rate. The results are given in table A.1 which shows this proportion at four alternative rates of interest and four lengths of life expectancy.⁴

It should be emphasized that the streams of receipts, of income envisaged here (as well as

⁴The above formulation is based on the assumption that payments accrue at the beginning of each period. If, alternatively, payments accrue at the end of each period, X/R becomes $1 - \frac{1}{(1+r)^n}$ which, however, should yield estimates not very deviant from those yielded by equation (4).

Table A.1

Proportion of Receipts from Oil Sales
that should be Reckoned to Income

Life Expectancy of Oil Reserves (years)	Real Interest Rate (% per annum)			
	1	2	5	10
15	.15	.27	.52	.78
20	.19	.34	.62	.86
30	.27	.46	.77	.95
40	.34	.56	.86	.98
50	.40	.64	.91	.99

the interest rates) have to be expressed in real terms in order for the central concept of maintaining future real consumption (so necessary for the definition of income) to be ensured. In the above calculations an implicit assumption is that the terms of trade between oil and consumption goods would not alter, but it would be easy to adapt the same approach to handle any projected change in these terms of trade.⁵

From the first row of the table A.1 it can be seen that countries with small reserves in relation to actual extraction rates, such as Algeria (with a life expectancy for its oil of about 15 years), have to consider only a small part of their receipts as income, in contrast to more fortunate states such as Saudi Arabia or the United Arab Emirates, (with roughly 50 years expectancy for their oil) that can reckon to income a much higher proportion of their oil receipts. The same country, however, if it is able to invest its financial surplus at high interest rates, can increase the proportion of income to receipts (moving in the table from the first column towards the last). If the interest rate earned on investments is a positive 1 percent per annum in real terms (a high enough level, considering the negative returns on financial investments earned by many petroleum exporters), we can read from the first column in the table that Algeria's income would be only 15 percent of its receipts, Saudi Arabia's 40 percent and OPEC's on average (with 38 years life expectancy) about one-third.⁶

The taxation laws of many countries, it should be added, exempt from income tax a

⁵If the terms of trade between oil and consumption goods improve in favor of the former during, say, the next 10 years and worsens afterwards, the effect on X/R may be ignored, especially where life expectancy is long. The greatest impact of such a change would be on the countries with the nearest horizon, but even then, a 2 percent per annum improvement in petroleum prices would raise the Algerian ratio only moderately.

⁶The life expectancy for oil reserves used here refers to 1978, as given by Bijan Mossavar-Rahmani, "Oil, Turmoil, and OPEC Policy Choices," in *New Policy Imperatives for Energy Producers*, ed. Ragaei El Mallakh and Dorothea H. El Mallakh (Boulder, Colorado: International Research Center for Energy and Economic Development, 1980).

substantial part of revenue from the sale of oil (and other minerals) in recognition of the fact that such revenues are not wholly income.⁷

The above should suffice to support my proposition that reckoning all petroleum receipts (accruing to the oil-exporting countries) to income exaggerates the level of income imputed to these countries, most of which remain poor and underdeveloped. In parallel, their external surpluses should not be treated as if they were surpluses on current account in their balances of payments, having the same implications as surpluses emanating from current production.⁸

⁷The United States tax laws, beginning in 1925, fixed as a depletion allowance — exempt from income tax — 27.5 percent of the gross receipts from oil extraction, later (in the 1960s) reduced to 22 percent, subject to the proviso that this should not exceed 50 percent of the difference between cost and receipts in any one year.

⁸Gottfried Haberler has expressed doubt about the propriety of treating as surpluses OPEC's excess receipts from petroleum over expenditure.

"Nor need I go into the important question whether in a deeper sense the word 'surplus' is not inappropriate, for the reason that these surpluses merely reflect the depletion of an exhaustible resource — of oil in the ground — and do not represent an addition to real wealth" (Gottfried Haberler, "Oil, Inflation, Recession, and the International Monetary System," *Journal of Energy and Development*, spring 1976, p. 184, note 12).

Appendix B

IS OPEC CHARGING LESS THAN MONOPOLY PRICES?

A monopolist seeks to maximize his profits by charging a price at which his marginal cost equals his marginal revenue. If he has no marginal cost, the monopoly price would be at a point (on the industry demand curve facing him) where the price elasticity of demand is minus one and marginal revenue is zero. Such would be the price expected to be charged by a petroleum monopolist if he were to regard his extraction costs as negligible. However, if his extraction costs are positive, the monopoly price will be associated with a price elasticity of demand numerically greater than unity, where marginal revenue is positive. The price elasticity of demand corresponding to a monopoly price for a good that commands scarcity rent would be higher still, since that price would be higher (and the quantity lower) than in the situation just described, and marginal revenue would be in excess of marginal cost. In all this we should have in mind not the short run but the long-run equilibrium of the monopolist, for it is well known that a monopolist may choose a short-run market strategy that yields less than maximum profits in pursuit of a "quiet life,"¹ safe from intrusion by governments or potential rivals.

¹"The best of all monopoly profits is a quiet life." J.R. Hicks, "Annual Survey of Economic Theory: The Theory of Monopoly," *Econometrica*, vol. 3 (1935), pp. 1-20, reprinted in American Economic Association, *Readings in Price Theory* (London: George Allen and Unwin, 1953), p. 369.

If it can be shown that the medium- to long-term price elasticity of world demand for petroleum exports by OPEC is numerically smaller than unity, it will be inescapable to conclude that OPEC is charging less than long-term monopoly prices. The interpretation of such behavior in terms of noneconomic factors would, of course, still be open to question.

Here I take the (medium-/long-run) elasticity of demand for world petroleum to equal that of demand by the OECD, i.e., -0.35. Considering that the share of OPEC exports in the total sales of world crude oil and products is about 0.8, and assuming that non-OPEC supply elasticity is +0.5, we can derive the elasticity of demand for OPEC exports according to the formula:²

$$\eta_{\text{OPEC}} = \frac{\eta_w - e(1 - k)}{k}$$

- where η_{OPEC} = the price elasticity of demand for OPEC petroleum exports;
- η_w = the price elasticity of demand for world petroleum exports;
- e = the elasticity of supply of petroleum from non-OPEC sources; and
- k = the OPEC market share (the share of OPEC exports in world exports of petroleum).

Therefore:

$$\begin{aligned} \eta_{\text{OPEC}} &= \frac{-0.35 - 0.5(0.2)}{0.8} \\ &= \frac{-0.45}{0.8} \\ &= -0.56. \end{aligned}$$

Even if the elasticity of supply of petroleum from non-OPEC sources is assumed to be +1 (meaning that a price rise of a given percentage would bring forth an expansion of non-OPEC sales by the same percentage), this would still leave us with an elasticity of demand for OPEC petroleum of about -0.7. It seems therefore that the price being charged by OPEC is less than the price a monopolist would charge to maximize his profits.³

²This formula was derived by Salah El Serafy, "The International Cotton Market since 1930 — A Study in the Regulation of Supply" (Doctoral dissertation, Oxford University, 1957).

³Elasticity values are used here as point elasticity estimates, associated with given price levels, and do imply variations of demand and supply in reaction to considerable changes in price — a procedure which might attract criticism.

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