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DEMAND ELASTICITY OF OIL AND THE MISALLOCATION-OF-RESOURCES THEORY

One of the principal arguments among academic economists against the percentage depletion provision for mineral producers in the Federal tax statutes is that it results in the misallocation of both financial and natural resources. According to Professor Arnold Harberger, the chief proponent of this theory, the fact that the mineral producing industry, by virtue of the percentage depletion provision, is subject to a lower effective income tax rate than other industries tends to alter the allocation of resources in the economy in favor of finding and developing more mineral deposits. For the lower tax rate, says Harberger, increases the mineral industry's rate of return relative to that of other industries. Consequently, more capital is attracted into the mineral producing sector of the economy than would otherwise be the case, thereby leaving less capital for investment in the other sectors. The additional capital is employed to create greater output of mineral products which in turn leads to lower prices and higher demand for them. Thus, say the proponents of this theory, the special tax provision has an un-neutral effect in that it distorts a) the normal allocation of capital resources among the various sectors of the economy and b) the normal rate of consumption of non-renewable natural resources.

The question of whether the statutory tax reduction is passed on directly to the consumer in the form of lower minerals prices or whether it is originally kept by the producer in the form of

higher returns on his investment is irrelevant in this connection, provided we assume the minerals industry to be internally competitive, and to have reasonably free entry. If the tax reduction is immediately shifted forward to the consumer, the ensuing lower price would create a higher demand for minerals which in turn would draw additional capital into the minerals sector for exploration and development purposes. If the tax reduction is not shifted forward, the increase in the rate of return would attract additional capital which would be employed to find and develop more mineral supplies, resulting eventually in a lowering of prices.

Of course, it is also possible that some part of the special tax benefit is shifted to consumers while the balance is permanently retained by the mineral producers. But this could only occur if the resulting higher rate of return did not attract sufficient additional capital to bring the rate back to the status quo ante. Hence, any permanent increase in the rate of return, traceable to the percentage depletion allowance, would indicate that - to the extent of the increase - no direct alteration in the normal allocation of resources had occurred among the various industrial sectors of the economy.

It is the thesis of this paper that the applicability of the misallocation-of-resources theory is directly proportional to the demand elasticity of the affected product. We will attempt to demonstrate that the demand elasticity of crude oil and its derivatives is very low and that therefore the theory has only a

very limited applicability to the oil producing industry.

To understand the relationship between resource allocation and demand elasticity let us look at the abstract theoretical model of an industry with perfect competition which manufactures a product with a demand elasticity of zero. Assume now that the cost structure of that industry declined for some reason. Given the above competitive conditions, the cost savings would have to be passed on to the consumers of the industry's product. However, in the complete absence of demand elasticity the lower price would have no effect on the level of consumption. Consequently, no additional capital would be required to broaden the industry's supply base so that no re-allocation of outside capital into this industry would occur. On the other hand, the consumers of the industry's product would spend less money, in the aggregate, than before the price reduction. They would therefore have more funds available for purchases of other goods and services or for accumulating savings. Thus, indirectly, a re-allocation of funds from the industry whose cost structure has declined to other sectors of the economy would occur under the conditions supposed in this model.

How close does the oil industry approach the above model? Regarding competition, we may postulate on the basis of such indicators as concentration ratio, freedom of entry, price fluctuations, etc., that the oil industry is neither monopolistic nor oligopolistic but is reasonably competitive. This assumption is not in

contradiction with the statements on that point made by the proponents of the misallocation-of-resources theory.

The equivalent to the decrease in the cost structure in our model is, of course, the introduction of the percentage depletion provision. However, there is a difference: the decline of the cost in our model was of an autonomous nature while the percentage depletion provision represents a cost reduction "underwritten" by the rest of the community which must pay correspondingly higher taxes or do with fewer government services. The question then is what, if anything, the community receives in return for this sacrifice. In Professor Harberger's opinion the return to the community consists of making oil investment more attractive, thereby raising its level as well as that of oil exploration, production and consumption from what it would be without this tax provision. This chain of reactions obviously presupposes a fairly high degree of demand elasticity for oil.

In this author's view, the community's tax sacrifice is returned to it principally in the form of lower oil prices, unaccompanied by higher levels of oil investment, production or consumption. Such a view clearly presupposes a relatively low degree of demand elasticity.

Before proceeding with an analysis of this view, it should be pointed out that Harberger in his writings has never elaborated on the problem of demand elasticity but has apparently assumed, as a

matter of course, that oil demand is quite sensitive to oil prices. Probably a demand elasticity of unity would seem reasonable to him.

Since oil is our primary commercial energy source our analysis must begin with an inquiry into the demand elasticity of inanimate commercial energy in general. Four pertinent characteristics of energy can be distinguished in this connection:

1. commercial energy is absolutely essential in a modern society;
2. no adequate substitute of any kind exists for commercial energy;
3. commercial energy is almost always utilized by means of a special conversion equipment whose amortization, maintenance and servicing costs are usually considerably higher than the cost of the fuel to operate it; and
4. a large share of energy consumption is a direct function of uncontrollable environmental factors, such as climactic conditions and daylight span.

Thus, the consumer must have commercial energy, he cannot find a substitute for it, he has little control over the level of much of his consumption, and - from electric razors to jet planes - the cost of energy is usually far less than the cost of utilizing it*. All these factors indicate clearly that the demand for energy is largely insensitive to price fluctuations.

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* Some exceptions to this last point exist among certain high energy-consuming industries. However, by and large, energy is a relatively small item in the total cost of industrial production. A recent study by the Energy Committee of the European Common Market Commission has estimated that energy represents 9 per cent of the prime cost of manufacturing. Since energy costs in the U.S. are lower while labor costs are much higher than in Western Europe, we may assume that the average cost of energy in U.S. industries is well below 9 per cent of prime manufacturing costs.

Consequently, a moderate increase or decrease in the cost of energy - such as could be traced to the introduction or withdrawal of existing percentage depletion provisions - would not have a significant impact on the levels of demand, supply or capital investment in the energy sector of the economy.

Let us now examine the demand elasticity of oil products* within this framework. Here we must differentiate between those oil products which are not subject to inter-fuels competition and those which are. The first category, which consists primarily of fuels for automotive vehicles and aircraft, accounts for almost 50 per cent of total U.S. oil demand. These fuels display all the aforementioned characteristics affecting the level of general energy demand elasticity. Thus gasoline consumption accounts for only 20 per cent of total automobile upkeep and amortization while only 12 per cent of all private car trips among urban and suburban U.S. residents are of a social or recreational nature. Furthermore, available gasoline marketing statistics indicates that even fairly severe gasoline price changes at the pump have had no measurable impact on overall gasoline consumption. We may therefore conclude that the demand elasticity of gasoline is extremely low, a fact which has been frequently acknowledged within the oil industry**.

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* We are not concerned with the elasticity of crude oil, since crude oil as such has no utility until it is refined into its various derivatives. Thus, the crude oil market is really a function of the market for refined products.

** McDonald cites a demand elasticity quotient of 0.13 in his Brookings paper (see his footnote #139).

Now let us look at the oil products which are subject to inter-fuels competition. One approach would be to ignore these products for the purpose of our analysis by assuming - as is frequently done - that any cost increase attributable to a reduction in the existing percentage depletion allowance would be passed on entirely to the non-competitive oil products (primarily motor fuel) so that the price of the other oil products could continue to remain competitive with other energy sources. However, this would still leave open the question of whether historically the percentage depletion provision has not favored the consumption of oil over other fuels, thereby causing a misallocation of resources within the energy sector.

There is of course considerable inter-fuels competition between oil and natural gas. However, substitution between these two fuels may be discounted for our purposes, since both are subject to the same percentage depletion rate so that any change in the rate would affect both. It must be recognized that percentage depletion has a stronger impact on the end user price in the case of oil than in the case of gas. But this is immaterial, since any shift from oil to gas consumption or investment would not involve the re-allocation of resources between different sectors or industries but in most cases just between different divisions of the same company. Furthermore, any increase in the exploration for gas could be expected to bring forth additional quantities of oil, just as the reverse has been true in the past.

Oil products which compete with coal (whose tax benefits from percentage depletion are much smaller than those of the oil industry) are primarily light fuel oil, diesel oil and residual fuel oil. In the case of light fuel oil, which is used mainly for residential purposes, the inroads into coal markets are not based on cost differentials but purely on physical differences. For the household price of bituminous coal and of anthracite is still at least 60 per cent, respectively 40 per cent, below that of distillate fuel oil. Percentage depletion was therefore not a factor in the shift from coal to oil in the American heating market. Similarly, displacement of coal by diesel oil as a railroad fuel was not due to fuel cost differentials which favor coal but to the fact that diesel engines are six to seven times as efficient as steam engines and require less servicing.

The principal coal-competitive oil product is residual fuel oil. However, for at least the past three decades residual fuel oil has been considered an unprofitable by-product by U.S. refiners, to be sold at whatever cost is necessary to dispose of it. Hence, the percentage depletion provision could not have had any impact on the competitiveness of residual fuel oil. The same applies to competition between oil and water power which is limited to a small number of electric utilities burning residual fuel oil.

In summary, then, competition between petroleum and other fuels is a) quite limited and b) not based on cost differentials traceable to any difference in tax treatments. It would seem, therefore,

that the demand elasticity of the fuel-competitive oil products - provided we ignore competition between oil and gas - is no higher than that of automotive and aviation fuels*.

Having stated the argument that the demand elasticity and substitutability of all major oil products is very low and that therefore any change in the cost structure of oil has a much smaller effect on consumption than on consumer prices and expenditures for oil products, it would be useful to demonstrate this thesis quantitatively. Unfortunately, this requires a number of arbitrary, and therefore challengeable, assumptions. The demonstration is attempted here nevertheless. However, its main purpose is not to calculate accurately the economic impact of the percentage depletion provision but rather to illustrate some of the interdependences discussed in this paper.

Our calculation is based on the following assumptions:

1. The tax savings of the percentage depletion provision are shifted entirely to consumers in the form of lower prices;
2. All price savings are concentrated on motor and aviation fuels**;

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* McDonald, in his footnote #139, believes the demand elasticity of the competitive oil products to be somewhat higher than that of gasoline. This author disagrees with this view, since optional consumption for space heating, industrial, railroad and utility purposes is much smaller than for private automobile driving.

** This assumption is not unreasonable since the oil industry has traditionally concentrated most of its marketing efforts on gasoline.

3. The price elasticity of demand for motor fuels is assumed to be 0.1, following the calculation in the paper, "The Elasticity of Demand for Gasoline in the State of Washington";
4. McDonald's calculation is accepted that in case of a complete shift from percentage depletion to cost depletion crude oil prices would have to be raised by a maximum of 60¢ per barrel in order to return oil industry earnings to the status quo ante.

Assuming, then, that the cost benefit of percentage depletion to the end user equals 60¢ per barrel of crude oil, the cost benefit to motor fuel consumers would be about 3¢ per gallon or $1.26 per barrel, which is equal to roughly 10 per cent of the pump price including excise taxes. The U.S. consumer saves therefore annually about 2.3 billion dollars, nn the basis of current consumption of 1.8 billion barrels of motor and aviation fuel. At the same time, the 10 per cent price savings are assumed to induce him to consume 1 per cent more motor fuel than he would otherwise. At 30¢ per gallon this would mean an additional annual expenditure of $23 million so that his net savings on his motor fuel bill would be 2.07 billion dollars per year. This is somewhat more than the maximum of 1.75 billion dollars in additional taxes which the oil industry would have to pay annually in the absence of the percentage depletion provision (see McDonald Brookings paper, page 122).

A 1 per cent increase in gasoline demand in consequence of the percentage depletion would require an increase in crude oil production of 0.5 per cent to 1.0 per cent, depending on the ability of refiners to adjust their yield. Let us assume a midpoint of

0.75 per cent and apply it to last year's total U.S. capital expenditure of $4.35 billion by the thirty-three largest oil companies, as reported by the Chase Manhattan Bank. Thus, assuming that an 0.75 per cent increase in demand would require an equal increase in capital expenditure, the U.S. oil industry needed an additional $32.6 million last year as a consequence of the percentage depletion provision. This would be the actual amount of the "misallocation of capital" and it must be compared with the aforementioned $2.07 billion of consumer net savings which are available for investment elsewhere by virtue of the percentage depletion provision.