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A number of special tax allowances for the extraction of oil and gas have been developed over the years which constitute a considerable subsidy to the oil and gas industry. Although various "economic fairness" arguments have been raised to justify these allowances, the most forceful arguments have always been pragmatic: (1) The allowances are required in a high-risk industry to encourage the capital flow required for exploration to maintain a sufficient level of proved reserves, and (2) their elimination would cause a substantial rise in the price of fuels.[1] These arguments have a particular thrust today in a period when the consumer is experiencing oil and gas shortages and prices are rising steeply.

The major tax allowances in question are the oil and gas depletion allowance, which permits a write-off of 22 percent of the gross wellhead revenues limited to 50 percent of net revenue, and the system of expensing, which allows immediate write-off of much of the initial costs of exploration and drilling. Various methods of transfer payments can also circumvent the 50 percent of net revenue limitation.[2] The revenue loss to the government due to these various subsidies is substantial. In 1968, for example, CONSAD Research Corporation estimated that the total special tax advantages on production of crude oil totaled $2.25 billion of which $1.5 billion was attributed to the depletion allowance and $0.75 billion was attributed to expensing.[3] The result has been an overall rate of tax payment to the

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1. National Petroleum Council, Guide to NPC Report on United States Energy Outlook 21 (1972).

2. U.S. Treasury Dep't, Tax Reform Studies and Proposals, Joint Publication of the Ways and Means Committee of the House of Representatives and Committee on Finance of the U.S. Senate, 91st Cong., 1st Sess. pt. 3, at 413 (1969).

3. CONSAD Research Corporation, *The Economic Factors Affecting the Leval of Domestic Petroleum Reserves,* in Tax Reform Studies and Proposals, *supra* note 2, pt. 4, at 4.

government in the neighborhood of 3 percent for the major oil companies. This extremely low tax rate is due, in part, to foreign production, from which it is often possible to obtain tax credits on foreign payments such that foreign production is essentially untaxed by the U.S. government.

In the late 1960's there was increasing pressure from middle-income taxpayers to obtain tax relief by closing loopholes in the tax laws which allowed some individuals and corporations with large incomes to pay little in taxes. Prime targets were the oil and gas depletion allowances. Although these allowances were shared by other extractive industries, the 27.5 percent depletion allowance in oil and gas contrasted strongly with the 10 percent or less depletion allowance for most other mining industries. In the Tax Reform Act of 1969 the oil and gas depletion allowance was reduced from 27.5 to the present 22.0 percent.

During the period shortly before the enactment of the tax reform law, there was considerable scholarly discussion of the merits of the special tax treatment for oil and gas. The discussion centered on the questions whether the special tax treatment distorted the overall allocation of resources and whether it was an effective measure to insure adequate oil reserves. The general conclusion to the first question was that there was indeed economic distortion with excess capital moving into the petroleum industry. In addition to the theoretical arguments, the need for output prorationing was pointed to as an external fact indicating overcapacity. On the second question, statistical analysis indicated that lowering the price of crude oil would result in a lowering of reserves. But the effect was inelastic, i.e., less than proportionate, with a 1 percent reduction in price leading to, at most, a 0.3 percent reduction in reserves. The effect of special tax provisions on resource allocation within the petroleum industry is analyzed in the following section of this paper.

In subsequent sections, we examine the effect of the special tax treatment of the oil and gas industry in the light of new developments and broader energy policy considerations. Superficially, it might seem, as espoused by the petroleum industry, that in times of shortages even greater inducements to deplete should be made. However, our findings indicate the contrary. The economic distortion that results from oil and gas subsidies both encourages consumption and biases against less favored, nondepletable energy alternatives. It makes little sense for the federal government to extol the virtues of energy conservation and diversification while maintaining a tax policy which effectively does the opposite.

TAX POLICY AND RESOURCE ALLOCATION WITHIN THE PETROLEUM INDUSTRY

The economic literature on special tax provision for the petroleum industry has been developing over the past two decades. Harberger[4] presented the classical argument against special incentives. Tax breaks result initially in excess profits, then in a subsidized flow of capital into production, and finally in excess consumption rather than "letting the market work." Excess profits can result to the extent that the tax savings are not transferred to the consumer through lower prices or to suppliers of inputs to the petroleum industry through increased costs. Excess investment results as existing and new petroleum-producing firms expand capacity in an effort to capture a larger share of the more profitable market, thus leading to nonoptimum resource utilization. Excess consumption can occur when the tax savings to the petroleum industry result in lower prices which induce consumers to use more. In fact, a mixture of all three effects results. Many attempts have been made to determine the magnitudes of each of the effects for both percentage depletion and expensing.[5]

Two econometric analyses have been undertaken to estimate the responsiveness of petroleum exploration to price and, by implication, to tax incentives. Fisher[6] investigated the responsiveness of wildcat well drilling and discoveries to changes in petroleum prices and other factors. Shortly thereafter, Erickson improved upon Fisher's work and concluded that "the overall elasticity of supply for petroleum discoveries is +0.90."[7] A supply elasticity of 0.90 means that a 10 percent increase in price results in a 9 percent increase in the rate of

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4. Harberger. *The Taxation of Mineral Industries*, in Federal Tax Policy for Economic Growth and Stability 439 (1955) (Compendium of papers presented to the Joint Committee on the Economic Report, 84th Cong., 1st Sess. (1955)).

5. Davidson, *Public Policy Problems of the Domestic Crude Oil Industry*, 53 Am. Econ. Rev. 85 (1963); Davidson, *The Depletion Allowance Revisited*, 10 Natural Resources J. 1 (1970); Kahn, *The Depletion Allowance and Cartelization*, 54 Am. Econ. Rev. 286 (1964); Kahn, *The Combined Effects of Prorationing, the Depletion Allowance, and Import Quotas on the Cost of Producing Oil in the U.S.*, 10 Natural Resources J. 54 (1970); McDonald, *Percentage Depletion and the Allocation of Resources: The Case of Oil and Gas*, 14 Nat'l Tax J. 323 (1961); McDonald, *Distinctive Tax Treatment of Income from Oil and Gas Production*, 10 Natural Resources J. 97 (1970); Mead, *The System of Government Subsidies to the Oil Industry*, 10 Natural Resources J. 113 (1970).

6. F. Fisher, Supply and Costs in the U.S. Petroleum Industry: Two Econometric Studies 1-40 (1964).

7. E. Erickson, Economic Incentives, Industrial Structure, and the Supply of Crude Oil Discoveries in the U.S., *1946-1958-59* 40 (unpublished Ph.D. dissertation, Vanderbilt University, 1968).

discovery from wildcat drilling. It should be borne in mind, however, that the analysis investigated only wildcat drilling, i.e., exploratory drilling in unproven areas. This is only a small fraction of total exploratory drilling; furthermore, the transition from discovery to reserves through development drilling is not incorporated in the analysis. Thus, while it is tempting to argue on the basis of the 0.90 wildcat-discovery elasticity that the industry is quick to turn incentives into reserves, it is best to heed a comment by Fisher:

> This analysis has applied strictly to wildcat drilling and to total amounts of oil and gas in known fields. This is not the same as performing the more directly relevant analysis of the responses to economic incentives of other exploratory and development drilling and of known and readily available oil and gas reserves.[8]

A relevant analysis was performed by the CONSAD Research Corporation for the Office of Tax Analysis of the U.S. Treasury Department in 1968. In this analysis an inventory model was developed for the industry which related reserves (inventory) to the market price of crude oil relative to the cost of acquiring reserves and to the level of production. Depending on the functional forms and lag variables assumed, reserve relative price elasticities ranged from 0.020 to 0.173.[9] Since these are very low elasticities, the CONSAD researchers chose to use in the remainder of their analysis a conservatively high elasticity of 0.270 which was one standard deviation above their highest estimate. Based on this estimate, they conclude: "The result of elimination of percentage depletion would be a 3.1% reserve decline. The result of eliminating intangible expensing would be a 4.0% decline in reserve levels, and the results of both would be a 7.1% decline."[10] Using their mean estimate of the elasticity (0.122), the estimate of the percentage change in reserves is less than half of the above.

The CONSAD analysis also overestimates the effect of depletion and expensing on reserves by considering them as equivalent to price increases and by assuming that the demand for petroleum is perfectly inelastic. With a demand elasticity of about -1, the increase in the quantity demanded results in a change in price only half as great.

The beneficial effect of the depletion allowance on reserves is further reduced when marginal production is properly considered.

8. Fisher, *supra* note 6, at 38.

9. CONSAD Research Corporation, *supra* note 3, at 12-5. The inventory model approach used by CONSAD has methodological problems readily conceded by its authors. As this is the only econometric analysis available, we rely on their estimates as an "order of magnitude" starting point for our analysis.

10. *Id.* at 8.3-8.4.

Percentage depletion is more advantageous to firms with higher profits. This effect is demonstrated more fully in a mathematical model (see Appendix). Here we will show how this operates using natural gas as an example. In 1970 the finding rate for gas was 2×10^5 cubic feet per foot drilled, with an average drilling cost of $26 per foot, giving a drilling cost of $\$0.13/10^3$ cubic feet. At that time the price of gas was $\$0.17/10^3$ cubic feet, leaving little incentive for new drilling. Finding rates have, in fact, been decreasing sharply.[11] The depletion allowance only slightly increases the incentive for unprofitable drilling; moreover, it is an impediment to granting price increases since it increases the windfall profits that accrue to low-cost producers.

To understand in detail the dynamics of increasing reserves, attention must also be given to the distinction between extensive and intensive margins; i.e., reserves can be increased both by extending development to new fields and by intensifying recovery in already developed fields. Little distinction between these two margins has been made in the literature. On the intensive margin, approximately an additional one-fourth to one-third of the 300 billion barrels of oil remaining in already developed reservoirs could be produced using more expensive, intensive recovery techniques. The National Petroleum Council estimates that 28.5 billion barrels of oil between 1971 and 1985 will be added to reserves through secondary recovery programs costing an additional $0.25-$0.60 per barrel and tertiary programs costing an additional $1.00-$1.25 per barrel.[12] For fields that could benefit from secondary and tertiary recovery techniques, such as a large proportion of the fields with stripper wells, costs are already sufficiently high that the depletion allowance has a negligible impact on the decision to institute the advanced recovery techniques. We conclude that the depletion allowance has a minimal effect on reserves; its main effect within the industry is to favor the extensive margin over the intensive margin.

The expensing of intangible drilling and development costs reduces tax costs directly and thus leads to increased activity on the margin and consequently tends to increase reserves. The analysis of the CONSAD report shows that even in this case the effect is small. Expensing and the depletion allowance share the characteristic of favoring the extensive margin. Secondary recovery techniques and the intensive margin generally entail higher material, monitoring, and management costs and lower capital costs than the extensive margin. Even if capital were treated the same on the two margins, expensing

11. National Petroleum Council, *supra* note 1.
12. *Id.*

would increase supply from the extensive margin more than from the intensive margin due to the difference in capital intensities. But capital is treated differently on the two margins. Intangible costs are almost exclusively defined in terms of well drilling, i.e., the extensive margin. On the other hand, "equipment costs" which are depreciated over time include both the acquisition and installation costs of non-well-drilling equipment.[13] Secondary recovery capital would fall largely into the latter category. Thus, expensing favors the intensive margin both because of the increased use of capital on the extensive margin and because a smaller proportion of the capital on the intensive margin can be expensed.

The different tax treatment of the two margins has environmental and social consequences as well: increased recovery from existing fields entails few additional environmental conflicts. The area has already undergone development and subsequent environmental disruption is minimal. Extending the period of recovery can extend the useful life of pipelines and other equipment and postpone the economic decline and social disruption of dependent communities. Expansion on the extensive margin has pushed petroleum development onto the Outer Continental Shelf and to the North Slope of Alaska. These environments are being disturbed significantly for the first time, and conflicts between petroleum and other values and potential uses are occurring.

Another aspect of the internal development of the petroleum industry is the advantage given to a vertically integrated company which obtains its profits from crude production rather than refining. Kahn has pointed out that, at the 27.5 percent depletion level with product prices constant, an integrated company would increase its profits as crude prices increase if it produces at least 77 percent of its own crude.[14] With some major oil companies this is indeed the case, leading to artificial pressure to increase crude prices at the expense of refining. The net result has been a squeeze on refinery profits which has discouraged expansion of refineries. This price squeeze is, in part, responsible for the refinery shortage we are experiencing today.

In conclusion, this section notes that percentage depletion and expensing are very inefficient ways of increasing reserves as compared to alternative possibilities. Using the high (0.27) estimate of relative price reserve elasticity and treating these tax subsidies as equivalent to price increases, the cost to the federal treasury amounts to about $0.50 per barrel per year for reserves added through expensing and about $1.45 per barrel per year for reserves added from the

13. S. Porter, Petroleum Accounting Practices 118 (1965).
14. Kahn, *supra* note 5.

depletion allowance. Using the mean of the CONSAD elasticity estimates (0.122) more than doubles these costs. The increased consumption due to decreasing price very substantially increases this cost. In contrast, in an alternative method of maintaining reserves Mead and Sorenson have estimated that the true annual cost of maintaining reserves in a field such as Elk Hills is between $0.09 and $0.32 per barrel.[15] Thus, if the goal of the depletion allowance and expensing is to increase reserves, one has chosen a very uneconomic way of achieving it.[16]

TAX DISTORTIONS BETWEEN PETROLEUM AND OTHER ENERGY SOURCES

Oil and gas account for nearly 80 percent of the energy consumed in the United States today. Coal, the other major source, accounts for nearly 20 percent and also has special tax advantages similar to those for petroleum. Percentage depletion for coal is only 10 percent, but the capital-expensing provisions apparently are more advantageous for coal than for petroleum. This is so because intangible expenses are a larger fraction of total costs for coal than for petroleum.[17] Uranium accounts for a little more than 1 percent of our energy but is growing rapidly. Uranium extractors can claim up to 22 percent as percentage depletion and also benefit from expensing provisions. For both coal and uranium—as in the case of petroleum—these tax provisions result in excess capital investment, increased rents to resource owners, and greater production available to consumers at lower prices. Since about 97 percent of our energy comes from mined, nonrenewable resources subject to similar special tax advantages, distortions between these existing sources have been minimal. We must then ask the question whether 97 percent of our energy comes from depletable sources partly because of the depletion allowance and whether potential renewable sources of energy in the future will be suboptimally utilized because of the special tax provisions for nonrenewable energy resources.

The importance of developing alternative energy sources has been well established. Hubbert has estimated that we have already found approximately 70 percent of the oil we are going to find in the lower 48 states.[18] Our domestic oil production has already peaked and is declining. The estimates for reserves of natural gas are similar.

15. Mead & Sorenson, *A National Defense Petroleum Reserve Alternative to Oil Import Quotas,* 47 Land Econ. 211 (1971).

16. Federal treasury costs have been used in both cases.

17. Agria, *Special Tax Treatment of Mineral Industries,* in The Taxation of Income from Capital 77-122 (Harberger and Bailey, eds. 1969).

18. Hubbert, *Energy Resources,* in Resources and Man 157-242 (1969).

Although these estimates may be somewhat pessimistic, in part because the effect of price on supply is ignored, higher estimates only push the exhaustion of our petroleum resources a few years further into the future.

In the light of these results, it is evident that consideration should be given to exploiting our larger energy reserves and to developing the renewable energy sources. In fact, the trend has been in the opposite direction. Windmills have come and gone except in isolated rural areas. Solar power, which had been used for water heating in the southern states, has been almost entirely replaced by cheaper gas heating. Close substitutes for energy, such as insulation and building design, were also given more attention some years ago than they have been in the recent past. These declines in the use of renewable energy sources and of ecologically desirable alternatives have been due, in part, to the real cheapness of fossil fuels and to the tax advantages that the depletable energy resources enjoy.

A particularly important example of a renewable energy source is solar energy. It is in plentiful supply and has the additional advantage of having few detrimental environmental side effects. Used for space and hot water heating in the home, it causes no air pollution, does not have to be transmitted over long distances, does not have large space requirements, and is nearly thermally neutral. Unfortunately, the development of a solar energy industry faces special problems in the areas of information, uncertainty, and borrowing because of the large role played by the many small investors who must choose to install solar equipment in their homes. It would appear to be in the public interest to grant solar energy rather than petroleum special tax incentives.

A study by Tybout and Löf based on 1961 costs (abstracted in Table I) indicated that, for newly constructed dwellings, a solar and electric system was cheaper than an all-electric system in six of the eight diverse U.S. locations considered.[19] In two of the eight locations a combined oil and solar system was superior to an all-oil system. In one location a solar and gas system was possibly cheaper than an all-gas system. The relative costs of construction associated with solar equipment installation have risen steadily since this study, but recently all energy prices have increased dramatically. Thus, within the range of uncertainty created by rapidly changing conditions, the relative values of the Tybout and Löf study are reasonable today. Though solar systems are competitive in some areas of the country, they have not been adopted by homeowners because of lack

19. Tybout & Löf, *Solar House Heating*, 10 Natural Resources J. 268 (1970).

of information, uncertainty, and high interest rates on consumer loans. This situation presents an opportunity for solar system leasing companies to develop for the purpose of providing homeowners with information, performance warranties, and lower borrowing rates. Indeed, Southern California Edison, a private utility, is currently experimenting in this form of enterprise.

Under current tax laws, a solar system leasing company would have no special tax advantages. On the other hand, the special tax provisions for petroleum and natural gas represent about a 15 percent subsidy. If the low estimates of solar heat costs in Table 1 are deflated by 15 percent, combined solar-electric systems are cheaper than all-electric systems in every location; and combined solar-oil systems are superior to all-oil systems in three out of eight of the locations.

TABLE 1
Cost of Space Heat

Location	Solar Heat Low	Solar Heat High	Electricity	Oil	Gas
	dollars per 10^6 Btu				
Santa Maria, California	1.10	1.84	4.44	1.62	1.42
Albuquerque, New Mexico	1.60	2.32	4.76	2.07	0.89
Phoenix, Arizona	2.05	3.55	4.41	1.60	0.79
Omaha, Nebraska	2.45	3.16	3.27	1.32	1.05
Boston, Massachusetts	2.50	3.15	5.37	1.76	1.73
Charleston, South Carolina	2.55	4.16	4.36	1.55	0.96
Seattle-Tacoma, Washington	2.60	4.05	2.28	2.00	1.83
Miami, Florida	4.05	6.48	5.03	1.73	2.81

Source: Adapted from Table 2 in Tybout & Löf, *Solar House Heating*, 10 Natural Resources J. 268, 308 (1970).

In the same context we can also compare the cost of crude oil with the costs of more abundant fossil fuels from which oil and gas could be manfactured and that can supply a substancial part of our oil and gas needs in the near future. Rubin et al. have estimated the city-gate prices of oil and gas as converted from oil shale and coal.[20] Table 2 presents their results for those processes which are well advance in the development as of 1970. The costs are compared with oil between $3.50 and $4.50 per barrel which was a reasonable price range at that time. One sees that the prices range from 20 percent higher to almost double the cost of oil. Since much of the cost is related to conversion and is probably not depletable, the special tax

20. B. Rubin, S. Winter, W. Ramsey & G. Werth, A Rationale for Setting Priorities for New Energy Technology Research and Development 46 (University of California, Lawrence Livermore Laboratory, UCRL-51511, 1974).

TABLE 2
Los Angeles City-Gate Prices for New Supplies of Thermal Energy

Item	Mining cost	Unit cost	Conversion	Cost, including transportation
	dollars per barrel	cents per 10^6 Btu		
Conventional oil	4-5	70-85	0	70-85
Mined oil shale	0	10	70-85	80-95
	dollars per ton			
Liquified coal	2-4	10-20	60-85	84-123
Coal gasification (surface)	2-4	10-20	60-85	79-107

Source: Adapted from Table B-1 in B. Rubin, S. Winter, W. Ramsey, & G. Werth, A Rationale for Setting Priorities for New Energy Technology Research and Development, (University of California, Lawrence Laboratory, URCL-51511, 1974).

advantages favor the continued depletion of our oil and gas reserves over the development of our larger reserves, using more capital-intensive processes.[21] Although oil prices have risen sharply since then, these increases are due to reductions in foreign supply rather than to rising domestic production costs, leaving the relative competitive picture substantially unchanged.

THE EFFECT OF TAX POLICIES ON DEMAND FOR PETROLEUM

It has already been noted that one effect of the depletion allowance is that part of the reduction in industry costs has been passed on to the consumer in lower prices; coupled with a negative demand elasticity, this led to enhanced consumption of petroleum. The effect occurs together with the increased costs arising from less efficient use of resources and the increased profits accruing to the industry.

In attempting to counter the public's general opinion that the depletion allowance fosters windfall profits, the petroleum industry contends that the depletion allowance is, in fact, a subsidy to the consumer.[22] At 1970 prices of $3.00 per barrel for crude oil, they claim that the loss of the depletion allowance alone would precipitate a $0.50 per-barrel increase in crude price or an increase of 16.5 percent. This is higher than the 11 percent equivalence between the depletion allowance and increased prices, as given in the CONSAD report, and appears to assume incorrectly that nearly all the tax savings are passed on to the consumer. As shown in the foregoing

21. *Id.* at 13-37.
22. National Petroleum Council, *supra* note 1.

section on tax policy and resource allocation, only part of this total is reflected in lower prices, the rest going to increased costs or increased profits in the short run.

The supply-and-demand elasticities of crude oil are not well-known at present. Mead, [23] in a review of econometric estimates of the long-run demand for gasoline, argues that the elasticity is probably somewhat greater than -0.75. Another end use of crude oil—that of generating electricity—has received a more detailed treatment. Mount, Chapman, and Tyrrell[24] have calculated the price elasticity for residential demand to be -1.2, for commercial demand to be -1.4, and for industrial demand to be -1.8. The elasticities of crude oil would tend to be lower since cost is only part of the cost of the end products. This would be cancelled, at least partly, when fuel substitutability is taken into account. For purposes of the following discussion, we will take the demand elasticity to be -1.

An estimate of the supply elasticity can be taken from the work of Erickson[25] who found a rate of new discoveries from wildcat drilling to be +0.9. As argued earlier, this work looks at only a small segment of the industry and, as shown, could not be translated into reserves. One might expect, however, that increased production on known fields would be at least as elastic. This latter component, while increasing supply, would tend to decrease reserves resulting, in part, in the previously discussed discrepancy between the results of Erickson and the CONSAD report. The National Petroleum Council estimates that a change in crude price from $5.28 per barrel to $6.69 per barrel by 1985 would result in an increase in production from 10.4 million barrels per day to 15.5 million barrels per day for a supply elasticity of +1.2. From these results, it appears reasonable to estimate a supply elasticity of +1.

The effects of special tax treatments are summarized in the supply-and-demand curves of Figure 1. The supply-and-demand curves for petroleum crude in the absence of the allowances are shown as the dark lines at plus and minus 45° on logarithmic scales (elasticities of +1 and -1, respectively). These slopes are illustrative but also, as one sees, qualitatively correct. The effect of the depletion allowance is represented as an effective increase in price as seen by the supplier and is tied to the demand curve for clarity. The effect of expensing is shown as a reduction in the cost of production and is

23. W. Mead, Discussion of Dynamic Demand Analysis of Selected Energy Resources by H. S. Houthakker, P. K. Verleger, and D. P. Sheehan (presented at Annual Meeting of the Am. Econ. Ass'n, 1973).

24. T. Mount, L. Chapman, and T. Tyrrell, Electricity Demand in the U.S.: An Econometric Analysis 9, Table 3 (1973) (Oak Ridge National Lab. Report ORNL-NSF-EP-49).

25. Erickson, *supra* note 7, at 73.

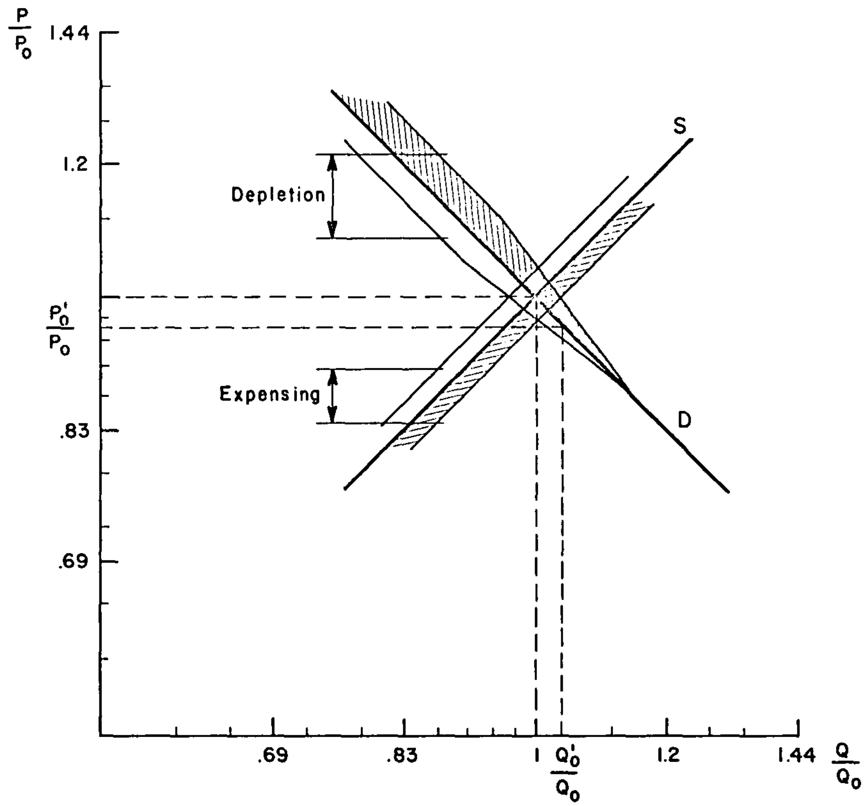

FIGURE 1. The Effect of Special Tax Provisions on Quantities of Petroleum Supplied and Demanded Assuming Elasticities of +1 and −1, Respectively (The Competitive Market Equilibrium is at 1, 1)

tied to the supply curve. Since there are increased inefficiencies of production associated with the tax allowances, the crosshatched portions represent the net effective increase in price and decrease in cost as seen by the industry. Furthermore, the depletion allowance becomes less effective near the margin represented by the truncation of the depletion area. The net effect is to move the equilibrium point from P_O, Q_O to P_O', Q_O'. Half of the net difference between price and cost has been passed on to the consumer in reduced prices leading to an enhancement in the quantity consumed. This enhanced consumption, as discussed earlier, is a major reason for the ineffectiveness of tax allowances in providing increased reserves. For the supply-and-demand elasticities as chosen, the tax subsidies have increased consumption by a percentage half as large as the total percentage shifts of the effective supply-and-demand curves. If a smaller demand elasticity had been chosen, consumption would still increase but by a smaller factor. In a world in which the finiteness of our resources is becoming clearly apparent, this subsidy to consume must surely be considered to be contrary to society's goals. The special tax treatment has artifically stimulated past consumption at the expense of future consumption.

Enhancement of demand is not the only demand-related effect of tax subsidies. Demand is also distorted by making the price of energy cheaper with respect to other products, e.g., (1) the incremental heat used in a home is made relatively cheaper with respect to the amortized cost of the insulation necessary to save it; (2) the decision to buy a large car instead of a small one is based, in part, on the subsidized price of gasoline; and (3) the amortized extra cost of a more efficient air conditioner is imbalanced against the cost of the extra energy used by a cheaper, less efficient one. Although it is difficult to determine quantitatively the individual distortions of these separate effects, the overall effect is described in the demand elasticity. As the current energy crunch makes the consumer more aware of the alternatives, this elasticity can be expected to increase, emphasizing the need to eliminate economic distortions favoring energy consumption.

The question of fairness also arises on the consumer side when the benefits of a nonneutral tax are passed on to the consumers. Since all taxpayers must collectively pay the differential required to support the tax benefits, the small user of petroleum products is, on the average, subsidizing the large user. The owner of a 20-mile-per-gallon Volkswagen is subsidizing the owner of a 10-mile-per-gallon Cadillac.

As a final note to the question of our subsidizing energy consumption, it has become apparent that resource limitation is not the only reason that this is inappropriate economic policy. The question is not only whether we should subsidize depletable over nondepletable resources, but also how much energy a society can use before the excess energy consumption creates more social ill than social good. The unlocking of the vast oil shale resources in the West also promises to generate large-scale environmental degradation. The employment of fission reactors on a massive scale raises societal problems of control of radioactive wastes and of dealing with the possibility of disastrous though improbable accidents for which we have, as yet, no anwers. Even the relatively benign solar energy, if introduced for the central generation of electricity on a very large scale, has its attendant problems of land and water use. Rather than subsidize energy consumption, it is clear that we should be taxing it so that it pays, as far as possible, for its true societal costs.

CONCLUSIONS IN THE LIGHT OF RECENT ENERGY DEVELOPMENTS

The existing special tax provisions produce distortions which increase the real cost of extracting petroleum, result in excess profits for some producers, and lower the cost of crude oil to consumers. Because the subsidy is partly passed on to consumers, a larger quantity of oil is consumed in the present, resulting both in less oil for the future and delays in the development of alternative renewable energy sources such as solar energy. An objective of these special tax provisions is to increase reserves. Empirical studies suggest, however, that percentage depletion and expensing together lead to, at most, a 7 percent increase in the level of reserves. Using average rather than high estimates of the impact reduces this by more than half. Furthermore, the studies did not consider the effects of demand on price and did not consider the effects on the marginal producer. Each of these factors reduces the impact on reserves of the special tax provisions by a factor of about two. Thus, the net effect is more likely between 0 and 2 percent. The cost to the federal treasury is very high–greater than the cost of simply having the federal government develop and hold reserves.[26] Furthermore, the tax provisions distort production from the intensive toward the extensive margin, thereby encouraging the uphill fight to find the last new oil remaining in the most unlikely places, while up to 300 billion additional barrels could be rediscovered from already developed fields. A further distortion takes place in that the special tax advantages on crude encourage integrated companies to take maximum profits on crude rather than on refined products. This has been one of the causes of the present shortage of refineries.

In addition to the distortions within the industry, the tax subsidies favor depletable over renewable energy sources, such as solar energy, and favor liquid and gaseous petroleum products over the more processing intensive recovery of oil from oil shale or the generation of gas from coal. By reducing the price of fuels, the special tax advantages encourage consumption and thereby earlier depletion of our resources.

New discoveries, new technology, and a generally competitive industrial structure have historically kept the price of crude oil low and falling. Under these circumstances, the industry pleaded that special incentives were necessary to induce adequate exploration for new oil. Recent monopolistic cutbacks in foreign supplies have increased prices dramatically. These higher prices in themselves provide far

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26. Mead & Sorenson, *supra* note 15.

more incentive than the special tax provisions. Exploration and development expenditures are increasing substantially.

Clearly, neither the public nor their elected representatives will long sustain special subsidies to an industry reaping windfall profits. Although the special tax subsidies have long been cherished by the petroleum industry, this new situation is beginning to change the attitudes of the industry itself. Atlantic-Richfield has been the first to break with the traditional policy toward these subsidies. Board Chairman Robert O. Anderson has stated:

> The oil depletion allowance once had validity and good purpose, but unfortunately it has become an absolute battlefield for the industry. It's hard to give up a financial resource, but the domestic oil producers have recently had a low rate of return on invested capital, and I have a strong feeling that we have to reintroduce the dynamics of the marketplace back into the industry.[27]

In a similar vein, Atlantic-Richfield President Thorton Bradshaw has stated:

> The so-called tax breaks it provided with its enactment in the 1920's did provide a good way of compensating for a depleted resource. But since that time it has ceased to be needed and there is no way of explaining to the public that the oil depletion allowance is a subsidy to the consumer, not to the companies.[28]

From an industry perspective, their conclusions parallel those of Kahn and those of this paper.

In the current situation in which the government controls the price of oil, there is no justification for special tax advantages. Exploration can be encouraged by price increases alone without the production distortions of the tax provisions. With the elimination of the distortions, the price increase that brings about an equivalent increase in supply should be less than the existing tax subsidy per barrel.

While this paper has emphasized the distortions induced by spcial tax provisions on domestic production, these provisions should not be eliminated without making corresponding changes in the tax treatment of foreign petroleum earnings and expenses. Elimination of depletion and expensing alone would make foreign investment relatively more attractive than before, which would increase our dependence on foreign-controlled petroleum. In addition, foreign petroleum production is dominated by six to eight large firms, whereas domestic production is far more competitive. A reduction in incentives to

27. San Francisco Chronicle, December 25, 1973, at 1, cols. 2,3.
28. *Id.*

produce oil domestically, without comparable reductions in the incentive to produce abroad, would further reduce competition within the petroleum industry and increase the economic and political power of the major international firms.

There are legitimate arguments that special tax provisions may be appropriate for the petroleum industry. The objectives of the industry and the outcome of an individual firm's rational behavior in a market system can differ from society's objectives and the outcomes society would choose. Special tax provisions have been advocated by economists such as McKie[29] on the basis of risk differences and by Miller[30] on the basis of land ownership fragmentation which impairs efficient development and production. The key problem is to develop tax provisions which, in fact, bring the industry's behavior closer to the social optimum. The most important impact of percentage depletion is to hasten depletion. The major effect of expensing intangible well drilling and development costs is to encourage the use of some forms of capital at the expense of other forms of capital and other inputs. Since the major outcomes of these tax provisions are inconsistent with social objectives, the provisions should be eliminated.

The Arab oil embargo has shown that increased reserves, coupled with increased productive capacity, would be in society's interest. While percentage depletion and expensing may have had a small effect on reserves and producing capacity, the outcome over time was to drain U.S. resources first and make the United States subsequently more vulnerable to foreign enbargoes. This was predictable given that these provisions stimulated the withdrawal far more than the holding of oil. But other better-directed tax provisions could establish special reserves and productive capacity effectively over time for use in emergencies. An unused reserve and productive capacity allowance or a direct subsidy payment based on reserves and unused productive capacity would encourage the holding of oil and production equipment. The existence of this excess capacity could eliminate the threat of foreign embargoes in the present while simultaneously saving conventional petroleum and stimulating the development of other energy sources for future generations. In another approach a negative depreciation allowance or extraction tax could induce the holding of reserves while, at the same time, it could be tailored at an approprate declining rate so as not to impede the complete extrac-

29. McKie, *Market Structure and Uncertainty in Oil and Gas Exploration*, 74 Q. J. Econ. 543 (1960).

30. Miller, *Some Implications of Land Ownership Patterns for Petroleum Policy*, 49 Land Econ. 414 (1973).

tion from a field. Such a tax could be used to compensate for environmental costs that do not now appear in the supply-demand balance. The much needed development of alternative energy sources would be given some indirect stimulus through higher petroleum prices. For other objectives, such as environmental protection or increasing the competitiveness of the industry, there will be other policies which would directly induce the industry to move toward the desired social end. The current tax provisions do not lead to any of these societal goals.

APPENDIX

Presented here is a simple mathematical model to indicate qualitatively the increased production arising from the depletion allowance and the insensitivity for marginal producers. The net profits of a firm are to be

$$\Pi = PQ - CQ - T \tag{1}$$

where Q is the quantity sold, P and C are price and variable cost per unit quantity, and T is the corporate tax. In the absence of the depletion allowance, it is taken (nominally) that

$$T = 0.5\ (PQ - CQ). \tag{2}$$

It is assumed that additional capital will move into the firm as needed for expanding production, provided the return exceeds a fixed percentage, say,

$$R = \frac{\Pi}{KQ} = 0.1 \tag{3}$$

where K is the capital required to produce a unit quantity. For an individual producer, P = constant; and it is assumed that C and K are increasing functions of Q. For simplicity of analysis, take $C = \bar{C}Q$ and $K = \bar{K}Q$ where the barred functions are constants. Substituting (1) and (2) in (3), together with the above assumptions, one obtains

$$\frac{P - \bar{C}Q}{\bar{K}Q} \geq 0.2; \tag{4}$$

and it is solved for Q to obtain the equilibrium quantity delivered:

$$Q_o \leq \frac{P}{\bar{C} + 0.2\bar{K}}\ . \tag{5}$$

If a 22 percent (nominal) depletion allowance is now introduced, equation (2) for the tax becomes

$$T = 0.5\ (PQ - CQ - 0.22\ PQ); \tag{6}$$

and with assumptions, as above, one obtains

$$Q_1 \leq \frac{1.22P}{\bar{C} + 0.2\bar{K}} \tag{7}$$

as the equilibrium. Given the functions selected, the full 22 percent depletion allowance appears as 22 percent greater production. (Here one is not concerned with the elasticity of demand.)

For a less profitable producer (one closer to the margin), the depletion allowance cannot be fully taken but is limited by the requirement that the allowance does not exceed 50 percent of net income. In this limit the tax becomes

$$T = 0.25\ (PQ - CQ). \tag{8}$$

Substituting (6) in (1) and then in (3), as previously, and solving for Q, one obtains

$$Q_2 \leq \frac{P}{\bar{C} + 0.133\bar{K}}\ . \tag{9}$$

In this case the increase in the quantity produced is related only to $\bar{K}$ and is thus generally reduced over the previous case. In the limit when there is little capital required, such as stripper well operation, the function $\bar{C}$ dominates over $0.133\bar{K}$ in the denominator in (9); and there is little additional quantity produced over that without the depletion allowance. In fact, if the demand elasticity were also considered, as in the text, the price would have fallen in response to the overall increased production; and the operator of the stripper wells actually would be producing less at equilibrium.