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PERCENTAGE DEPLETION AND THE LEVEL OF DOMESTIC MINERAL PRODUCTION

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There has been much controversy about the effects of percentage depletion. To affect the level of output or price the depletion allowance must affect the economics of the marginal mineral deposits. For the operators of these deposits, the depletion allowance is equivalent to a preferential income rate. Although percentage depletion is usually defended as an incentive to exploration, it will be shown that it actually works the opposite way. Percentage depletion is just one aspect of the tax treatment of mineral production. However, the other aspects such as the expensing of intangible drilling costs or dry holes will not be discussed here.

HOW DEPLETION WORKS

I will briefly review the law applicable to depletion.[1] The expenses which are recovered through depletion are those of acquiring the mineral deposit to be exploited which include land purchase, the payment of bonuses for the signing of a lease, lease acquisition, and exploration. Certain exploration expenses are expensed: among others, dry hole costs, unrecovered expenses allocated to properties abandoned, and costs of exploration where no lease or land is acquired. In addition, for solid minerals the expenses of exploration may be deducted in certain cases. A capital account must be maintained for each mineral property to which expenditures for depletable assets are charged and from which depletion is deducted. The accumulated expenditures in this account minus accumulated depletion provide the basis for calculating capital gain taxes if the property is sold.

The law provides for two methods of calculating depletion: cost depletion[2] and percentage depletion.[3] With cost depletion the original cost of the mineral deposit is divided by the number of tons

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*Energy Branch, Office of Management and Budget. This paper represents the personal views of the author and does not necessarily represent the position of the Office of Management and Budget.

1. *See* K. Miller, Oil and Gas Federal Income Taxation (1957); *see also* Int. Rev. Code of 1954, § § 611-614 and applicable regulations.
2. Int. Rev. Code of 1954, § 611-612.
3. *Id.* § 613.

or barrels to be produced and this amount is deducted as a cost of each ton or barrel mined. While there are several problems with cost depletion, this provision has occasioned relatively little controversy.

However, in most cases the taxpayer takes percentage depletion rather than cost depletion. In 1960 cost depletion on all minerals accounted for only $310 million out of total depletion of $3,196 million.[4] The allowable percentage depletion is a specified fraction of the gross value of production subject to the limitation that the depletion cannot exceed half of the net income from the property. The statutory depletion rates[5] for certain common minerals produced domestically are as follows:

Minerals	*Depletion Percentage*
Oil and gas, sulphur, uranium, lead, zinc, bauxite	22
Gold, silver, copper, and iron ore	15
Coal and lignite	10
Clay for brickmaking	7.5
Sand and gravel	5
Phosphate rock, potash, limestone, granite	14

In general, there is no published information to indicate how often depletion is taken at the full statutory rate and how often it is limited to 50 percent of net income. However, a study of the tax returns of selected large U.S. oil companies made for Senator Proxmire by the Treasury Department showed that in 1967 depletion at the full statutory rate (then 27.5 percent) was $1,421 million and that depletion based on half of net income was $209 million.[6] Cost depletion was only $49 million. For oil and gas, the bulk of the depletion is at the full statutory rate.

For other minerals, there is no direct information on how often the net income limitation comes into effect. Using Treasury Department data from 1960 corporate tax returns,[7] an indication can be

4. Internal Revenue Service, U.S. Treasury Dep't, Statistics of Income 1960, Supplemental Report 38, Table 20 (1966).

5. Int. Rev. Code of 1954, § 613(b).

6. Letter from John S. Nolan, Deputy Assistant Secretary, U.S. Treasury Dep't, to Senator Proxmire, Sept. 15, 1971; *see also* Internal Revenue Service, U.S. Treasury Dep't, Statistics of Income 1969, at 14, Table 2 (1973).

7. Statistics of Income 1960, Supplemental Report, *supra* note 4, at 37, Table 19.

obtained. The results of dividing total depletion (including cost depletion) by the depletion that would have resulted from using the statutory rates are as follows:

	Percentage
All minerals	92.9
Oil and gas (then subject to depletion at 27½%)	96.5
Minerals depleted at 23%	76.6
Sulfur	103.0
Uranium	65.6
Other metals including lead, zinc, bauxite	54.7
Minerals depleted at 15%	86.7
Clay	79.4
Metals	89.7
Limestone	73.0
Magnesite	52.9
Phosphate Rock	96.4
Coal (10% depletion)	48.8
Minerals depleted at 5%	87.8
Gravel, sand, and stone	90.7
Firms in Metal Mining	82.6
Iron ores	83.0
Copper, lead and zinc, silver and gold ores	90.6
Other metals	63.7

The high ratio of total depletion to that which would result from the application of percentage depletion at statutory rates (combined with the rarity of cost depletion) suggests that most depletion is taken at the full statutory rates. The principal exceptions are for coal, uranium, magnesite, and limestone, and to a lesser extent iron ore. However, as will be shown, the effects of depletion on the mining industry do not depend on how it affects the average mine or well, but on how it affects the marginal mine or well.

THE ECONOMICS OF THE MINERAL INDUSTRIES

It would be useful at this point to review briefly the process of output and price determination in the mineral industries. There is a wide range of costs of production among mineral deposits due to variations in seam thickness, overburden depth, concentrations of the mineral in the ore, etc. At any given time there are some deposits that are clearly worth working at a somewhat higher price. A separate supply curve can be constructed for each deposit showing the amount that will be produced at that price. These can be summed horizontally to give an industry supply curve. Over the long run, the most important determinant of the slope and shape of this curve is the variation with price in the number of deposits that it is economical to exploit. The final price is determined in the standard manner by the intersection of the demand and supply curves.

If tax policy has any impact on the quantities produced and on price, it is presumably by shifting the supply curve in the vicinity of its point of intersection with the demand curve. A tax subsidy might, for instance, delay the abandonment of wells or mines whose costs of production would exceed the price without the subsidy. A subsidy may also cause certain mines to come into production that would not pay without the subsidy. In certain cases, a subsidy may make additional production profitable from an already producing mine.

The point of this rather elementary discussion is that a subsidy has an effect on the volume of production (and hence on the price) only to the extent that there is potential production with costs close enough to the price that the production is economical with the subsidy, but not economical without it. Such production is customarily referred to as marginal production. Conversely, the effects of a subsidy on the costs of the inframarginal production that would occur with or without the subsidy are simply irrelevant. Thus, to analyze the effect of a tax subsidy on production, we must identify the marginal production whose costs would be changed. Clearly, such production will be the production whose costs are only slightly below the price that the product sells for (in the popular parlance, marginally profitable production).

PERCENTAGE DEPLETION AT THE FULL STATUTORY RATE

Let us consider the implications of taking percentage depletion at the full statutory rate. Let d be the statutory depletion rate, R be the revenues (gross income), and C be the costs. By definition, net profits are R-C and percentage depletion is dR. The net profits limitation requires that depletion be limited to half of net profits from a property. Thus, for the full percentage depletion to be taken:

$$dR \leq \tfrac{1}{2}(R\text{-}C)$$

or

$$C \leq R\text{-}2dR$$

and

$$C/R \leq 1\text{-}2d$$

Thus, if the percentage depletion is being taken at the full statutory rate, the costs as a percentage of revenue must be less than or equal to one minus twice the depletion rate for that mineral.

This means that where full depletion is being taken, the accounting costs for oil and gas, uranium, sulfur, lead, etc., are below 56 percent of the value of production, that costs for iron and copper ore are below 70 percent of value, that costs for coal are below 80 percent of value, and that costs for sand and gravel are below 90 percent of value. Such costs imply that the deposit is an inframarginal one that would be exploited even without percentage depletion (except possibly for sand and gravel). Thus, percentage depletion at the full statutory rate is likely to have little impact on the volume of production from known deposits (exploration will be discussed later).

THE ANALYSIS OF PERCENTAGE DEPLETION LIMITED TO HALF OF NET PROFITS

Any effect of percentage depletion on mineral production is most likely to be through making otherwise unprofitable deposits profitable. Since "marginal" deposits would have their depletion limited to half of net profits, it is necessary to analyze the effects of a depletion allowance that is half of net profits.

If P is accounting profits, then depletion for tax purposes is P/2 for the marginal properties. The profits after depletion are P/2, and the income tax is tP/2, where t is the nominal income tax rate. Thus, for the price-controlling marginal property, percentage depletion is essentially a halving of the applicable income tax rate, and should be analyzed as such. With the corporate income tax at 48 percent, the effective income tax rate on investments in developing marginal mineral deposits is only 24 percent. In essence, the cost of capital for marginal mining ventures is reduced by almost one third.[8] Because one of the economic costs of exploiting a mineral deposit is return on capital, this reduced cost of capital encourages greater mineral production. The subsidy to marginal mineral production from the depletion allowance is not some specified fraction of the value of production, but is about one third of the cost of capital (for corporations).

EFFECTS ON THE SUPPLY CURVES

According to *Statistics of Income for 1969,*[9] the average mining

8. An investment in a marginal mining venture need yield only (1-.48)/(1-.24) or 68.4 percent of the minimum yield in other sectors.

9. Internal Revenue Service, U.S. Treasury Dep't, Statistics of Income 1969, at 14, Table 2 (1973).

firm had nondèpletable assets[10] equal to 1.31 times the business receipts of the firm. The ratio of the after tax income of all corporations to their net worth was 7.7 percent in that year. If the marginal mining firm required this after tax rate of return, it would require a return of 14.8 percent before taxes without the depletion allowance and 10.1 percent with the depletion allowance. The availability of the depletion allowance would amount then to a subsidy of 4.7 percentage points of the capital costs per year. This would lower the price needed to stimulate production from the marginal mine by 6.2 percent of the selling price of the mineral. In more technical terms, the supply curve would be shifted downwards by 6.2 percent. The effect on the final market prices would depend on the relative slopes of the demand and supply curves near the point of intersection, but one would normally expect the decline in market price to be appreciably less than this. In particular, if the two curves have the same slope, the decline in price would be half as great, or 3 percent.

The capital-output ratios (including depletable property) for individual branches of mining were 2.01 for metal mining, .82 for coal mining, 1.27 for oil and gas, and 1.13 for non-metallic mining except fuels. This suggests price reductions (assuming equal slopes for demand and supply curves) resulting from depletion of 4.7 percent for metals, 1.9 percent for coal, 2.4 percent for oil and gas (excluding the effects on exploration discussed below), and 2.7 percent for non-metallic minerals. The numbers are small enough to make it likely that the welfare losses from non-neutral taxation are minor.

Non-metallic minerals include sand and gravel mining on which the depletion rate is only 5 percent. With a capital-output ratio in excess of one it is likely that many of the marginal sand and gravel operations would show accounting profits in excess of 10 percent. In these cases, the depletion allowance would not be half of net profits, but would be 5 percent of gross. This would make the reduction in sand and gravel prices 2.5 percent if the demand and supply curves have equal slopes.

EFFECTS ON CAPITAL INTENSITY

Besides encouraging a greater volume of mineral production,

10. It was assumed, in accordance with Ricardian rent theory, that the miner of the marginal mineral deposit would not have paid a significant amount for the rights to mine the deposit. Thus, the value of depletable assets was deducted from the total assets. This may overstate the assets dedicated to mining since many mining companies have other facilities such as smelters. It also assumes the marginal company has the same capital-output ratio as the average company, an assumption that may be false, since the inframarginal deposit probably requires less of all factors of production, including capital, than the marginal deposits.

depletion at half of net profits also encourages the use of a more capital intensive technology. With capital unusually cheap, it pays to substitute capital for labor or other items of expense. This arises because economies in the utilization of labor (or economies in other expenses) not only reduce costs but also increase the allowable depletion by half of the savings in costs. Viewed another way, the Government gives a tax deduction equal to almost half of the costs saved by mechanization or other capital investments. Since there appears to be little public benefit from concentrating capital on marginal mines, this effect of percentage depletion encourages undesirable patterns of capital investment.

A possible rationale for subsidizing investments in poor mineral deposits would be that these investments are unusually risky because a small fall in prices could eliminate all profits, just as a small increase in prices could greatly increase them. Some might feel that, without some subsidy, less than optimal investments would occur in such deposits.

It should be realized that there is no incentive to increase capital intensity where depletion is taken as a percentage of the market value of production, which is where most depletion is taken. The opposite is implied by the Harberger,[11] Steiner,[12] and the Agria treatment.[13] Where depletion varies with total production, additional capital investment yields additional depletion only if production is increased.

SOME CAVEATS

The thrust of the argument so far has been that depletion as a percentage of the value of production has no effect on the level of production because deposits eligible for depletion at the full statutory rate are not at the margin of being economical. However, some caveats are in order. One is that when considering whether or not to explore a prospect, very little is known about whether the mineral exists or what its cost will be. A marginal exploration project may yield an inframarginal deposit if successful. This is an important factor for oil and gas, where depletion can usually be taken at the full rate once a discovery is made. For solid minerals, the location of the deposit is more often known.

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

12. Steiner, *Percentage Depletion and Resource Allocation*, in 105 House Comm. on Ways & Means, 86th Cong., 1st Sess., Tax Revision Compendium 949 (1959).

13. Agria, *Special Tax Treatment of Mineral Industries*, in The Taxation of Income from Capital 77 (A. Harberger & M. Bailey eds. 1969).

It should also be noted that costs for tax purposes are not necessarily the true economic costs. Accounting costs do not include the normal return on the capital investment. For minerals other than oil or gas, certain exploration and development expenses may be deducted when incurred, rather than being capitalized and deducted over the life of the deposit. For oil and gas wells, dry hole costs and intangible drilling costs are normally deducted when incurred and do not appear as costs in later years.

It is likely that the available discretion in allocating overhead costs is used° to minimize the allocation to mines whose depletion is limited to half of net income. Such costs may be allocated to non-mining parts of the business, money losing mines (including those in the development stage) and mines taking depletion at the full statutory rate.

Also, as has been pointed out by DeChazeau and Kahn,[14] and by Manes,[15] the depletion allowance provides an incentive for an integrated company to raise the price of the mineral produced. However, the calculation of the degree of self-sufficiency required (77 percent in Manes) to make a price increase in the interest of the producer, even if final product prices are not raised, is too low. Their calculations fail to allow for the fact that both royalties and severance taxes are frequently a percentage of the value of production, and an increase in price also increases the amount paid for these items.[16] Thus, for the reasons given above, it is possible that certain truly marginal properties could have accounting profits that are high enough to permit depletion at the full statutory rate.

ADDITIONAL PRODUCTION FROM INFRAMARGINAL DEPOSITS

Assuming that elasticity in the supply curve for a mineral results largely from shifts in the number of deposits being exploited, depletion as a percentage of production can have no effect on the quantity produced since (by definition) such production is too profitable to be marginal. However, there is an intensive margin as well as the extensive one discussed up to now. Increased production from an inframarginal deposit brings not only whatever the production sells for but also additional depletion equivalent to some fraction of the value of production. This subsidy for increased production, as noted by Agria,[17] should result in some increase in production.

14. M. DeChazeau & A. Kahn, Integration and Competition in the Petroleum Industry 420 (1959).
15. Manes, *More Fuel on the Depletion Fire,* 16 Nat'l Tax J. 102 (1963).
16. Mancke, *The Petroleum Conspiracy: A Costly Myth,* 22 Pub. Policy 1 (1974).
17. Agria, *supra* note 13.

Still, just as the very fact that a mineral deposit is eligible for the full statutory rate shows that it is inframarginal, its very profitability makes it likely to be produced at the maximum rate the resource will permit. Imagine a deposit where an increase in production is possible. This would probably be done through duplicating the existing operation. In this case, it is likely that the increased costs would be at least as low as the average costs for the whole deposit. In many cases the marginal costs would be much lower because of the spreading of overhead. Thus, if the marginal costs of an increase in production are as low or lower than the current average costs, one would expect a profit-maximizing firm to have already pushed production to the maximum that can be supported by the resource base. It must be remembered that mineral deposits are exhaustible and that increasing production now does not usually result in increased total depletion but merely in earlier deduction of depletion that would eventually be deducted in any case.

Still, there are certain cases in which the level of output from an inframarginal mine is influenced by the depletion allowance. The law on minerals other than oil and gas permits aggregating, for tax purposes, mines which are part of the same operating unit. This provision may permit an unprofitable mine to be subsidized by a mine whose depletion is not limited by the net income rule. On a single oil lease, there may be an individual well or producing horizon that would be unprofitable without percentage depletion.

Within an inframarginal mine, there may be an area of high cost production which is worth exploiting only because the increased gross production brings increased depletion. In a metal mine this may be a fringe of low grade ore. In general, percentage depletion should result in a small increase in the optimal rate of exploitation of a deposit. However, in total the likely increase in production from existing inframarginal deposits due to percentage depletion is likely to be limited.

COMPARISON WITH OTHER WORK

The typical approach to the depletion allowance has been that it is a subsidy to domestic mineral production which results in a somewhat higher level of production than would have otherwise occurred. This was the belief of the participants in the debate about the non-neutrality of the depletion allowance conducted in the National Tax Journal and elsewhere starting in the early sixties.[18] Both David-

18. *See* Eldridge, *Rate of Return, Resource Allocation and Percentage Depletion,* 15 Nat'l Tax J. 209 (1962); McDonald, *Distinctive Tax Treatment of Income from Oil and Gas Production,* 10 Nat. Res. J. 97 (1970); McDonald, *On the Non-Neutrality of Corporate Income Taxation: A Reply to Steiner,* 17 Nat'l Tax J. 101 (1964); McDonald, *Percentage Depletion and Tax Neutrality: A Reply to Messrs. Musgrave and Eldridge,* 15 Nat'l Tax J.

son[19] and Hause[20] have stated that the depletion allowance is essentially a negative ad valorem tax and can be analyzed as such. Gerard Brannon[21] in his most recent works appears to view the depletion allowance as an ad valorem subsidy which lowers the price of oil, gas, and other minerals. The net income limitation is treated only as a provision which somewhat lowers the level of the subsidy without changing its basic economic effects. He applies this methodology even to coal, for which the net profits limitation is quite important. The analysis given here shows that the depletion allowance is more complex. Because of the net income limitation, the closer a deposit comes to being marginal, the smaller the subsidy is. In particular, the depletion allowance cannot make an unprofitable mine profitable, and hence cannot prevent the abandonment of unprofitable properties (such as stripper wells). Thus, the effect on output and prices is much less than would result from an ad valorem subsidy of the size of the depletion allowance.

Another series of analysts has looked at the depletion allowance from the view of the effect on the return to capital. This approach was originated by Harberger,[22] improved by Steiner,[23] and most recently utilized by Agria.[24] The equations used by these writers treat the depletion allowance as an exemption from taxation of a specified fraction of net profits (p in their notation), with the fraction calculated from the tax data for each mineral. While this may be a useful technique for examining the aggregate effects of the tax preferences for minerals in total, it is of little value in understanding the depletion allowance. The functional form used is simply wrong. The depletion allowance is a function of the net profit of the property only when the net profit is less than twice the statutory rate.

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314 (1962); McDonald, *Percentage Depletion and the Allocation of Resources: The Case of Oil and Gas,* 14 Nat'l Tax J. 323 (1961); Musgrave, *Another Look at Depletion,* 15 Nat'l Tax J. 205 (1962); Steiner, *The Non-Neutrality of Corporate Income Taxation–With and Without Depletion,* 16 Nat'l Tax J. 238 (1963); Steiner *supra* note 12; Mead, *The System of Government Subsidies to the Oil Industry,* 10 Nat. Res. J. 113 (1970); Kahn, *The Depletion Allowance in the Context of Cartelization,* 54 Am. Econ. Rev. 286 (1964); Kahn, *The Combined Effects of Prorationing, the Depletion Allowance, and Import Quotas on the Cost of Producing Crude Oil in the United States,* 10 Nat. Res. J. 53 (1970).

19. Davidson, *The Depletion Allowance Revisited,* 10 Nat. Res. J. 1 (1970); Davidson, *Public Policy Problems of the Domestic Crude Industry,* 53 Am. Econ. Rev. 85 (1963).

20. Hause, *The Economic Consequences of Percentage Depletion Allowances,* 16 Nat'l Tax J. 405 (1963).

21. G. Brannon, Energy Taxes and Subsidies 26 (1974); Brannon, *Existing Tax Differentials and Subsidies Relating to the Energy Industries,* in Studies in Energy Tax Policy 8, 16-17 (G. Brannon ed. forthcoming).

22. Harberger, *supra* note 11.

23. Steiner, *supra* note 12.

24. Agria, *supra* note 13.

Where it is appropriate to make depletion a function of net profits, the ratio is set by law at .5, not the much lower ratios used in these studies (based on total depletion and total profits). Once net profits exceed twice the statutory rate, the depletion allowance is no longer determined by net profits but by gross production. Hence, the depletion allowance has the effect of making mineral investments more profitable only if it goes to increase the volume of production. As argued above, such an increase in profitability is unlikely to result in much additional investment that would not have occurred in any case. Thus mis-allocation of resources should be minor where the full statutory rate is used.

Interestingly, the Committee on Ways and Means has apparently recognized the critical effect of the net income limitation. In the proposed Oil and Energy Tax Act of 1974, a bill which would eliminate percentage depletion for oil, they proposed to raise the 50 percent limit to 100 percent.[25]

EFFECTS ON RENTS AND PRICES OF MINERAL LANDS

It has been argued above that because of the net income limitation, the depletion allowance has relatively little effect on the level of domestic mineral production. This limits the extent to which it could influence the prices of the mineral produced. In any case, the price for most minerals is determined either on the world market or by government price controls, and the effects of the level of domestic production on price must be small. It follows that only a small part of the benefits from percentage depletion are passed on to the consumers. The remainder is presumedly retained by the producing firm and eventually passed on to the owners of mineralized lands. Thus, it appears that landowners are the primary beneficiaries of percentage depletion. However, the effects of percentage depletion on different grades of mineral deposits will differ.

Percentage depletion, when limited to half of net profits, clearly increases the rents earned by mineral properties because the after-tax profits from any property will be greater than they otherwise would have been found by the factor $(1-\frac{1}{2}t)/(1-t)$. If a mining firm reduces its mining costs by purchasing a better property (thicker seams, less overburden, higher grade ores, etc.), the Government will give a subsidy amounting to half of the savings in costs, provided that the subsidy does not exceed some specified fraction of the value of the

25. H.R. 14462, 93d Cong., 2d Sess. § 103(b) (1974). *See* House Comm. on Ways & Means, 93d Cong., 2d Sess., Report on the Oil and Gas Energy Tax Act of 1974, at 45 (1974). H.R. 14462 was not approved. [*But see* The Tax Reduction Act of 1975, Act of Mar. 29, 1975, which drastically revised the depletion allowance for oil and gas. Ed.]

mineral output (22 percent for oil and gas, 10 percent for coal, etc.). The principal offset is that the mining firm foregoes cost depletion from its purchase of mineral lands. This subsidy for the purchase of mineral-bearing lands seldom serves to increase production or to lower prices since mineral lands typically have few alternative uses. Instead, it is capitalized into the value of the property, causing much of the benefit from the reduction in the income tax rate to go to landowners.

The limitation of depletion to a specified percentage of the value of production has a major effect on the willingness of firms to purchase high grade mineral deposits. One part of this effect is obvious: once the statutory depletion limit has been reached, a high-grade (low cost) deposit brings no more depletion deductions than a lower grade deposit (provided this deposit still qualifies for the statutory rate).

However, there is a second, more subtle, effect. If the mining firm invests additional funds in purchasing depreciable property, the firm will eventually be able to recover its investment through depreciation. However, if the same amount of money is invested in paying a premium to obtain an exceptionally low-cost-of-mining mineral deposit (beyond what is needed to qualify for the statutory rate), the premium generates no additional tax deductions. All expenditures for purchase of mineral property (including bonuses but not royalties) must be recovered through depletion. But since the amount of depletion is limited to a specified percentage of the value of production, the premium generates no additional tax deductions. In effect, it must be paid from after-tax income. This naturally reduces the amount a mining company can pay in the form of premiums for very high quality mineral deposits. Thus, the effects of the special provisions for depletion on land rents are very high for the lower grade deposits, but they decrease quite rapidly once profits exceed the level needed to qualify for the statutory depletion rate. For the best deposits, the market value may be high enough so that cost depletion exceeds percentage depletion, and the latter does not affect land values at all.

The discussion so far has dealt with the amounts that the operator of a mineral property would be willing to pay in bonuses or land purchase for mineral lands. However, the depletion allowance can be taken on royalties and bonuses (if production is subsequently established). This would make investors willing to pay more to purchase mineral-bearing lands than they would pay to purchase an equal stream of pre-tax earnings from other assets. For instance, a taxpayer in the 50 percent income tax bracket should be willing to pay up to 28.2 percent more for a petroleum property than for a comparable nonmineral investment. This consideration does not affect the fraction of the sales price of petroleum that goes as royalties or bonuses to landowners, but merely increases the capitalized value of these payments and raises land values.

Even this effect is moderated by the provision that the basis for capital gains taxation is the purchase price minus the depletion that has been taken. Very high depletion deductions quickly reduce the basis of a mineral property to zero and result in the full sales value of the property being subject to capital gains taxation if the property is again sold. Thus, some of the revenue lost through percentage depletion may be recovered through increased capital gain taxation.

EFFECTS ON EXPLORATION

Percentage depletion is frequently defended as an incentive for exploration. However, analysis shows that percentage depletion actually has the effect of discouraging geological and geophysical exploration. These expenses are recoverable only through depletion, based on either the value of production or the net profits from the property. In neither case do expenditures on geological and geophysical exploration result in any additional deductions. They cannot be deducted as expenses since they are for depletable assets. Unlike expenditures to purchase a piece of machinery, they cannot be depreciated. For practical purposes, these expenses are nondeductible. While on an average basis the depletion deductions are more than adequate to recover actual costs (hence the objections to them on equity grounds), on a marginal basis they are nondeductible.

A dollar spent on any nondepletable expense results in a reduction in after-tax income of only $1-t$, where t is the marginal tax rate of the firm or individual. For corporations, t is 48 percent, hence a dollar of expense reduces after-tax income by 52 cents while an extra dollar of production increases after-tax income by 52 cents. As a result, the rational mining operator will spend up to one dollar to obtain one dollar of before-tax income. However, a firm will be willing to spend only 52 cents on geological and geophysical exploration in order to obtain an additional dollar of before-tax income. In other words, the return on nondrilling exploration must be nearly twice as high as on other forms of expenditure before such exploration is worth undertaking.

Since there is some flexibility in substituting drilling for geological and geophysical expenditures, it is likely that this very large differential in tax treatment leads to too much drilling and not enough use of geological and geophysical methods of exploration. As has been pointed out elsewhere by Edward Miller,[26] the land ownership pattern in this country has already induced a substantial bias against exploration in completely new areas because the new information acquired will prove beneficial to landowners and leaseholders over a large area extending well beyond the exploring firm's leases. Frequently, a whole area is proved productive by the effort of one firm which had leased only a small fraction of the area.

Of course, in many cases other methods of recovering the expenses in the depletable expense account are used, and the disincentive effects described above are reduced or eliminated. In some cases, cost depletion is used. Here, each additional dollar of depletable expense eventually generates an additional dollar of depletion charges. However, because of the prorating of these depletion deductions over the total production of the mine or well, the tax treatment may still be non-neutral.

If a program of geological and geophysical exploration does not result in the acquisition of any properties, the expenses of the program may be written off at the completion of the program. Also, unrecovered depletable expenses allocated to a property may be deducted when that property is abandoned. Since most petroleum leases are eventually abandoned without the establishment of any production, many exploration expenses are deducted through this route. However, a long delay before abandonment of a lease will result in the present value of the deductions being greatly reduced. While the abandonment provisions are not part of percentage depletion, their operation does moderate some of the adverse effects arising from percentage depletion.

Still, it is surprising to discover that percentage depletion, which is traditionally defended as a subsidy for exploration, actually penalizes the geological and geophysical work that is so necessary to discover new fields. Interestingly, the Committee on Ways and Means in the proposed Oil and Gas Tax Act of 1974[27] proposed to permit geological and geophysical expenses to be treated as intangible drilling expenses rather than as items that must be recovered through depletion or writeoffs on abandonment. Since this is in a bill to raise oil industry taxes, the committee may have been aware of the above effects.

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

27. *See* Report on the Oil and Gas Energy Tax Act of 1974, *supra* note 25.

CONCLUSIONS

This paper argues that because of the net income limitation, the tax subsidy to production from the marginal mineral deposit is much less than would be implied by the statutory rates. This, in turn, implies a relatively weak effect of percentage depletion on the level of domestic mineral production. Because of the net income limitation, percentage depletion is least for those who need it to continue in production. This weakens the position of both those who support percentage depletion on the basis that it is a necessary subsidy to mineral production and those who attack percentage depletion on the basis that it distorts the pattern of resource use. Because the effect on the level of production is minor, it has probably done relatively little to lower the prices to the consumer of mineral products. Since the consumer has not been a major beneficiary of percentage depletion, the benefits must have gone to the firms mining the deposits and the owners of the land containing them. Percentage depletion has raised the value of mineral land not only by raising the profits of the firms that exploit them, but also by providing unusually low tax rates for the stream of royalties paid by the firm mining the deposit. Percentage depletion at the full statutory rate may have encouraged some mineral exploration since a marginal exploration prospect may still yield an inframarginal discovery. For deposits where the net income limitation is effective, a more capital intensive technology is encouraged.

While percentage depletion is usually defended as providing a major incentive for exploration, on closer analysis it is found that it actually discourages geological and geophysical exploration expenditures by making most such expenditures nondeductible on a marginal basis. In any event, most capitalized exploration expenditures are eventually deducted on abandonment of the property to which allocated.