Journal of Natural Resources & Environmental Law

Volume 11
Issue 2 *Journal of Natural Resources & Environmental Law, Volume 11, Issue 2*

Article 2

January 1996

Economic Approaches to Nonrenewable Resource Taxation

Keith J. Brewer
Natural Resources Canada

Stephen E. Hamilton
Woodard, Hall & Primm, P.C.

Richard A. Westin
University of Houston

Economic Approaches to Nonrenewable Resource Taxation

KEITH J. BREWER*
STEPHEN E. HAMILTON**
AND RICHARD A. WESTIN***

The purpose of this Article is to provide the reader with a survey of the current status of natural resource economics insofar as it relates to tax policy. The topic is limited to oil, gas and minerals.

The Article begins with a review of the kinds of oil and gas exploitation contracts that arose in the U.S. in a free-wheeling industry, the primary feature of which is that private owners of the oil and gas interests are able to enforce the property interests created by those contracts. The subject is important because (1) those contracts spread into the mining (and to a lesser extent the timber) industry, and (2) the contracts are closely analogous to later tax systems in which the state owns the resources.

There is a tendency among thinkers in the area to overlook these market-based arrangements and to imagine that they are logically separate from tax systems. They are not separate. Moreover, by understanding the private forms, one is well-armed to evaluate the taxation of natural resources and to detect the limits, especially the inflexibility, of government-designed systems. One can then ask questions about the wisdom of any particular country's choices in the field of natural resource taxation. The Article then moves to the economist's stand on the subject, as expressed in the prevailing literature. Finally, the Article closes with some policy considerations with respect to structuring tax systems in which the state is the proprietor of the resources.

---

* Director-General, Economic and Financial Policy Analysis Branch, Natural Resources Canada; Ph.D. Economics, 1972, McGill University; M.A. 1966, University of Alberta; B.A. 1961, Oxford University.

** Attorney, Woodard, Hall & Primm, P.C., Houston, Texas; J.D. 1975, University of Texas School of Law; LL.M. Taxation, 1993, University of Houston Law Center; A.B. 1975, Rice University. Formerly served as Special Counsel to the Saudi Arabian Oil Co. (Saudi ARAMCO).

*** Professor, University of Houston Law Center; J.D. 1972, University of Pennsylvania School of Law; M.B.A. 1968, B.A. Economics, 1967, Columbia University.

I. OVERVIEW

It is perfectly possible to describe, in economic terms, an efficient theoretical model for allocating risks and incentives to find and extract exhaustible natural resources, without ever mentioning the concept of taxation. In reality, however, the existence of an accompanying legal superstructure of accessible courts, private remedies, and open markets for information to ensure and enforce the allocation of rights and risks agreed to by the parties is paramount. Otherwise, translation of any efficient theoretical model to practice would be an impossibility.

The modern state is fueled by the need for stable revenue sources, and the administration and regulation of such economic rights becomes a necessity. The character and source of these revenues is of particular concern to economists, and is the central theme of this Article.

"In contrast to taxation of most goods, the taxation of nonrenewable resources tends to induce complex intertemporal avoidance behavior" on the part of producers.[1] The central dilemma is that although a tax on economic rent is conceptually neutral, taxation of nonrenewable resources inevitably causes a response by the taxpayer. Such behavior must be of interest to state authorities seeking to optimize revenue from the extraction of exhaustible resources. Economists have proceeded on the basis of increasingly sophisticated models of resource extraction, but the differences in parameters among the models have led to varying conclusions for purposes of setting fiscal policy. Even so, a review of this economic literature demonstrates broad agreement as to the basic economic behavior induced by each of the common forms of nonrenewable resource taxation.

In order to facilitate that review, this Article examines the array of possible legal mineral interests developed by the private sector to assign risks and rewards in a free-wheeling minerals extraction industry in which private persons can own mineral interests. To aid the reader's understanding, key economic terms will then be defined, and the underlying assumptions or variations of major models will be briefly noted. Then, the economic implications of particular tax models are summarized, and to the extent economists have differed or added significant considerations to the debate, the differences are noted.

---

[1] Villamor Gamponia & Robert Mendelsohn, *The Taxation of Exhaustible Resources*, Q.J. ECON. 165 (Feb. 1985).

II. MINERAL INTERESTS AS RISKS AND REWARDS FOR DEVELOPMENT

Most nations currently considering taxation of natural resources are not engaged in the task of creating and regulating *new* forms of property rights ownership; almost everywhere, the nature of property interests involved in the process of minerals extraction is well developed. In the United States, there is a long tradition of private ownership of subsurface mineral rights; nearly everywhere else, the developer now deals with the state or its designee as the sole owner of rights to subsurface resources. Because hydrocarbon and mineral extraction industries came to maturity early on in North America, a vocabulary of familiar terms is now used worldwide in natural resource production. Individuals use this vocabulary to describe the degrees of contractual risk and responsibilities undertaken by the operator and the residual rights holder. National legislatures elsewhere in the world have also adopted it to describe natural resource taxes. Even states that have no tradition of private ownership of minerals in place often use this vocabulary, with the healthy result that in any working exploration and development agreement between a private investor-developer and a state, or virtually any risk and profit-sharing arrangement arrived at between the parties, can be expressly characterized and understood. Any system of tax burdens and incentives imposed on the development project may be imposed either by contract or upon the developer in its capacity as a taxpayer under domestic tax law, or some combination of the two.

Under the U.S. system of mineral exploration and production, assignments of risk and anticipated profit are generally effected through the mechanism of the mineral lease,[2] an extremely flexible legal instrument, invariably drafted by the landowner[3] and operator with an eye to sharing in the most powerful tax incentive for present mineral production—the U.S. system of mineral depletion allowances. The goals of the private landowner entering into a lease are to maximize revenue (which generally also means maximizing exploration and production) under the lease, while minimizing damage and waste to the land itself.[4] Unless the owner-lessor is wealthy enough to explore and market directly, or to hire driller-operators outright,[5] it must rely on the operator-

---

[2] *See generally* RICHARD A. WESTIN & FRED F. MURRAY, TAXATION OF NATURAL RESOURCES: OIL, GAS, MINERALS AND TIMBER 1-7 (1987).

[3] Or transferee or subtransferee of the mineral rights.

[4] Uisdean R. Vass, *A Comparison of American and British Offshore Oil Development During the Reagan and Thatcher Administrations (Pt. I)*, 21 TULSA L.J. 23, 28 (1985).

[5] *Id.* at 27.

lessee to bear all costs of exploration, extraction and marketing, and retains only a non-operating interest as a less risky asset.[6] Beyond the acquisition and development costs the operator-lessee assumes, such a producer is faced with other strategic concerns—allocation of scarce capital over multiple possible extraction sites, observation of sound extraction processes to avoid damage to the source of supply (including environmental liabilities), and (in the case of integrated producers) the quest for new sources of supply elsewhere to satisfy its open-ended inventory needs.[7]

In American law the mineral lease serves as both a conveyance of a form of real property interest and as a contractual arrangement between the parties,[8] and endures as long as there is "production in paying quantities."[9] U.S. federal tax treatment regards the two essential interests created by execution of the lease to be: (1) the working interest, which is the lessee's interest in mineral property that is burdened with the cost of development and operation of extraction;[10] and, (2) the reserved nonoperating interest, unburdened by development cost of the owner-lessor. The owner-lessor typically receives: payment of a bonus in return for his conveyance; delay rentals in return for the lessee's privilege of deferring exploration; and royalties once mineral production commences.[11] All other interests or payments connected with execution of a lease, whether "royalty interests, overriding royalties, net-profit interests, undivided interests," production payment obligations, or others, stem from the creation of these two interests and are briefly described below.

Royalty. The usual meaning of a royalty is a payment made to the landowner for extraction of a natural resource, based on output by value or on occasion at a fixed price per unit of output.[12] In states where the taxing authority is the natural resource owner, the economic benefit accrues invariably to the same entity, regardless of whether the royalty

---

[6] WESTIN & MURRAY, *supra* note 2, at 12. Of course, the landowner who grants a mineral lease remains subject to the inherent risk that unproductive assays or test wells on the leased tract may devalue the future lease value of his surrounding holdings.

[7] Charles O. Galvin, *The "Ought" and "is" of Oil-And-Gas Taxation*, 73 HARV. L. REV. 1441, 1447-49 (1960).

[8] *Id.* at 1485.

[9] *Id.* at 1486.

[10] Ava C. Cornwell, *Treatment of Oil and Gas Working Interests Under the New Section 469 Temporary Regulations*, 37 OIL & GAS TAX Q. 478, 480 (1988).

[11] Galvin, *supra* note 7, at 1482.

[12] *See* RICHARD A. WESTIN, SHEPARD'S TAX DICTIONARY 550-51 (1993-94) (providing definition of royalty and other relevant tax terms).

is imposed as a fee or a tax. Under U.S. common law a royalty may be created by grant or reservation under a mineral lease,[13] and commonly in the southwestern United States consists of one-eighth share of gross production.[14] Many standard leases provide for guaranteed payment of a minimum royalty regardless of production, which can be avoided by the lessee or sublessee by surrendering the lease.[15] A grantor-lessor may be entitled to other payments from the lessee in respect of long-term expectations of future production from leased land. Such payments are *delay rentals* if made in respect of mineral sites not yet subject to production, and *shut-in royalties* if associated with producing mineral land subsequently removed from production.

Bonus. Bonuses are payments to the owner for entering into the contract, payable without regard to production, and are generally perceived as a substitute for a larger stream of royalties. It assures the owner of income, and tests the confidence of the operator.

A bonus is rarely stated as a tax, although governments frequently insist on various bonuses along the path from exploration to development. For both the landowner and the government the reward is the chance to recover the opportunity cost associated with tying up the property. In some cases, the developer—as in the diamond industry—never plans to develop the property, and instead it relies on bonuses and lease payments to keep excess production off the market.

Overriding Royalty. In the southwestern United States this is typically a reservation of one-sixteenth of the leaseholder's seven-eighths interest in gross production, with an accompanying assignment of the working interest by sublease where both the overriding royalty and sublease are limited to the term of the underlying lease.[16]

When stated as a tax, a royalty serves the same purpose as for the landowner; it assures the government that it will receive revenues even if the taxpayer is unable to make a profit.

Net Profits Interest. This is a reservation or grant measured by a fraction of net profits rather than gross production. Its exact terms depend on the contract, but it is typically payable when the project produces a net cash surplus.[17]

Net profit interests become income taxes when exacted by a legislature. The base of such a tax, whatever its exact details, is gross

---

[13] WESTIN & MURRAY, *supra* note 2, at 13.

[14] Vass, *supra* note 4, at 28.

[15] WESTIN & MURRAY, *supra* note 2, at 22-3.

[16] Galvin, supra note 7, at 1441, 1478 n.108.

[17] *Id.* at 1478 n.109.

income minus appropriate expenses. Governments are as free as individuals to structure their details. Governments often enact a special natural resource-related tax law. Failing that, they modify their basic income tax rules to account for the peculiarities of the natural resources industry. The United States, for example, chose the latter path.[18]

Production Payment. This subordinate lease interest entitles the holder to a predetermined quantity of mineral production, or a fixed sum of money realizable out of production, over some term under the lease.[19] Both net profits interests and production payments may be conveyed either in return for direct investment, or to obtain the services of the driller, geologist, attorney, accountant and others,[20] all of whom thereby share in the ultimate success or failure of the project with no other liability on their part.[21] Production payments are often used as bases for lending money to the operator or landowner with respect to the natural resource project. Russia, for example, has reportedly pledged a large measure of its oil and gas wealth by means of loans collateralized by forms of production payments.

Production payments may arise in concessions, but they are not part of the natural resource tax systems. This is not surprising, because they are generally used as financing arrangements.

A. Definitions

Various economic and taxation terms discussed in nonrenewable resource literature may present initial confusion for the lay reader. To assist the reader, these can be summarized briefly.

Economic Rent. At this stage it may be worthwhile to elaborate on the meaning of "economic rent" and its applicability to real world situations. At its simplest, the concept of economic rent just means the ex post surplus or benefit that accrues to the owner from an activity, over and above what would be required by the owner to be induced to engage in the activity in the first place (i.e., ex ante).[22] It is one short step then to try to measure economic rent as the difference between the actual price received and the price which would be required to induce the

---

[18] WESTIN & MURRAY, *supra* note 2, at 9-10.

[19] Galvin, *supra* note 7 at 1478 n.111.

[20] *Id.* at 1489.

[21] For the majority of such interest-holders, tax on any gain realized from the venture has been mitigated by application of the sophisticated U.S. depletion allowance rules, which have usually subjected nonoperating economic interests in mineral extraction to percentage depletion allowance. *See* WESTIN & MURRAY, *supra* note 2, at 113-52.

[22] ALBERT M. CHURCH, TAXATION OF NONRENEWABLE RESOURCES 64 (1981).

owner to engage in the activity. The minimum price acceptable to the owner to induce him to engage in the activity would, of course, have to incorporate opportunity cost and, therefore, normal rates of profit on the activity (including payments for all factors of production, especially capital).

It is in the translation of this concept into practice, and in the examination of decision-making, both ex ante and ex post, that difficulties arise. These are difficulties of measurement, and also difficulties of getting agreement between the opposing parties on the measure. That is why any taxing authority that might have a view about economic rent as being "the maximum that can be taxed away" must not only have a view about the expected (i.e., ex ante) progression of the economic parameters of price and cost over time, but must also guess correctly as to what will be the outcome and, therefore, the resulting ability of companies to pay taxes. In what follows, the reader should be aware that these questions of "how time is handled" are complications on top of the simplified, and more or less steady-state framework within which such concepts of this Article are introduced.

A consistently positive economic rent is known as a "pure profit."[23] Since they are defined after all costs, pure profits are generally considered irrelevant to economic decision-making.[24] And since such post-decision taxes "impose no penalty on potential output"[25] they are generally viewed as a justifiable base for taxation[26] and a source of fascination for microeconomists and government tax planners. Theoretically, all positive economic rent or "pure profit" is allocable by the central taxing authority, once the producer's total costs (including that share of costs classifiable as sufficient producer's profits) are subtracted.[27] Economists therefore emphasize that non-distortional taxes should utilize pure profits as their tax base.[28] Economic rent can accrue to the owner in a free-wheeling situation, and to the state as the modern owner of the resource.

User Cost. A related term is user cost, also termed *resource rent* or *scarcity profit*, which has been called the opportunity cost of producing

---

[23] *Id.* at 62.

[24] CHRIS ROWLAND & DANNY HANN, THE ECONOMICS OF NORTH SEA OIL TAXATION 5 (1987).

[25] MALCOLM GILLIS ET AL., TAX AND INVESTMENT POLICIES FOR HARD MINERALS: PUBLIC AND MULTINATIONAL ENTERPRISES IN INDONESIA 153 (1980).

[26] ROWLAND & HANN, *supra* note 25, at 4.

[27] MERRIE G. KLAPP, THE SOVEREIGN ENTREPRENEUR. OIL POLICIES IN ADVANCED AND LESS DEVELOPED CAPITALIST COUNTRIES 69 (1987).

[28] ROWLAND & HANN, *supra* note 25, at 54.

from an exhaustible resource in the present, rather than deferring production to the most favorable future period,[29] at which time, if discovery and development costs continue to increase, the present value of a unit of proven reserve will be higher.[30] Another authority calls user cost "the amount that a fully informed, knowledgeable buyer would pay for the ownership rights to a resource *in situ*."[31] For the major OPEC oil producers, for example, with their large proven reserves and extensive undeveloped fields, user cost may be negligible, or even negative.[32] Taken together, the per-unit cost of extraction, plus user cost, determine market price.[33] Where technology and demand are constant, "user cost is positive and increases at the prevailing rate of interest," leading to increasing rates of market prices.[34]

Grading. The phenomenon of resource grading becomes significant when the student of resource economics abandons the assumption that individual resource deposits are of uniform quality and readily distinguished from their surroundings.[35] In the real world most known resource deposits are of varying quality. If the relative quality of the respective deposits are assayed and compared upon discovery, then assuming per-unit ore extraction costs are the same for all deposits and product prices remain constant over time,[36] economists commonly assume producers will "grade select," that is, maximize revenue by extracting resource deposits in diminishing order of their quality.[37] Eventually a production source will be reached which becomes prohibitively expensive to mine, and is left in place; this is known as the "cutoff grade."[38] Unless per-unit ore extraction costs change thereafter, product grades lower than the cutoff grade will not be extracted, a phenomenon known as "high-grading." High grading can only be studied in the context of models that permit variations in the total amount extracted, either through modeling that involves exploration for new

---

[29] Robert D. Cairns, *A Model of Exhaustible Resource Exploitation With Ricardian Rent*, 13 J. ENVTL. ECON. & MGMT. 313, 313 (1986).

[30] M.A. Adelman et al., *User Cost in Oil Production*, 13 RESOURCES & ENERGY 217, 223 (1991).

[31] CHURCH, *supra* note 23, at 37.

[32] Adelman et al., *supra* note 31, at 235.

[33] CHURCH, *supra* note 23, at 40.

[34] *Id.* at 65.

[35] Cairns, *supra* note 30, at 314.

[36] GILLIS, *supra* note 26, at 64.

[37] Economic equations supporting this intuitively logical position are set out in PARTHA S. DASGUPTA & GEOFFREY M. HEAL, ECONOMIC THEORY AND EXHAUSTIBLE RESOURCES 172-74 (1979).

[38] Cairns, *supra* note 30, at 314.

reserves or permits extracted cost to vary in relation to the size of the remaining reserve.[39]

Tilting. Tilting refers to a reallocation of resource production, either forward or backward along a derived resource extraction time path.[40] Less extraction of an exhaustible resource in earlier time periods, offset by greater extraction in later periods, is termed "backward tilting," while greater extraction in earlier times, resulting in lower production later on, is "forward tilting." Such skewing of the production path need not necessarily result in changes in cumulative extraction or changes in total production.[41] The significance of tilting as a potential source of economic distortion lies in the risk that, through the imposition of a particular tax, extraction will be propelled toward periods where the present value of taxes is lower, depriving the taxing authority of part of its anticipated revenue from taxation.[42]

Tax Shifting and Exporting. Tax shifting refers to the response of a resource producer upon whom a tax is imposed, in reallocating resources so that some portion of the ultimate burden of the tax is borne by others, usually through changes in price of affected commodities.[43] Any incidence of shifting implies that the initial tax burden is not falling on true economic rent as defined above.[44] In the process of shifting, inefficient allocation of resources can occur, leading to a return in revenue to the taxing authority which is *less* than the aggregate burden of the tax itself.[45] An implicit assumption of ordinary tax shifting is that the cumulative effects of tax are confined to the economic unit where the tax arises. Tax exporting occurs whenever some portion of the burden of a tax can be shifted beyond the borders of the taxing authority.[46] In the context of nonrenewable resources, tax exporting may occur

---

[39] ROBERT T. DEACON, RESOURCES FOR THE FUTURE (ENERGY & NATURAL RESOURCES DIV.), TAXATION, DEPLETION, AND WELFARE: A SIMULATION STUDY OF THE U.S. PETROLEUM RESOURCE 21 (1990).

[40] *Id.* at 1.

[41] Margaret E. Slade, *Tax Policy and the Supply of Exhaustible Resources: Theory and Practice*, 60 LAND ECON. 133, 139 (1984).

[42] Jeffrey A. Krautkraemer, *Taxation, Ore Quality Selection, and the Depletion of a Heterogeneous Deposit of a Nonrenewable Resource*, 18 J. ENVTL. ECON. & MGMT. 120, 133 (1990).

[43] CHURCH, *supra* note 23, at 56-7 (providing an explanation of tax-shifting in the context of an elementary supply-demand situation).

[44] Mandy J. Wahby, *Petroleum Taxation and Efficiency: The Canadian System in Question*, 9 J. ENERGY & DEV. 111, 112 (1984).

[45] CHURCH, *supra* note 23, at 94-5.

[46] *Id.* at 109.

whenever the taxing authority dominates the resource market,[47] and may take either the form of an implied tax on the capital of nonresident investors, or, whenever the nonrenewable resource is exported, an implied tax on the nonresident consumers of products made from the resource.[48] The relative elasticities of the supply of capital and of consumer demand for the resource will determine upon which of these objects the incidence of such an implied tax falls.[49]

Ring Fencing. Ring fencing is not at all an economic effect. Rather it is a tax device used by resource-taxing states to avoid risk sharing on unprofitable operations by refusing to allow an enterprise to set off expenses or losses from such projects against profitable projects, in periods where the enterprise is engaged in a variety of operations.[50] For example, in calculating corporate taxes for North Sea oil producers, Britain has employed a "ring fence around oil exploration and production activities in the U.K. and its Continental Shelf."[51]

B. Central Assumptions

Certain explicit and implicit assumptions underlie the economic analyses surveyed here. The first is that the supply of the resource is finite and exhaustible through extraction under competitive incentives for production.[52] For most purposes, a steady-state technology, composed of a menu of known industrial techniques, is also assumed. That assumption is based on the fact that a firm may, in theory, compensate or offset all or part of the incidence of an output tax by adopting a technology with a lower per-unit production cost, the capital acquisition and start-up costs of which are not negligible. In addition, such offsets only provide per-unit savings over the long term, absent tax or other incentives for such adoption. A third assumption is that an international market for the resource exists at all times, so that there is a free market world price for the resource. A fourth, related assumption is that no major effects on the international market will be created by the act of bringing the anticipated resource output online, and that all of the resource output that can be produced can be sold at current market

---

[47] *Id.*

[48] *Id.*

[49] ROWLAND & HANN, *supra* note 25, at 55.

[50] Kameel I. F. Khan, *Petroleum Taxation and Contracts in the Third World-A Law and Policy Perspective*, 22 J. WORLD TRADE, 67, 76-7 n.24 (1988).

[51] ALEXANDER G. KEMP & DAVID ROSE, INVESTMENT IN OIL EXPLORATION AND DEVELOPMENT 7 (1982).

[52] DEACON, *supra* note 40, at 20.

prices.

III. VARIABLES AMONG ECONOMIC MODELS

Economic research on taxation of nonrenewable resources has its genesis in the field of ore mining and processing. Nevertheless, those commentators who have focused specifically on hydrocarbon extraction have proceeded on essentially identical assumptions, and reached comparable conclusions regarding the effects of taxation on production decisions. However, certain recent writers have addressed important variables of resource development models, and to the extent that their works have introduced new factors or challenged underlying assumptions, their efforts need to be briefly noted here.

A principal economic variable is the difference between a monopolistic and a competitive resource extraction model. A competitive market for exploration and exploitation rights bears directly on the level of economic rent the state may allocate to itself in tax revenues. Since, as noted previously, economic rent equals total resource revenue less total costs, including a producer's profit,[53] "the greater the competition among private companies for access to resource sites, the smaller will be the profit share they are willing to accept in order to gain access"[54] and the greater total portion of economic rent accruing to government revenue. Viewed purely in the exploration mode, such competition for licenses may have a down side. British authors suggest that intense competition for exploratory licenses and the successively higher bids required to obtain licenses may displace other opportunities of commensurate value or increase the company's borrowing costs, thereby lowering anticipated profits and inhibiting further exploration.[55]

On the other hand, a monopolistic producer with complete control over resource production, and therefore the ability to affect prices, will maximize profits by extracting the resource more slowly than if the industry were organized competitively, and therefore behave in a manner that is overly conservative of the resource.[56] In his research, Yücel confirms that "the rate of extraction and the overall level of exploration are lower and prices are higher with a monopolistic producer," and "the amount of reserves left in the ground at the end of the time horizon is

---

[53] *See supra* note 26 and accompanying text.

[54] KLAPP, *supra* note 28, at 69.

[55] ROWLAND & HANN, *supra* note 25, at 14.

[56] CHURCH, *supra* note 23, at 43-4.

generally higher for monopoly."[57]

Central to conclusions regarding resource grading and the cut-off grade determination are the assumptions made regarding the resource-composition alternatives available for immediate extraction by producers. Successive studies have considered a homogeneous deposit or deposits,[58] multiple deposits—each of which are intrinsically homogeneous but of varying quality when compared among themselves,[59] and resource deposits of varying intrinsic quality.[60] Although the quality variable is, in the context of grade selection, usually confined to discussions of resources which are mined, hydrocarbon deposits which may or may not require additional processing due to the presence or absence of associated contaminants such as paraffin, sulfur and sour gases, are probably true analogs to the heterogeneous ore deposit. While the effects of particular taxes on various deposit models are provided in the next section, the principal difference in determining grade between deposits known to be internally homogeneous and those known in advance to be heterogeneous is that, if the nature of deposits is known, the grade choice in the first case can be more carefully considered, resulting in less wasteful extraction than is the case with heterogenous deposits, where the grading decision must be constantly reassessed and redetermined.[61]

While many economists addressing nonrenewable resources assume that extracted resources are sold directly (and any output or other taxes imposed upon such unprocessed resource sales), others have assumed taxation at an intervening stage of refining or processing prior to the commodity leaving the producer's hands.[62] Such a modified assumption is both logical (since states may and do impose taxes at varying stages of resource production) and relevant, since taxes imposed at early stages of production are invariably passed on to later buyers. Moreover, the

---

[57] Mine K. Yücel, *Severance Taxes and Market Structure in an Exhaustible Resource Industry*, 16 J. ENVTL. ECON. & MGMT. 134, 139 (1989).

[58] H. Stewart Burness, *On the Taxation of Nonreplenishable Natural Resources*, 3 J. Envtl. Econ. & Mgmt. 289, 290-91 (1976).

[59] Robert F. Conrad & Bryce Hool, *Resource Taxation with Heterogeneous Quality and Endogenous* Reserves, 16 J. PUB. ECON. 17 (1981) [hereinafter *Resource Taxation*].

[60] Krautkraemer, *supra* note 43, at 133.

[61] *Id.* at 120-25, 133-34. *See also* Burness, *supra* note 59, at 290-94; *Resource Taxation*, *supra* note 60, at 19-22. *Cf.* DOUGLAS R. BOHI & MICHAEL A. TOMAN, ANALYZING NONRENEWABLE RESOURCE SUPPLY 43-49 (1984) (providing a theoretical model for development of "joint products" found together, such as gold and silver, in the belief that an assumption of homogenous product is often wrong).

[62] *See, e.g.*, GILLIS, *supra* note 26, at 110 ("Relatively little attention has been given in the economic literature to the harmful effects that output-based taxes may have on concentration decisions and other minerals-processing decisions.").

resource producer which is vertically integrated entirely within the taxing authority's jurisdiction will experience the amplified distortions of a tax imposed on initial (raw) output, or on multiple stages of production, unless the cumulative tax burden can be ultimately exported.[63]

Classic economic models, as noted previously, assume both fixed, and therefore fully exhaustible mineral reserves and an extraction cost which does not vary with cumulative past output or remaining reserves.[64] Such assumptions have significance for related assumptions regarding competitive price trends over time, generally conceived as moving gradually upward.[65] But some recent writers part with these assumptions in models of oil and gas supply, noting that as a practical matter the assumption of incomplete physical exhaustion seems more appropriate. Resource deposits such as oil are not completely exhausted but are abandoned long before this point because they become uneconomical to extract.[66] From his study of classical full exhaustion models, Adelman concludes that "given the fixed-stock assumption, the value of a unit in-ground should equal the spot price net of extraction cost."[67] This theoretical equality is not borne out in then-current world market prices, under which oil in the ground is worth roughly one-half of its net wellhead price, and coal reserves are usually less than one percent of the world spot price.[68] What we observe in the real world, says Adelman, "are not one time stocks immaculately created to be consumed, but inventories of 'proved reserves,' constantly renewed by investment in finding and development. Over time, the investment needed per unit-added is forced up by diminishing returns, and forced down by increasing knowledge."[69]

Bohi and Toman therefore conclude that the economist Hotelling's "*r* percent rule," i.e., that rates of return per physical unit of the resource are equal to the discount rate "has limited practical applicability, despite its widespread use. To fully understand the dynamics of resource supply, it is necessary to use more complex models that recognize both depletion effects and additions to reserves through exploration and development."[70]

---

[63] For a thorough discussion of these principles, *see generally* Slade, *supra* note 42.

[64] *See* BOHI & TOMAN, *supra* note 62, at 23.

[65] DASGUPTA & HEAL, *supra* note 38, at 179.

[66] BOHI & TOMAN, *supra* note 62, at 13.

[67] Adelman, *supra* note 31, at 222-23.

[68] *Id.*

[69] *Id.* at 218.

[70] BOHI & TOMAN, *supra* note 62, at 25.

IV. SURVEY OF NONRENEWABLE RESOURCE TAX MODELS

Property Tax Model. Since Hotelling's premier study in 1931,[71] there has been general agreement among economists that imposition of a property tax on the value of a nonrenewable resource deposit in the ground tends to accelerate resource extraction,[72] and this extraction will also tend to be concentrated on the higher grades.[73] Gamponia and Mendelsohn note that the burden of the property tax primarily falls upon the owner of the resource, so that "the shift of extraction from the future to the present increases the present value of consumer surplus, even though the total value of the resource falls."[74] The owners are subsidizing consumers in the owners' effort to avoid paying taxes.[75] This rapid extraction of proven reserves of any taxed resource is combined with a slowdown in drilling programs in the case of petroleum, so as to diminish taxable reserves.[76]

Other writers have focused on the uncertain assumptions inherent in capitalizing estimated reserves of a resource for tax purposes, a point made by Burness, who observed that firms tend to report exploration costs rather than the value of reserves which would be quite arbitrary even if firms chose to report this figure.[77] Church reports that virtually all jurisdictions employing in-ground property taxes have ceased to rely on capitalizing techniques.[78]

> In order to determine annual net income for the life of the mine, accurate forecasts of revenues and costs must be made. This entails knowing future prices and the costs of extraction, processing, and transporting the resource. Additionally, the rate of extraction and economically exploitable reserves determine mine life, and this must be estimated as well. Once the net annual profit is calculated from these data, it must be

---

[71] Harold Hotelling, *The Economics of Exhaustible Resources*, 39 J. POL. ECON. 75 (1931).

[72] *See, e.g.*, CHURCH, *supra* note 23, at 67-8 (providing a numerical example of the effects of property taxes on the rate of extraction in the context of mining); DEACON, *supra* note 40, at 23; Gamponia & Mendelsohn, *supra* note 1, at 165; Krautkraemer, *supra* note 43, at 129-30; *see generally Resource Taxation*, *supra* note 60.

[73] *Resource Taxation*, *supra* note 60, at 29.

[74] Gamponia & Mendelsohn, *supra* note 1, at 177-78.

[75] *Id.* at 165.

[76] DEACON, *supra* note 40, at 17.

[77] Burness, *supra* note 59, at 298 n.10.

[78] CHURCH, *supra* note 23, at 79.

capitalized . . . .[79]

Since the information necessary to make such estimates is rarely available, most jurisdictions instead employ a discounted cash flow analysis.[80]

A few economists have considered the effects of a property tax on exploration, and have typically found that such a tax discourages exploration and related development, on the assumption that increased identified reserves increases total potential tax liability, and thus increases carrying costs over the life of the project.[81]

Franchise or License Tax. The form of tax most closely related to the *in situ* property tax is an annual franchise or license tax on the firm's right to extract the resource, considered by Burness [82]and by Heaps.[83] Since "the franchise tax is one that can be avoided by reducing the length of time the [resource site] is in operation," imposition of the franchise tax "causes increased rates of extraction and earlier resource depletion."[84]

Output Taxes. Generally speaking, severance taxes are of two types: a flat per-unit tax on production, and a tax imposed ad valorem calculated as a proportion of the value of annual production. The latter form of severance tax is frequently termed a royalty.[85]

Per-unit severance taxes on production have received less attention from economists than have royalties.[86] Measurement of the effects of a per-unit tax on output and grading depends on how the unit price and the rate of unit tax vary with time. A common assumption of economists, generally borne out in reality, is that given constant demand, unit prices tend to increase over time.[87] To the extent that the unit tax rate remains constant in such an environment (either through legislation or through contractual agreement with producers) the magnitude of the effects of such a tax on production and grade selection ought to diminish over time. To the extent resource producers adhere to this assumption, there

---

[79] *Id.*

[80] *Id.*

[81] *See* CHURCH, *supra* note 23, at 75 (summarizing other writers' conclusions).

[82] Burness, *supra* note 59, at 294-95.

[83] Terry Heaps, *The Taxation of Nonreplenishable Natural Resources Revisited*, 12 J. ENVTL. ECON. & MGMT. 14, 21 (1985).

[84] *Id.* at 21; *see also* Burness, *supra* note 59, at 295.

[85] *See supra* notes 13-16 and accompanying text. These do appear never to have any analogy in the free-wheeling oil and gas industry, probably because it is too rigid.

[86] *See* Wahby, *supra* note 45, at 112; DEACON, *supra* note 40, at 12; Krautkraemer, *supra* note 43, at 128-29.

[87] Or, more specifically in economic terms: "User cost grows at the rate of interest." CHURCH, *supra* note 23, at 41.

exists an incentive to defer production of the resource to the future. Nevertheless, many natural resource commodities have experienced spectacular falls in short to medium-term unit prices on world markets over the last two decades. Such a fall would have a strong adverse effect on profits of any resource producer subject to a politically determined constant tax on unit output. The difficulties for taxing authorities and resource investors alike in gauging future movements in both world resource prices and unit tax rates is appreciable. That is one of the reasons for the attraction of taxes based on profits in some jurisdictions.

Ad valorem severance taxes more commonly provide a basis for study and discussion. A severance tax, as noted, is a fixed proportion of the value of current output calculated at the current market price.[88] Since the per-unit market price for any period is variable, the per-unit value of the severance tax also fluctuates. Economists generally agree that the imposition of a severance tax tends to shift extraction into the future, when the present value of the tax is less.[89] This tendency is generally regarded as conserving the known resource reserve. That assumption has been qualified in a study by Yücel, who observes that a severance tax decreases exploration, leading to lessened additions to new reserves.[90] Because "additions to the initial resource stock from exploration are less," the result is a "lower level of resources at the end of the time horizon."[91] An output-based tax is generally viewed as not discriminating between the differing qualities of resource product being extracted. Since a producer is assumed to have the ability to discriminate in deciding whether to develop mines or fields of marginal quality, it will forego those investments in production where extraction costs are higher, or product quality lower, than the standard level assumed in imposing the tax, causing loss of potential product revenue to the taxing entity.

Corporate Income and Profits Taxes and Incentives. A corporate income or profits tax on resource production, if constant over time, is borne entirely by the firm.[92] "Since in the short run neither the price received for the mineral nor the cost of obtaining it are affected by the income tax, the mine operator has no reason to raise the cutoff grade or to change the rate of production."[93] Recent economists have concluded,

---

[88] *See supra* note 86 and accompanying text.

[89] *See* DEACON, *supra* note 40, at 20-2; *Resource Taxation*, *supra* note 60, at 26-7; Gamponia & Mendelsohn, *supra* note 1, at 178-79; Krautkraemer, *supra* note 43, at 121.

[90] Yücel, *supra* note 58, at 147.

[91] *Id.*

[92] Wahby, *supra* note 45, at 114-15. This is the government analog of a net profits interest.

[93] GILLIS, *supra* note 26, at 66.

virtually without exception, that such a tax will have no net effect on market price, the rate of extraction, grade selection, or total output recovery from an operating mine or field.[94] By virtue of its neutrality most regard such a tax as the least oppressive means of collecting economic rent.[95] Clearly greater attention might be paid in the economic literature to the point in the production chronology at which an initial income or profits tax should be imposed. Slade is exceptional in separating the exploration and production models, and in pointing out the role an existing profits tax may have in discouraging investment at the time decisions whether to commence exploration activities are made.[96]

Economists are also less than precise in defining the elements of the taxable income upon which tax is to be imposed. Deacon provides a good general guide, noting that to the degree provisions are included for expensing capital outlays, the income tax will come to resemble a tax on the cash flow of the industry, and thus be relatively distortion free in its effect.[97]

Some analysts point to the differing effects an income or profits tax produces when it is not constant, but is instead increasing. Rowland and Hann assert that "it is not relevant to development decisions whether a tax is progressive... as long as the tax base is pure profits."[98] However, if an income tax is raised, or the costs of production under a progressive model income tax increase

> to a level at which the costs of capital cannot be covered, then equipment will not be replaced, and the mine may be shut down sooner than had been planned before the tax increase. Thus in the long run, income tax increases can also lead to high grading, shortening the life of the mine and reducing its total mineral output.[99]

The effects of combining a depletion allowance with a system of

---

[94] *See, e.g.*, Burness, *supra* note 59, at 302; *Resource Taxation*, *supra* note 60, at 30; Robert F. Conrad & R. Bryce Hool, *Intertemporal Extraction of Mineral Resources Under Variable Rate Taxes*, 60 LAND ECON. 319, 324 (1984) [hereinafter *Intertemporal Extraction*]; Gamponia & Mendelsohn, *supra* note 1, at 167; Krautkraemer, *supra* note 43, at 121; Slade, *supra* note 42, at 142; Wahby, *supra* note 45, at 115-16.

[95] Khan, *supra* note 51, at 74.

[96] Slade, *supra* note 42, at 142-43.

[97] DEACON, *supra* note 40, at 22.

[98] ROWLAND & HANN, *supra* note 25, at 46.

[99] GILLIS, *supra* note 26, at 66.

profits taxation are frequently discussed.[100] A depletion allowance is a tax incentive or subsidy to production often authorized as a deduction from income in connection with profits tax schemes, and is not neutral in its effects on output or grade selection. Depletion allowances may take the form either of cost depletion (a fixed monetary allowance per unit of output) or percentage depletion (a fixed proportion of the current value of output). Under the well developed U.S. depletion incentive system, as resource interests are used up, cost depletion causes a ratable reduction in basis while percentage depletion permits deductions in excess of basis.[101] The market-sensitive system of divided mineral interests ensures each interest holder may claim a depletion deduction on his own share.[102] For example, a lease bonus paid to the lessor of a working mineral interest, taxed as ordinary income when received, is subject to cost depletion only, and reduces the bonus recipient's basis in his retained interest.[103] The generally accepted economic tendencies of depletion allowances are to reallocate resource extraction from the future to the present,[104] and decrease the extraction source's present value.[105]

Windfall or Excess Profits Tax. Certain taxes are intended to capture levels of pure profit so far in excess of the rate of return required for making the investment that they have no bearing on investment, exploration or development decisions.[106] These profits may, therefore, be captured by the state in their entirety. Such extraordinary returns may be due to unusually large or exceptionally high quality resource discoveries, or may be caused by unprecedented and unanticipated rises in the world price of the commodity—well above the prices in force at the time the state's tax base was last determined, as in the case of certain crude oil windfall profits taxes imposed in the 1980's. A windfall or excess profits tax may, if set above the true level of extraction cost including producer's profit, be truly nondistortionary and neutral in capturing pure economic profit or revenue. In practice, the difficulty falls in computing the profit level at which the tax commences for industries in which producers do not typically provide information on rates of return.[107] According to one authority, "if the gains (or losses) [of mineral extraction] were even remotely anticipated, then they should be

---

[100] *Resource Taxation, supra* note 60, at 30-31.

[101] WESTIN & MURRAY, *supra* note 2, at 113, referring to U.S. practice.

[102] *Id.* at 14.

[103] *Id.* at 116.

[104] *Resource Taxation, supra* note 60, at 30 n.17.

[105] CHURCH, *supra* note 23, at 81.

[106] Khan, *supra* note 51, at 78.

[107] *Id.* at 79.

viewed as a reward (or penalty) for bearing risks and hence must be excluded from pure profits."[108]

V. THE OPTIMAL NONRENEWABLE RESOURCE PLAN AS A NATIONAL OBJECTIVE

Even with this well-developed and growing body of economic theory available to state tax planners, the place of the efficient economic model of resource taxation in the hierarchy of national objectives a state must consider is sometimes in doubt. Some of the economists who have practical experience with state policies have noted a real dichotomy between policy choices for initial exploration and for ongoing exploitation, a difference rarely suggested in the theoretical literature.[109] One practical problem has been dealt with by Campbell and Lindner, who note a major disfunction in models that propose taxation of exploration and production as a continuum: while "mineral taxation will be neutral if all costs can be deducted against taxable income . . . firms which conduct exploration programmes which result in a decision not to mine, or firms which decide to mine when realised net present value turns out to be negative may have no taxable income against which losses can be deducted."[110]

With particular regard to oil exploration, one study of a dozen state systems of petroleum taxation concluded that "the majority of the fiscal systems are structurally unhelpful to the needs of a risk-averse investor contemplating the development of high cost fields."[111] One reviewer has identified ten distinct forms of risk that must be identified and evaluated by the international minerals developer and its financiers: reservoir, completion, technology or production, market, co-participant, cost overrun, operator, political, foreign exchange and force majeure.[112] At least two of these, political and foreign exchange risk, would appear to have no direct analogs in U.S. domestic mineral production.

Even when the policy goal of the state is confined to raising maximum revenue from taxing an exhaustible resource with a minimum of economic distortion, the state is confronted with a host of considerations beyond the purely economic concerns addressed thus far.

---

[108] ROWLAND & HANN, *supra* note 25, at 5.

[109] H.F. Campbell & R.K. Lindner, *A Model of Mineral Exploration and Resource Taxation*, 95 ECON. J. 146, 154 (1985).

[110] *Id.* at 154.

[111] KEMP & ROSE, *supra* note 52, at 34.

[112] Richard A. Ladbury, *Financing Resource Projects*, 62 AUSTL. L.J. 937, 937-43 (1988).

In practice, these may be discussed according to the groupings set forth by Sneed:[113] adequacy, practicality, equity, reduced economic inequality, free market compatibility, stability and maintenance of political order. Church ranks common nonrenewable resource taxes upon criteria similar to Sneed's.[114]

In recent reports on the experiences of developing nations, accounts of difficulties of administration (Sneed's "practicality") with otherwise model taxes figure largely. As noted previously, while the property tax is not difficult to administer, fervent discussions take place among economists as to whether such a tax can ever be said to be administered "correctly," because of the difficulties inherent in evaluating the capitalized worth of the resource property remaining. Relatively few sales of resource property at published prices take place for comparison, and Church gives a summary of the criticisms usually made of the two most widely used formulas for capitalizing present income streams to yield property value.[115] In their report on Indonesia, Gillis and Beals note a substantial "compliance problem" related to the corporation income tax, which did not apparently extend to Indonesia's output-based export tax.[116] Writing on petroleum taxation in Canada, Wahby also notes that gross-output taxes, while "held in low esteem by economists," remain popular with state governments because the data needed to calculate the tax are easily obtainable and costs of enforcement are low.[117] Unlike income taxes, one need not deal with the accounting principles behind depletion, costs, and depreciation deductions.[118] Worst of all to administer are excess profits taxes. Gillis and Beals conclude that "the more successful are such [excess profits] taxes in capturing 'windfalls,' without harmful side effects, the more complex—and, very likely, difficult to administer—must be their structure. And the more easily administered are excess profits taxes, the less is it likely they will adequately capture rents."[119]

As to free market compatibility, Gillis and Beals succinctly note the five potentially significant ways output-based taxes distort free market production decisions, each of which has already been discussed here. Such taxes may: "1) distort the initial investment decision by causing

---

[113] Joseph J. Sneed, *The Criteria of Federal Income Tax Policy*, 17 STANFORD L. REV. 567 (1965).

[114] CHURCH, *supra* note 23, at 87-92.

[115] *Id.* at 76-80.

[116] GILLIS, *supra* note 26, at 87.

[117] Wahby, *supra* note 45, at 114-15.

[118] *Id.*

[119] GILLIS, *supra* note 26, at 155.

some projects not to be developed; 2) give rise to 'high grading' of [resource deposits]; 3) shift extraction to the future; 4) cause postponement of extraction of better grade [deposits]; or 5) reduce total recovery from a given [deposit]."[120]

As already noted, excess profits taxes earn high marks for being free of market-distorting effects.[121] Because such taxes are triggered by a specific rate of return on total investment and not on equity investment, they do not distort weak and average operations. In addition, in cases of highly profitable operations the state obtains an additional share, without having to disturb underlying contractual arrangements.

As to stability, it is suggested that government and private producers each view entirely different taxes as inherently more stabilizing to revenue. Under a royalty arrangement, government revenues are more stable, while "the company experiences less variation in its after tax income" under an income tax regime.[122] The stability of return on private capital under an income tax has particular significance for exploration. This is true because, all other things being equal, investors do not like risk, and as countries' use of income taxes increase exploration activity increases.[123] On the other hand, the stability of revenue to the taxing authorities attainable under royalty arrangements is doubtless one reason such arrangements still exist.

VI. NONRENEWABLE RESOURCE TAX SCHEMES IN PRACTICE

Given the disparity in identified resources among various nations, direct comparison of their systems for exhaustible resource taxation would be futile. It would be almost as unrewarding to weigh individual nations' tax schemes against the most approximate economists' model for such tax; almost no country relies on a single revenue-producing levy on any mineral, and the varieties of hybrid forms are legion. However, clearly dysfunctional mineral development schemes are rich laboratories for further study, and nations which have repeatedly altered their resource tax systems in recent years provide a basis for internal comparisons, particularly when such tax programs are charted against the variations in revenue that accompanied them.

The United Kingdom's experience in taxing its North Sea oil discoveries has been much discussed. Since 1976 Britain has relied on

---

[120] *Id.* at 160.

[121] *See supra* notes 107-109 and accompanying text.

[122] *Id.* at 60.

[123] *Id.*

three separate levies, as amended from time to time: (1) a royalty levied at the well-head, at rates tied to the timing of issuance of the particular license for the oil's source; (2) a corporate profits tax (CT) calculated at 52%; and (3) the Petroleum Revenue Tax (PRT) on profits, calculated at 45%.[124] As noted above, Britain employs ring-fencing to prohibit North Sea profits from being offset by North Sea losses. From the standpoint of the entrepreneurial risk taker, the U.K. system of offshore ring fencing "prevents tax losses and double tax relief derived elsewhere being used against North Sea profits and restricts the capacity of the companies to obtain relief for advance corporation tax."[125] While PRT is deducted from the corporate income on which CT is then levied,[126] CT has been criticized by British economists as distortional because it is "a tax on the excess of revenues over historic costs, and may affect development decisions since historic costs are a poor reflection of normal returns on capital."[127] One study calculated that the share of economic rent taken by the government from offshore fields under this arrangement varied from 22% on fields of very low profitability to almost 75% on large, highly profitable fields.[128] That study revealed a considerable disparity between incentives to present and newly entering producers. For an ongoing, taxpaying investor, new field developments are not inhibited,[129]while the percentage of tax take in present value terms for new investors can reach very high levels under adverse operating conditions, exceeding 100% of economic rent in some cases, and possibly inhibiting new field development.[130]

From 1986 to 1992, Norway utilized a petroleum tax system composed of: (1) a capital tax at 0.3%; (2) a general corporate (municipal) tax of 23%; (3) a general (national) corporate tax of 27.8%; (4) a special tax of 30%; and (5) a production royalty (deductible from income tax) between 8 and 16%.[131] State participation, never less than 50% and often higher under Norwegian licensing procedures, can result

---

[124] TERENCE DAINTITH & B. G. D. M. WILLOUGHBY, A MANUAL OF UNITED KINGDOM OIL AND GAS LAW 91 (1977).

[125] J. A. KAY & M. A. KING, THE BRITISH TAX SYSTEM 191 (3d ed. 1983).

[126] *Id.* at 190.

[127] ROWLAND & HANN, *supra* note 25, at 58.

[128] A. Kemp, *Development Risks and Petroleum Fiscal Systems: A Comparative Study of the UK, Norway, Denmark and the Netherlands*, 13 ENERGY J. 17, 23 (1992).

[129] *Id.* at 28.

[130] *Id.* at 29.

[131] Stig Sollund, *Norway. 1992 Petroleum Tax Reform*, 1992 EUR. TAX'N 222, 222. (As part of the reform discussed by Sollund, Norway has recently reduced the combined corporate tax burden–items (2) and (3) above–from 50.8% to 28% for all corporations.)

in total government takes of between 80% and 90%. However, such participation is on a full risk sharing basis, which means that while it provides some downside protection to investors the overall potential for return on investment is reduced as well.[132]

The Netherlands, a third North Sea oil producer, employs the traditional three resource taxes: a royalty, a corporate tax (CT) and a special petroleum tax based on profit share (SPS).[133] The Netherlands essentially calculates royalties and SPS on a per-field basis,[134] and while royalties are as usual deducted from profits in calculating the two profits taxes, "the interdependence between CT and SPS takes a special form: SPS is deductible from the base of CT while CT is creditable against SPS."[135] The royalty has been criticized as a regressive element whose negative impact on development increases at high levels of development cost.[136] Nevertheless, overall offshore development costs are low compared to other North Sea producers, and total government take has been estimated at between 60% and 70%.[137]

The author of the recent study on North Sea oil taxation from which these tax rates estimates come concludes that in none of the countries is there a fiscal system which is directly targeted at economic rents, but in all except the Netherlands the schemes are now entirely profit-related—a significant structural improvement from the regimes introduced in the 1970s.[138] Other countries have also attempted to introduce more profit and field sensitive schemes.

Ghana relies on its Petroleum Income Tax Law, imposing a tax of 50% of "chargeable income" but allowing a different percentage or alternatively another kind of tax "in lieu of income tax" to be negotiated under a petroleum agreement between the state and the hydrocarbon producer.[139] Even though such a negotiated tax would presumably be lower than the statutory rate,[140] the device has been criticized on grounds of equity and certainty because of the sensitive nature of the industry and its ramifications in both domestic and international politics.[141]

---

[132] Kemp, *supra* note 129, at 28.

[133] Dominique Thon, *A Note on the Structure of the Dutch Petroleum Taxation System*, 6 J. ENERGY & NAT. RESOURCES L. 162, 162 (1988).

[134] *Id.* at 163.

[135] *Id.* at 162.

[136] Kemp, *supra* note 129, at 37.

[137] *Id.*

[138] *Id.* at 37-8.

[139] R. Bannerman, *Ghana's Petroleum Tax Law*, INT'L FIN. L. REV. (January 1989) 35, 35.

[140] *Id.*

[141] *Id.* at 36.

Australia employs an additional profits tax on petroleum, known as the Resource Rent Tax (RRT), which has been adopted by developing countries.[142] Introduced in 1984, the tax applies to new offshore fields on a project basis, and replaces earlier excise and royalty tax schemes where it applies.[143] The RRT is "payable only after the oil company has recovered its cost and earned an agreed threshold rate of return. . . . The tax is levied on the accumulated value, i.e., value of cash receipts less total outlay, in the year it becomes positive."[144] Because the risk-taking entrepreneur is assured full capital recovery plus profit return, regardless of price changes, field size, production and cost conditions the tax has been touted as helping to maximize economic rent with a minimum of distortion.[145]

Papua New Guinea's current tax structure, developed with the assistance of Australian economists, combines an RRT above a threshold return to investment of 15% with the country's pre-existing ad valorem royalty (1.25%), a Flat Profits Tax (33.3%), an Additional Profits Tax (APT), and a Withholding Tax of 15% on dividends paid to foreign shareholders, for a total tax rate of 70% on profits above the threshold return.[146] Under the Papua New Guinea system, "which combines low rates of royalty and flat rate profits tax, a high rate of tax on 'above-normal' profits and a provision for accelerated depreciation for marginal mines," the national government has managed to capture a high proportion of presumed pure profits from extraction "while ensuring continued investment in exploration and in existing and new mines."[147]

Namibia, a still largely unexplored area for hydrocarbons, recently adopted a petroleum tax scheme appropriately tailored for a state at the outset of minerals development, composed of (1) a 12.5% legislated royalty, negotiable for marginal fields;[148] (2) an income tax on 42% of taxable income; and, (3) a three-tiered, partially negotiable additional profits tax which is based on a company's rate of return calculated at successive levels of 15, 20 and 25% with the APT on the 15% tier fixed

---

[142] Khan, *supra* note 51, at 78.

[143] Michael Hunt, *Government Policy and Legislation Regarding Mineral and Petroleum Resources*, 62 AUSTL. L.J. 841, 862 (1988).

[144] Khan, *supra* note 51, at 78.

[145] *Id.* at 79.

[146] Ciaran O'Faricheallaigh, *Mineral Taxation in Less Developed Countries: Papua New Guinea's Balanced System*, 45 AM. J. ECON. & SOC. 291, 293 (1986).

[147] *Id.* at 294.

[148] M.P. Light & H. Shimutwikeni, *Namibia, Practically Unexplored, May Have Land, Offshore Potential*, OIL & GAS J. (April 8, 1991) 85, 86.

at 25% and subsequent tiers at negotiable rates.[149] No signature, levy, production or bonus payments must be paid to the government,[150] and Namibia's version of ring fencing for cost accounting "[o]perates on an original exploration license area basis, not field by field, allowing developers to recoup total expenditure at a faster rate."[151]

VII. SOURCES OF REAL WORLD DISTORTION FROM ECONOMIC MODELS OF TAXATION

Shortfalls in Tax Administration. One principal distortion of national tax policy discussed in recent years is the rise, for political reasons, of state enterprises to run mineral operations, often with privileged tax treatment and consequent revenue decreases.

Distorting Effects of Competing Tax Authorities. Federally structured taxing authorities which compete in garnering mineral resources and revenues face special problems. While in theory there would seem no impediment to producing enterprises adjusting to successive, incremental layers of taxing authority as elements of producer cost (any more than there would be to successive levels of differently imposed tax originating with a single authority), in practice such tax planning has seldom proceeded so smoothly. A detailed account of Canadian tax policy changes demonstrates that in the wake of the 1973 world oil price rise, the Canadian Federal Government, faced with an eroded tax base due to increases in provincial royalties, declared provincial royalties nondeductible at the very time Alberta's provincial government sought to capture a part of the petroleum industry's windfall profits by boosting its royalty rate.[152] The result was a threatened slowdown in domestic oil production, which engendered further ad hoc governmental responses at both taxing levels.[153] The need to fund distinct levels of government authority separately, combined with a continuing temptation to attempt to export provincial severance taxes, may have made Canada's quest for maximum economic revenue from petroleum more difficult. A recent study of severance taxes in the U.S. Federal System summarized economic researchers' conclusions on the

---

[149] *Id.*

[150] *Id.*

[151] *Id.*

[152] Wahby, *supra* note 45, at 119. This applies to non-fuel minerals as well. For example, British Columbia's provincial taxes were increasing but were deductible (before 1976) for federal corporate income tax purposes, the result was an obvious detriment to Canadian federal revenues.

[153] *Id.*

effects of energy tax exporting in such a system. Among these conclusions are that: (1) in a federal system, "efficient taxation of resources can be achieved only by federal taxation or extensive revenue sharing among states.";[154] 2) geographic variation in the presence of resources induces state taxing authorities to pursue output-based tax policies that lead to inefficient migration of labor and capital;[155] and (3) from an efficient fiscal federalism standpoint, consumption taxes and income taxes (which are less subject to exporting) are preferable to severance taxes.[156]

Distortions Due to External Tax Policies. Firms engaged in mineral exploration and production in the real world frequently have dual allegiances—to the host country, which oversees resource development on its territory, and to the country of their incorporation and business headquarters. This means such multinational, vertically integrated enterprises make key business decisions in response to the tax incentives (or disincentives) provided by both nations. If the tax returns of the integrated enterprise are consolidated in the home country, then the home country's tax policies regarding resource exploration and extraction abroad will have a pronounced influence on the tax regime chosen by the country seeking to develop resource production through foreign firms. Most influential of all is the corporate tax system of the United States, which gives full credit for income taxes paid by foreign branches of U.S. corporations, up to the level of U.S. liability on foreign source income, but only allows an expense deduction, rather than tax credit for royalties (either fees or taxes) paid to foreign resource owners or governments.[157] Consequently, foreign states utilizing branches of U.S. resource developers are given an additional reason to adopt corporate income rather than royalty schemes, and "to impose [such] income taxes in amounts up to the tax liability due the United States." by such branch.[158] Similarly, taxes paid under a foreign system of ring fencing are not subject to a U.S. tax credit, which can result in a U.S. based enterprise

---

[154] ROBERT DEACON ET AL., TAXING ENERGY. OIL SEVERANCE TAXATION AND THE ECONOMY 45 (1990) [hereinafter TAXING ENERGY].

[155] *Id.*

[156] *Id.* at 43-4.

[157] GILLIS, *supra* note 26, at 130-31.

[158] John F. Due, *Taxation of Natural Resources in the Developing Countries, in* READINGS ON TAXATION IN DEVELOPING COUNTRIES 186, 198 (Richard M. Bird & Oliver Oldman, eds., 3d ed. 1975); Khan, *supra* note 51, at 74, 81.

being taxed twice on the same income—a disincentive to exploration.[159] While gauging tax levies to meet complementary foreign tax credits may constitute a serendipitous form of tax exporting, the risk for tax planners is that such foreign credits cannot be counted on into the future. Reliance on them as an element of tax policy introduces a component of uncertainty in estimating the profitability of future resource production.

Non-Revenue Incentives to Accelerate Development. Another major source of distortion in the exhaustible resource policies of developing nations lies in the dilemma such governments face in choosing between an optimal resource exploration and extraction program with stable, high yield government revenues over a considerable time, and rapid development along broad social fronts and under strong internal and external political impetuses, even when resource revenue models might caution in favor of slower resource exploitation. By increasing tax incentives such as immediate deductibility of exploration and drilling costs or depletion allowances, a government may spur exploration to an excessive level, and in doing so will sacrifice total realizable revenue. According to one group of researchers: "The firm has nothing to lose by additional exploration spending, while the government is sacrificing revenue. Further exploration expenditures become disadvantageous to the government far short of the point at which they become disadvantageous to the firm."[160]

The policies of Malaysia in 1980-85, which involved "making concessions on production-sharing terms and corporate income taxes in order to stimulate multinational oil exploration and development,"[161] appear to be a clear example of a developing nation sacrificing long-term revenue in order to obtain a quick production payoff and to paper over a worsening short-term balance of payments picture.[162]

Institutional Uncertainties Induced by State Planners. One common problem is the need to coordinate state agencies to formulate a coherent national policy with respect to mining—especially the agencies responsible for tax administration. Thailand's recent experience offers eloquent testimony of the way a mineral development policy may be distorted to the point of complete hiatus due to a lack of judicial or quasi-judicial sources of finality in decision-making. In Thailand's case,

---

[159] Khan, *supra* note 51, at 77. For an excellent discussion of U.S. foreign tax credit principles *see* Kameel Khan, *International Taxation: Taxation of U.S. Petroleum Companies and Foreign Credits*, 6 J. ENERGY & NAT. RESOURCES L. 154-61 (1988).

[160] Due, *supra* note 159, at 194.

[161] KLAPP, *supra* note 28, at 124.

[162] *Id.*

"[e]ach government agency has its own 'law' to administer,"[163] usually in the form of internal ministry directives only obliquely alluded to by statutes, not publicly available to the investor, and not susceptible to judicial review absent government fraud or misconduct.[164] In such an investment climate, negotiations on minerals exploitation take on a "shifting sand character."[165] Meanwhile, government policy makers fail to grasp the opportunity for investment:

> We have seen this in many recent cases of government-initiated projects . . . . [I]n the petroleum or petrochemical fields, construction costs have increased tremendously as a result of the Gulf War, thereby effectively rendering certain projects that were previously regarded as viable uneconomical. The same holds true for minerals, where fluctuations of world prices, discoveries of new sources, new substitutions, and new technologies . . . cause the window of opportunity to change. It is unlikely that the window of opportunity would exist, say, for six to ten years while . . . the contract [is] concluded, unless economic, market, and technological conditions have come . . . full circle.[166]

VIII. A REVIEW OF ACTUAL MINING SYSTEMS

This Article began by emphasizing how early oil and gas and/or mining agreements between private sector participants shared the risks and the rewards of development, and how these paved the way for more sophisticated arrangements whereby government itself became a "partner" with the objective of appropriating some of the revenues from exploitation of nonrenewable resources. Over time, the array of regimes which impose tax on resource industries throughout the world has become enormously complex.[167] Tax provisions, and the tax burdens on companies, are constantly being appraised and fine-tuned. Currently, world-wide democratization and globalization movements are giving rise

---

[163] Jayavadh Bunnag, *Thailand's Mineral Resources Crisis—A Legal Practitioner's Viewpoint*, 10 J. ENERGY & NAT. RESOURCES L. 164, 165 (1992).

[164] *Id.* at 168.

[165] *Id.* at 169.

[166] *Id.*

[167] Minerals and Metals Sector, Natural Resources Canada, Canada's Mining Industry: A Global Perspective, April 1996, at 73 [hereinafter *Global Perspective*] (noting that "the comparison of profit-based taxes and royalties among competing jurisdictions is very complex, given the diverse nature of tax regimes.").

to a degree of competition among taxation jurisdictions in the world that probably has never been witnessed before. Governments are under pressure not to be "out of line" in imposing tax burdens on companies exploiting mineral resources, the more so since the mineral industry may be one of the few engines of growth for economic development.

A diverse array of tax schemes are imposed world-wide. In the area of nonprofit-based taxes, such as capital, sales, fuel, payroll and employment-related, property, water, and others,[168] there is a strong element of fixed cost from the point of view of the company. These taxes show some similarity with private or government royalties, where payments have to be made irrespective of the profit level or ability of a company to pay tax in the particular taxation year in question.[169] The group of taxes classified as taxes on income are constructed with the objective that payments to governments will be higher in years in which the company has a greater ability to pay, and vice versa. This simply puts government in the position of sharing in the net profit fortunes of the company. There has been a trend in recent years, particularly because of the intense competition among jurisdictions to attract mineral investment, for even government royalties and mining taxes to take on the form of taxes on net income.[170]

In the realm of income-based taxes, a plethora of tax rates, incentives, special write-offs, and other provisions exist.[171] It is no wonder that companies, governments and tax practitioners have difficulty knowing the "bottom line" in terms of the burden imposed by a particular tax system on a company exploiting a mineral resource in a particular jurisdiction. A series of studies carried out in Canada have attempted to provide a snapshot of the actual tax burden imposed by competing tax jurisdictions;[172] the analysis is restricted to profit-based taxes and does not purport to cover the "total tax burden."[173]

---

[168] *Id.* at 77.

[169] *See supra* text accompanying notes 13-16.

[170] *See* Government/Industry Task Force on Investment Climate, Intergovernmental Working Group on the Mineral Industry, *Final Report on Mineral Taxation Concerns*, September 1993, at vii-viii [hereinafter *Final Report*] (noting that "[s]ince the late 1980's, there have been numerous changes to tax rules in the world's major mineral producing countries").

[171] *Id.* ("[i]n attempting to document and analyze the world's various tax regimes applicable to mining, the Task Force undertook a daunting task to say the least.").

[172] The majority of citations in this section refer to these Canadian studies, which were carried out by various branches of Natural Resources Canada. Dr. Keith Brewer is the Director-General of the Economic and Financial Analysis Branch, Mineral and Metals Sector, Natural Resources Canada, and participated in and/or authored many of the studies/final reports.

[173] The total tax burden imposed by a given jurisdiction is measured by the proportion of profit taken as tax from the company by the taxing jurisdiction. *Global Perspective*, *supra* note 168, at 77.

Nevertheless, the reader may be surprised by some of the key findings that appear on detailed examination of the world mineral tax system.

First, the range of statutory income tax rates[174] is wide, from well over 50% in some jurisdictions to as low as 15% in others (where earnings can be repatriated out of the country, however).[175] Nevertheless, the actual tax burden[176] imposed on an individual firm is not spread so widely. The "competitive range" of tax burden is, for the most part, is in the 30 to 40% range.[177] Some jurisdictions impose tax burdens above 40%, and there are also some below 30%.[178] The reason for this narrower range is that jurisdictions with high statutory tax rates tend also to allow tax deductions and/or incentives or other write-offs, which mitigate the high statutory rates somewhat. A case in point is Canada, which has high statutory rates but where provisions such as the resource allowance, fast write-offs for exploration and development and an accelerated capital cost allowance mean that taxable income can be zero for perhaps six or more years after a mine starts up.[179] Percentage depletion in the United States is another example of a write-off that is very useful to companies in reducing the overall tax burden.[180]

Second, the burden of income-based taxes on a company is the result of multiplying the statutory tax rate by the "tax base." It is by modifying the tax base that governments often exert influence on the annual tax actually payable. Therefore, the tax base can be critical for a firm considering investing in mineral exploration in a given jurisdiction.

Third, in practice most income tax based systems in the world sit somewhere between two opposing types of structures: One set spreads depreciation charges and other write-offs over the life of the project, and therefore requires tax payments at a relatively low tax rate as soon as commercial production starts. The other type allows fast write-offs and other front-loaded investment incentives, thereby allowing for a relatively long initial tax-free period. After the "tax-free" period is over,

---

[174] *Id.* at 74 ("Statutory tax rates are the actual tax rates embedded in the tax Acts of the various jurisdictions.")

[175] Government/Industry Task Force on the Canadian Mineral Investment Climate, Intergovernmental Working Group on the Mineral Industry: *International Tax Reference Charts for the Mining Industry*, September 1993, Table 2.1 [hereinafter *International Charts*] (noting that while Chile's statutory tax rate is 15%, Papua New Guinea's is upwards of 50%).

[176] *See supra* note 174 and accompanying text.

[177] *See, e.g., Global Perspective, supra* note 168, at 84 (documenting average effective tax rates on base-metal operations); *see also Final Report, supra* note 171, at 11.

[178] *Global Perspective, supra* note 168, at 84.

[179] *International Charts, supra* note 176, at Table 2.1.

[180] *Id.*

a relatively high statutory tax rate then applies.[181]

How these different tax regimes render an exact calculation of tax payable depends on the economic situation itself. The mining industry is notoriously cyclical, with price fluctuations being rather large over the economic cycle.[182] Thus, the existence or absence of loss carry-forwards is important in determining whether any tax deduction write-offs can be utilized by a company. Very important as well is the actual level of profitability of the prospective operation.[183] For instance, if a mine is extremely profitable, it is usually found that the existence of up-front deduction and write-offs (available in some tax systems) are of relatively little value to a firm.[184] In such a case, it is more the statutory percentage rate of tax that determines the proportion of a company's before-tax profits that are appropriated by government through net income-type taxes. On the other hand, it has been found that, if the realized rate of profit of a company is down around 10% per annum, then (in such a "low profit" case),the existence of up-front deductions present in some tax systems becomes the principal determinant of both the time profile of tax payments and also the overall tax burden.[185]

What do these different tax structures mean for companies? Tax regimes that combine a relatively high statutory tax rate with generous front-loaded incentives can temper the risk to a company in the early years of mine life, by the provision of a tax-free period. Such tax regimes place a relatively light burden on marginal operations (and thus reduce the chances of early closure), but place a relatively heavy burden on more profitable operations, which reduces the attractiveness of new investment. In contrast, tax regimes featuring a low tax rate but no special up-front incentives leave a higher proportion of the downside risk, as well as of the potential reward, in the hands of the project owner. Which regime is better depends on many factors, including whether it is viewed from the point of view of the company or the government, whether the mineral development turns out to be profitable or marginal (something not easily foreseen), and whether one wishes to hedge one's bets against an unpredictable future.

As to the future, one thing is certain: change. Many developing nations in Latin America, Africa and the Asia-Pacific regions are

---

[181] *See Global Perspective*, *supra* note 168, at 73.

[182] *See* Keith Brewer, et al., *Fiscal Systems*, RESOURCES POL'Y 131, 143-45 (June, 1989) [hereinafter *Fiscal Systems*].

[183] *Id.* at 139-41.

[184] *See id.* (discussing the sensitivity of effective tax rates to changes in project profitability).

[185] *Id.*

aggressively introducing new incentive measures.[186] Somewhat paradoxically, some countries have introduced capital taxes as a way to ensure a level of tax revenue.[187] The future direction will surely be guided by notions of government revenue stability and the need to keep companies competitive—and these opposing forces will be heavily influenced by world economic conditions of demand and price.

CONCLUSIONS

One can glean at least a few basic principles from this review. First, to the extent that resource economists rely on models which assume finite resources, the economic consequences of imposing particular forms of taxation on the production process considered in isolation appear capable of identification, even of rough estimation, and are therefore—paradoxically—ultimately of limited interest even to sovereign states. A state whose resources are finite, or convincingly estimated as finite, will have little use for the long-term strategic resource planning that justifies remolding its taxes on production. The interest, and consequently the need for further economic study, lies in the effects of taxation and tax subsidization on exploration—the essential activity that precedes production and continually replenishes it.

Second, from any exploration program, a sovereign state seeks *both* verification of possible extraction sites and an accurate idea of the real extent of its reserves.[188] Apart from underwriting costs of exploration directly or through tax subsidy, the sovereign owner has no inducement to offer the exploration developer but the potential for a return on future production from the anticipated reserve. The dilemma for the sovereign owner is that the attractiveness of that inducement will be continually reappraised by the operator, based on the very findings the sovereign state has commissioned—a process that lasts so long as further exploration is expected to yield profitable results. The necessity of providing an economic incentive even to exploratory developers whose findings are negative (as to *either* discovery or potential production) suggests that natural resource taxation rates for existing production must always be set at something *less* than full recovery of *known* economic rent if an exploratory program is expected to continue indefinitely.

---

[186] Government/Industry Task Force on the Canadian Mineral Investment Climate, Intergovernmental Working Group on the Mineral Industry, *Background Study on Mineral Taxation Concerns: Incentive Regimes for Mineral Exploration*, September 1993, at 21-25.

[187] *Final Report*, *supra* note 171, at 19-20.

[188] *Id.*

Third, the effective measurement of the economic rent which can be allocated by state authorities in connection with exhaustible resource extraction, without consequent economic distortion of the extraction process, depends on the choice of a time profile for exploration and development commonly agreed upon by entrepreneurs and state planners.[189] Any shift thereafter in the time profile (such as that occasioned by a change in the existing tax structure) implies a new set of marginal incentives in computing risk-bearing returns of any venture.[190]

Fourth, in the ongoing encounters between prospective mineral producers and a sovereign state, the inevitable topic will be venture risk. Private developers with proven entrepreneurial records are typically good at risk assessment, and poor at risk absorption. Sovereign states are poor at risk assessment and reasonably adept at risk absorption. The beauty of the fragmenting of mineral interests under the American common law mineral leasing system may lie not merely in the reallocation of prospective profit and potential risk among numerous economic interests, but in the collective benefits the entire enterprise receives from the highly individuated risk assessment analysis each actor undertakes from the standpoint of his own economic self-interest. To the attentive state policy maker, this market analysis is available free of cost, and may prove highly reliable, so long as the state's own subsidies and tax incentives are not part of any individual entrepreneur's objective venture risk equation.

Fifth, while states that are dependent on venture risk analysis can benefit by carrying out individual risk assessments on the impersonally motivated evaluations of monopoly producers or subsidized state actors, there are certain aspects of resource development in which the concerns of even a fully enlightened state can never approximate the motives of individual venturers. Among the essential differences are these:

Sovereign's lack of political isolation. "[T]he government, unlike the private lessor, can vary the contractual relationship" with private developers, in response to "changing social and economic conditions."[191] Even where the sovereign refrains from the exercise of such power, the perception of that possibility existence alone may cause resource producers to evaluate investment prospects differently than they would in the private marketplace.

Sovereign's potential for re-evaluating its bargains in light of its

---

[189] Wahby, *supra* note 45, at 113.

[190] *See* ROWLAND & HANN, *supra* note 25, at 71.

[191] Vass, *supra* note 4, at 29.

vulnerability to constituent opinion. A state "is a trustee in a macroeconomic context" with "responsibilities ...to...many groups,"[192] to whom the state's political leadership may be ultimately accountable. No invisible hand ensures that even economically prudent policies will be popular in the short term. Thus, a government's political self interest in survival may distort the country's economic self-interest.

There has been a lot of wrestling over the years in the field of economics over the problem of how to analyze situations in a manageable way when we know that all of the exogenous factors change every day. In concept, economists usually start off by using a steady-state equilibrium model. This has the advantage that one can talk about assumptions, and then one only has to change one or two exogenous variables at a time to talk about their impact. In real life of course, many factors are often changing simultaneously, and this upsets the ability to state with any degree of certainty what are truisms. In the economics field, the criticisms that have been leveled against neo-classical economics, as it is taught at the elementary level, are really of this sort.

This sort of observation is helpful as a warning not to trust simple models in a real life situation, but the authors also feel there is no way around having to apply oneself to the discipline of the simple models surveyed in this Article.

FROM THEORY TO PRACTICE

As stated earlier, the core difficulty for government planners is to select a fiscal and regulatory regime that will collect the full measure of rent in light of all the real world factors. Numerous factors bedevil that process, including limited worldwide mining budgets, misinformation about political risk, and so forth. We believe that the advice falls into several categories.

First, information is paramount: geological data and information about the legal, administrative systems, and political systems should be freely available at minimum cost (whatever that term may mean precisely).

Second, empirical studies are needed; governments should systematically collect data on the impact of its tax system on the natural resources sector. Governments cannot rely on companies' bold declarations because companies have an incentive to minimize taxes. In addition, countries should share empirical data on taxation as well as be

---

[192] *Id.*

aware of each others' taxes. Universities and specialized institutes should be encouraged to train geologists and other to gain a full understanding of how operators and landowners—whether or not governmental—can logically share the risks and rewards of natural resource projects. A case method approach to teaching this topic could be especially powerful.