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Natural Resource Tax Policy in Developing Countries

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1/ I wish to acknowledge the helpful comments of Ved Gandhi.

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I. Introduction

1. Statement of the issue

The taxation of natural resources is of interest, not only due to its importance as a revenue source 1/ and a factor in the stability of fiscal systems, 2/ but because it is conceptually different from the analysis of other forms of taxation. Nevertheless, economists have continued to advise countries to adopt particular taxes on the basis of standard tax policy criteria. The policy advice has been to move toward neutral excess profit taxes or, in some cases, auction or bonus bidding procedures. This stands in marked contrast to the natural resource tax practices of developing countries which, while revealing a range of tax arrangements, place reliance on ad valorem royalties which are viewed as inferior in any standard tax analysis. 3/

Natural resource tax proposals arrived at by means of conventional tax analysis are typically inappropriate in a policy context for several reasons. Resource taxes are a quid pro quo for the right to extract a publicly owned resource and, as such, are the price for a property right. 4/ In contrast to this, conventional tax policy is concerned with raising a given amount of revenue while minimizing resulting efficiency, equity, and administrative costs. Adopting this latter approach suggests the use of different taxes than would a consideration of resource taxes as prices for extraction rights. 5/ In designing resource taxes as prices, consideration of transaction costs, which do not enter into conventional tax policy deliberations, is required.

1/ Based on mid-1970s' data Gillis (1982) p. 628 found that natural resources provided between 5 and 15 percent of total central government receipts in Thailand, Colombia, Honduras, Panama, Peru, and the Philippines; between 15 and 25 percent in Chile and Malaysia; in excess of 25 percent in Ecuador, Mexico, Jamaica, Liberia, Zaire, and Zambia; and in excess of 50 percent in Bolivia, Indonesia, Gabon, the Malaysian state of Sabah, Papua New Guinea, and New Caledonia.

2/ Mexico and Nigeria are two of the more widely known cases where the problem has arisen.

3/ An ad valorem royalty is levied at a percentage rate on a tax base such as the value of production or export of the natural resource.

4/ With the exception of the United States, where some mineral rights are privately owned, minerals are under the jurisdiction of either sub-national or national governments. For countries which have been subject to British influence, this was often achieved by restricting land grants to surface rights. In other cases, provision for public ownership is constitutional. Mexico has provided for federal ownership of mineral rights in its constitution since 1883 and Venezuela since 1881. See Stokes (1961).

5/ For an examination of this issue see Nellor (1983).

The excess profit taxes or auctions proposed by economists do not take account of these issues which are crucial to achieving efficient resource development. Excess profit taxes will no longer be equivalent to one another in their effects, and whether or not an excess profit tax of any form will be favored will depend on the nature of transaction costs in any particular case. On the other hand, it may be the case that an ad valorem royalty will be superior to some, or all, forms of excess profit taxes. This paper attempts to establish these propositions and, in so doing, bridge the gap between the theory and practice of natural resource taxation.

2. The concept of transaction costs

Transaction costs exist when there are gains from trade which are not realized due to institutional or bargaining problems. The term is adopted in this paper to label cases where some factor prevents governments and prospective resource developers from negotiating mutually beneficial resource leases which would generate efficient resource exploration, development, and extraction decisions. 1/ There are a variety of transaction costs in negotiating natural resource contracts. 2/ First, rather than maximizing the present value of its return, the government may place greater weight on returns received in the short term, than that consistent with social efficiency. Second, although the terms (including tax arrangements) of the property rights transfer will be negotiated and specified in a contract, there may be uncertainty over the inviolability of those terms. 3/ This results because the government has a dual role--it is not only a party to the contract, but it also defines the legal framework and enforcement mechanism within which the contract is made, enabling it to autonomously legislate changes in resource tax and other arrangements previously negotiated. Third, while a current government may negotiate in good faith and abide by the terms of a contract, there is often a third party--namely, a future government--who is not a signatory to the contract and may, or

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1/ The concept of transaction costs is taken from the externality literature. In that context, transaction costs are used to identify cases where, due to factors such as the free-rider problem, parties to an externality relationship are unable to negotiate a mutually beneficial agreement despite the presence of gains from trade.

2/ A complication not considered here is that governments may not seek to maximize their financial return, but may pursue additional investment in the resources sector, in local refining of extracted resources, or in production processes which are relatively labor intensive. The pursuit of those objectives will result in a misallocation of resources. Aspects of this question are considered in Nellor and Clarke (1983).

3/ Dam (1976), in his examination of oil lease contracts states, "what is crucial is the degree of protection afforded against state abrogation of the license and against retrospective measures that have the effect of reducing the value of the license." (p. 175).

may not, feel bound by its terms. These potential transaction costs have implications for the optimal design of resource taxes.

3. Outline of the paper

The second section of the paper surveys resource tax systems in developing countries and the third section considers what other writers have proposed as desirable tax arrangements. The discussion in these sections raises some obvious questions, for it shows a clear divergence between the policies employed by developing countries and those proposed by economists. In fact, standard tax analysis suggests the resource taxes employed by developing countries are inadequate; they unnecessarily discourage production with consequent reductions in tax revenue and ultimately investment and employment. The fourth section presents one hypothesis to explain this divergence between theory and practice. It argues that once transaction costs are taken into account, opposition to many of the tax reform proposals have a logical rationale and that, while a country by country study would be required, there may be a sound rationale for the resource tax policies employed in many developing countries.

II. A Survey of Natural Resource Tax Policy

This section considers the resource tax instruments of a sample of 31 developing countries (see Appendix Table 3). The survey is restricted to an examination of non-oil resource tax instruments and attempts to isolate the general characteristics of the policies employed to enable their subsequent evaluation.

While the resource tax policy of any two countries differs, there are certain policy similarities across countries, and these are evident in Appendix Table 3. Most countries rely on more than one tax instrument for gaining a return from resource extraction. There are four major tax types employed with varying frequency. Many countries have property taxes or fees which are typically fixed payments per mineral claim held. Some countries employ income taxes and in two cases excess profit taxes are used. The excess profit tax is levied when the return exceeds a threshold rate of return on total funds employed (Papua New Guinea) or on capital employed (Indonesia).

Despite the presence of these other taxes, the ad valorem royalty, levied either at the production or export stage, is the most frequently employed tax. 1/ In many cases the royalty is determined on the basis of official world prices to avoid the transfer pricing problem. While the rates of tax are generally constant, although different between minerals, there are examples where the ad valorem tax rates are progressive

1/ It is interesting to note that specific, or per unit, royalties are almost totally absent.

with respect to either the fineness of the ore, world price of the mineral, or some measure of profitability. In cases where the ad valorem royalty is creditable against other taxes, such as an income or excess profit tax, the royalty is serving as a minimum tax in those years where the project is insufficiently profitable to have otherwise resulted in a tax liability.

Particular care needs to be taken in evaluating the information contained in Appendix Table 3. In most cases resource producers and countries will write specific contracts containing the arrangements that pertain to the particular company and mines, and these may differ from the generally legislated provisions. Second in most, but not all cases, mining companies are also subject to general corporate income tax provisions. Third, in many cases countries are gaining a return from natural resource development through an equity share in the development, and this is not always clear in reading the tax legislation. 1/

III. An Optimal Resource Tax?

1. The objective of resource taxation

The commonly made proposition that the resource taxes employed in developing countries fail, as they encourage inefficient investment and extraction decisions, is based on an examination of resource taxes in terms of standard tax criteria rather than as the price for an asset being sold by government. 2/ In other words, resource taxes are evaluated in terms of an efficiency criterion; the smaller the effects of a tax on exploration, investment, and production decisions, the better the tax. The concern with efficiency reflects the view that factors of production should be used to maximize the value of the mine, for that will permit the greatest aggregate return to the owner of the resource prospect and its developer. If the taxes employed by developing countries do not satisfy efficiency criteria, it is argued that additional returns could be made by introducing other (more neutral) taxes.

1/ In some cases the ownership takes the form of gaining a share of production which, in effect, is equivalent to an ad valorem royalty.

2/ This view is evident in many discussions and is expressed by Garnaut and Clunies-Ross (1975) in their presentation of the resource rent tax to be discussed below. They state (p. 272), that the task of resource taxation is to maximize the long-term social product of the industry and capture for the public as large a share of the benefits as possible. They favor their resource rent tax proposal as it "appears to do less to reduce efficiency in the use of resources than alternative taxation systems in any economy." Some authors, who have noted certain of the issues raised in this paper, fail to integrate them into their analysis and in fact exclude taxes, such as ad valorem royalties from consideration on conventional efficiency grounds. See, for example, Palmer (1980), p. 532.

2. Evaluating resource taxes

a. Efficiency criteria

The analysis of resource taxes recognizes the possibility of tax-created distortions in several decisions. The resource firm must decide on the level of investment on exploration and its location, the level of production of a natural resource, and the technology used to extract it. Further, there are decisions of an intertemporal dimension which determine the rate of extraction and, ultimately, the extent to which a resource deposit will be exploited. The resource company is assumed to be profit maximizing and, consequently, will extract the resource to the point where its marginal return (defined as the resource price less the marginal extraction cost) is equal to that from the next best use of its productive factors. To achieve this aim, the producer has to decide whether to extract the resource today or leave it in the ground to extract in the future. Given the maximizing assumption, made above, the producer will seek to equate the marginal returns in each period. In any year the return, on using factors of production in extraction, must be at least as good as the interest rate that would be received if funds were used elsewhere, and the return from extraction in any year must be equal to that expected in other years. If, for example, the return in year 5 is less than that in year 6, the producer will be better off by shifting extraction to year 6. This intertemporal maximization takes place in constant dollars and therefore the difference between the price of the resource and the marginal extraction cost will rise at the companies' discount rate. 1/

b. Royalties

The introduction of taxes can create a tax wedge and distort the resource producers' decisions resulting in changes in rates of extraction, the amount of ore ultimately extracted, the method or technology of extraction, and the location of natural resource exploration and extraction. A specific per unit royalty--a fixed amount per unit of resource extracted--or an ad valorem royalty--a percentage of the value of resource extracted--reduce the net price (gross price less extraction cost) and result in both reduced extraction and modified rates of extraction.

A specific royalty reduces the expected price, to be received from extracting a unit of ore, by the same dollar amount in any period. Since the nominal value of the tax is fixed, the present value of the tax decreases through time, creating the incentive to reallocate extraction from the present to the future. Ad valorem royalties reduce

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1/ This is the Hotelling result. See Hotelling (1931).

the discounted price received in each period by the same proportion. A proportional tax on the value of production will collect a higher tax per unit, the higher is the resource price. The resource company can lower tax payments on the same output by extracting less ore in periods of higher discounted prices and more ore in low-price periods. The impact of both forms of royalty is to raise the marginal cost of extraction resulting in the incentive to increase the cut-off grade beneath which ore is left in the ground.

c. Income taxes

The impact of an income tax on the rate and level of extraction will depend on its specific provisions. To the extent that it reduces the after-tax return to invested capital, by, for example, allowing fixed nominal depreciation allowances, less ore will be extracted. Nevertheless, while inconclusive on theoretical grounds, it has been found that an income tax is generally more efficient than specific or ad valorem royalties. 1/ The difference, however, is only large when tax receipts represent a large share of resource rent.

d. Excess profit taxes

There do exist, at least in theory, taxes which will not impinge on any exploration, investment, or extraction decision. These lump-sum taxes are known as excess profit taxes as they are levied on returns in excess of a normal or required rate of return on investment. These taxes may be either income taxes allowing for the full cost of all factors of production, or cash flow taxes, with symmetrical treatment of gains and losses. 2/ The neutral income tax would allow for the immediate write-off of current costs and would have depreciation and interest deductibility provisions where the present value of these deductions equals capital costs. The cash flow tax permits immediate write-off of all costs. Both taxes would provide symmetrical treatment of profits and losses. The employment of neutral taxes, such as those noted, will, by definition, raise no revenue unless the mine's earnings exceed normal profits.

The possibility of little or no revenue receipts is not necessarily perceived as a concern, for underlying much discussion of resource taxation is the notion that natural resource extraction yields significant

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1/ See the study of Bradley, Helliwell, and Livernois (1981) on copper.

2/ While income or profit taxes are based on a measure of net income in the tax period, cash flow taxes are based on the total receipts of an activity less its total costs for the period, whether the transactions be of a current or capital form. The cash flow form of taxation is often associated with Brown (1948). More recently it has been considered by the U.S. Treasury (1977) and proposed by Meade (1978).

economic or scarcity rents, and the issue for taxation theorists is to define a mechanism by which the country can gain some, or all, of these rents without discouraging investment. 1/ It is in the country's interest, so the argument goes, to employ an efficient tax, as that will maximize the value of rents and hence the amount of revenue they can expect. 2/ It is on this basis that proposals for excess profit taxes are often made.

A particular form of the cash flow tax which has been proposed in the context of natural resources is the resource rent tax. 3/ It differs from a standard cash flow tax in that rather than providing the taxpayer with a rebate when cash flow is negative, the taxpayer carries forward losses at a rate of interest, ideally the firm's opportunity cost of funds, to be set against positive cash flows in the future. In each period, the company or project, depending on the tax unit, calculates its cash flow by subtracting all expenses (both current and capital) from revenue. If this amount is positive a tax is imposed on this base. If the cash flow is negative, it is carried forward to the next tax period at a rate of interest, and set against any future positive cash flow. 4/ Therefore, no tax is paid until the return on the funds expended is equal to the rate at which accumulated negative cash flows are carried forward and hence, if this rate of return is not received, there will be no tax liability. 5/ In the context of natural resources, with large initial capital outlays, there will typically be no tax liability, if ever, until several years into a resource development. If this rate of interest is the tax unit's required rate of return, the tax base will accurately measure economic rent. While there is no justification for leaving any economic rent in the developer's hands, the tax cannot be levied at a rate of 100 percent as that will generate incentives to dissipate rents through increases in operating costs.

1/ Economic rent is a return to a factor in excess of the return required for its supply and can arise in the mineral sector as there is a limited supply of homogeneous mines.

2/ Bradley (1976) illustrates that where a country can influence the world price of a mineral, a "distorting" tax may be preferable.

3/ See Garnaut and Clunies-Ross (1975).

4/ This differs from carry forward of losses under general company income taxes. In these cases losses are carried forward at their nominal value.

5/ If a project is never profitable a resource rent tax will not be neutral (or equivalent to a cash flow tax) unless it provides for a tax rebate, equal to the tax rate times the accumulated losses.

The practical implementation of this tax raises numerous problems. 1/ The rate of interest at which negative cash flows are carried forward must be accurately defined, because the tax unit issue is critical and all inputs, including those such as geological expertise, need to be accurately costed in defining the tax base. It is by no means unreasonable to argue that a resource rent tax will be a distorting tax and that the relevant comparison is between this and other nonneutral taxes. In this context, the theoretical superiority of a resource rent tax does not provide any prima facie case for its practical application. Nevertheless, while the implementation of particular taxes will be tempered by administrative considerations, the theory in essence proposes a unique best tax. 2/

e. Auctions

The preceding analysis is restricted to an examination of taxation on the premise that a tax will be employed. If, in the context of publicly owned natural resource rights, taxes are viewed as prices, numerous contractual arrangements can be conceived which might emerge between a producer and a resource-owning country. One standard solution from a theoretical point of view, although rarely employed outside the United States, is to auction resource rights and receive a single payment which, depending on the auction mechanism, would approximate the expected present value of the resource rights. 3/

An auction system would obviate the need to design a neutral resource tax system. It would seem preferable to the resource rent tax as it removes the incentive to dissipate rents such that, at least theoretically, the total of expected rents could go to the government. It has been pointed out, however, that the choice of an auction versus taxation has implications for the bearing of investment risk and hence the perceived value of the resource prospect. If payment for resource rights is made in the form of a single initial payment, the investment risk of the project rests solely with the developer, whereas a contract incorporating taxation as the method of payment places some risk with the government. In other words, with taxation as the means of payment, the government's return on its resource ownership is dependent on production and, depending on the tax base, the profitability of the undertaking, whereas with an up-front auction the payment is received irrespective of the outcome of the investment. In recognition of this

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1/ Some of these problems are considered in Nellor (1981) and Olewiler (1980). Two Canadian provinces that attempted to use such taxes abandoned them apparently on administrative grounds. Gillis (1982) notes that such taxes are notoriously difficult to administer. On the other hand, Papua New Guinea employs such a tax.

2/ The comparison of a distorting "excess profit tax" and other distorting taxes such as an ad valorem tax has not been widely considered.

3/ It is not our aim to consider auctions, or bonus bidding, in any detail here. For a discussion of this question see Dam (1976), McDonald (1979), Ramsey (1980), and Robinson (1983).

point, Leland (1978) demonstrated that the value of the resource prospect could be maximized by governments employing both an auction and an excess profit tax, with the relative importance of each payment depending on the relative risk averseness of the contracting parties.

3. The theory versus the practice of resource taxation

The theory of resource taxation proposes adoption of a single resource tax which is neutral with respect to all decisions made by the resource corporation. The reality of resource taxation in developing countries, as outlined in Section II, is that countries often employ more than one tax, ensuring that payment will be regularly made, and that ad valorem royalties are the most widely used tax. The tax theory, presented in the first parts of this section, would suggest that such taxes are inferior, as they discourage the level of extraction and reduce the value of the prospect and the possible tax return to the government.

One prevalent view used to explain this divergence between theory and practice is that multinational mining firms enjoy a bargaining superiority over the resource-owning developing countries and hence can gain more favorable tax measures. 1/ If this were the case, it would be in the producer's interest to have a neutral, if any, tax rather than a distorting tax reducing the value of the prospect. Another explanation is that developing countries are learning, and there is gradually evolving a more effective system of resource taxation. 2/ In accord with this view, there is no doubt that ad valorem royalties are substantially easier to administer than excess profit taxes. However, while these explanations for the divergence of practice from theory may have some relevance they are not convincing. Among other drawbacks, these hypotheses imply that developing countries are all in uniformly weak bargaining positions, and secondly, as many developed economies also employ the distorting ad valorem royalties, that administrative factors are not the sole rationalization for their use.

IV. Resource Tax Contracts and Transaction Costs

The resource tax proposals generated by the analysis outlined in the previous section would be appropriate in a case where resource contracts were binding. By their very nature, however, contracts between sovereign governments and mining corporations cannot be enforced and this injects an element of political risk into such arrangements. 3/

1/ See, for example, Smith and Wells (1975).

2/ See Gillis (1982) for a discussion along these lines.

3/ While this paper's concern is with how tax arrangements might influence this risk, other procedural rules have been used in an attempt to minimize risk. For example, some Indonesian contracts provided for disputes over contractual terms to be arbitrated upon by the International Center for Settlement of Investment Disputes.

This risk is the likelihood of changes in the investment climate resulting from political decisions. 1/ The particular element of this risk with which we are concerned is a change in the tax arrangements. This section considers resource taxation in a setting that attempts to capture this salient characteristic of resource development. It focuses on the structure of the tax arrangements in natural resource contracts for encouraging efficient resource extraction. 2/

The expectation of ex post changes to tax arrangements can turn an otherwise profitable investment into an undesirable project to the loss of both the resource-owning government and the mining corporation. The assessment of this risk is a major element in the decision on whether or not to embark onto a mineral exploration or development program. 3/ Kobrin (1980) in an empirical study of expropriation of foreign enterprise assets, concludes that expropriation is not the result of general political attitudes, but reflects a calculation by the host country of the costs and benefits of nationalizing a particular project or corporation. Clearly, therefore, the prospective developer will be concerned to reduce this benefit-cost ratio. Similarly, a country wishing to encourage resource development will wish to promote the perception of a stable investment environment.

1. The nature of the resources sector

If resource development and extraction took place at an instant in time, concern over the issue of binding contracts between governments and producers, and the method of payment for the right to extract resources, would be less likely to arise. In fact, of course, resource development is characterized by large initial investment and long lead times. As a result, natural resource activities are often characterized by relatively large quasi-rents which, in the presence of nonbinding contracts, tempt governments to introduce new fiscal measures to increase their return. 4/ The anticipation of these actions can have a detrimental effect on investment in the resources sector.

1/ We can distinguish between market risk and political risk. The discussion in the preceding section noted the presence of market risks, for example, the price of the mineral on world markets, but implicitly assumed political risk was nonexistent.

2/ See, for example, Prast and Lax (1982).

3/ The model does not incorporate the tax distortions to investment noted in Section III. These factors will be relevant in an ultimate summation of the merits of alternative taxes. The analysis in this section is based on Nellor and Robinson (1983).

4/ Quasi-rents arise when revenues exceed current-year costs but in fact are a required return on previously invested capital. They are not necessarily true or scarcity rents, which arise only when there is a limited supply of some given quality mineral deposit.

While other investments may be characterized by large outlays and long lead times, investment in natural resources is further differentiated. The return to investment in natural resources, especially oil and natural gas, is highly variable due to lack of knowledge of geological structures. The inevitable presence of failed investments means that the return to successful projects will be higher than that earned elsewhere in the economy. This alone may encourage a government to introduce additional tax measures, however, in addition, as resource rights are publicly owned, the presence of large reported profits will result in accusations that the nation's birthright has been given away. Whether this is true, or whether the return is simply quasi-rents, there may be sufficient political motivation for a government to use its sovereignty to abrogate the terms of a resource contract. 1/

It is in both the producers' and society's interest to bind future governments to the fiscal terms of the contract. A binding contract (and a neutral tax structure in terms of the discussion in Section III) will permit efficient extraction of the resource, and hence maximization of the value which can be distributed between the country and the producer. The absence of a binding contract will mean there are potential gains from trade which are lost, for there is a risk that a future government will expropriate some of the returns from mineral development which were to accrue to the producer. The anticipation of these events, by reducing the expected value of the prospect, will result in a reduced payment to the country, too little extraction from a resource deposit, and too rapid extraction. For example, it has been suggested that during the 1960s foreign oil producers in the Middle East anticipated the subsequent nationalization movement and extracted oil "too rapidly," 2/ suppressing world oil prices and exacerbating the subsequent swing in oil prices introduced by the Organization of Petroleum Exporting Countries (OPEC).

2. A model of natural resource lease contracts

a. The model

The model is designed to capture the possible response of future governments to resource developments characterized by large initial outlays and long lead times. These circumstances give rise to the possibility of large net cash flows (reported profits) 3/ which have the appearance of significant above-normal profits although they may be a normal return to previously invested capital. While the model

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1/ Kobrin (1980) finds that natural resource projects are more vulnerable to expropriation than other activities.

2/ This result can be derived by applying Hotelling's analysis in a case where nationalization is anticipated.

3/ Cash flow in any period is equal to revenue received in that period less operating and capital costs incurred in that period. Net cash flow is equal to cash flow less taxes paid in that period.

examines a two-period case, the conclusions for a multiperiod long-term setting are easily drawn. Similarly, while expropriation is considered, this serves as a proxy for any fiscal measure raising taxes subsequent to the signing of a contract. 1/

The two-period model examines the behavior of three agents: a potential resource producer, the current government, and a future government. 2/ The producer maximizes expected profit. Two possible objectives of the current government are examined in turn. First, that it seeks to maximize tax revenue in the current period and secondly, that it is concerned with tax revenue over both periods. The future government, which also maximizes revenue, has the choice of receiving the second-period tax payment negotiated between the current (first-period) government and the producer, or of expropriating any net cash flow received by the producer in the second period.

The probability that a future government will expropriate any net cash flow, designated by the term ρ, is given by the expression,

$$\rho = \rho\ (T_F, NCF_F) \qquad 0 \leq \rho \leq 1 \qquad (1)$$

where T_F is future tax payments, and NCF_F is the future net cash flow. 3/ The probability of expropriation is negatively related to future tax payments (the derivative of ρ with respect to T_F, ρ_1, is negative) as the greater the government's receipts, the less likely it is to expropriate, and positively related to net cash flow (the derivative of ρ with respect to NCF_F, ρ_2, is positive) as the larger is the cash flow, the more likely that a government will expropriate. The net cash flow term not only reflects the returns from the particular leasehold, but is a "state of the world" variable indicating that large, unexpected changes in resource prices, yielding their owners' windfalls, will add to the chance of expropriation. 4/ An asymmetry in the response pattern of government is assumed; if cash flows are negative the government is not likely to subsidize the producer. Secondly, it is re-emphasized that the possible expropriation action by a future government is a simplifying assumption to represent introduction of any additional fiscal measure and is not critical to the argument or its conclusions.

1/ For example, in 1974 Jamaica increased the taxes on bauxite by 600 percent. See Gillis and McLure (1975).

2/ The future government may be conceived of as having the same membership as the current government, but as acting independently of any decisions made currently.

3/ Net cash flow in the future, NCF_F, is equal to $(P_F - OC_F)\ Q_F - T_F$, where P_F is the future mineral price, OC_F future operating costs, and Q_F the quantity of the mineral sold in the future.

4/ For example, changes in OPEC oil pricing involve large changes in the profitability of a range of oil and non-oil resources.

b. Current government maximizes current revenue

While resource developments may not yield any profit until many years after investment a government, motivated by self-interest, may be interested in current revenue alone despite any negative efficiency consequences. More generally, if a government does not have security of tenure, it may discount future returns substantially. To model, in our two-period setting, the possibility that the development may not be profitable until many years after the life of the government, it is assumed that it cares nothing for future revenue.

(1) The behavior of the producer

Consider the problem from the producer's perspective. Despite being somewhat counterintuitive, the producer is likely to want to make tax payments to the future government. By payment of all due taxes in future years the producer can reduce the risk of expropriation. The producer will have a self-interest in payment of taxes when these payments increase expected profits by more than the value of the taxes. In other words, taxes become an investment in securing observance of the contract, and consequently the producer will seek to pay an additional dollar of taxes as long as this increases expected profits by at least a dollar.

Expected profit for the producer is given by,

$$\pi = - I_c+(P_c-OC_c)Q_c-T_c + (1-\rho) \left[(P_F-OC_F)Q_F-T_F\right]/(1+r) \qquad (2)$$

where I_c is the initial investment, P_c and P_F the current and future price of the resource, OC_c and OC_F the current and future operating costs, Q_c and Q_F the current and future minerals sold, and r the discount rate employed by the producer. The firm seeks to maximize profits so, if it had to choose the value of future taxes, T_F, it would want to satisfy the condition that any further increase in future taxes would reduce expected profit. This condition is derived by differentiating the expression for profit, equation (2), with respect to future taxes and setting that equal to zero. This is,

$$\frac{\partial \pi}{\partial T_F} = \frac{-(1-\rho)}{(1+r)} - \rho_1 \frac{NCF_F}{(1+r)} + \rho_2 \frac{NCF_F}{(1+r)} = 0 \qquad (3)$$

A necessary and sufficient condition for the producer to seek the payment of future taxes is that equation (3) be positive when the value of future taxes, T_F, is zero. Whether the expression will actually be positive is theoretically ambiguous, and depends on the specific form of

the ρ function. 1/ On the one hand, payment of future taxes reduces profit (as does any cost), but it also reduces the risk of expropriation possibly adding to profit even more. This would be the case if, for example, the probability of expropriation was one when T_F was zero and less than one with any minimal tax payment. 2/

(2) The behavior of the current government

The maximand of the current government is tax revenue received in its period of office. While the preceding subsection was conducted solely in terms of the producer's interest, this is identical to that of the current government. The government is faced with the constraint that producers will only enter into a contract if they perceive a positive net present value of their investment. Therefore, the maximum level of current taxes is equal to the producer's perceived present value of the prospect less both future taxes and the producer's required return. From this formulation it can be deduced that the current government will be interested in maximizing the producer's perceived value of the prospect, for that will maximize the amount of taxation producers will pay while still proceeding with the development. From the examination of the producer's behavior it is evident that expected profit is partially a function of the level of future taxes. Consequently, as a first step, the current government will attempt to define future tax payments such that the producer's expected profits are maximized. Maximum current taxes are then the net present value of the prospect less the present value of future taxes.

1/ The first term in equation (3) represents the loss in future profits of an additional dollar of future tax payments at the existing probability of expropriation. That is, the expected value of $1 of profits is $(1-\rho)$ and this is discounted at the rate of r. This term will be negative and small. The remaining terms of equation (3) reflect the fact that an additional dollar of future tax payments will influence the probability of expropriation, ρ, and, through changes in ρ, the expected profitability of the mineral deposit. The first of these terms is the reduction in the probability of expropriation of the net cash flow as a direct consequence of the increase in future tax payments, while the second term is the indirect effect that the higher tax payment reduces the producer's net cash flow and hence the probability of expropriation in the second period. Both the second and third terms are positive, by assumption on the signs of the first derivatives ρ_1 and ρ_2, and will have their greatest values when future taxes are low.

2/ Note that in these circumstances, the net cash flow must be positive as otherwise the producer would not outlay the initial investment, I_C, irrespective of the fiscal measures adopted.

Hence, it is in the mutual interest of the current government and the producer to make payments to a future government although neither cares about the future per se. Consequently, there is a presumption against reliance on an auction, for example, for that would mean future taxes would be zero, which would increase the risk of expropriation and reduce expected profits from production. In a case where expropriation is certain if future taxes are zero, producers would only bid the value of first period net returns. As natural resource investment is front-ended this amount will be relatively insignificant. Second, the amount of future taxes each desires will be equivalent. The current government's expectations regarding expropriation are not of concern, the relevant factor is the producer's expectations, for the producer must anticipate a positive return on his investment. The relative importance of current and future taxes will depend on the risk of expropriation and how it varies with tax payments.

c. Current government concerned about current and future revenue

If the current government is concerned about future, as well as current, tax revenue, the choice of taxes becomes more complex. While the general reasoning of the government is the same, current taxes, T_c, can no longer be solved as a residual, as the government's preference function specifies, possibly unequal, positive weights on returns received currently and in the future. The government will seek to maximize its return (comprising period-one revenue, T_c, and the expected value of second-period revenue $(1-\rho_g)T_F+\rho_g VEP$ according to its preferences for current and future revenue, subject to the return to the producer being non-negative. This problem is,

$$\underset{T_c,T_F}{\text{Max}}\ U(T_c,(1-\rho_g)T_F + \rho_g VEP) \qquad U_1,\ U_2 > 0$$

$$\text{subject to } - I_c + (P_c-OC_c)Q_c-T_c+(1-\rho)\left[(P_F-OC_F)Q_F-T_F\right]/(1+r) \geq 0 \qquad (4)$$

where VEP is the value of the expropriated property if that occurs and ρ_g is the current government's perception of the probability of expropriation. 1/ The constraint is the expected net present value of the resource rights to the producer. If the Lagrangian is maximized with respect to future taxes, T_F, we get,

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1/ The ρ_g function is a function of the same arguments as the ρ function, equation (1). The first argument is future taxes, T_F, and the second argument is future net cash flow, NCF_F. Consequently, the signs on the derivatives of the function with respect to these arguments will be $\rho_{g1}<0$ and $\rho_{g2}>0$. U_1 and U_2 are the derivatives of the government's objective function with respect to current and future returns, respectively. While in part b. of this section, U_2 was assumed zero, in this part both U_1 and U_2 are positive.

$$U_2[(1-\rho_g) + \rho_{g1}(VEP-T_F) - \rho_{g2}(VEP-T_F)]$$

$$+ \lambda \left[\frac{-(1-\rho)}{(1+r)} - \rho_1 \frac{NCF_F}{(1+r)} + \rho_2 \frac{NCF_F}{(1+r)}\right] = 0 \qquad (5)$$

The interpretation of both terms in this expression is similar to that presented in equation (3) and also, from equation (3), it is known that when the second term is set equal to zero, that will maximize expected profit which, in turn, permits maximization of current taxes. Consequently, if the second term in equation (5) is zero, the government that cares about current and future taxes would only seek additional future taxation (compared to a government concerned only with current revenue) if the first term was greater than zero. That is, if

$$(1-\rho_g) - \rho_{g1}(T_F-VEP) + \rho_{g2}(T_F-VEP) > 0 \qquad (6)$$

at that T_F value. All three terms are positive if T_F is greater than VEP. 1/ Hence if T_F, given in equation (3), is greater than the expropriated value of property, the current government will seek a higher level of future tax payments while if the expropriated value is greater than T_F, the sign is ambiguous. In sum, even should a government care about future, as well as current, tax revenue it will not necessarily provide for any additional future taxation than in a case where it was only concerned with current tax payments.

Independently of a government's time preference for revenues, it will want to provide for future tax payments. These payments may be greater where the government is concerned with revenue over the life of the mine, but will depend on the government's time preference and the producer's perception of expropriation risk and are likely to vary with the cash flow of the resource project.

d. The choice of tax type

To this point future cash flow was known with certainty and, consequently, definition of tax payments could be made independently of the producer's behavior. When this assumption is relaxed, it is necessary to specify a tax base and rate structure which, for all possible outcomes (defined in terms of prices, production, costs, etc.), would ideally replicate the tax payments derived should future cash flow be certain.

It is impossible to define tax arrangements for a particular project without considering the specific ρ function and the probability distribution of outcomes of a resource development. However, the probable consequences of employing particular taxes can be considered

1/ Note $\rho_{g1}<0$ and $\rho_{g2}>0$.

by examining their general attributes in the context of the model. For example, an ad valorem royalty may be desirable as it generates some payment whenever producers generate a cash flow (including the current period) and, because that payment will rise with production and resource prices. In contrast to this, consider a resource rent tax payable when a certain threshold rate of return on total outlay has been exceeded. 1/ First, current taxes, T_c, will almost certainly be zero. Secondly, for some range of values of the future net cash flow, NCF_F, satisfaction of equation (3) 2/ may require positive future revenue, T_F, although the resource rent tax may yield no revenue. In other words, net cash flow could be extremely large and T_F zero, both of which imply a high risk of expropriation. 3/ In Section III it was pointed out that, for a profitable investment, the cash flow and resource rent forms of excess profit taxes are neutral and equivalent. In the context of this model, however, as the timing of tax liability will vary between taxes, the risk of expropriation, and hence expected profitability, of the two taxes will differ with consequences for investment in the resources sector.

In Tables 1 and 2 the operation of an ad valorem royalty and a resource rent tax is illustrated. The example depicts a hypothetical resource project with a 15-year life. The columns show investment outlay I, operating costs OC, revenue R, and cash flow CF. 4/ The pretax cash flow of the mine is $166.67 in period-one dollars. In order to consider the implications of the risk of expropriation, a particular form of the ρ function is arbitrarily specified. 5/ The probability of expropriation in any period i, ρ_i, is

$$\rho_i = \frac{\frac{NCF_i}{T_i}}{\text{Max}\left[\frac{NCF_i}{T_i}\right]} \qquad (7)$$

when the right-hand side is positive, and 0 for nonpositive values. The numerator is the ratio of net cash flow to taxes, while the denominator is a notion of the maximum value the ratio could take. This is consistent with the earlier discussion, as the higher are tax payments the lower is ρ, while a large net cash flow would increase ρ. The maximum value of

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1/ This tax was discussed in Section III.

2/ $(\partial\pi/\partial T_F) = 0$.

3/ A sufficient condition for preferring an ad valorem royalty alone (and where a resource rent tax is unambiguously inferior) would be that $\rho=0$ whenever T_F is positive and $\rho=1$ whenever T_F was zero.

4/ The basic figures are taken from the presentation of the resource rent tax by Garnaut and Clunies-Ross (1975).

5/ The ρ function must satisfy the following conditions:

$$0 \leq \rho \leq 1, \ \rho_1 < 0 \text{ and } \rho_2 > 0.$$

this expression is interpreted as that value when expropriation is certain ($\rho = 1$). For the purpose of the example, this value is defined by assuming that if reported profit in any year is 200 percent (three times investment and operating costs), then expropriation will occur. It is then possible to define the ρ values, and calculate the expected profitability of the project.

The ad valorem royalty is levied at a 10 percent rate on revenue. This means that there is no royalty payable in the first two years of development ($R = 0$), however, for convenience of our specification of ρ, it is assumed that a tax of $1 is paid in any period where the tax would otherwise be zero. 1/ These tax payments sum to $87.63, in period-one dollars, and reduce the after-tax net present value to $79.06. 2/ Application of the ρ values to net cash flow reduces the expected profitability to $64.03. The difference between $79.06 and $64.03 is, in some sense, a measure of the cost of expropriation risk.

This can be contrasted with the operation of the resource rent tax in Table 2. 3/ The base of the resource rent tax is the cash flow accumulated at the discount rate (set at 15 percent). When this value becomes positive, a 50 percent tax is imposed and then the process of accumulating cash flow begins at zero once again. 4/ The tax payable over the life of the mine is $88.77 and net cash flow, before allowing for expropriation risk, is $77.97. This outcome is by design as it corresponds, almost identically, to that achieved in the ad valorem tax case, that is, both tax regimes generate approximately the same revenue. Calculation of the ρ values and expected profitability show, however, that there is an expected loss of $228.95 and investment in the resource development would not go ahead. The reduction in net income as a result of expropriation risk is $366.92 (compared to $15.03 with the ad valorem royalty).

It can be argued that this outcome is by design of the ρ function and the "maximum" return to the project. This is correct although the

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1/ Otherwise $\text{Max}[NCF_1/T_1]$ would go to infinity when there was zero taxes.

2/ The present value of tax payments and after-tax net cash flow do not sum to pretax cash flow due to a rounding error.

3/ This comparison is not strictly legitimate in the sense that an ad valorem royalty raises the marginal cost of extraction and hence can influence net cash flow if the rate and magnitude of extraction vary in response to the tax. On the other hand, the supposedly neutral resource rent tax which theoretically has no such effects, requires appropriate specification of the discount rate to prevent over- or undercapitalization. See Nellor (1981).

4/ The nominal $1 tax is ignored in calculating the resource rent tax base.

conclusion remains under a range of alternative specifications. However, more importantly, the illustration captures the important characteristics of the taxes lending plausibility to the qualitative nature of the conclusions. The resource rent tax is characterized by very large and very small values of ρ while the ad valorem royalty is associated with moderate and stable values of ρ. The resource rent tax involves no tax liability until the initial capital outlay is compensated for-resulting in high ρ values--and then when the values of ρ decline, discounting of the future returns means that they are of diminished value. The ad valorem royalty, by contrast, provides for a stable series of tax payments which hold the ρ value at a lower level.

Should a government become secure that it will be in office over the life of the mine and/or that it can borrow against anticipated future tax revenue, the desirable value of T_P may become greater. 1/ Once again, this does not mean that an excess profits tax will be employed; as such a tax may provide little or no revenue even though the cash flow is significant. However, if in addition to government being concerned with revenue over the life of a resource development, producers perceive minimal risk of autonomous changes in contracts (a low value of ρ)--perhaps the case in more stable economies--then we would expect relatively greater reliance on so-called "neutral" taxes such as the excess profit taxes outlined in Section III. 2/

V. Conclusion

This paper examined the design of resource tax policy in developing countries. Natural resource developers are seeking a stable environment in which they perceive the likelihood of gaining a return on their investment, while resource-owning countries seek development to convert their resource wealth into additional consumption and investment opportunities. In designing and considering the reform of resource taxes, the characteristics of extraction associated with the implications of public ownership require consideration. The returns to resource development are variable due to the lack of knowledge of geological structures. Consequently, some developments are necessarily characterized by high returns. Secondly, resource development involves large initial capital outlays and long lead times with, as a result, substantial quasi-rents. Finally, in the case of publicly owned resources, there are transaction costs preventing the attainment of a binding contract between the resource developer and the government. The most important of these costs arises as the government occupies a dual position: one as a

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1/ As section c. indicated, this result is not certain although it does seem most plausible.

2/ In a setting where ρ was zero, the actual tax arrangements would depend on the attitude to risk of the government and the producer. See discussion of Leland (1978) in Section III.

party to the resource development contract and a second as the enforcement mechanism in contractual relations. Consequently, contracts do not bind governments and, when associated with the preceding characteristics of natural resource development, give rise to significant political risk in resource investments. It is to the mutual advantage of the developer and the government to reduce this risk, and it was suggested that this may be achieved partially by design of resource tax policy.

The resource-owning government will maximize its return by maximizing the investor's perceived value of the prospect, for that will ensure the greatest willingness to pay for extraction rights. The expected value of the resource prospect is a function of movements in both market (price) and political variables. In the context of expectations of political variables, the particular concern is with respect to discretionary changes in the tax arrangements applicable to a resource extraction contract. The issue arises as there are transaction costs preventing the conclusion of a binding contract between the developer and the resource-owning government. It was suggested that not only is the level of tax revenue relevant in considering political risk, but the time pattern of revenue is also an important variable. The probability of ex post tax changes increases the lower are taxes, that is, a reduction in risk, and this needs to be traded off against the direct cost to profits of additional taxes. Secondly, the introduction of ex post fiscal changes is greater, the larger is the net cash flow of the project. Consequently, even should a government be unconcerned with future revenue (as it may no longer be in office), it should adopt tax arrangements which involve future payments. Whether a government with a longer time perspective will employ taxes involving larger future payments will depend on the cash flow of the project and the intensity of the government's preferences. In either case, taxes will vary, to some degree, with cash flow.

Consequently, in a country where producers perceive some risk of ex post tax changes, it would be inappropriate to rely on an auction mechanism. The resource rent tax is also unlikely to be used as it involves tax payments that result in large net cash flows, creating conditions where the introduction of new fiscal measures is more likely. The analysis also shows that not only will the appropriate resource tax policy vary between countries, but the appropriate policy for a particular country can vary over time. In the limiting case, if the perceived probability of ex post fiscal measures is zero it is then optimal to pursue conventional efficiency objectives.

Table 1. Expected Profitability in the Presence of a 10 Percent Ad Valorem Royalty 1/

Year	(1) I	(2) OC	(3) R	(4) CF 2/	(5) Tax 3/	(6) After-Tax NCF 4/	(7) ρ 5/	(8) Expected NCF 6/
1	100	0	0	-100	1	-101	0	-101
2	300	0	0	-300	1	-301	0	-301
3	50	50	50	-50	5	-55	0	-55
4	0	50	200	150	20	130	0.03	126.1
5	0	50	200	150	20	130	0.03	126.1
6	0	50	200	150	20	130	0.03	126.1
7	0	50	200	150	20	130	0.03	126.1
8	0	50	200	150	20	130	0.03	126.1
9	0	50	200	150	20	130	0.03	126.1
10	0	50	200	150	20	130	0.03	126.1
11	200	50	200	-50	20	-70	0	-70
12	0	50	200	150	20	130	0.03	126.1
13	0	50	200	150	20	130	0.03	126.1
14	0	50	200	150	20	130	0.03	126.1
15	0	50	200	150	20	130	0.03	126.1
Net present value (15 percent discount rate)				166.67	87.63	79.06		64.03

Source: Author's calculations.

1/ Definition of terms: I--investment; OC--operating costs; R--revenue; CF--cash flow; NCF--net cash flow, and ρ--probability of expropriation.

2/ Equal to column 3 less columns 1 and 2.

3/ Equal to 10 percent of column 3 and equal to one if that is zero.

4/ Equal to column 4 minus column 5.

5/ Solved for by calculating column 6 divided by column 5 and dividing that by three times the sum of columns 1, 2, and 5. If the answer is negative, ρ is set at zero; if the answer exceeds one, ρ is set at one; otherwise, ρ is equal to the solution.

6/ Equals one minus column 7 all multiplied by column 6.

Table 2. Expected Profitability in the Presence of a Resource Rent Tax 1/

Year	(1) I	(2) OC	(3) R	(4) CF 2/	(5) Accumulated CF 3/	(6) Tax 4/	(7) After-tax NCF 5/	(8) ρ 6/	(9) Expected NCF 7/
1	100	0	0	-100	-100	1	-101	0	-101
2	300	0	0	-300	-415	1	-301	0	-301
3	50	50	50	-50	-527.25	1	-51	0	-51
4	0	50	200	150	-456.34	1	149	0.97	4.47
5	0	50	200	150	-374.79	1	149	0.97	4.47
6	0	50	200	150	-281.01	1	149	0.97	4.47
7	0	50	200	150	-173.16	1	149	0.97	4.47
8	0	50	200	150	-49.13	1	149	0.97	4.47
9	0	50	200	150	93.5	46.75	103.25	0.01	102.22
10	0	50	200	150	150	75	75	0	75
11	200	50	200	-50	-50	1	-51	0	-51
12	0	50	200	150	92.5	46.25	103.75	0.01	102.71
13	0	50	200	150	150	75	75	0	75
14	0	50	200	150	150	75	75	0	75
15	0	50	200	150	150	75	75	0	75
Net present value (15 percent discount rate)						88.77	77.97		-288.95

Source: Author's calculations.

1/ Definition of terms: I--investment; OC--operating costs; R--revenue; CF--cash flow; NCF--net cash flow; and ρ--probability of expropriation.

2/ Equal to column 3 less columns 1 and 2.

3/ Equal to column 2 plus the preceding value in column 5, brought forward at a 15 percent interest rate. When the value of column 6 (tax paid) exceeds one there is nothing brought forward.

4/ Equal to 50 percent of column 5 whenever column 5 is positive, otherwise set equal to one.

5/ Equal to column 4 minus column 6.

6/ Solved for by calculating column 7 divided by column 6 and dividing that by three times the sum of columns 1, 2, and 6. If the answer is negative, ρ is set at zero; if the answer exceeds one, ρ is set at one; otherwise, ρ is equal to the solution.

7/ Equal to one minus column 8 all multiplied by column 7.

Table 3. Selected Developing Countries: Taxation of Natural Resources

Country	Mineral	Tax	Tax Base	Exemptions/ Deductions	Rate	Other
Bolivia		Fees: mining license (annual)	Mining claims		Claims / $b Per Claim Up to 5,000 — 1.20 10,000 — 2.40 15,000 — 3.60 20,000 — 4.80 Over 20,000 — 6.00	
		Land assessment	Mining concession		$b 15 per hectare.	
	Tin, copper, lead, zinc, and others	Royalty--a presumptive income tax	Expected taxable profit (sales value less the expected mining production costs given, by mineral, in the legislation. Base may not differ significantly from gross output value).		Tin and copper: 50 percent. Lead and zinc: 20 percent.	If the expected costs exceed the sales value then no royalty is paid. The royalty rate is reduced if the ore is less than 25 percent fineness.
	Silver, bismuth, and others	Ad valorem royalty	Gross value based on official prices.		Silver: 7 percent; Bismuth: 3 percent; Other: 1.5 percent.	
	Uranium	Ad valorem royalty	Value of production.	Royalty paid from share of production going to government ownership.	3 percent.	There is a production sharing contract in operation. These arrangements apply to the first contract negotiated.
Botswana		Mineral rights tax	Square kilometers or assessed value of mineral rights.		R 40 per square kilometer or 10 percent of value of mineral rights.	The tax burden is determined by imposing the greater of the two tax measures.
Cameroon			Cubic meters.		CFAF 500 to CFAF 3,300 according to quality.	
Chile	Copper	Ad valorem royalty	Sales value.	Imposed on small firms.	2 percent.	This substitutes for all other taxes in the case of small firms. Other firms pay the general income tax.
	Uranium	General income tax or an ad valorem royalty.	Sales value.		50 percent.	This rate can be reduced.
Colombia	Uranium, emeralds, platinum, and others.	Ad valorem royalty.	Sales value.	Mining in inaccessable regions may receive a five-year tax holiday.	Uranium: 5 percent.	Production sharing contract in force for uranium and the royalty is deducted prior to the production split.
					Emeralds and platinum: 5 percent.	
				Small firms are exempt.	Nonmetallic minerals: 3 percent.	
Costa Rica		Fee (annual).	Mining claim.		¢ 50 for each claim, ¢ 25 for each supporting claim. ¢ 200 for each placer claim, ¢ 100 for each supporting claim protecting a placer.	
		Specific royalty.	Dry metric tons of ore.		US$0.25.	Payable to the State.
					US$0.05.	Payable to the municipality of the canton where mine located.

Table 3 (continued). Selected Developing Countries: Taxation of Natural Resources

Country	Mineral	Tax	Tax Base	Exemptions/ Deductions	Rate	Other
Dominican Republic		Mining patent.	Hectares mined.			A fee payable semi-annually.
		Royalty.	f.o.b. export value.		5 percent.	Can be credited against income tax for the same year. Seen as a minimum tax.
		Income tax.	Definition of net income in force on granting of concession.	Any deduction due to exhaustion of the mine including depreciation of capital equipment.	40 percent.	
Ecuador		Surface tax.	Hectares mined per year.		Nonmetallic S/. 10. Metallic S/. 50	
	Metallic.	Royalty.	Sales less cost of production.		A percentage not exceeding 16 percent.	
	Nonmetallic.	Royalty.	Value of production.		4 percent.	
El Salvador		Surface tax.	Each claim granted and class of substance exploited.		Specified by executive power.	
Fiji		Royalty.	Value of production.		10-12.5 percent.	Rate depends on amount of production. Firms can be exempted from the normal income tax by the Minister.
Gabon	Uranium.	Export tax and royalty.	Value of production.		5 percent.	Companies receive a seven-year holiday from the general income tax.
Ghana		Ad valorem royalty.	Value of minerals.	Minister may make exemptions.	Rate depends on yield ratio. Yield Ratio / Tax Rate 0- 15 / 15 15- 25 / 25 25- 35 / 35 35- 45 / 45 45- 60 / 60 60- 70 / 70 70- 80 / 80 80-100 / 100	Yield ratio is (value of minerals - operating costs) ÷ value of minerals.
Guatemala		Fee	On granting of concession.			
		Surface tax.				
		Royalty.	Value of production.		7 percent.	
Haiti		Ad valorem royalty.	Value of production.		10 percent.	
Honduras		Fee.	On granting of concession.			
		Surface tax.				
		Royalty.	Value of production.		Gold and silver: 4 percent. Nonmetallic minerals: 2 percent.	Paid at export or at production if for domestic use.
Indonesia		Ad valorem royalty.	Value of production.		Variable with respect to mineral prices.	
		Excess profits tax	Profits exceeding a 15 percent rate of return on capital stock.	Company income tax treated as a cost.	60 percent.	Profits can be averaged over three years. Company income tax rate reduced for first ten years.
		Property tax and land rates.				

Table 3 (continued). Selected Developing Countries: Taxation of Natural Resources

Country	Mineral	Tax	Tax Base	Exemptions/ Deductions	Rate	Other
Jamaica	Bauxite	Ad valorem royalty.	Value of aluminum ingot.		7 percent.	Assumes some minimum level of production.
	Other than bauxite.		Return after deducting permitted expenditures and amortization--known as the yield.		- Where yield < 15 percent of value, tax is 5 percent of yield; - where yield is 15-30 percent of value, tax is 5 percent of yield plus 1/5 percent of yield for each point above 15 percent; - where yield exceeds 30 percent of value, tax is 8 percent of yield plus 2/5 percent for each point above 30.	If royalty is less than 1/2 percent of the value then 1/2 percent is paid, a minimum tax.
Malaysia	Tin	Export tax, (progressive ad valorem rates).	Ore sold.		Maximum: 16 percent.	Rates vary with price. Export tax is deductible from the general income tax.
		Excess profit tax.	Profit exceeding abitrarily defined standard.		10 percent.	
	Iron ore.	Ad valorem export tax.			15 percent.	
	Other metalliferous ores.				10 percent.	
	Gold.				5 percent.	
	Nonmetallics				2.5 percent.	
Mexico		Surface tax.	Claims.		Metallic: Mex$60 per claim. Nonmetallic: Mex$10 per claim.	
		Ad valorem royalty.	Value of production.	If fineness less than a certain level no tax payable. Applies to gold, copper, zinc, lead, and silver.	General rate: 7 percent. Gold, silver: 9 percent. Iron, coal: 4 percent.	Rates reduced for new mines.
New Caledonia	Nickel.	Ad valorem royalty.	Exports.			
Nicaragua		Fee.	Grant of concession.			
		Surface tax.				
		Ad valorem tax.	Value of production.		5 percent, but rate will vary with world price.	
Niger	Uranium and other minerals.	Ad valorem tax.			5 percent.	10-20 year tax holiday from turnover tax, export, and import duties.
Papua New Guinea	Copper	Excess profit tax.	Profit in excess of a specified rate of return.		70 percent.	Payable in addition to general income tax.
Paraguay		License fee.				
		Ad valorem tax.	Value of production.		5 percent.	
Peru	Copper	Ad valorem tax.	f.o.b. value of exports.	Exclude exports < US$18,000 per year.	4 percent.	Creditable against income tax liability.
		Land rent and fees.				

Table 3 (concluded). Selected Developing Countries: Taxation of Natural Resources

Country	Mineral	Tax	Tax Base	Exemptions/ Deductions	Rate	Other
Philippines	Copper	Ad valorem tax.	Value of production.	Five-year exemption.	2 percent.	
		Export tax.	Excess over a declared basic export price.	Five-year exemption.	30 percent.	
Sierra Leone	Diamonds	Income tax.	Value of product less operating expenses, interest and losses brought forward.		27 1/2 percent.	
	Iron ore.	Income tax.	Defined as in general company tax case.		5 percent.	Payable in addition to the general company income tax but subject to limit on total tax payable: 50 percent on first 1,000,000 55 percent in excess of 1,000,000
	Titanium.	Ad valorem royalty.	Net sale value at export.	Deduct cost of transport from mine to port.	2 1/2 percent.	Payable in addition to income tax but the sum of the two taxes is not to exceed 50 percent of assessable income.
Thailand	Tin	Ad valorem tax.	Value of production based on presumptive price.	Only levied on excess over a posted price.	25 percent.	Lower rates apply to other minerals.
Uruguay		Surface tax.	Hectares of claim.		NUr$5.64 per hectare per year.	
		Ad valorem tax.	Value of production.		Amount fixed in concession.	
		Export tax.	Value of exports.		1/2 percent.	
Zaire	Copper and others.	Export tax.			28.6 percent.	Export tax is general but not at uniform rates.
		Export surtax.	f.o.b. price two months prior to sale.		5-40 percent.	The surtax is only levied on copper products and at progressive rates.
Zambia		Income tax.	Assessable income (defined as in general income tax).		Copper: 51 percent. Lead, zinc, and cobalt: 20 percent. Amethysts: 15 percent. Gold: 10 percent.	The tax is deductibl in computing general income taxation.

Sources: Organization of American States, Mining and Petroleum Legislation in Latin America and the Caribbean (Dobbs Ferry, New York: Ocean Publications, Inc., 1981); International Bureau of Fiscal Documentation, Taxes and Investment in Asia and the Pacific; International Bureau of Fiscal Documentation, Taxes in Africa; Price Waterhouse & Co., Doing Business In ...; Gillis (1980); Bucovetsky, Gillis, and Wells (1978); and Beals, Gillis, and Jenkins (1980).

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