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INTERNATIONAL ISSUES

THE DISTRIBUTIONAL IMPLICATIONS OF THE TAXATION OF NATURAL RESOURCES

by Malcolm Gillis and Charles E. McLure, Jr.

I. INTRODUCTION

Few economic events of the early 1970s have attracted more attention than the large increases in taxes or quasi-taxes levied upon primary products, especially natural resources, by a small number of countries that control large segments of world markets for these commodities. The most important case, of course, is petroleum. The actions of the Organization of Petroleum Exporting Countries (OPEC) have caused chaos in the economies of developed as well as developing nations, and may yet wreck the international monetary system. Even worse, many already desperately poor countries have been further impoverished by paying higher prices for imports of primary products, particularly fossil fuels. Of course, we tend to think of the gains from the increases in taxes as accruing primarily to the low-density countries of the Middle East, many of which already enjoy extraordinarily high per capita incomes. But several poor countries such as Indonesia and Nigeria have also been able to improve their economic status at the expense of the developed countries—although also at the expense of other poor countries—so that the tax increases do not necessarily make the worldwide distribution of income less equal.

Looking with envy at the success of OPEC and other earlier, but less spectacular, instances of cooperative action by producer countries, other countries have sought to duplicate the success of these cartels, in commodities ranging from bananas to mercury and copper.¹ The success or failure of such further efforts to form cartels will, of course, have distributional implications roughly similar to those of the OPEC cartel. The colluding countries will improve their positions at the expense of either consuming nations or creditor nations if they are successful in shifting the new taxes from their own people to people of other countries. Many, but not all, of the producing countries are in the developing world, and most of the nations that supply

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capital are in the developed world. Thus backward shifting of the taxes to owners of capital would generally tend to equalize the worldwide distribution of income. On the other hand, as noted above, consuming nations are both rich and poor, so that forward shifting to consumers has less clear-cut distributional effects. But one thing stands out in the discussion to this point. If we are to know how the taxes under discussion affect the worldwide distribution of income, we must know their incidence, that is, whether they can be shifted, and in which direction.

We propose some guidelines based on economic analysis of the determinants of the incidence of taxes on natural resources and other primary products. In section II we discuss the conditions under which various kinds of taxes on primary products can be shifted forward and backward to non-residents of the taxing nations. Then in section III we apply the framework developed earlier to analyze one specific case, beginning with the large tax Jamaica imposed upon bauxite in the summer of 1974. We believe that the general framework and this example will assist the reader in appraising the likely incidence of various other taxes on primary products (or the chances of success of other attempts at cartelization).²

II. THE GENERAL DETERMINANTS OF INCIDENCE

Table I (p. 149) presents the general determinants of the incidence of taxes on natural resources. Because this table and its explanation employ a bit of the economist's shorthand notation, it seems convenient to digress from the main subject long enough to explain a few of the terms used in this table and the remainder of the paper.³

A. Definitions

Resource rents are earned by owners of an asset (such as a natural resource) that is provided by nature and that has no alternative use.

Differential resource rents exist when favorable conditions such as low transportation costs, ease of extraction of the resource, high quality ores, etc., result in higher resource rents than are generally available.

Quasi-rents are earned on capital that is invested in some activity, and that, being specific to such use, has no alternative use in the short run. In the long run, as capital depreciates and funds become available for other investments, they will be employed in activities in which it is expected that they can earn a *normal return*. If an investment is particularly good, the resulting quasi-rents exceed normal returns during the subsequent short run, but if the investment is less successful (or is rendered so by tax policy) quasi-rents can fall below the normal return expected when the investment was undertaken.

Finally, *monopoly rents* occur when barriers to entry into an industry allow the firms already in the industry to charge prices high enough to earn extraordinarily high returns on their investments, even in the long run, because of

the lack of any threat of competition from new entrants. Monopoly rents are found more frequently in *oligopolistic industries*, in which a few firms dominate an industry, than in the relatively rare cases of non-governmental pure *monopoly*, in which there is but one firm in the industry.

B. Market Dominance

The first determinant of the ability to shift taxes on natural resources is the position of the taxing nation or nations in the relevant market for the taxed resource. One nation producing a small portion of the world's supply of a mineral, for example, could not hope to export a tax on that mineral to nonresident consumers through higher prices, because the world price would be almost totally unaffected by the nation's imposition of the tax. Rather, the tax would reduce returns to producers of the mineral in the short run and perhaps render production unprofitable in the long run, as discussed further below. On the other hand, a nation or group of cooperating nations responsible for the entire world production of a product might be able to shift a substantial portion of any tax on that product to consumers in other countries. Of course, the most common cases are in the middle ground of partial dominance, since few, if any, important products are completely dominated by one country and cartels are at least as difficult to organize and maintain among countries as they are among firms.⁴ Finally, we must note explicitly that the relevant market for a commodity may not always be easy to demarcate, because of the presence of substitutes of various degrees of perfection. As we shall note below, for example, aluminum may be easily replaced by glass and steel in the container market and is competitive with copper in the electrical industry, but has no rivals in the production of aircraft.

C. Mobility of Factors

If capital is not mobile out of a taxing country, or even out of a taxed industry within the country, it is essentially earning quasi-rents, according to the definition given in part A of this section. In such a case, any tax that cannot be shifted simply reduces these quasi-rents and is borne by investors in the taxed industry. If, on the other hand, capital is mobile, either out of the taxing nation or out of the taxed industry, it can largely escape the tax. Since much mining and refining equipment is not easily transferred to other domestic uses and since it is often difficult or prohibitively expensive to dismantle such machinery and move it out of the taxing nation (even if the nation would permit such a response to its tax policy), the question of capital mobility basically hinges on whether we are discussing the short run or the long run of economic theory. Whereas in the short run capital is fixed and earning quasi-rents, in the long run depreciation of facilities generally renders capital mobile.⁵

Labor may also be relatively immobile in response to taxes that are shifted backwards to it, for several reasons. For example, a certain group may, by tradition, work in the mines and mills of a country and continue to do so even following a tax-induced reduction in wages. Other cultural factors, such as geographical preferences or discrimination in other occupations, may limit groups to the taxed industries. In such cases these workers are essentially immobile and, like the owners of immobile capital, they earn quasi-rents, rather than wages determined competitively in the nationwide market. A somewhat different situation occurs in those instances in which unionization has resulted in workers receiving wages above the competitive wage rate. In such cases the worker is not immobile in quite the same sense as in the previously discussed case, but the results are similar: the worker is receiving a form of monopoly rent and will not, within limits, leave the industry even if his wage is reduced somewhat by the backwards shifting of the tax levied on his employer.⁶

Finally, we should note that in most cases the natural resource is itself highly immobile in the sense that it may have little alternative use. To the extent that this is true, the resource is earning resource rents which are a highly vulnerable target for countries wanting to raise additional revenues, perhaps at the expense of nonresidents, while avoiding undesirable economic consequences. As noted below, the type of tax, the economics of transporting the resource, and institutional factors are important determinants of the extent to which a given tax will come to rest on resource rents.

D. Industrial Structure

The incidence of a particular tax is likely to depend in important ways upon the extent to which the market is dominated by a few firms, as well as the extent of dominance by taxing countries. In particular, a tax levied on a competitive industry by dominant nations is more likely to be shifted in full to consumers than is a similar tax levied upon a monopolist. The reason for this apparently anomalous result is that the monopolist would presumably have maximized his profits in the absence of the tax. In that case, part of the tax would cut into his monopoly profits, rather than being shifted to consumers. In general we expect that about half the tax would come out of profits and only about half would be reflected in higher prices.⁷

Of course, as suggested above, monopoly is rare, and in the world of natural resources, perfect competition is, too. The more common form of industrial structure is oligopoly. Unfortunately, economic theory can tell us little about the price response of an oligopolistic industry to an increase in the taxes it pays—or more accurately, it can tell us just about anything, depending upon the assumptions we make about the behavior of the firms (that is, upon which theory of oligopoly we accept). This is not the place to attempt a taxonomy of the many theories of oligopoly and their implications for tax incidence.⁸

Rather, we simply note that if the industry has maximized the joint profits of its member firms, the results will resemble those of the monopoly case, but if it has not, the results will be more like those of the competitive case.⁹

Finally, as noted above, unionization may result in workers receiving a form of monopoly rent. But unionization and industrial concentration tend to go together. Moreover, multinational firms tend to pay more than the local wage rate, even in the absence of union pressures, in order to reduce turnover, avoid labor discontent, etc. Thus workers may be sharing in the monopoly and resource rents of their employers.

E. Type of Tax

Taxes and quasi-taxes on natural resources can take a multitude of forms, but we shall restrict our attention to two general forms: the production tax and the income or profits tax.¹⁰ The production tax, if levied by nations that dominate the market, would be shifted forward in large part. On the other hand, if it were levied by a non-dominant nation, the tax would be likely to reduce the quasi-rents of owners of immobile capital in the short run. It would tend to discourage continuation of production in the taxing nation in the long run, unless there were some mitigating factor such as differential resource rents that could be tapped through backward shifting. Of course, it is possible that some of the burdens on capital would be shared by labor specific to the taxed industry.

The situation is somewhat different where income taxes are concerned. For one thing, there are problems of the transfer price appropriate to use for intra-firm transactions in calculating taxable profits (especially those of multinational firms) that are less critical in the case of production taxes. Second, from a theoretical point of view, the incidence of profits taxes is considerably more uncertain than is that of production taxes. Beyond that, income taxes are levied on the entire return to capital, including normal returns to equity capital, as well as pure profits (monopoly rents, in the present discussion). Thus these taxes are likely to have economic effects somewhat different from those of a tax on pure profits. In particular, to the extent that the tax drives the return to equity capital below what can be earned on alternative investments, it, too, would discourage investment in refining in the taxing nation, even though in the short run it would merely reduce the various rents. Finally, foreign tax credits are generally available only for income taxes. As long as income taxes do not exceed amounts allowed as foreign tax credits by capital-exporting nations, those nations bear the full burden of income taxes levied by the natural resource-producing nations. Similarly the existence of full crediting reduces the amount of tax that must be borne by either consumers or recipients of factor incomes. Therefore, in what follows we consider only income (profits) taxes (and other taxes) that are not credited.

F. Final Considerations

Several additional determinants of the incidence of taxation of natural resources do not fit easily into the taxonomy of table 1, and would make it undesirably complicated, even if they did. For example, it matters greatly whether contractual arrangements can be altered in response to changes in tax policy. Examples of contracts that might be altered are labor contracts, supply contracts, lease arrangements, etc. Moreover, it is important to know whether the natural resource can be exported for processing elsewhere if local processors attempt to shift taxes backward to the mining stage. In some cases economic considerations, especially weight loss and costs of transportation, dictate on-site processing, but in others they do not. In addition, there may be restrictions on the export of unprocessed natural resources, especially if the country is experiencing severe problems with excess capacity in its own processing plants. The importance of the resource cost in the total costs of final products is an important determinant of the possibilities of shifting a tax forward to consumers. Clearly the tax can be shifted more easily if the resource is a relatively minor component of the cost of final products. Beyond that, the existence of differential resource rents is an important determinant of whether heavy taxes can be levied without rendering the industry economically non-viable in the taxing nation. A final consideration is purely mechanical. Once we have identified the consumers and factor owners who bear the various taxes we must allocate the taxes to their nations of residence.

G. The Taxonomy

If we ignore severance taxes, suppress repeated mention that labor may share in the burden of some taxes (especially in unionized industries and in industries with substantial amounts of resource rents and monopoly rents), and ignore the existence of differential resource rents, we can identify the twelve cases presented in table 1. As in the previous discussion, we distinguish between the owners of resources and the capitalists who exploit the resources and process them, though the two groups may, in reality, be largely the same in many cases. The first group receives resource rents, including differential resource rents. The second receives normal returns to capital in the long run, quasi-rents in the short run, and perhaps monopoly rents.

Case 1: Production taxes levied on competitive industries by nations dominating the world market for a resource would be shifted in large part to consumers, if capital is mobile. In each case examined, income taxes would be borne by owners of natural resources to the extent that they applied to resource rents. But that part of income taxes falling on the normal return to equity capital would be likely to be shifted to consumers, since any tendency to reduce the return to capital would result in capital being invested in other industries, perhaps in other countries.

TABLE I
GENERAL DETERMINANTS OF THE INCIDENCE
OF TAXES ON NATURAL RESOURCES

I. Market dominance by taxing nations	Yes		No	
II. Capital mobility from taxed sector	Yes	No	Yes	No
III. Industrial structure				
a. Competition	1	4	7	10
b. Monopoly	2	5	8	11
c. Oligopoly	3	6	9	12

Case 2: Only about half of the production tax levied on the monopolist would be shifted to consumers, even if the taxing nations dominated the market. The remainder would be borne by recipients of monopoly rents. To the extent that it applied to economic profits, the profits or income tax would be borne by capitalists. To the extent that the tax hit the normal return to capital, the result would be similar to the analogous part of the tax in the competitive industry. The existence of monopoly rents in the taxed industry might make that industry more attractive than other investment opportunities, however, so long as the tax does not completely offset that attraction. Thus in a particular case it is important to know the magnitude of the monopoly rents in the industry and to compare them with the size of the taxes tending to reduce the return to capital.

Case 3: As suggested earlier, the results for oligopoly are likely to resemble those for either monopoly or competition, depending upon the extent to which profits of the industry have been maximized in the absence of the tax.

Cases 4-6: With capital completely immobile, a tax either on production or on the profits of refiners is likely to be borne by recipients of quasi-rents and, where relevant, by recipients of monopoly rents. Given existing patterns of ownership of processing capacity, such a tax would result in substantial amounts of short-run exporting of taxes to capitalists in developed countries. Thus in either the long run or the short run nations that dominate world markets for important products are likely to be able to export taxes on those products. But the implications for the worldwide distribution of income are somewhat different in the two cases. In the short-run (capital immobile) case the primary burden is likely to be on capitalists, a group which can be characterized with reasonable accuracy as the upper income groups in the developed nations. But in the long run the burden comes to be borne increasingly by consumers, that is, by lower income groups in the developed nations and in increasing proportions by citizens of the poorer countries.¹¹

Case 7: In this case a country that does not dominate the world market levies a tax on processing of a natural resource, even though the capital employed in the processing industry is mobile. Because of non-dominance the tax cannot be shifted to consumers, and because capital is mobile neither form of tax can reduce the normal return to capital, which in a competitive industry is the only return capital receives. If the taxed resource cannot be exported in unprocessed form, say because of transportation costs or government regulations, the tax may be shifted backward to owners of the natural resource. But if the resource can be exported for processing elsewhere, the tax may well destroy the refining industry in the taxing nation. If this occurs, the burden of the tax may fall largely upon labor, due to the reduction in the country's capital-labor ratio and the need to absorb the released labor elsewhere.¹²

Case 8: This case is remarkably similar to the competitive case. Economic theory tells us that profits are maximized when marginal cost (the incremental cost of producing a unit of output) equals marginal revenue. But if the taxing nation does not dominate the world market, marginal revenues are determined in the world market. Thus the tax has no effect on the profit-maximizing price and is therefore not shifted to consumers. And because capital is completely mobile, by assumption, the tax cannot reduce the normal return the monopolist receives, though it may reduce monopoly rents. Thus in this case, as in case 7, either a processing tax or a profits tax on processing will tend to depress the processing industry in the taxing nation, unless conditions are such that it can be shifted backward to owners of natural resources or that it simply reduces monopoly rents.

Case 9: As in cases 7 and 8, either tax would be borne by recipients of resource rents (and perhaps labor) if conditions allowed, and would tend to destroy the industry if not.

Case 10: The price of output is determined in world markets, because of non-dominance, and capital is fixed in supply to the taxing nation, and therefore earning quasi-rents. Either a production tax or a profits tax reduces those quasi-rents. Of course, this is only short-run analysis, and it is to be expected that in the long run the results will be as described in case 7.

Cases 11 and 12: These cases have results similar to those in case 10, with the added feature that monopoly rents will be reduced as well. The important distinction between these three cases and the three previous cases is that the passage of time tends to concentrate the burden of the tax upon workers and owners of resources as capitalists remove (or threaten to remove) their processing facilities in response to a tax that makes their continued investment in the taxing nation unprofitable. This may or may not result in a more progressive domestic tax burden and increased exporting of the tax, depending upon the patterns of incidence and the ownership of the natural resources and processing facilities. But because dominance is necessary (if

not sufficient) for shifting tax burdens to consumers and because ownership of both resources and processing facilities is concentrated in the developed countries, it is virtually certain that taxes levied by nondominant nations will have a more egalitarian effect on the worldwide distribution of income than those levied by dominant nations. Finally, it appears that cases 1 through 3, in which we find both market dominance and factor mobility, are quite different from cases 4 through 12. In the first group of cases consumers, including those in poor countries, are likely to bear a considerable burden of any taxes on natural resources. In the other cases the absence of either market dominance or capital mobility, or both, results in difficulties in shifting either a tax on production or a tax on profits in the processing industry forward to consumers. To the extent that capitalists and owners of resources are concentrated in the developed countries and in the upper income classes in all countries, natural resources taxes levied in the context of cases 4 through 12 are likely to make both the distributions of income within countries and the worldwide distribution of income more equal.

III. THE BAUXITE CASE

From 1901 through 1936, there were six major cartel agreements between companies in the international trade of aluminum, all of which seem to have been successful in raising prices significantly above what would have been expected in the absence of the agreements.¹³ Until 1974 there were no examples of international commodity agreements or cartel-like arrangements in bauxite, the principal ore from which aluminum oxide (alumina) is refined for later smelting into aluminum ingot. In March 1974, however, seven major bauxite producing nations (Australia, Guinea, Guyana, Jamaica, Sierra Leone, Surinam, and Yugoslavia) took the first formal steps, in Conarky, Guinea, for establishing the International Bauxite Association (IBA). By November 1974, the IBA was fully established, with permanent headquarters in Kingston, Jamaica, and three new members (The Dominican Republic, Ghana, and Haiti) had been admitted to membership.¹⁴ The only significant developing-country producer still outside the IBA fold is Indonesia, whose 1973 production was about 2% of world mine output.¹⁵

Although the members have steadfastly avoided using the "cartel" label for IBA, and have not yet taken simultaneous coordinated actions, the goals of IBA (securing higher revenues from bauxite and alumina and developing vertically integrated aluminum industries in member countries) are not atypical of past cartels formed by producing firms. Following the initial IBA meetings, however, Jamaica announced in May 1974 unilateral actions designed to expand its bauxite revenues by U.S. \$170 million per year, or about 50% of total tax receipts for 1973-74. The measure served to raise the nation's tax revenue (exclusive of royalties of U.S. \$0.55 per ton)

from bauxite from about \$1.34 to about \$10.50 per ton, an increase of almost 700%. The government also announced its intention to secure a sizable increase in participation in the bauxite and alumina operations of the large international aluminum firms present in that country, which together hold under lease or ownership some 1.5 billion tons of bauxite reserves, or over 80% of estimated Jamaican reserves.¹⁶ Because of the difficulty of determining profits attributable to operations in Jamaica, the new tax was levied on production, rather than on profits. And because of the difficulties in determining an arms-length or free market price for bauxite, the tax was geared to the price of aluminum ingot (7.5% of the realized price, as determined by the government, on shipments of primary aluminum for 1974-75, to rise in steps to 8.5% by 1976). Finally, to forestall the possibility that the aluminum companies might counter by reducing production, the tax was based on a presumed minimum level of production equal to somewhat over 90% of estimated production.

Within two months of Jamaica's unilateral actions, Guyana announced virtually identical taxes,¹⁷ and the Dominican Republic was considering similar measures.¹⁸ Surinam implemented changes nearly matching those of Jamaica in mid-December 1974, enacting taxes of about \$10.00 per ton, retroactive to January 1, 1974.¹⁹ Finally, in early 1975, Guinea and Haiti imposed stiffer bauxite levies modeled along the lines of the Jamaican measures.²⁰ Of the ten IBA members, only Australia, Sierra Leone, and Yugoslavia had refrained, as of this writing, from announcing tax increases on a scale comparable to the Jamaican levies. (But the executive board of IBA intends to forge a common pricing formula for bauxite by no later than November 1975.)²¹

There is little doubt that the Jamaican government, as well as the governments of other IBA members which followed the Jamaican initiative, expected the increase in the tax to be borne by foreigners. In this section we utilize the conceptual framework developed in the previous section to determine whether this is a reasonable expectation. The focus is, naturally enough, upon the existence of market dominance and upon the presence of resource rents, quasi-rents, and monopoly rents. It will be convenient to reverse the order in which industrial structure and capital mobility are considered.

A. Dominance

Aluminum is the most plentiful metal found in the earth's crust (8% of the earth's crust by weight) and occurs in bauxite and all clays.²² Aluminum-bearing materials other than bauxite have not been extensively exploited, however, as their low aluminum oxide content (and/or high silica content) relative to the bauxite deposits found in IBA nations has rendered derivation of alumina from these materials a much more costly proposition.²³ Bauxite

is still the cheapest source of aluminum, but known world reserves of bauxite are sufficient to support 268 years of world aluminum needs at 1973 levels of production, so that the ore hardly qualifies as an example of "rare earth." Fully 63% of world bauxite reserves, however, are located in the territory of the original seven IBA members, who also accounted for 62% of world mine production in 1973. The U.S. has only about 1% of world bauxite reserves,²⁴ while other non-communist nations outside of IBA account for less than one third of world reserves and less than one quarter of 1973 production. Australia alone accounts for 30% of world bauxite reserves, followed by Guinea at 23% and Jamaica at nearly 7%. Within IBA, three of the ten members are responsible for a heavy share of total world production. In 1973, Australia (23%), Jamaica (20%), and Surinam (10%) accounted for 53% of world mine production (see table 2).

TABLE 2
WORLD BAUXITE PRODUCTION 1973
(Percentage of Totals)

I. <i>IBA Members</i>	68.7
1. Australia	22.7
2. Jamaica	20.0
3. Surinam	9.9
4. Guyana	5.1
5. Guinea	4.3
6. Yugoslavia	3.2 ^a
7. Sierra Leone	1.0 ^a
8. Other IBA members (Haiti, Ghana, Dominican Republic)	2.5 ^a
II. <i>Rest of World</i>	31.3 ^b
1. Indonesia	1.8 ^b
2. U.S.S.R.	6.9
3. France	4.5
4. United States	2.7
5. Other nations	15.4

^a Authors' estimate.

^b Department of Mining, Republic of Indonesia.

SOURCE: Unless otherwise indicated, *Commodity Yearbook*, 1974.

The four largest producers of bauxite have a particularly strong position, especially in their primary markets, even without the support of other IBA

members. The Caribbean producers in general enjoy an especially advantageous position in the U.S. market. Jamaica and Surinam alone accounted for 75% of U.S. bauxite imports in 1973. For the period 1968-1972, the four most important Caribbean producers (Jamaica, Surinam, Guyana, and the Dominican Republic) accounted for fully 91% of U.S. imports of bauxite, or about 80% of U.S. mine production plus imports.²⁵

These facts, and others considered briefly below, suggest that IBA nations can export a substantial portion of their recent increases in taxes on bauxite. Most obviously, tax exporting to foreign consumers may be possible at least in the short- to medium-term. This conclusion would be strengthened by Australian support of common pricing formulas favored by other IBA members, but may be weakened by considerations of industrial structure.²⁶ Perhaps equally important, locational and other advantages of the Caribbean deposits create important differential rents that are particularly vulnerable to appropriation through fiscal measures.

Although Jamaican deposits contain only 50% alumina (about equal to that of much of the Australian and Indonesian deposits), they enjoy significant advantages of physical accessibility, low silica content (bauxites with low silica content are the cheapest to process by the Bayer method) and low transport costs. Guyana's deposits are less accessible (owing to a heavy overburden of sand and clay). The alumina content of Guyana's ore (57%) is the highest in the world for major deposits, however, and the country has a virtual monopoly on calcined bauxite (used in the abrasives and refractory industries). Discovery and exploitation of sizable new bauxite fields of comparable quality and accessibility does not appear likely to exert significant downward pressure on differential resource rents of Caribbean deposits through the medium term. The few known large, unexploited deposits are distant from the markets of Jamaica, Guyana, and Surinam (and are located in other IBA nations, or in nations likely to join IBA, such as Indonesia).

The nature of alumina refining—which involves substantial weight reduction (typically 50%)—also generates differential locational rents, above those accruing to bauxite deposits, as such. Recent and projected increases in shipping costs are expected to increase the premium for processing alumina near extraction sites.

B. Industrial Structure

The international aluminum industry is dominated by six major producers (Alcoa, Alcan, Kaiser, Reynolds, Pechiney, and Alusuisse), who together held 66% of the net equity ownership of western capacity (1970) in primary aluminum²⁷ and an undetermined but probably equally large share in net equity in bauxite mining and refining. The six major producers are all fully

integrated from bauxite to metal and are active in mining and processing activities throughout the world, often through joint ventures with one another and with smaller companies. American and Canadian firms have a relatively greater role in the Caribbean, European firms tend to dominate in Africa, and nearly all have substantial investments in Australia and the Far East. Concentration in aluminum smelting has declined since 1950.²⁸ But the substantial economies of large-scale production at this stage, in which (before the energy crisis) 60% of total aluminum cost was incurred, still work to the advantage of the major producers. The six major firms control 80% of western-world primary aluminum capacity, about half of world trade in bauxite, alumina, and aluminum, and a large share of fabrication capacity.²⁹ Given the preponderance of the majors at all stages of bauxite-alumina-aluminum markets and their predilection for cooperative behavior, which is facilitated by participation in joint ventures among the six, it is hardly arguable that substantial potential exists for monopoly and monopsony rents from Caribbean mining activity. The existence of monopoly rents, of course, reduces the possibility of shifting to consumers, but increases that of exporting the tax to non-resident capitalists.

C. Capital Mobility

In the short run quasi-rents accrue to the multinational firms engaged in the mining of bauxite or the refining of alumina. The package of inputs earning quasi-rents includes not only capital, but the associated technological, management, and (often) labor skills required for modern, capital-intensive mining. Given the longevity of the substantial amounts of capital invested (\$800 million in Jamaica, for example³⁰), the "short run" of economic theory may turn out to be lengthy, and the appropriation of quasi-rents could be the vehicle of considerable tax exporting. In addition, several of the major international firms have invested heavily in alumina refining in IBA nations. As most of these refineries are designed to process specific grades of bauxite, adapting them to different grades of bauxite, not to mention non-bauxite aluminum-bearing materials, would require large investments. Thus capital invested in alumina refining is not likely to be highly mobile. But while the multinational firms can do little in the short run to combat the reduction of their quasi- (and other) rents,³¹ in the long run they can move, especially if the tax policies of the bauxite-producing nations are not fully coordinated. Whether in the long run capital is driven out depends in large part on whether (and the extent that) increased taxes on bauxite go beyond the mere capturing of differential resource rents plus a portion of monopoly rents, and encroach upon the normal return to capital and technical knowledge and skills.

D. Other Considerations

1. Ordinary Demand and Cost Considerations

The recent fiscal measures enacted by the bauxite producing nations of the Caribbean provide a good example of the importance of being unimportant. Bauxite costs as a proportion of ingot costs (before 1974) have been placed at 10%, while the costs of refining alumina and smelting are 18-20% and 60-70%, respectively.³² Therefore, the Jamaican tax increase would, if fully passed forward, raise ingot prices by only about two cents per pound, or by 6% over prices prevailing in July 1974.³³ Whether a price increase of this magnitude would induce substantial short-term shifts away from aluminum, the second most used metal in the U.S., is difficult to determine.³⁴ The conductivity, strength-to-weight, corrosion-resistance, and formability of aluminum suggest that existing substitutes, such as steel, copper, and plastics, would not be likely to make substantial inroads into aluminum's markets. Costs of replacing aluminum in transport and electrical applications would be particularly high, although substitution could easily be achieved in the beverage and container industry (16% of the aluminum market). Finally, scrap supplied about 19% of total U.S. aluminum production in 1972-73.³⁵ Tax-induced increases in aluminum prices could spur recycling efforts, but this is quite a limited source of supply, except in the short run.

Probably the major source of concern for the Caribbean members of IBA is the possibility of longer-term displacement of bauxite by other aluminum-bearing materials in abundant supply in the U.S. and elsewhere in the developed world. The U.S. is rich in aluminum-bearing clays, such as nepheline synite, and has substantial deposits of alunite and anorthosite. But the alumina content of these ores is, at between 30% and 38%, significantly lower than that of most Caribbean, and for that matter, most IBA deposits (except the low silica deposits of trihydrate bauxite in Australia, with an alumina content of 35%). Furthermore, from all accounts the technology for extracting alumina from non-bauxite materials is still in the pilot-study stage. The U.S. also has very large dawsonite resources, contained in the same formations as oil shale in the Rocky Mountains. If the U.S. were to opt for a policy of extracting oil from shale, dawsonite (with an alumina content of 35%) would be a sizable by-product, and could supply the world's aluminum needs for decades. The possibility of competition from dawsonite would seem to pose little threat to IBA members, however, at least at present tax levels. On the contrary, if IBA members were convinced that the U.S. intends to exploit its oil shale reserves, they would be well advised to raise taxes on bauxite even further, in order to extract the maximum rents before large-scale generation of dawsonite or dramatic technical change in aluminum refining and smelting renders their bauxite deposits worthless.³⁶

2. *Type of Tax*

As noted earlier, Jamaica, Guyana, and other IBA members levied higher production taxes, rather than profits taxes, on bauxite producers. This is rather difficult to explain, since foreign tax credits are generally available only for income taxes. But beyond that, it is necessary to notice that the Jamaican tax is no ordinary production tax in that it presumes a minimum level of production. Thus it is in effect a lump sum tax if production falls below the stipulated level and is truly related to production only after the presumed minimum is surpassed. This feature prevents the majors from holding Jamaica hostage by temporarily shifting production to their mines in other countries and thereby depressing the Jamaican economy. To the contrary, Jamaica in effect is holding the firms hostage. As the tax must be paid, whether bauxite is mined or not, the only economical thing to do, for the time being, is to mine at least the minimum level stipulated by law.

E. Summary

Jamaica and other Caribbean members of IBA effectively dominate the North American bauxite market and are behaving in a consciously parallel, if not collusive manner. IBA members as a whole could dominate the world bauxite market if Australia should fully support IBA goals. Moreover, the industrial structure is oligopolistic. Thus in the short run, in which capital is essentially immobile, we are dealing with case 6 of our conceptual framework. Over the long run, market dominance may weaken (if the tax ultimately renders Caribbean or other IBA bauxite non-competitive) or it may increase (if IBA becomes a strong worldwide cartel). Thus, in the long run we are dealing with either case 3 or case 9. In case 3 we would expect substantial (say 50-100%) shifting to consumers; depending upon the behavior of the oligopolistic firms that dominate the world and U.S. markets, substantial short-run shifting to consumers might occur even in case 6. Recipients of resource and monopoly rents would bear the remainder of the burden in these cases, and they and recipients of quasi-rents would bear the full burden if case 9 turns out to be relevant. Given consumption patterns and the effective ownership of the major aluminum firms and Caribbean bauxite deposits, there seems to be little doubt that substantial amounts of the new bauxite taxes can be exported in both the short run and the long run, subject only to constraints imposed by weakness of the IBA and (if IBA proves to be impotent) the level of differential resource rents.

Whether the IBA will be a viable cartel is, of course, unpredictable. And because of the lack of generally recognized arms-length prices for bauxite, it is not possible without further detailed analysis to determine precisely whether the recent tax increases in Jamaica and other IBA nations have served to wrest away the entire amount of differential resource rent accruing to their bauxite deposits. Similarly, it is also impossible to determine the

size of monopoly rents in mining activity, because of the complexities of marketing and pricing and the nature of oligopolistic interaction between multinational enterprises. But the behavior of several of these firms provides some operational evidence that in fact Jamaica, Guyana, Surinam, and others have not gone too far—and perhaps that the major aluminum producers expect the IBA to achieve its objectives cooperatively. Although all the firms operating in Jamaica filed arbitration requests with the International Center for Settlement of Investment Disputes (ICSID) immediately after the tax increase, within six months one of the largest (Kaiser) not only agreed to abandon ICSID proceedings against Jamaica, but assented to the government's purchase of 51% of the firm's bauxite mining assets.³⁷ In return, the company will receive a guarantee on reserves sufficient to maintain current rates of extraction for thirty years. Though Kaiser has geographically less diversified holdings of bauxite than the other majors, and was therefore under more pressure to settle, this action was nonetheless a significant development.

A few months after preliminary negotiations with Kaiser were completed, another major company, Revere, settled with the Jamaican government on much the same terms as established for Kaiser, and also agreed to expand its alumina capacity on the island by nearly three-fold.³⁸ The Revere agreement was followed in April 1975 by a settlement between Reynolds Aluminum and the Jamaican government. Like Kaiser, both Revere and Reynolds agreed to sell to the government 51% interest in the companies' mining operations, and both agreed to withdraw proceedings from ICSID.³⁹

The last two of the North American companies operating in Jamaica, Alcan and Alcoa, had not come to terms by May 1975. Because Alcoa depends on Jamaican bauxite for only 17% of its aluminum production—much less than the producers who have already agreed to Jamaican government terms—it will probably be the last company to reach an agreement, if indeed it decides to remain on the island.⁴⁰

NOTES

1. The analysis in the remainder of the paper refers to taxes imposed on various products or on the profits earned in extracting or processing the products, even though in many cases we are dealing with higher royalties, governmentally posted prices, marketing boards, etc., rather than with taxes *per se*.

2. One of the responses to OPEC's actions has been for petroleum-producing states in the United States to raise their taxes on the production and/or refining of petroleum products in an attempt to capture some of the windfall gains generated by the higher prices for oil and petroleum products, or to export some of the higher taxes to residents of other states. The analysis presented here is of direct relevance in the appraisal of the likely economic effects of such taxes.

3. These concepts are explained more fully in Helen Hughes, "The Distribution of Gains from Foreign Direct Investment in Mineral Development," Southeast Asia Development Advisory Group, Asia Society, SEADAG Papers on Problems of Development in Southeast Asia, 74-10 (New York, 1974).

The theoretical underpinnings for the analysis presented here are contained in Charles E. McLure, Jr., "Commodity Tax Incidence in Open Economies," *National Tax Journal* 17 (June 1964): 187-204; "The Interstate Exporting of State and Local Taxes: Estimates for 1962," *National Tax Journal* 20 (March 1967): 49-75; and "General Equilibrium Incidence Analysis: The Harberger Model after Ten Years," *Journal of Public Economics* 4 (1975): 125-161.

4. We ignore the possibility of coordinated action by consumer nations against producer nations. Given the large number of nations that would have to cooperate if such action were to be effective, and the rewards from being outside a buyers' cartel in the event of economic warfare between consumers and producers, it seems unlikely that cooperation among consumer nations will be an important influence in determining the ultimate incidence of the taxes under discussion.

5. Of course, for the purpose of this analysis, if equipment can be transferred to alternative uses or shipped to countries in which its output is not subject to tax, it is mobile. On the other hand, even in the long run capital may be essentially immobile if repatriation of funds is blocked by exchange controls and if investment must be maintained in the taxed industry whether or not it is optimal, or even profitable, for the firm to do so. These qualifications illustrate the necessity of detailed analysis of individual cases.

6. Labor may also share in the burden of taxation, even if it is mobile and labor markets are competitive, if the tax results in the release of labor from the industry and the labor cannot be absorbed into the remainder of the economy without depressing wage rates. The extent to which this occurs depends upon the relative importance of the natural resources sector in the total economy, whether capital is also shifted to the remainder of the economy, the factor proportions (capital/labor ratios) in the various sectors, and the ease of absorbing labor into the remaining sectors, as indicated by elasticities of substitution. In what follows we shall ignore this complicated qualification, even though in many cases it may be quite important.

7. For more detailed explanations of this result, see, for example, Richard A. Musgrave and Peggy Musgrave, *Public Finance in Theory and Practice* (New York: McGraw-Hill, 1973), pp. 433-434 and 436-438; and (at a somewhat more advanced level) Richard A. Musgrave, *The Theory of Public Finance* (New York: McGraw-Hill, 1959), pp. 287-299. Briefly, the argument is that the tax moves the monopolist away from the price that maximizes profits. Roughly one-half of the tax is reflected in reduced profits, rather than in either higher prices or lower costs.

8. The interested reader is referred to Musgrave, *Theory of Public Finance*, chapter 13, for a survey of the subject; and to William Fellner, *Competition Among the Few* (New York: Knopf, 1949), for a more detailed survey of oligopoly models. Among the more interesting and potentially important aspects of this subject, and ones that are seldom discussed in theoretical analyses, are the relations between firms and nations. Firms might, as they did in Jamaica, band together in the effort to prevent increases in taxes. Or they might encourage nations to raise taxes. It has been suggested, for example, that the latter course was followed by the international oil companies, since a higher price for OPEC oil would increase the value of the firms' reserves in the United States. The question is beyond the scope of this paper, though the analysis presented here should prove useful in isolating instances in which firms would act in the two ways just described.

9. In certain cases one or a few purchasing firms acting cooperatively may dominate the market for the output of a country or group of countries. The incidence of taxes levied on such monopsonistic firms can be analyzed using theoretical constructs similar to those used in the

analysis of monopoly. A firm which was monopsonistic in input markets but sold in competitive output markets would, as in the monopoly case, bear about half the burden of the tax. But in this case the remaining half of the burden would be borne by resource owners, rather than by consumers. A firm that was both a monopolist and a monopsonist could shift about half of the tax in each direction, but would nonetheless suffer a reduction in profits. Finally, as is true on the product side, oligopsony (few buyers) is more common than monopsony. But the theory of oligopsonistic behavior is even less developed than that of oligopoly behavior. Given the tendency for collusion among firms in input markets to give way to competition, and the rarity of pure monopsony, we ignore the possibility of monopsony in what follows.

10. We treat export and production taxes together, since for practical purposes they generally have similar distributional effects. A third type of tax, the severance tax, is imposed upon the removal of the natural resource from the earth. To the extent that the resource can be extracted with little marginal cost, such a tax cannot be shifted by the owner of the resource. If non-residents own the resource, most of the tax will be exported. But costless extraction is unusual, and the production-profits distinction will suffice for most purposes.

We use the term "owner" to identify the persons or organizations who have economic interests in the resource during the relevant period of time. This may, of course, be someone who has leased the mineral rights from the actual owner. But the legal owner would have an economic interest in the resource if the rental payments were based on value of production.

11. The observant reader might reasonably ask how this conclusion squares with the earlier statements—and the observable reality—that the OPEC increases in oil were shifted to consumers. The problem is that the price increases were really increases determined by a group of colluding owners of resources who had not previously maximized their joint profits, and not taxes *per se*. Furthermore, the quasi-taxes are more like severance taxes than like refining taxes. If present prices maximize profits and if the resources in question were owned by some third party, further increases in the taxes would be borne primarily by the owners of the resource, rather than being shifted forward.

12. Note that in this case the tax might have an appreciable burden, even if it yielded little revenue. In fact the welfare loss could greatly exceed the amount of revenue generated.

13. The criterion of "success" here is whether or not the organization was able to raise prices at least 200% above the unit costs of production and distribution and keep them there for a significant period of time (about two years). See Paul A. MacAvoy, "A Review of Research Findings on the Longevity of International Cartel Agreements," unpublished memorandum, October 1974, p. I and appendix.

14. United States Department of the Interior, Bureau of Mines, *Mineral Trade Notes 71*, No. 12 (December 1974): 29.

15. Departamen Pertambangan, Republik Indonesia, *Pertambangan Indonesia*, 1973, p. 104.

16. M. Manley, "Statement Before the Parliament of Jamaica on Current Bauxite Negotiations," May 15, 1974.

The international firms are Alcan, Alcoa, Anaconda, Kaiser, Reynolds, Pechiney, and Alusuisse.

17. Guyana's tax was set at about 6% of the aluminum ingot price. Given the higher aluminum oxide content of Guyana bauxite, the production tax per ton of bauxite virtually matched that of Jamaica. The December Surinam measures clearly had the same intent.

18. *New York Times*, July 11, 1974. The Dominican Republic finally secured the agreement of Alcoa on higher bauxite levies in December (*New York Times*, December 21, 1974, p. 41).

19. *New York Times*, December 21, 1974, p. 41.

20. *Financial Times*, March 11, 1975.

21. *Wall Street Journal*, April 23, 1975, p. 7.
22. A. M. Bateman, *Economic Mineral Deposits* (New York: Wiley, 1950), p. 213.
23. Aluminum oxide content of Jamaican and Australian bauxite deposits is about 50%; Arkansas bauxite reserves contain 40%-60% alumina, while the aluminum oxide content of Guyana ore is about 57%. The typical aluminum oxide content of bauxite exports from Indonesia, a non-IBA member, is 53.5%. Aluminum oxide content of typical non-bauxite aluminum-bearing materials (anorthosite, alunite, dawsonite, kaolin-type clays) runs from 25% to 45% less than most bauxite found in IBA nations, although low-silica Australian deposits of bauxite with alumina content of only 35% are now mined. See U.S. Department of the Interior, *Commodity Data Summaries*, Washington, D.C., 1974, and Departamen Pertambangan, *Pertambangan Indonesia*, p. 101.
24. *United States Mineral Resources*, Geological Survey Professional Paper No. 820 (U.S. Government Printing Office, Washington, D.C., 1973).
25. U.S. Department of the Interior, *Commodity Data Summaries*, 1974, pp. 15-16. IBA members also accounted for over 95% of 1973 U.S. imports of alumina, with the greatest share (57.4%) coming from Australia, followed by Jamaica (26.8%) and Surinam (11.3%).
26. Australian spokesmen in IBA have indicated that that nation will have to study any common pricing proposals "very carefully" (*Wall Street Journal*, March 10, 1975, p. 16). Whether or not any common policy on pricing could, in the medium to long term, be effective without Australian support, is an open question.
27. R. A. McKern, *Multinational Enterprise and National Resources: A Study of Foreign Direct Investment in Australian Mining Industry* (unpublished D.B.A. thesis, Harvard University, 1972), Appendix A, p. 76.
28. Raymond Vernon, "Competition Policy Toward Multinational Enterprise," *American Economic Review* 64 (May 1974): 276.
29. McKern, *Multinational Enterprise and National Resources*, Appendix B, p. 73.
30. North American Aluminum Producers in Jamaica, Press Conference, New York, May 16, 1974.
31. Indeed, a phased withdrawal from Jamaica would appear to be ruled out by the minimum tonnage provisions enacted in May. See *Metal Bulletin*, No. 5954, January 3, 1975, p. 19.
32. McKern, *Multinational Enterprise and Natural Resources*, p. B-76.
33. International Economic Policy Association, *U.S. Natural Resource Requirements and Foreign Economic Policy*, Washington, D.C., July 1974, p. 82.
34. According to the Department of Interior figures (*Commodity Data Summaries*, 1974), U.S. demand for aluminum increased 18% in 1973, and world demand also increased dramatically in the face of rising world prices. On the other hand, American and world demand sagged badly in the last half of 1974 and first quarter of 1975, and producers' primary aluminum inventories in February 1975 stood at 89% above February 1974 levels (see *Wall Street Journal*, April 23, 1975, p. 5). But it cannot simply be assumed that this is a result of the taxes. Demand for aluminum is strongly cyclical and would normally be adversely affected by world recession. In fact, the industry apparently believes that present market weakness may last until October 1976, after which users may face several years in which the metal will be in short supply (see *The Economist*, March 1, 1975, p. 64).
35. *Commodity Data Summaries*, p. 2.
36. Recognition of the future threat to bauxite from technological progress apparently figured heavily in the Jamaican decision to opt for drastic increases in taxes on bauxite in 1974, rather than phasing in increases in taxes over a longer period. The Jamaican Prime Minister was

explicit on this point in May 1974: "If present reports are correct, the time may not be too distant when technological progress will begin to yield substitutes for bauxite" (Manley, "Statement Before the Parliament of Jamaica," p. 2).

37. *Financial Times*, November 22, 1974.

38. *Ibid.*, March 6, 1975, p. 23.

39. *Ibid.*, April 15, 1975, p. 24.

40. *Ibid.*, March 6, 1975, p. 23.