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MANAGEMENT OF COMMODITY RESOURCES IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT:

GOVERNANCE ISSUES FOR THE MINERAL SECTOR

Report by the UNCTAD secretariat

Contents

Foreword

The present report summarizes some of the findings of an UNCTAD project which has examined the role of the mineral sector in the development process of developing countries (MINDEV). The aim of the project has been to identify those policies or instruments which are most likely to enhance the contribution of the non-fuel mineral sector to economic development and promote a broader-based and eventually self-sustaining process of development. The project has been funded by the governments of Norway and Sweden, and the UNCTAD secretariat wishes to express its thanks for their support.

The rationale for the project has been that for most developing countries the exploitation of their natural resources, together with trade in the primary products derived therefrom, continues to provide the main basis for their economic growth. Even for developing countries that do not at present have any significant mineral sector activity within their territories, as is the case for many of the least developed countries, development of mineral resources may provide one of the few feasible ways of increasing economic growth. This resource-based process of growth is often perceived as an export-oriented activity whereby primary commodities are exchanged by developing countries for the capital required to expand, diversify and eventually industrialize their economies. The development process is also affected, however, by the nature and extent of the feedback between the exploitation of a country's natural resources and other sectors of the domestic economy. The more extensive this feedback, the greater is likely to be the value of resource-based development for the country concerned. This issue is especially relevant to the exploitation of non-renewable resources, since feedback will necessarily cease as the resources are exhausted. At that time, the capital represented by the original mineral deposit should have been replaced by other forms of capital capable of yielding the same return.

Work within the UNCTAD project has been oriented towards the national level since the problems addressed are directly experienced and policies ultimately implemented at that level. A number of case studies on individual countries have been carried out with a view to describing in detail these countries' experiences and identifying the particular problems encountered. Case studies have been prepared on the Dominican Republic, Indonesia and Peru, and a case study on Zimbabwe is in preparation. The present report builds on those case studies, as well as on other conclusions that have emerged from the study of the mineral sector in various countries during the project, including from a number of regional seminars held within the project (in Perth, Australia, Santiago, Chile, and Ouarzazate, Morocco).

The present report deals with the issue of "governance" as it applies to the mineral sector; that is, the role of the State in maintaining a legal and regulatory framework for the mining and metals industries, providing services and otherwise fostering a climate conducive to their sustainable development, defining mechanisms for the solution of conflicts between those industries and other interests, and ensuring that the sector's activities contribute to economic and social development and to the general well-being of the population.

I. Introduction

The general trend towards deregulation and liberalization has had far-reaching consequences for the way in which the role of the state *vis-à-vis* the enterprise sector is viewed. This trend has obviously also affected perceptions of the proper role of the state as regards the mineral sector. In the present paper, an attempt is made to describe the content of governance in the era of deregulation. Following a brief review of how perceptions of the role of the state *vis-à-vis* the mineral sector have changed over the past decades, in particular in developing countries, the body of the report is devoted to two areas of governance which indisputably fall within the state's responsibilities, but where perceptions concerning both the policy content and the degree of influence it should exercise may differ: the setting of economic conditions for the mineral sector, and the management of mineral and other natural resources, including environmental resources.

Historically, the legitimacy of the State's interest in the mineral sector was not questioned. Indeed, regulation of mining and appropriation of the values resulting from it are among the earliest recorded activities of the State, and many States have been built on mineral wealth. State or crown ownership of mineral resources was the rule in many countries before the industrial era; and following the advent of industrialization, the State in most developed countries retained specific prerogatives and authority with regard to mining, more so than in the case of other industries. Many of the institutions thus established have remained in place, thus according the mining industry a somewhat unique position in the formulation and implementation of government policies.

However, the importance attached to the mineral sector by developed country governments has tended to diminish along with the sector's share of total production. In most developed countries, with the possible exceptions of Australia and Canada, where the mineral sector is of larger overall economic importance than in other developed countries, the role of the State with regard to the mining industry is now seen as in principle no different from its role with regard to other industries. Nevertheless, there remain differences in the treatment of the industry, which are largely due to traditions of detailed regulation, the need to regulate the rights to mineral finds which justifies the existence of separate mineral resources legislation, and specific environmental regulations. The role of the State with regard to mining has thus come to be seen mainly as a regulatory one. The latest, and perhaps last, example of developed country governments taking a specific interest in the mineral sector and defining it as an area worthy of particular political attention was in the 1970s when, as a result of actions principally by developing countries with a view to increasing their control over natural resources on their territories, several industrialized countries instituted programmes intended to ensure security of supply of mineral raw materials.[1]

In developing countries, perceptions of the role of the State with regard to mineral resources have also changed considerably over the last couple of decades. Although developments have differed among individual countries and regions, mainly as a result of different historical circumstances, in particular the time at which they achieved independence from colonial powers, some broad trends are nevertheless discernible.

In colonial Africa and Asia, mining was the subject of detailed regulation, but the role of the State was seen to be mainly to ensure that the colonial territory was open for prospecting and mining; and it was not envisaged that the State itself might wish to participate in the exploitation of minerals or to initiate a

strategy for their development in terms of its overall planning objectives (Brown and Faber, 1977, pp. 1-2). In Latin American countries, which became independent earlier, the domestic private sector had a strong position in mining in the nineteenth and early twentieth centuries. Foreign direct investment, particularly by North American companies, became important after the Second World War, while the role of the State continued to be limited.

In the 1960s and 1970s, the idea of a strong public sector in developing economies became predominant. Most developing countries gave priority to the objective of economic independence, as an extension of the struggle for political independence from former colonial powers. While this in itself did not necessarily imply a strong role for the State, governments were, however, also influenced by the economic ideas of the time, which largely developed from experiences in Latin America. The prevalent view of economic development was strongly influenced by the phenomenon of structural deterioration in the terms of trade between countries exporting primary products and those exporting manufactured goods. It was argued that the benefits of international trade were unequally distributed and would lead to the impoverishment of countries exporting primary products. Industrialization on a national basis, guided by the State, was seen as the only policy that could break economic dependence. Import-substituting industrialization and resource-based industrialization - as alternatives or as complementary strategies - were expected to lead to the eventual establishment of diversified and competitive industrial sectors. The State had to take an active role in this development, since domestic private industry was small and poor in terms of capital and technology. Accordingly, the State had to operate both as formulator of planning objectives, since economic thinking was strongly influenced by ideas of central planning and the development process was seen as something that should be planned, and as executor of industrialization policies. The mineral sector was seen as an engine of growth and a base for industrialization, and because of its strategic importance in the industrialization process it became a priority object of state control.

As a result, most developing countries strengthened the role of the State through nationalizations and creation of new state-owned companies, increased taxation and attempts to obtain improved prices through collective action. State ownership of minerals in the ground became the rule where this was not already the case, and direct state participation in mining increased.

Since the early 1980s, the pendulum has swung in the other direction. The debt crisis, combined with the deterioration in developing countries' terms of trade, had a serious negative impact on the external accounts of these countries. In addition, deep recessions resulting from these external shocks reduced the volume of tax earnings. Most governments had to implement severe austerity policies as part of structural adjustment programmes and, in the process, were forced to reconsider the role of the State. Furthermore, the results of the earlier, assertive policies had often been disappointing. State-owned enterprises had often proved to be incapable of generating the large profits expected, ambitious tax schemes had deterred the foreign investment that was sought as a complement to the state-owned mineral companies, and collective action to raise commodity prices had generally failed. Increased external indebtedness forced developing countries to increase exports in order to service debts. Since the necessary capital for investment in export industries could not be raised domestically, it became necessary to attract foreign investment and conditions had to be made more favourable for investors. In many countries, state-owned enterprises were privatized, partly to reduce fiscal deficits, and partly because their economic performance had not been satisfactory.

The new political and economic environment that has emerged from this "rebalancing" process is one in which developing countries are anxious to attract foreign investment in mining, and have to design their policies with this objective in mind, sometimes relegating other concerns and development objectives, including a "fair" share of profits from mining, adequate environmental safeguards and mining's contribution to the general development process, to the second rank of priorities.

Under these circumstances, it becomes all the more important to identify those areas in which the State's scarce resources, in terms of budgets, policy-making and personnel, need to be concentrated in order to achieve the desired results. Experiences within different policy areas are discussed below with a view to contributing to this process of establishing priorities.

II. Setting the economic conditions for the mineral sector

1. The legal and regulatory framework

The mineral sector is clearly affected by government regulation in a large number of areas. Like other industries, it is the subject of general regulation in areas such as foreign trade, taxation, transportation, the natural environment, and workers' health and safety. In several of these areas, specific regulations for mining have been introduced with the aim of meeting the concerns that are particular to the mining industry.

Mining is somewhat unique among industrial activities in requiring a set of regulations of its own, usually embodied in a mining law. There are several reasons for establishing a set of regulations specifically for mining. First, given the long lead time for identification of an economic mineral deposit and development of a mine, and given the large sums invested before any economic return materializes, the rights to the deposit must be guaranteed over a long period. Second, it has generally been considered that a particular piece of land will produce more value if mined than if used for other purposes and that mining should therefore be accorded precedence over other land uses. For these reasons, almost all governments have deemed it appropriate to separate surface and underground property rights, with the State usually owning the sub-surface and hence the mineral rights.[2] The separation of rights enables the State to dispose of the mineral rights by transferring or otherwise allocating them to mine operators. This requires that guidelines for settling conflicts with other land uses be established and that mechanisms be devised for resolving competing claims to the same deposit (in some cases, the solution has been for the State to exercise discretionary power to decide who should exploit a mineral deposit). Exceptions to the precedence of mining, together with rules for compensation, also have to be laid down. Such exceptions are becoming increasingly common as environmental and conservation concerns have achieved higher priority; and, indeed, the existence of a precedence for mining can now be questioned in several countries.

In addition, there are a number of other interests that require attention. The State has an interest in preventing mine operators from achieving a monopoly position as regards mining rights in a country or a region, thus stopping other potential investors from exploring or developing deposits. Therefore, governments usually try to ensure that exploration takes place as quickly as possible and that exploitation is not unduly delayed. The State may also wish to ensure that information on mineral resources is widely available, and it may establish reporting requirements whereby mine operators have to make basic geological information collected through exploration publicly available. Other considerations may also be deemed to merit inclusion in the mining law, such as workers' health and safety, minimization of environmental damage, orderly marketing of minerals, provision of infrastructure and access to this infrastructure for the general public, services to workers and to people in the surrounding neighbourhood, transfer of technology and skills, support to domestic suppliers of inputs and promotion of downstream processing. All of these considerations can be made part of the regulatory framework for mining.

Governments have chosen different ways of ensuring that the objectives just mentioned are achieved. In some countries, they are incorporated in the mining law, in others they are distributed among various other laws and the mining law is used mainly to deal with the issue of titles to mineral deposits. The advantage of specifying conditions in the mining law is of course that this enables the government to take into account the particular characteristics of mining and the differences between this industry and others.

The disadvantage is that law and practice regarding mining may progressively diverge from the practice in other areas. Furthermore, the objective of a completely comprehensive and detailed mining code may be difficult to achieve, since it would require the inclusion of regulations which fall within the jurisdiction of several ministries and agencies.

Governments also strike different balances between legal regulations and contractual arrangements. While some of them spell out in the mining law or in other legislation all the relevant conditions pertaining to exploration and development, others leave conditions largely open to negotiation. In most developed countries mining rights are based on law and regulation, with some exceptions provided by state and provincial governments in Australia and Canada. Agreements in these jurisdictions, however, usually deal only with specific issues such as transportation or protection of indigenous populations, although the State of Western Australia has concluded agreements with mining and other companies covering a wider range of issues (Gardner, 1990).

Developing countries have used agreements with foreign investors to a much greater extent. In many cases, the mining law is applied in its entirety to domestically owned operations, while for foreign investors it is seen as providing only a general framework. In some cases, the reason for relying on an investment agreement rather than law and regulation has been the size and economic importance of a particular project relative to the national economy, as well as the absence of well-developed mining legislation. In other countries, such as Indonesia, where more than 100 agreements have been concluded since 1967, investment agreements are the preferred procedure (UNCTAD, 1994a). The advantage of contractual arrangements is their flexibility and the possibility of tailoring conditions to the characteristics of individual projects. Not least, they may allow the government to maximize its possibilities of levying taxes on the operation. Investment agreements also allow countries to learn from experience and to modify conditions from one project to another. A final reason for preferring to regulate conditions in an agreement is that for large projects it is not sufficient from the investor's point of view to rely on general laws and regulations. Several factors, including taxation, tariffs and foreign exchange regulations, are crucial to the economic viability of the project, and with a large project the government could be tempted to change these once an investment has been made. Accordingly, detailed agreements encompassing almost all conditions that could affect the operation and economic circumstances of the project are often concluded.

The legal framework for mining in many developing countries has been considerably revised in recent years or is being reviewed as a consequence of the political and economic changes described in the preceding section. Since the mid-1980s, over 75 countries have adopted new mineral laws, made major revisions to existing laws or are currently working on draft legislation.[3] Some general trends can be discerned from this process.

First, legislation is being simplified and permitting procedures are being streamlined. At the same time, fewer conditions are being left open to the exclusive discretion of governments, with investment agreements providing flexibility where needed.

Second, restrictions on foreign investment are being eliminated, along with provisions for mandatory state or domestic participation in projects. Instead, governments increasingly rely on taxation to ensure for themselves a share of the revenue from mineral production. The structure of taxation is changing and

becoming more sophisticated, with governments moving towards taxation schemes that attempt to combine attractiveness to investors with maximization of government revenue.

Third, other concerns, in particular those pertaining to environmental protection, but also those pertaining to relations with local communities, are increasingly being included in mining legislation. As the process of development continues and other institutions are established to handle these concerns, however, some of them are removed from the mining legislation to other, specialized legislation.

2. Foreign investment

Before the political changes of the 1960s and 1970s, foreign investors in mining in developing countries generally enjoyed conditions that must be described as very generous, benefiting from very long term concessions, fiscal stability and favourable taxation conditions. Conditions in Latin America have been summarized as follows:

> "On the one hand, the mining codes held that the minerals in the soil and the subsoil are the property of the State, but on the other hand a system of very advantageous concessions was instituted for investors which gave them the right to use, enjoy and freely dispose of the product of their activities in the areas given to them under concession for a practically indefinite length of time (50 years or more), with guarantees of tax and exchange stability. The investors paid a very small land rent which enabled them to maintain large areas indefinitely without being exploited, as part of their world reserves for possible exploitations, while the host state, in practice, lacked the capacity to question or annul a concession ... the taxation of profits was excessively low (between 6% and 25% of the taxable amount), while the effective rate of tax was even lower because of various types of deductions and exemptions. A typical deduction was based on the "depletion" factor of the deposits exploited by the transnational corporations, even though the non-renewable resource was the property of the State. Under these arrangements, the enterprises were allowed to deduct, free of all charges, 15% and in exceptional cases even as much as 50% of their profits, although they were, it is true, obliged to reinvest the amounts corresponding to this deduction. Investors were also permitted to make accelerated depreciation reserves in respect of machinery and equipment at a rate of up to 20% per year and to readjust their capital to take account of variations in the purchasing power of the national currency." (Kñakal, 1984, pp. 4-5)

As a result of the political and economic changes during the 1960s, the attitude of developing country governments to foreign investment became significantly less accommodating. Mining operations owned by foreign companies were nationalized in many countries. Prominent examples include full or partial nationalization of copper operations and reserves in Chile, Peru, Zaire and Zambia, of bauxite/alumina companies in Guyana and Jamaica, and of tin companies in Malaysia.

In Chile, partial nationalization of the major copper companies in the late 1960s, with conditions that were relatively favourable to them, was followed by full nationalization in 1971, when the valuation of

the companies was based on their book value and deductions were made for previous "excessive" profits, resulting in no compensation to the owners (Kñakal, 1984, pp. 24-32). In Peru, holders of mining concessions were obliged to submit new investment projects to the Government for approval. A principle of "no work, no protection" was applied, resulting in the cancellation of more than 4,000 unworked concessions, which reverted to the State. (Kñakal, 1984, pp. 14-15). In 1974, the Cerro de Pasco Corporation was nationalized (Radetzki and Zorn, 1979, p. 39). In Zaire, the properties of Union Minière du Haut Katanga were nationalized in 1967, to form the state-owned company Gécamines, and in Zambia, the Government acquired 51 per cent of the shares of Anglo American's copper holdings, which became Nchanga Consolidated Mines, in 1969 (Radetzki and Zorn, 1979, pp. 37, 40). In Guyana, the local subsidiary of the Canadian aluminium company Alcan was nationalized in 1971 (Grabow-von Dahlen, 1987, p. 288). In Jamaica, agreements made with the foreign bauxite and alumina companies in 1976-1978 included provisions for the nationalization of mining lands and for the establishment of joint enterprises, with the Government holding from 6 to 51 per cent of the assets (Kñakal, 1984, pp. 45-51). In Malaysia, the Malaysian Mining Corporation (MMC) was formed by the Government's buying equity in existing tin mining operations in the mid-1960s (Tham Weng Sek, 1989).

The attitude to foreign investment in mining has changed over the past couple of decades in most developing countries. In the early 1980s, exploration by foreign companies was usually permitted, but security of tenure linking exploration to mining was weak; that is, exploring companies were not assured of the right to exploit deposits discovered. Foreign direct investment was permitted in most countries, but often only with participation by domestic companies, either state or privately owned. The security of a right to explore has generally been strengthened in recent years, with many mining codes now recognizing that right as exclusive within the exploration area. The link between the exploration right and the right to mine has also been strengthened in most countries. In addition, the mechanisms for settling disputes have been made more acceptable to foreign investors, with many recent investment agreements providing for international arbitration of specified disputes, and with many countries having entered into various bilateral and multilateral investment treaties that accord investors some form of protection against unilateral actions by host country governments (UNCTAD, 1994b, pp. 296-300). Remaining limits on foreign ownership or exploration by foreign companies may apply to border areas, although these limits tend also to have been relaxed in recent years, as in Bolivia in 1990 and Peru in 1994, or to special "reserves", where only the government may explore, although these have also been abolished in many cases, as in Peru (UNCTAD, 1993, p. 82) and the Dominican Republic (UNCTAD, 1995b, p. 30). Reasons for these changes include the need to increase export income in order to service mounting external debts, and the increasing scale and capital needs of mining projects. Accordingly, most developing countries now try actively to attract foreign investment in mining. It should be noted in this context, however, that many developed countries restrict investment by foreign-owned companies in mining (UNCTAD, 1994b, pp. 294-295).

The shift in the attitude to foreign investment is reflected in international exploration and investment patterns. Unfortunately, available time series data on international exploration cover only the last few years. Furthermore, they are generally not very reliable, since they are usually based on samples of companies, the composition of which may have changed over the years, and since the definition of exploration costs, in particular the distinction made between costs of exploration and development, may differ from one source to another.

The level of exploration expenditures is strongly influenced by events within individual commodity industries, such as technological developments that make ore in hitherto uneconomic deposit types economically recoverable, the emergence of new end-uses that lead to expectations of increasing demand, and other factors influencing expectations regarding future demand and prices. Accordingly, during certain periods, exploration aimed at identifying deposits of a particular commodity has dominated international exploration. The following periods can be identified since the 1960s (Eggert, 1992, pp. 51-54):

1960s to early 1970s: Exploration for bauxite and for porphyry copper deposits dominated. Advances in the Bayer process used for alumina refining permitted the use of bauxite with a lower aluminium oxide content and relatively high iron and silica contents, thus making economic a new class of bauxite deposits in countries such as Australia. Exploration for such deposits resulted in an increase in reserves that made further exploration unnecessary. Accordingly, bauxite exploration since the early 1970s has been negligible. Advances in mining and beneficiation technology, coupled with rapidly increasing demand, also made possible the exploitation of porphyry copper deposits, i.e., large deposits with a low (0.5 to 2 per cent) copper content which is relatively evenly distributed in the host rock. Intensive exploration for this type of deposit resulted in a large number of them being discovered in Argentina, Canada, Chile, Indonesia, Iran, Panama, Papua New Guinea and the United States.

Late 1970s: The search for uranium dominated exploration in this period, increasing sixfold between 1972 and 1979. It was stimulated by the rapid growth in nuclear power generating capacity in the late 1960s and early 1970s and by expectations of continued growth. The uranium exploration boom - and the period of high uranium prices - came to an abrupt end in the early 1980s following the discovery of enormous reserves in Australia and Canada and, even more importantly, drastic downward revisions of projections for future growth in nuclear power generating capacity.

1980s: Gold was the main target for exploration in the 1980s. In Australia, Canada and the United States, gold exploration accounted for more than half of total exploration expenditures for metallic minerals. Large gold exploration programmes were also carried out in several developing countries. Three factors contributed to the increase in exploration for gold. First, the price of gold was generally high in historical terms. Second, improvements in leaching and carbon-in-pulp recovery techniques cut the cost of extracting gold from low-grade deposits. Third, advances in exploration techniques facilitated the identification of gold deposits.

Although changing priorities regarding the minerals targeted for exploration are likely to have had a strong influence also on the geographical distribution of exploration, it nevertheless appears to be generally recognized that the share of exploration funds spent in developing countries fell as a result of policy changes in those countries. According to one source (Crowson, 1988, p. 27), exploration spending in developing countries decreased from over 40 per cent of total exploration spending in the 1960s to just over 20 per cent in the early 1970s and remained at about the same level in the early 1980s. Another source (Radetzki, 1982, pp. 41-42) puts the date of the downturn earlier, pointing out that data for the

1960s are strongly influenced by one single project and that developing countries' much higher share in world mineral production than in exploration and mining investment implies higher previous levels of exploration and investment than those prevailing in the 1960s. Thus, the downturn in the share of exploration spending going to developing countries would have occurred earlier. This argument could be disputed on the grounds that higher ore grades in developing countries led to a lower capital/output ratio and a correspondingly higher share in world mineral production than in investment. Similarly, it could be argued that exploration was relatively more successful in the largely unexplored territories of developing countries and that a smaller amount of exploration funds resulted in more deposits being identified. While the exact timing and magnitude of the downturn could be the subject of discussion, it is not disputed that the portion of international exploration funds used for exploration in developing countries in recent decades has been considerably lower than their share of world mineral output and lower than would have been justified on geological grounds alone.

Recent policy changes in developing countries have, however, led to increased interest in exploration in those countries, and their share of world-wide exploration may have increased to as much as 45 per cent by 1994 and over 50 per cent in 1995, most of it accounted for by Latin America (Mining Journal, 1994b and 1996a). Meanwhile, exploration spending in general rose significantly during the 1980s, particularly as a result of the increased interest in exploration for gold.[4] Gold exploration has however decreased in the past few years, and this has led to lower exploration expenditure overall.

A similar pattern of development over time can be observed with regard to investment in mining. Again, reliable data are scarce, but it appears to be generally recognized that foreign direct investment decreased as a source of finance for mining and metals projects from the 1960s. While this was to a large extent directly due to changes in host countries' attitudes to foreign investment, which made investors less willing to risk their money, developments within international mining companies themselves also played a significant role, in particular from the mid-1970s. Previously, the principal source of funds for new investment had been equity or accumulated profits, with close to 90 per cent of total capital requirements for developing country mining up to the 1960s being met from these sources (Radetzki and Zorn, 1979, p. 54). However, the slump in metals prices and demand in the mid-1970s dramatically reduced the ability of mining companies to fund projects from their own capital. At the same time, investment costs rose, further exacerbating the situation. Mining companies thus had to turn to new sources of finance, particularly project finance, with a resulting increase in the debt/equity ratio of new projects.

Developments in host countries reinforced this trend in several ways. First, limitations on foreign ownership of mining operations often imposed a requirement on investors to provide governments or other domestic interests with "free" equity. Rather than raising the whole amount of capital needed for the investment from their own resources and then giving perhaps half of it away, companies much preferred giving governments half of a project loan - along with half of the responsibility for repayment. Second, while taxation on mining in developing countries had generally been very favourable to investors, most developing country governments raised taxes drastically in the 1970s. They did, however, normally allow tax deductions for interest on debt. Accordingly, assuming a 50 per cent rate of taxation, while a project with an internal rate of return of, say, 15 per cent before taxes would yield only 7.5 per cent after taxes if financed from equity, it would yield 10 per cent if half of the funds were borrowed at 10 per cent. Third, mining companies, very aware of the nationalizations of operations that had taken place, sometimes without

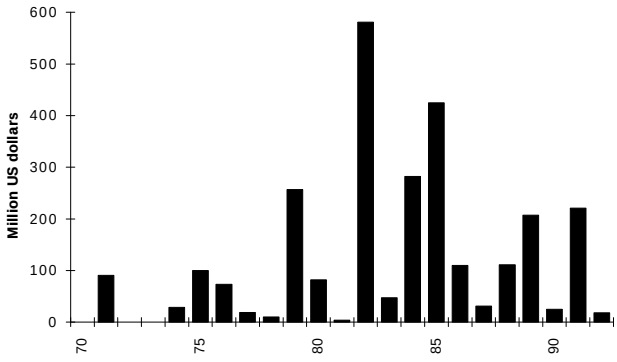
adequate compensation from the companies' point of view, reasoned that equity could be nationalized but loans could not.

As already stated, project financing was the main new method of raising capital. From the companies' viewpoint, project finance had several advantages in addition to the ones already mentioned. First, it allowed companies to keep loans off their own balance sheets, thus maintaining their creditworthiness. Second, it provided additional assurance against unilateral action by host governments such as nationalization, since banks insisted on including this in the loan conditions, and were in a better position than the mining companies to enforce those conditions. Third, project finance was possibly the only feasible way of raising the very large amounts of capital that were needed for many new mining projects in the 1970s, since it allowed the risk to be shared among a large number of parties.

In parallel with project finance, other "new forms of investment" also evolved. These included joint ventures, licensing arrangements, invest-and-import and loan-and-import, management contracts and production-sharing contracts.[5] What all these instruments have in common is that they reduce investors' risks.

In this context should also be mentioned the role of the international financial institutions. World Bank lending to mining projects has been important in many cases, not least because World Bank approval of a project has tended to facilitate the raising of other finance. Figure 1 shows World Bank and IDA (International Development Agency) lending to mineral projects from 1970 to 1992.

Figure 1 World Bank and IDA lending to mineral projects 1970-1992 (source: World Bank)



In the 1980s and 1990s, foreign direct investment in mining in developing countries has again increased. While there appears to have been no significant change in the proportion of equity and external financing of projects, and while new forms of lending such as gold loans[6] have facilitated the implementation of many new projects, policy changes in developing countries have led to an increased willingness on the part of investors to enter into new projects in these countries, particularly in Latin America. Privatizations of state-owned mining enterprises have constituted a significant part of foreign direct investment in recent years, and are likely to continue to account for a portion of that investment in years to come (see section II.4 below).

Although many developing countries have been successful in attracting foreign investment in mining in recent years, it is clear that there are important differences between countries and that prospective investors rank countries differently from the point of view of attractiveness to mining investors. Table 1

shows the results of two such rankings carried out respectively in 1969 (Michener, 1969) and 1990 (Johnson, 1990). The 1969 ranking represents a combination of "political climate" and "geologic climate". In the 1990 survey, companies were asked where they believed active minerals exploration was probable in the early 1990s, and ranks are based on the number of companies mentioning a particular country. While the two surveys did not attempt to measure the same parameters, the correlation between the two measures would be expected to be strong. As can be seen from the table, ten of the 21 countries included in the 1969 rankings were present also in the 1990 list (Australia, Canada, Mexico, New Zealand, the United States, Brazil, Indonesia, Malaysia, Thailand and Chile), and only three (Papua New Guinea, China and Botswana) were "newcomers". It thus appears that exploration - and by extension, investment - remains oriented towards a relatively small group of countries.

Table 1. Ranking of countries' attractiveness to investors in mining, 1969 and 1990

Country	Rank 1969	1990
Australia	1	3
Canada	2	2
Mexico	3	7
South Africa	4	-
New Zealand	5	10
Angola	6	-
Mozambique	7	-
United States	8	1
Brazil	9	8
Zimbabwe	10	-
Argentina	11	-
Indonesia	12	5
Malaysia	13	13
Thailand	14	10
Philippines	15	-
Chile	16	4
Peru	17	-
Colombia	18	-
Burma	19	-
Bolivia	20	-
Venezuela	21	-
Papua New Guinea	-	6
China	-	8
Botswana	-	10

Sources: Michener, 1969; Johnson, 1990.

An important reason for the differences between countries, both as regards historical exploration spending and the type of rankings shown in table 1, would be expected to be "geological attractiveness", which in turn could be expected to be correlated with the land surface of countries. However, differences in size clearly do not account for the entire difference in geological attractiveness, nor is geological attractiveness the decisive factor influencing decisions on exploration spending. Several surveys have been conducted to determine which factors are most important to investors. The results of three such surveys are shown in table 2. Box 1 gives a brief description of the foreign investment regime in Indonesia, a country which is generally considered to offer attractive conditions for investment in mining, and which meets most of the criteria mentioned in the surveys.

Box 1. Conditions for foreign investment in mining in Indonesia, fifth generation of Contracts of Work (COW), since 1990

General	
Duration of COW	30 years extendable, all conditions stable during life of COW
Legal status	Act passed by parliament
Divestment	51% to Government or Indonesian nationals by end of 10th year (15th year in certain areas)
Repatriation of capital	Allowed for profits, repayment of loans, depreciation, proceeds from sales of shares, and expenses of expatriate staff
Fiscal conditions	
Maximum interest charges	Calculated on the basis of a debt/equity ratio of 5:1 for investment less than US$ 200 million, or 8:1 if more
Operating loss carried forward	8 years
Depreciation	Equipment with life of less than 4 years: 50% Equipment with life between 4 and 8 years: 25% Equipment with life of more than 8 years: 12.5%
Exemption from import duties	During first 10 years of commercial production
Land rent	General survey: US$ 0.025-0.05/hectare Exploration: US$ 0.10-0.35/hectare Feasibility and construction: US$ 0.50/hectare Operation: US$ 1.50-3.50/hectare
Minimum expenditure	General survey: US$ 250/square kilometre Exploration: US$ 1,000/square kilometre
Royalty	1-2 per cent, depending on price
Regional and other taxes	For General survey, Exploration and Feasibility equal to land rent, at operating stage land rent plus 0.5% of 20% of gross revenue
Withholding tax	15% for permanent foreign residents, 20% for non-permanent residents
Export tax	Levied on copper concentrates, sliding scale
Corporate income tax	15% up to Rp. 10 million (approx. US$ 5,000) 25% between Rp. 10 million and 50 million, 35% above Rp. 50 million
Income tax, expatriate employees	20% if working in Indonesia less than 183 days/year, otherwise same as Indonesian nationals

Source: Adapted from Gandataruna, 1991.

Table 2. Ranking of exploration and investment criteria in three surveys of mining companies (in decreasing order of importance)

O'Neill, 1992	Otto, 1992	Johnson, 1990
1. Right to mine successful discovery	1. Geological potential for target minerals[a]	1. Right to mine
2. Equitable profit repatriation	2. Security of tenure	2. Right to repatriate profits
3. Attractive geology	3. Ability to repatriate profits	3. Management control
4. Management control	4. Internal rate of return[b]	4. Equity control
5. Political stability and safety	5. Consistency and constancy of mineral policies	5. Tax terms fixed
6. Transparent and predictable taxes and royalties	6. Stability of exploration/mining terms	6. Modern minerals legislation
7. Equity control	7. Ability to predetermine tax liability	7. Rules fixed for life of mine
8. Effective and modern mining legislation	8. Realistic foreign exchange regulations	
9. Efficient and corruption-free bureaucracy	9. Company has management control	
10. Availability of convertible currency	10. Return on investment[b]	
11. Rules fixed for life of mine	11. Mineral ownership	
12. Acceptable labour laws	12. Ability to predetermine environment-related obligations	
13. Access to existing discovery	13. Net present value[b]	
14. Guaranteed access to international arbitration	14. Stability of fiscal regime	
15. Fast track project approval procedures	15. Method and level of tax levies	
16. Updated geological database and mapping	16. Ability to raise external financing	
17. Acceptable environmental laws and procedures	17. Export/import policies	
18. United Nations or World Bank support	18. Long-term national stability	
19. Reasonable infrastructure	19. Permitted external accounts	
20. Availability of indigenous professionals	20. Ability to apply geological assessment techniques[a]	
	21. Established mineral titles system	
	22. Competitive cost index[b]	
	23. Majority equity ownership	
	24. Modern mineral legislation	
	25. Internal conflicts	
	26. Right to transfer ownership	
	27. Surface/land ownership	
	28. Break-even year	

Sources: O'Neill, 1992, p. 231; Otto, 1992, pp. 337-338; Johnson, 1990.

[a] Exploration criterion

[b] Investment criterion

The survey by O'Neill was addressed to Australian companies with interests in Africa and focused on investment criteria (O'Neill, 1992, p. 231). The one by Otto addressed criteria for exploration or mining investment decisions (Otto, 1992, pp. 337-338). Criteria have been ranked according to the number of companies that considered them to be very important, with the average of the response concerning exploration programmes and investment projects being used when a criterion applies to both types of decisions (responses were strongly correlated between the two types of decisions). Only those criteria which were considered very important by at least 17 out of 39 responding companies have been included here. In the survey by Johnson, the ranking was based on the proportion of companies which indicated that a factor was critical to the decision to undertake a major exploration programme in a country and therefore not negotiable (Johnson, 1990).

The right to mine a successful discovery or security of tenure comes at the top or in second place in all the lists, demonstrating the importance of this factor. As already noted, governments in many developing countries have strengthened the link between exploration rights and mining rights, providing for almost automatic granting of mining permits to successful explorers. While this may appear simple, a mutually acceptable mineral investment regime has to strike the necessary balance between a company's legitimate expectations and its desire to avoid bureaucratic intervention on the one hand and, on the other hand, a country's reasonable concern about the impact of a large-scale mining operation on the economy of a region and on the natural environment. The latter concern may dilute the automaticity of the right to mine a discovery.

Equitable profit repatriation, transparent, predictable and stable taxes and royalties, and availability of convertible currency all concern the immediate financial conditions for investment. Recently introduced tax regimes in developing countries attempt to reduce risks to investors and to take due account of both the government's interest in maximizing tax revenue over the long term and the company's interest in maximizing the return on invested capital. It is clear from the surveys that the stability and predictability of the taxation system are more important than the actual rates of taxation (within certain limits, presumably). In this context should also be mentioned the importance of avoiding indirect taxes or import duties which may be detrimental to the viability of mining projects. High taxes on fuel, for instance, can have a major impact on production costs and have been criticized in some countries (Andrews, 1991; UNCTAD, 1993, pp. 51, 64). Most countries have therefore introduced drawback provisions, whereby import duties and value added tax paid on inputs or equipment are repaid when minerals are exported. The availability of convertible currency merits a separate comment. Many developing countries with non-convertible currencies and shortages of foreign exchange have established systems for foreign exchange allocation which may prove quite onerous for mining companies and lead to delays in the procurement of inputs and equipment. Some countries, recognizing that such systems may lead to undesirable consequences in the case of mining operations, which are generally export-oriented and net foreign currency earners, have introduced the possibility of setting up escrow accounts outside the host country to handle foreign exchange transactions. There are usually strict obligations in respect of reporting to the monetary authorities of the host country, which will monitor foreign exchange transactions through the account (Andrews, 1991; Kumar, 1990).

That an attractive geology is important should not require any comment. A good geological database is also seen as valuable, although it is somewhat surprising that this factor is not accorded more

importance. This may possibly be explained by low expectations. for example, a majority of respondents in a similar survey carried out by the World Bank said that information is less readily available for countries in Africa than for developing countries in other regions, and that information was least adequate *inter alia* regarding basic geological data (World Bank, 1992, p. 17). Chapter III discusses the provision of geological information.

Management and equity control are clearly important. As already mentioned, developing country governments have generally relaxed requirements for minimum domestic ownership. In some cases, requirements for free equity have been changed to a requirement to offer participation to domestic companies or to an option for the government to purchase a share of the operation at prices determined in an impartial manner.

Stable conditions, whether in general or more specifically related to the project conditions, are clearly important, given the longevity of mining projects. Many governments "freeze" conditions existing at the time of investment to extend over a long period of time, typically 25 years. In order to provide investors with additional assurance, mining investment agreements in some countries, for instance Indonesia (UNCTAD, 1994a), have to be approved by parliament and acquire the status of law. Nevertheless, disputes may arise, and it is then important that dispute settlement mechanisms have been established. An increasing number of developing countries choose to subscribe to ICSID (International Centre for Settlement of Investment Disputes) and MIGA (Multilateral Investment Guarantee Agency), both of which are affiliates of the World Bank. ICSID arbitrates investment disputes between host governments and investors; MIGA insures private investments against various forms of political risk.

Having modern mining legislation which is efficiently administered is obviously a major advantage for countries aiming to attract foreign investment. Delays in obtaining approvals, extensive coordination procedures among several government departments and unclear lines of authority all add to the cost of projects, not least in terms of scarce management time. Some countries have chosen to establish a "single-stop agency" which handles approval of all foreign investment projects. This solution usually results in reductions in the time necessary for project approval and may help in avoiding problems that may otherwise arise because of conflicting provisions in different sets of laws, a typical example being conflicts over land use, which is usually regulated in land laws and can create major problems in densely populated countries.[7] One problem of such agencies is, however, that they may lack sufficient expertise in mining.

The freedom to market products, although not explicitly included among the criteria listed in table 2, is also important to investors. Some developing countries have in the past required mining companies to market their product through a state-owned marketing company in order to deter transfer pricing. This practice, however, has now generally been abandoned. In Peru, for instance, the state-owned company Mineroperu Comercial (MINPECO) was set up in 1974 to market mineral exports. In the mid-1970s, it marketed about 90 per cent of Peru's mineral exports. but the effectiveness of the enterprise was adversely affected by a number of drawbacks of an administrative and bureaucratic nature, partly arising from the fact that MINPECO reported to the Ministry of Trade rather than to the Ministry of Energy and Mines. In the early 1980s, MINPECO's monopoly on marketing was relinquished, and until 1991 it confined its activities to marketing the products of the state-owned mining companies (Kñakal, 1984, pp. 19-22; UNCTAD, 1993, p. 78).

Most developing countries are now attempting to reform their legislation and institutions with a view to attracting foreign investment in mining. In view of the large potential returns to the government from large-scale mining projects, the question may arise whether this process might not lead to a "bidding war" between countries for investment, tempting some of them to reduce taxation rates, offer other economic incentives that might reduce the government's income from the investment, or be less demanding with regard to environmental management. To answer this question, it is important first to note that international mining companies, according to the surveys just reviewed, generally regard geological conditions as being of overriding importance. Other conditions are of little importance if the geology is not considered attractive. Furthermore, the absolute level of taxation is usually seen as less important than stable economic conditions, including taxation. One reason for this is that double taxation agreements usually provide for taxes paid in one country to be offset against taxes payable in the other. Consequently, if a government lowers its tax rates in order to attract foreign investment, this may result in more taxes being paid by the investing companies in their home countries, with no reduction of the total tax burden. Therefore, while tax regimes have to be "competitive" for investment to be attracted - that is, rates should not be too different from what is offered in other countries - it seems that little would be gained from keeping the rate of taxation very low. As regards other means of attracting investment by international mining and metals companies, there is no evidence of a bidding war developing. The question of environmental management is specifically addressed in section III.1 below. Finally, developing country governments have become better informed about prevailing investment conditions and they are therefore less likely to offer conditions that differ substantially from those of other countries.

3. Taxation

The governments of a large number of developing countries depend on tax income from the mineral sector for a high portion of their revenues. Table 3 shows some examples of the share of mineral taxes in total tax income for those African countries where the mineral sector is of major importance.

The mineral taxation system expresses the government's desire to share in the rents from mineral production. This can essentially be done in two different ways: through taxation or direct government ownership. This section deals with taxation, including the various fees or levies that may be imposed on mining enterprises. Section II.4 discusses government ownership.

Two main factors have influenced the design of taxation schemes for mining enterprises in most countries: the interest in taxing resource rents and the recognition of the high risks inherent in mining.

Mining enterprises are generally subject to the same taxes as other companies, including

Table 3. Mineral taxes in per cent of total tax income, 1989

Botswana		58
Guinea	72	
Namibia		36
Niger		16
Sierra Leone		67
Zaire		35
Zambia		16

Sources: World Bank, 1992, p. 3; Fozzard, 1990 (figure for Sierra Leone, 1990).

corporate income taxes, property taxes, duties on imports and various other types of indirect taxes. In addition to these taxes, many countries levy specific taxes on mining operations. The justification for these is to be found in the concept of resource rent. Resource rent can be defined as the value of the product of a mineral resource minus all the costs of production, including the minimum returns on capital that are necessary to induce investment, including exploration investment (Daniel, 1990, p. 22).

The resource rent arises from the fact that mineral deposits vary in composition, volume and location, so that the costs of extracting a certain quantity of saleable product will vary among operations, even if identical technologies are used. Thus, companies exploiting better deposits or deposits that are closer to markets will earn resource rents consisting of returns over and above the necessary compensation to production factors. Rents may also arise from market imperfections which allow companies to obtain prices over and above what would have been the case in competitive markets. Sometimes, resource rents are identified as arising from large temporary price increases. However, large profits for all mining companies in times of high prices do not by themselves indicate the existence of resource rents for all companies, since for the marginal companies the high prices will be offset by lower prices in downturns, leading, over the life of a mine, to a return that is equal to the minimum return on capital and just sufficient to keep the company in business.

While rents or quasi rents may exist in other industries, they generally arise from market imperfections such as differences in technology or market power, or from locational advantages. The resource rent, however, is independent of technological or managerial efficiency (although it can be dissipated as a result of inefficiencies in production).

The argument for taxing the resource rent relies, from a philosophical point of view, on the perception that since it does not derive from any effort by the company concerned, and since the State is the owner of mineral resources, the government has a better claim on the rent than the company. From the economic point of view, the attractiveness of taxing the resource rent lies in the fact that such a tax does not affect allocative efficiency; that is, it can be appropriated by the government without diverting investment funds from the mining sector to another industry (or vice versa), without altering the ranking of individual investment opportunities within the mining sector, and without changing the profit-maximizing level of production in an existing mine.

As regards the other important factor influencing mining taxation - the high risks - it should be noted that while risk is not exclusive to the mining industry, mining nevertheless entails certain types of risk not present or not as important in other industries. Exploration risk is the first of these risks faced by the company as seen over the life of a project. For all prospects examined, very few result in viable mines and the costs of exploration can be high. The average cost of discovering an economic deposit in the 1980s has been estimated at US$ 38 million for base metals in Canada, US$ 111 million for base metals in Australia, US$ 25 million for gold in Canada and US$ 63 million for gold in Australia (Bilodeau and Davidson, 1991). It has been estimated, in the cases of Australia and Canada, that an exploration expenditure of about US$ 100 million is necessary for the probability of discovery of at least one economic deposit to reach 90 per cent (Fozzard, 1990).

Once a deposit has been discovered and is to be developed, the mining company faces geological

risk, i.e., the risk of the deposit not having exactly the same characteristics as expected, and project risk, which arises because investment decisions are based on estimates of the technical parameters that determine project costs. While the latter type of risk is to some extent common to all kinds of industrial projects, it may be more important in the mining industry because of the long lead times.

Market risk is to some degree different in nature in a mining project than in other industrial ventures. While in other industries market acceptance may be a problem, the high degree of standardization of mineral products means that this is generally not so for mineral commodities, particularly for those commodities that are quoted on commodity exchanges. The situation is somewhat different for non-metallic minerals, where quality considerations and the possibility of identifying suitable end-uses for the product play a much more important role. The price risk is however considerably more important than in most other industries, given the large fluctuations in mineral and metal prices.

Finally, mining companies face political risk; that is, the risk of changes in government policies that may have negative effects on the economic viability of a project. Historically speaking, this risk has probably been more important in the mining industry than in other industries.

The importance of risk is further underlined by the long lead times and the capital-intensive nature of the mining industry. Typically, a mining project takes at least five years and sometimes as long as 15 years from initiation of an exploration programme to the start of production. During this period, payments have to be made for exploration, project development and construction. Accordingly, with the major share of costs normally occurring in the early parts of a project and income accruing only later, the distribution of the tax burden over time becomes crucial.

The problem from the State's point of view is how to identify, maximize and retain mineral rent for investment or consumption. The "taxation problem" consists of the design, in the face of uncertainty, of a system for sharing revenue between mining companies and the government which maximizes the flow of government revenue over time, which does not deter exploration and development activity that would otherwise be economically justified, which does not cause a resource to be exploited in an inefficient manner, and which does not leave substantial portions of rent to accrue to recipients other than the State (Daniel, pp. 4-5).

Governments have generally tried to reconcile the two objectives of maximizing government revenue and attracting mineral investment through mechanisms which aim at reducing the risks faced by mining companies while leaving the discounted value of the revenue flow to government as far as possible unaffected. Since the major risks and capital outlays occur in the early stages of projects and since governments tend to have a lower time preference than mining enterprises (that is, they apply a lower rate of interest when discounting future costs and incomes), mining taxation systems tend to aim at moving the incidence of taxation to a later period than would otherwise have been the case. The State thus collects its share at a relatively late stage in the project, often allowing the mining company to earn a "reasonable" return on its investment before taxing the resource rent. Inevitably, this taxation strategy also results in the State's assuming a larger share of the risk that it would have otherwise assumed.

Mining taxes typically fall into one of two categories: taxes on profits, and royalties based on

volume or value. Profit-related taxes, whether in the form of normal corporate income taxes or additional to these, aim explicitly or implicitly to capture the resource rent. While all countries levy corporate income taxes on mining enterprises, relatively few attempt to collect taxes on resource rents in non-fuel mineral mining over and above the income tax. These taxes are sometimes called “additional profit taxes” or “resource rent taxes”. Since the term "resource rent tax" may also refer to a tax that is imposed *only* on the resource rent,[8] the former term is used here. The situation is somewhat different in the oil industry, where most countries collect a tax on resource rents.

The better-known examples of countries successfully imposing additional profit taxes in the non-fuel mineral industry include Ghana and Papua New Guinea. Under Ghana's 1986 Minerals and Mining Law, an "Additional Profit Tax" at a rate of 25 per cent in addition to corporate income tax of 45 per cent is levied on the "carry-forward cash balance". This balance is calculated in such a way that it becomes positive only when the project has achieved a certain rate of return on total capital. In 1991, the threshold rate of return, which is negotiated with the Government, was 35 per cent for new mines and 17 per cent for existing mines (Duodu, 1991). Two agreements concluded with foreign investors in Papua New Guinea were innovative in defining the scope of resource rent taxes and were used as models in several other countries. The first of these agreements was the 1974 agreement with Bougainville Copper, whereby an additional profit tax of 70 per cent was levied whenever annual profits net of company income tax (at a rate of 33 1/3 per cent) exceeded a rate of return of 15 per cent on capital employed. The second was the 1976 Ok Tedi agreement, whereby a 35 per cent company income tax accrued until the full investment had been recovered. After the investment recovery period, a 70 per cent tax, comprising both ordinary company income tax and additional profit tax, was levied on income exceeding a 20 per cent rate of return on capital employed. The Ok Tedi model has since been incorporated in the general legislation, and applies to all mining projects (Brown and Faber, 1977, pp. 34-37; Land, 1991; Mikesell, 1983, pp. 270- 271).

Similar taxes have been used in several other developing countries, but they have often been abolished because of resistance from investors. The case of Indonesia is noteworthy in this respect. Although Indonesia must be considered as having been successful in attracting international mineral investment for the past 30 years, investment interest fell off considerably after the Government introduced a relatively modest tax on "windfall profits" in 1976 (the tax was levied at a rate of 60 per cent, after recovery of the investment, on income exceeding 15 per cent of total funds calculated on a three-year moving average). The tax was abolished in 1984 (UNCTAD, 1994a, p. 38; Gandataruna, 1991).

In most cases, additional profit taxes are imposed only after the investment has been recovered, and only on the portion of profits exceeding a certain, predetermined rate of return. This rate of return has usually been relatively high, 15 per cent or more on total capital. It should be noted that the application of the rate of return on the entire capital employed disregards the possibility that loans have usually been obtained at significantly lower rates. However, no government has been sure enough of its bargaining position to impose calculation of the return only on equity, after deduction of interest costs.

The international mining industry tends to be very suspicious of additional profit taxes and to argue that the high-risk nature of mining should mean that a higher rate of return should be tolerated than would be the case in other industries. In particular, it is argued that the very high return on some projects is offset by the much lower return on others and by failed exploration ventures (Stainton, 1991). Governments could

argue, for their part, that any project that does not achieve a threshold rate of return is unlikely to go ahead in any case, and that the additional profit tax would only be imposed once investment costs, *including exploration costs*, had been recovered (governments are however not willing to take the costs of failed exploration ventures in other countries or sometimes even in other locations in their own country into account when calculating the total investment costs). Nevertheless, it is indisputable that the existence of an additional profit tax, other things being equal, may tend to deter investors, particularly large international mining companies which are in a position to choose between a great number of potential projects in many countries. (Investment interest in Papua New Guinea, however, showed no sign of abating when additional profit taxes were introduced, thus illustrating the fact that if geological prospects are very favourable, the industry is prepared to accept this type of tax.) Another drawback of additional profit taxes is that they require a relatively high degree of sophistication on the part of taxation authorities and government negotiators, since it may be difficult to determine total investment costs, particularly *ex post*. For these reasons, most recent mining taxation systems use the normal corporate tax rate and make do without an additional profit tax. A progressive corporate income tax, with the scale of progression defined in an investment agreement, may achieve the same objective as an additional profit tax and may be easier to apply.

Governments have, however, been prepared to recognize that the risks of mining merit being taken into account when designing taxation systems. but this does not imply as far as governments are concerned that mining should be taxed at a lower rate than other enterprises. From their point of view, some of the arguments that may speak in favour of a lower rate of taxation for some industries - the interest in encouraging a company to grow and invest in expansion of production, creating more jobs and paying more taxes in the future - are absent in the case of mining. The total possible production from a given deposit is determined by nature, and it cannot be increased by using a lower taxation rate (provided that taxation is neutral *vis-à-vis* production decisions, as it would be expected to be in the case of taxes levied on profits). However, as noted above, governments attempt to distribute the tax burden over time in such a way as to reduce the mining companies' risk exposure. Tax holidays, once used in some countries - both developed and developing - having generally been abolished, governments have instead used mechanisms such as accelerated depreciation of investment in exploration and mine development with a view to moving the incidence of taxation to later stages of project life.[9]

One of the objectives of distributing the incidence of taxation in such a way as to avoid "front-loading" of projects is to stimulate exploration. As already mentioned, exploration is an activity with very uncertain rewards and few of the prospects explored ever end up as producing mines. On the other hand, compared with later stages of development, exploration is a relatively low-cost activity, and the number of successes can be said to be roughly proportional to the amount spent. Accordingly, since it is relatively cheap to offer tax incentives for exploration and since the effect in terms of the number of mines developed can be significant, governments often focus on methods of reducing exploration risk when designing their mining taxation schemes. An additional reason for stimulating exploration is that the geological information collected can be used by other explorers (provided that the mining legislation requires companies to release information that is not of immediate commercial interest), thus adding to the body of geological knowledge and increasing the probability of identifying economically viable deposits (Gillis, 1984, pp. 106-107).

Most governments allow exploration expenses to be deducted against profits, but some go further

in offering incentives. Exploration risk can be further reduced by allowing additional deductions or tax credits for exploration spending, so that the company receives a higher deduction than the amount actually spent. The government may also reimburse part of the exploration cost, either through an incentive programme,[10] or through "refundable taxes", whereby an explorer with no offsetting income against which to deduct exploration expenses receives a grant from the government equivalent to the value of the tax deduction that would otherwise have been made (Scott, 1991). In the latter case, the exploration cost cannot, of course, later be deducted against earnings. That tax-related incentives can be a powerful instrument for increasing exploration was demonstrated by the Canadian province of Quebec, where private funding of mineral exploration increased from C$ 22 million Canadian dollars in 1982 to C$ 692 million in 1987 as a result mainly of flow-through shares[11] and incentives allowing 133 1/3 per cent deduction for exploration expenses, or 166 2/3 per cent for surface exploration, (Brewer and Vance, 1991; Saumier, 1991).

Accelerated depreciation of mine development costs is allowed in many countries and is often complemented by provisions for carrying over losses to later years, thus reducing the incidence of taxation in the early stages of a project. Another interesting way of achieving the same objective which bears some resemblance to the additional profit tax is the two-tiered tax systems used in the Canadian provinces of Alberta and British Columbia. The aim of these systems is to allow a company to recover all its up-front costs before paying any high taxes. A small tax is levied on profits before deduction of up-front costs, and only when these are fully recovered (when the mine achieves "pay-out") is the higher tax levied (Scott, 1991).

An instrument that was relatively widely used in the past to stimulate exploration and mine development is the depletion allowance, which was originally intended to reflect the gradual depletion of the ore body, since part of the income stream from the mine was seen as constituting consumption of capital. Because of the difficulty in deciding on the proper rate of depletion allowance, a percentage depletion was generally used. The argument for the depletion allowance appears to be considerably weakened, however, if exploration and development expenses are deductible. Where the owner of the deposit is separate from the operator, there would seem to be some sense in allowing the owner to deduct depletion of the mineral resource against income from the resource in the form of royalties or other compensation (Brown and Faber, 1977, pp. 61-68). Historically, however, it has usually been argued that the depletion allowance is intended to take account of the costs of unsuccessful exploration (Gillis, 1984, pp. 108-109). However, if exploration and development costs are deductible, this again makes no sense. Thus, the depletion allowance was mainly used as an incentive to compensate for the perceived high risks of mining. Most countries where depletion allowances were used have now abandoned them as an unnecessarily crude and expensive (for the government) tool for reducing risk.

Whether profits are taxed at normal corporate income tax rates or are complemented with other types of taxes or incentives designed specifically for mining, developing countries often face problems in assessing them effectively. Assessing the profits of a large mining venture for taxation purposes can pose considerable problems for the tax authorities of a developing country, particularly if the venture is owned by a large transnational company with operations in many other countries. For instance, it may be difficult to determine whether the prices that the company reports having received for its products represent true arm's-length prices or contain an element of transfer pricing. In the oil industry, "posted prices" have been

used to counter this problem, particularly before the introduction of commodity exchanges for crude petroleum. This method has been less widely used in the non-fuel mining industry, mainly because representative price quotations for major metals, established by commodity exchanges, have existed for a longer time. Where reference prices have been used to determine the value of production independently of the company's accounts, taxes have generally not been used to establish "true profits", but have been levied on production or exports, as in the case of the export levies introduced by several bauxite exporting countries in the 1970s. Starting in 1974, a number of developing bauxite- and alumina-producing countries which were members of the International Bauxite Association (IBA), including the Dominican Republic, Guinea, Jamaica and Suriname, introduced levies on the production and/or export of these commodities. Since no internationally recognized prices existed for these commodities, a certain percentage of the average realized price for aluminium was used as the basis for valuation of production and exports. The percentage used was in most cases the one recommended by the IBA (Grabow-von Dahlen, 1987, pp. 238-261; Nappi, 1990, pp. 39-43).

Apart from the levies used by bauxite- and alumina-exporting countries, there are few examples of reference prices for products other than the one actually produced being used to determine profits (the calculation of taxes on base metal concentrate production or exports on the basis of prices of contained metal derives from firmly established industry practice and cannot be reegarded as controversial). One such example is the agreement concluded in 1988 between the Government of the Dominican Republic and the Canadian company Falconbridge's Dominican subsidiary. Although the company in question produced and exported ferronickel, the price of nickel on the London Metal Exchange was used to determine "deemed" income. Under the agreement, "deemed" costs were also calculated, independently of the company's accounts, which the Government did not trust. (Dunbar, 1991).

Another example is that of interest payments, which whether resulting from intra-company borrowing or from other sources, may be used as disguised profit distribution. If there are no limits on interest payments, very little profit may remain to be taxed by the government. For instance, the 1969 agreement between the Government of the Dominican Republic and Falconbridge's Dominican subsidiary contained no limits on interest payments. Since nickel prices remained low for several years after the mine had entered into production, the company contracted heavy debts to its owners. When prices subsequently improved, the interest payments eliminated taxable profits completely. The government's dissatisfaction with this outcome led to the renegotiation of the agreement (see above) (Dunbar, 1991). Governments have attempted to deal with this problem both by requiring verification of interest payments and by setting limits on debt/equity ratios. For instance, the Indonesian Government has included limits on deductible interest payments based on maximum debt/equity ratios in its agreements with foreign investors since 1967. The limits on these ratios have evolved over time, becoming generally less strict. In recent agreements, a distinction is also made between projects according to size, with projects with a total investment capital of more than US$ 200 million being allowed a debt/equity ratio of up to 8:1, as compared with 5:1 for smaller projects (Gandataruna, 1991). Finally, many governments impose restrictions on the repatriation of profits through withholding taxes on dividends and other capital transfers.

Given the problems associated with assessing corporate profits and imposing effective taxation, many countries have preferred to supplement corporate income tax with a royalty based on volume or value of production or exports. The political justification for royalties is usually that the government is entitled to some compensation for the depletion of a natural resource. Such a tax is relatively easy to apply and it

offers the additional advantages, important to many developing countries, of smoothing out variations in tax income and ensuring that the government collects at least some tax whether or not the company is profitable. There are many different types of royalties,[12] most of which however are disstinguished by the fact that they provide the government with a guaranteed income. Royalty rates vary, but they rarely exceed 10 per cent of production value for base metals or 15 per cent in the case of precious metals and gemstones. Royalties on non-metallic minerals are often very low. Usually, royalty payments can be credited against corporate income taxes payable in the same country.

The most important drawback of royalties is that they may lead to the loss of otherwise economically viable production. Since they increase marginal unit costs, they provide a disincentive to the extraction of low-grade or otherwise marginal ores, whether in a deposit or among several deposits. Therefore, deposits or parts of deposits that would normally have been exploited are left in the ground, and this leads to loss of income. The disincentive to exploration may have particularly serious consequences in terms of lost production. A study of the likely effects of a royalty on gold mining on public lands in the United States concludes that a royalty of 5 per cent would have led to a reduction of gold discoveries on public lands in the period 1986-1990 by somewhat less than one quarter, while a royalty of 12.5 per cent would have led to a reduction of discoveries by two thirds (Schantz, 1994). Another disadvantage is that whereas taxes paid on profits can usually be credited against taxes in the home countries of foreign investors, this is not possible for royalties in some important investor countries, notably the United States. Royalties thus increase a company's total tax burden and may deter investment.

Where mineral reserves are abundant and can be mined in several countries, some of which do not use royalties, the imposition of the latter by a government may lead to reallocation of production over the long term. The introduction of export levies on bauxite and alumina by several Caribbean countries in the mid-1970s is thought to have contributed substantially to the decline in production in these countries, with production increases taking place instead in Australia and Guinea. In Jamaica, government income from taxes increased from US$ 26.95 million in 1973 to a maximum of US$ 205.71 million in 1980. During the same period, however, bauxite production fell from 13.6 million tons to 12 million tons and continued to fall, declining to 8.3 million tons in 1982, with income from taxes dropping to US$ 135.51 million (United Nations Centre on Transnational Corporations, 1987). While it could be argued that the levies raised production costs to untenable levels, it deserves to be noted, however, that the increase in international oil prices also had a major impact on alumina production costs. This event was obviously not foreseen by the governments in question when they introduced the levies.

For all the reasons outlined above, many developing countries have reduced or eliminated royalties in recent years, sometimes replacing them with profit-based taxes, but in many cases accepting the short-term loss in the hope that more foreign investment will be attracted.

In addition to the incentives to exploration and mine development mentioned above, which are aimed mainly at promoting mining through redistribution of the taxation burden over time and reduction of risk, governments use various other types of incentives to attract investment in mining. Some of these fall into the category of traditional export promotion instruments, for instance exemption from import duties and value added tax or other indirect taxes on imported equipment and inputs. Such instruments are used by a large number of countries. Other tax incentives may be aimed at promoting further processing of minerals,

for instance through variable royalties which decrease with the degree of processing, or at stimulating investment in underdeveloped regions or regions with high unemployment through various kinds of regional development programmes.

In conclusion, although governments may have differing approaches to taxation of mineral enterprises, it can be generally stated that, subject to the general government objective of maximizing fiscal income, the taxation system should fulfil the following criteria (Kumar, 1991):

- *Equity*, that is, fairness in respect of the distribution of the tax burden;
- *Efficiency and neutrality*, that is, minimizing distortions in the efficient allocation of resources, and preserving incentives for risk taking;
- *Convenience* with respect to timing and manner of payment; and
- *Certainty*, that is, lack of arbitrariness in tax liabilities.

4. State participation

The arguments that have been used in developing countries for direct state ownership of mining operations follow directly from the arguments cited in chapter I concerning a prominent role for the State in general. Additional factors have also contributed to the establishment of state-owed mining enterprises. The mineral industry has often been seen to be of such vital importance to the national economy, both in terms of its size relative to the rest of the economy and because of its linkages to other industries, that it could not be left in the hands of private sector enterprise, whether foreign or domestic. Furthermore, the necessary capital could not be mobilized from the domestic private sector in countries with weak capital markets and a dearth of domestic investors prepared to undertake long-term risky investments. It was also perceived that resource rents could most easily be appropriated through state ownership of mining operations. Finally, the establishment of state mining enterprises was seen as an instrument for achieving social objectives such as regional development, reduction of unemployment, more equitable income distribution, development of infrastructure and improved social services such as health and education (Dobozi, 1989). Accordingly, state ownership of mining companies in developing countries increased dramatically in the 1960s and 1970s as a result mainly of nationalization of mining companies owned by transnational companies.[13] A large portion of new mining operations that entered production in the same period also had significant state participation.

State ownership of mining companies is not, however, confined to developing countries. There has at times been strong support for a role for the State in mining also in developed countries, and at various times the State has either initiated mining projects or nationalized existing mines. Examples include iron ore mining in France and Sweden, base metal mining in Finland, France and Spain, bauxite/alumina/aluminium production in France, Germany, Italy and Norway, and potash mining in the Canadian province of Saskatchewan. Some of the nationalizations in developed countries have, however, resulted from a desire to avoid closures of operations and the resulting unemployment, rather than being the expression of an

assertive policy on the part of the State.

Table 4 shows the evolution of state control.[14] It reveals that, for most minerals, state control peaked in the mid-1980s. In addition, it can be seen that developed country governments also had strong ownership interests in mining during at least part of the period in question, mainly through state-owned companies in Canada, Finland, France, Germany, South Africa, Spain, Sweden and the United Kingdom. State holdings in Canada, Germany, South Africa, Spain and the United Kingdom had however been significantly reduced by 1989 (UNCTAD, 1994c, pp. 42-43 and 86). Since theree have been very few new projects with substantial state participation since 1989, and since a number of state-controlled enterprises have been privatized since then, the share of such enterprises has fallen for most minerals and metals.

There is a large body of literature on state-owned enterprises in general, including many empirical studies of their performance.[15] These studies usually proceed from two basic assumptions concerning the differences between state-owned and private firms: (i) that since a state-owned enterprise is by definition run by managers who do not own the firm and since consequently no one, as a self-seeking agent, would take care of someone else's business as seriously as his or her own, the managers of state-owned enterprises will not strive to improve the firm's efficiency as an owner-manager would do with his or her own firm (the principal-agent problem); and (ii) that state-owned enterprises are very likely to be inefficient because there is no effective way to penalize bad performance (the disciplinary mechanism).

As regards the first assumption, it can be argued that the principal-agent problem is likely to exist to more or less the same degree in large privately owned enterprises, where there may be as many or more levels of delegation as in a state-owned enterprise, and where it cannot automatically be assumed that the objectives of managers at any level coincide with those of the share holders. As regards the disciplinary mechanism, it is traditionally argued that bad performance leads to falling profitability and the exit of share holders, resulting in the fall of share prices, which exposes the firm to the possibilities of take-over. This mechanism does not exist in the case of state-owned enterprises; that is, they are not allowed to go bankrupt. However, experience appears to show that large firms, whether privately or publicly owned, are not allowed to go bankrupt and that the disciplinary mechanism exists in neither case (there are also a number of examples of state-owned enterprises being liquidated). Furthermore, the history of mergers does not appear to show a systematic pattern of unprofitable firms being taken over or of profitability improving as a result of mergers (Chang and Singh, 1993, pp. 50-55).

A number of empirical studies have attempted to measure the performance of state-owned enterprises. At the more general level, it should be noted first that the few studies that have been carried out have failed to establish a relationship between the size of the public enterprise sector and variables such as per capita GDP and rate of growth of GDP (Chang and Singh, 1993, p. 46). At the level of individual enterprises, several studies have attempted to measure differences in profitability between privately and publicly owned firms. While some of these studies find that state-owned enterprises have had lower profitability, it could first be argued that the comparison is difficult because state-owned enterprises tend to be more common in particular sectors, where a relevant private comparator cannot always be identified. Second, as already mentioned, state-owned enterprises are usually established for reasons other than merely showing a profit, whether it be provision of employment, evening out income distribution or

stimulating development in individual industries or regions. Thus, given the intended positive externalities of state-owned enterprises, profit may not be the appropriate measure. More detailed analyses of state-owned enterprise performance, focusing on technical efficiency or cost efficiency, suffer to some degree from the same drawbacks. The results of the empirical studies carried out, particularly as regards developing countries, are inconclusive (Chang and Singh, 1993, pp. 55-66).

Table 4. State-controlled share of production of selected minerals and metals, 1975-1989 (per cent of world production, excluding socialist countries and countries in transition)

Mineral/metal	Developed countries			Developing countries		
	1975	1984	1989	1975	1984	1989
Bauxite	3.5	6.9	5.4	16.9	22.3	24.4
Alumina	8.4	14.7	13.3	4.5	6.3	9.8
Aluminium	11.9	19.9	22.1	3.5	8.5	11.0
Copper ore	3.0	7.7	3.3	31.3	38.0	35.7
Refined copper	2.8	5.5	3.3	18.9	27.2	26.2
Gold	0.7	2.0	0.6	2.3	2.6	2.3
Iron ore	7.8	13.7	8.1	21.6	27.1	31.0
Lead ore	6.5	9.9	5.7	5.9	8.1	6.5
Refined lead	4.7	11.1	3.4	3.1	3.2	2.8
Manganese ore	25.3	2.1	1.6	11.2	24.0	23.4
Nickel ore	1.0	13.9	11.7	2.6	6.7	6.4
Refined nickel	1.3	10.3	12.5	0.0	2.7	2.3
Phosphate rock	3.7	10.3	10.0	30.1	34.6	34.3
Potash	23.6	41.4	34.2	0.0	1.2	5.6
Tin ore	0.4	1.4	0.0	27.2	28.5	20.3
Refined tin	0.3	1.0	0.0	13.5	26.7	25.8
Zinc ore	6.0	8.6	7.3	8.7	10.1	9.0
Refined zinc	9.4	11.7	8.9	4.6	7.0	5.5

Source: UNCTAD, 1994c, annex tables 23 and 24.

Very few systematic studies of state-owned mineral enterprises, have been carried out,[16] and the debate on the subject has been based on examples of a few companies. Because the number of state-owned mining companies is limited and their performance is affected by a number of factors such as the competitiveness of the market in which they are operating, and the degree and nature of oversight by the government and others, it is difficult to draw any general conclusions. It is clear, however, that there are several state-owned mining enterprises that can be justifiably criticized for not being technologically dynamic, for being inefficient and for being too cash-poor to carry out adequately exploration and expansion of production. The case of the Bolivian tin company COMIBOL provides an example. The experience of this company has been summarized as follows:

> "... it developed a corporate mode of behaviour which maximized production in the short term to finance the country's efforts at economic growth, and ignored production costs, in part as a result of the burden of a political commitment to maintaining an excessively large workforce in a country with few alternative sources of employment. This mode of corporate behaviour prevented the investment either in exploring for new reserves, as existing ones were quickly depleted, or introducing new more efficient technology as plant and equipment grew obsolete ... The installation of what amounted to a puppet management supported by an inertial bureaucracy, which was reproduced in all the company's operating subsidiaries as well as its headquarters in La Paz, ensured that it was the Ministry of Mines and Metallurgy rather than a dynamic entrepreneurial elite or mine management system which determined corporate strategy." (Jordan and Warhurst, 1992, p. 20)

In a recent case study of the Zambian copper industry, which is dominated by the state-controlled enterprise Zambia Consolidated Copper Mines Limited (ZCCM), a simple econometric model was used to assess the relative importance of various factors contributing to the poor performance of state mining enterprises. It was found that factors inhibiting investment in the enterprise, such as the confiscation of copper revenues by the Government for other social needs, had a serious adverse effect on capacity and played an important role in explaining the decline of the Zambian copper industry. In contrast, factors contributing to inefficiency and poorer profit margins, including the pursuit of goals other than cost minimization and profit maximization, were not significant (Chundu and Tilton, 1994). Similarly, in the case of Peru, it has been argued that the Government's appropriation of the profits of state-owned mining companies and its reluctance to leave them with sufficient financial resources for new investment, replacement of equipment and maintenance were a major factor behind the companies' unsatisfactory performance (UNCTAD, 1993, pp. 42-46).

On the other hand, proponents of state-owned mining enterprises have pointed to examples of well-managed, dynamic companies - such as LKAB in Sweden, Outokumpu in Finland, Codelco in Chile and CVRD in Brazil - as evidence that state-owned enterprises can perform well in the mining industry. Perhaps one of the most important factors contributing to the better performance of efficient state-owned mining companies is the degree of autonomy that an enterprise has *vis-à-vis* government. Autonomy - or minimal interference by the State - is important not only with respect to day-to-day management issues but more especially with regard to strategic decisions, for example on capital investment, which can determine the long-term viability of the enterprise. In effect, the State is likely to lose out in the long run, to the extent of

eventually paying out subsidies, if it continually makes revenue demands or imposes other restrictions, such as limits on foreign exchange retention, which compromise the longer-term viability of the enterprise it owns. Paradoxically, autonomy is probably easier to achieve when the enterprise is highly profitable, since it can then better afford to provide a substantial income for the State and still retain some of its earnings for internal investment: In this regard, a superior resource endowment - exceptionally rich ore, for example - is evidently helpful, since it will generate substantial resource rents for the state enterprise concerned. Nevertheless, the marginal enterprise also, and perhaps especially, needs a large degree of operational autonomy, including the power to close down mining operations which have become irredeemably inefficient. Negotiating autonomy will always remain difficult, however, since the concept runs counter to some of the aims of state ownership. Moreover, autonomy by itself is not sufficient - a stable and competent management is necessary in order to make good use of operational flexibility.

A few points deserve to be noted on the differences between state-owned enterprises in general and state-owned mining enterprises in particular. First, the goal structure of the latter is probably even more complex than that of other state-owned enterprises. This is so because the export revenue and government income from mining enterprises are usually of national importance, which means that maximization of these two revenue streams is likely to have higher priority than company profitability. In addition, since mining usually takes place in areas far from major population centres, the non-economic objectives of the company (providing housing, educational and health facilities for its employees and their families and usually also the general population in the surrounding area, as well as infrastructure assisting regional economic development) are often relatively more important than for other state-owned companies.[17] These factors could be expected to lead to lower profitability and lower cost efficiency. Second, on the other hand, mining companies, with few exceptions, are export-oriented and operate in markets with relatively few imperfections. Thus, they are more exposed to competition than other state-owned enterprises. This would be expected to impose limits on inefficiency and stimulate cost efficiency.

More importantly, however, the mounting external debts and fiscal deficits of many developing countries during the 1980s and the conditionalities attached to economic adjustment lending programmes by international financial institutions put pressure on governments to initiate wide-ranging privatization programmes, including of state-owned mining enterprises. Accordingly, since the early 1980s, a large number of developing country governments have reduced state interest in mining.

Despite the recent spate of activity and announcements, there are reasons for viewing with some scepticism the trend towards the privatization of state-owned mining enterprises. As a general rule, unprofitable public enterprises are difficult if not impossible to sell and consequently the government often has to take action to make an enterprise profitable before privatizing it. Such action usually entails a technical and financial restructuring programme aimed at modernizing the technology used and reducing the company's debt burden. Once the necessary resources for implementing the restructuring programme have been found and it has been implemented, it may be asked why the government should want to divest itself of what is now a return-yielding asset. The answer to this is usually given as the imperative to reduce the size of the fiscal deficit. However, as the private sector is likely to pay no more for the firm than the present discounted value of its future profits, the sale is tantamount to bringing forward in time the government's future purchasing power. The sale has thus to be evaluated by asking whether such new-found funds are obtained on terms more favourable to the government than would be the case with more conventional forms

of borrowing. Moreover, in order to ensure that the privatization proposals are favourably received, the State may err on the side of underpricing the enterprise's shares. In this case, the public sector's long-term resource constraint will actually become greater with privatization than without it and will endanger the sustainability of the fiscal stance over the long run.

The general results of privatization programmes in developing countries are mixed. Usually, they have proceeded at a slower pace than planned. For instance, in a sample of 14 sub-Saharan African countries, only 29 actual sales were recorded, as compared with a target of 308 (Berg and Shirley, 1987). Results regarding privatization of mining enterprises have been similar. While developed country governments have divested themselves of interests in several large mineral and metals companies, there are so far few examples of successfully concluded privatizations in developing countries. One reason for this discrepancy may be that whereas the income from state-owned mineral enterprises has been a relatively small element of total government income in developed countries, it remains critical in many developing country budgets; and governments have thus been reluctant to relinquish control over such an important source of budget revenue, given the difficulties they perceive in extracting resource rents from privately owned mining companies. Income from mineral sales also provides groups associated with mineral production, including both company management and mine workers' unions, with significant political leverage, which may have been utilized to prevent privatization efforts. Thus, privatization plans have mostly been the response to a deteriorating financial situation and growing fiscal deficits, resulting from external shocks in the form of falling terms of trade and/or increased debt services, and have often formed part of structural adjustment programmes. Until 1993, however, few countries had made significant progress with their privatization plans as far as the mineral industry was concerned.

During the period from 1975 to 1993, there were only a few privatizations of mining companies in developing countries. Examples include reductions in the State's share of the Compañhia Vale do Rio Doce (CVRD, which produces mainly iron ore, but has interests also in manganese, bauxite/alumina/aluminium and gold production) in Brazil, and privatizations of minority state holdings in copper companies in Mexico. More ambitious privatization programmes have been presented since 1993, although in many cases they have not yet been implemented. Some of these concern major producers such as CVRD in Brazil, Zambia Consolidated Copper Mines Limited (ZCCM) in Zambia (copper) and P.T. Tambang Timah in Indonesia (tin, partial privatization).

The only major programme for privatization of state-held mining companies that has so far been successfully implemented is the one in Peru. The privatizations carried out until late 1995 under this programme are shown in table 5. The Peruvian privatization programme, which has relied on an international bidding process, has been part of a much broader economic reform programme aimed at restoring investor confidence in the country. Parts of this programme were specifically intended to change features which had reduced the country's attractiveness to international investors in mining. They included reforms of the mining code and of the taxation regulations for mining, as well as the opening up for exploration of large areas which had previously been reserved for the State.

There are several specific reasons for the slowness of the privatization process as regards mining enterprises. One is the size of the companies concerned. Generally speaking, it is impossible to use the stock market as a vehicle for privatization, even where stock markets exist. There are only 11 stock

exchanges in sub-Saharan Africa, and, with the exception of South Africa, all of these have "local" capitalization, dual-listed companies excepted, below US$ 3,000 million (Mining Journal, 1996b). Accordingly, international bidding and negotiated sales to selected international companies are the available solutions. In both cases, the preparations are expensive and time-consuming, and the financial negotiations may be very complex.

Table 5. Privatizations in the mining sector in Peru

Company	Type of property	Sales price (thousand US$)	Date
Buenaventura	Silver mine	1 510	19 July 1991
Minera Condestable	Copper mine	11 291	26 May 1992
Hierro Perú	Iron ore mine	120 000	5 Nov. 1992
Quellaveco[a]	Copper deposit	12 756	15 Dec. 1992
Cerro Verde[b]	Copper mine	35 447	10 Nov. 1993
Jehuamarca/Cañario[c]	Copper/gold deposit	100	25 Jan. 1994
Las Huaquillas[c]	Gold deposit	35	25 Jan. 1994
La Granja	Copper deposit	1 000	10 March 1994
Ilo	Copper refinery	66 626	22 April 1994
Colpar/Pallacochas[d]	Gold deposit	57	22 July 1994
Tintaya/Coroccuhuayco[e]	Copper mine	277 005	6 Oct. 1994
Cajamarquilla[f]	Zinc refinery	193 000	4 Nov. 1994
Berenguela[c]	Copper/silver deposit	40	8 March 1995

Source: Fernandez et al., R.V. 1995.

[a] Includes US$ 756,000 for payment of interest
[b] Total after price adjustment following auditing
[c] Initial annual payment
[d] Six-year concession.
[e] Sales price includes US$ 55 million for payment of debt and price adjustment of US$ 3.8 million in favour of Minero Peru.
[f] Includes US$ 112 million in instalments over 14 years, and US$ 40 million for debt.

Other difficulties are posed by the need to transfer non-commercial responsibilities, such as housing, health and education services for employees, either to public authorities or to the new owners, and the possible need for employment reductions. The employees of the original enterprise are unlikely to willingly accept reductions in the quality of services or in their own number. Depending on the power of the employees and their trade unions, the resolution of such problems can become a major political issue and is likely to be very lengthy. It should be noted that non-commercial responsibilities are usually more important in the case of mining companies than in other industries. Since mines tend to be located in remote areas far from major population centres, companies have often found it necessary to provide a wide range of services to employees in order to attract labour. While private companies often provide their employees with services similar to those provided by State-owned companies, the level of service to be provided in the future may become the subject of difficult negotiations.

The existence of environmental liabilities, which in the case of older operations can be very serious, may also lead to delays in the privatization process, since the new owners will be very reluctant to accept any obligation to clean up environmental damage resulting from past activities. The existence of such liabilities has been one of the major difficulties faced by the Peruvian Government in its privatization programme.

In the countries in transition, where production was wholly state-owned, privatization has frequently taken a form different from that in developing countries. In the Russian Federation, in particular, ownership has often been transferred to the previous management or employees, often against no or only symbolic payment. To date, there are no examples of existing operations being sold to foreign interests, although in a few cases foreign companies have acquired mineral rights or have into entered joint ventures. A lack of clarity regarding the future conditions facing foreign investors in the mining industry partly accounts for the absence of privatization linked to foreign investment.

In conclusion, it is recognized that the need to strengthen the government's financial position in the short term may have to take precedence in certain cases where the size of the fiscal deficit poses an obstacle to economic development and sales of government assets, including state-owned mining companies, is the only realistic solution. If the situation is less urgent, however, and the government is mainly interested in identifying ways of enhancing the contribution of the state-owned mineral sector to economic development, alternatives to full privatization may deserve consideration. These include public enterprise reform, management contracts, partial privatization and joint ventures.

Public enterprise reform in the context of state-owned mining companies normally takes the form of a technical and financial restructuring programme of the kind referred to above - that is, a programme aimed at modernizing the technology used and improving the company's financial situation. An important component is often the introduction of a management system that gives the company management sufficient autonomy in areas such as staffing, investment, marketing and production operations. Although such programmes may meet with opposition from entrenched interests and oblige the government to take difficult decisions, they allow the retention of the company as an income-yielding asset to the government. Restructuring programmes of this kind have been carried out at one time or another in almost all state-owned mining companies. The extent to which they have been successful appears to be strongly linked to

the extent of autonomy that has resulted from the restructuring as well as to management capacity.

Management contracts have been used in several developing countries, in particular following nationalization of a foreign-owned company, as was the case in Zambia, for instance. The management contract in such cases is usually viewed as an interim measure, intended to facilitate the transition from private to public ownership, and to be replaced eventually by national management. Less often, international mining companies have been asked to manage the operations of state-owned companies. Experiences of management contracts are mixed. Where previous owners have been asked to stay as managers, the transition to national management has often taken much longer than anticipated. Moreover, whatever the reasons for concluding a management contract, it almost inevitably raises the type of principal-agent problems referred to above. To ensure that the hired management pays adequate attention to profitability, a profit-related incentive scheme has to be introduced. At the same time, the government may insist that its non-economic objectives also be taken into account. The consequent potential for conflict between owner and management is probably one of the main reasons why large international mining companies are reluctant to enter into management contracts with state-owned mining companies.

Joint ventures, including production-sharing arrangements, between private mining companies and governments have been used in several countries, for instance in bauxite mining and alumina production in Jamaica and Guinea. Normally, they are used in combination with a management contract, where the private partner is responsible for the management of the joint property. Although they may result in problems similar to those of pure management contracts, these problems are often easier to resolve, since the private partner has a greater interest in safeguarding the profitability of the operation. The solution may, however, be at the expense of the government's non-economic objectives.

One conclusion that it may be possible to draw from the limited experience available is that economic and non-economic objectives need to be clearly defined and separated, regardless of the form of ownership and management. Thus, the governmeent's non-economic objectives with regard, for instance, to promotion of regional economic development or to foreign exchange effects could be negotiated with or recognized by the company in the same way as the objectives set by legislation concerning the natural environment or workers' health and safety. Subject to these governmental objectives, the management of the company should be expected to maximize profits over the life of the mineral deposit. In this way, many of the objectives of state ownership of mining companies could be achieved through means other than ownership, such as legislation or negotiated agreements with foreign investors, and this is likely to result in less confusion about company objectives. On the other hand, this should not be taken to mean that privatization, particularly if forced by financial constraints, is necessarily the preferable way to improve the financial performance of an existing state-owned mining company. Alternatives to full privatization, especially technical and economic restructuring and establishment of joint ventures, may be more likely to preserve the return on government assets and can be tailored to meet the government's non-economic objectives.

5. Policies for domestic mining

5.1. Formal mining companies

The mining industry in nearly all developing countries consists almost entirely of large foreign or state-owned enterprises on the one hand, and small-scale private firms and artisanal miners on the other. Except in some countries with relatively large and diversified economies, such as India, the Philippines, Malaysia, Mexico and Brazil, there are few examples of private domestic mining firms of large or even medium size in developing countries. In most such countries, this segment of the industry does not exist, and the private sector is represented only by small firms and artisanal miners mining mainly gold and gemstones and non-metallic minerals for construction. While it is true that some mineral deposits - because of economies of scale - can be exploited only by very large transnational companies, this does not sufficiently explain the absence of domestic private enterprise beyond small-scale mining in the sector in developing countries.

The situation in most developing countries contrasts with that in countries such as Australia, Canada and the United States, where there are large numbers of medium-scale private mining companies. In Europe, where there are few medium-size mining companies, their absence may be explained by powerful factors contributing to a high degree of concentration over a long period. Among these factors are previous or still existing legislation limiting foreign investment in mining, low trade barriers for raw materials, downward pressure on production costs as reductions in transport costs made overseas imports more competitive, and limited domestic market growth. Under these circumstances, in European countries with their mostly small land area and thus limited number of economically viable deposits, economies of scale often resulted in only one or two companies surviving in each country, sometimes eventually expanding beyond national borders to become large international companies. Examples of this process include Boliden in Sweden and Outokumpu in Finland.

It should be noted that the mining industry at the beginning of this century did not have the same differences between developing and developed countries. Several countries in Latin America, for instance, had thriving domestic mining sectors in the early 1900s based on private ownership. One example is Peru, which had an economically important domestic mining industry in the late nineteenth and early twentieth centrury. Changes in legislation at the turn of the century led to an inflow of foreign investment, however, and North American companies rapidly came to dominate the industry (Instituto de Estudios Económicos Mineros, 1991, pp. 20-22). Technological developments, the full exploitation of which required large amounts of capital, gave a competitive edge to large, technically sophisticated companies in North America and Europe - where the technological changes originated and could be exploited thanks to rapidly growing domestic capital and product markets - which used their advantage efficiently in taking over much of the industry in developing countries.

History alone, however, cannot explain the continued relative absence of domestic private enterprises in mining in developing countries. Five factors can be identified as underlying the phenomenon. The first is the limited size of domestic markets. Of the five countries mentioned above, Brazil, India and Mexico consume considerable amounts of metals and minerals. Large domestic demand and the additional support of high tariffs on imported metals are likely to have had a decisive positive influence on the growth of domestic private sector mining companies in these countries. In most developing countries, however, particularly in Africa, the domestic market can only absorb an insignificant portion of the output of even one medium-size base metal mine with smelter. Regional markets are also often limited in size, and the absence of factors promoting regional economic integration, such as well-developed infrastructure or regional trade

agreements, may make exports to overseas developed country markets preferable to regional sales.

The second factor is the absence of an environment favourable to private sector enterprise, sometimes resulting from policies emphasizing state-owned companies as a vehicle for industrialization and ignoring the potential of private entrepreneurial activity. Excessive regulation of factor and product markets, heavy taxation burdens on private enterprise and inappropriate trade policies, in particular high duties on imported equipment and inputs, are aspects of such policies. Furthermore, the macroeconomic disequilibria experienced by many developing countries in recent years have not been conducive to the growth of private enterprise, especially in long-term high-risk activities such as mining.

The third factor is limited access to risk capital. In developing countries with weak capital markets most of the investment capital has to be raised in the form of equity. In particular, if inflation and nominal interest rates are high, as in many developing countries, businesses may choose not to borrow, because of the risk of interest rates increasing more than their income (which will not accrue until several years after mine development has been initiated and may be eroded by exchange rate variations), and banks may not be willing to lend money to mining firms, because of the risk that high cost inflation and output price changes will reduce the borrower's ability to repay the loan.[18] Furthermore, since stock exchanges do not exist in many developing countries or, where they do exist, are difficult to use for medium-scale mining firms,[19] most of the investment has to be provided by the entrepreneur. In most developing countries, there are few individuals or private sector enterprises that would consider entering mining, with its large capital requirements, long lead times and uneven cash flow, under these circumstances, even if the profit potential is favourable. The situation is somewhat different with regard to the mining of non-metallic minerals, where the lead times are often shorter and product prices more stable.

The fourth of the five factors is that international marketing of mineral commodities can be complicated and may surpass the capabilities of developing country companies. Few such companies can afford to establish marketing organizations able to use modern risk management techniques. While trading companies are usually happy to take care of marketing and physical distribution as long as the product meets certain technical specifications, and may also be prepared to assist with risk management techniques, their services come at a price and may still require a great deal of sophistication on the part of the producing company to be used properly. Furthermore, government regulations on foreign exchange may preclude the use of many risk management techniques and make export financing in general difficult.

The last factor is lack of modern technology. Since prices of metals are established on the world market and since metal mining is normally for export, metal mining operations need to use mining and mineral processing technologies that result in low unit costs and high rates of recovery in order to be viable. While the technology itself is usually easily available, albeit at a price, it requires a skilled management and workforce to be applied effectively. Again, the situation is more favourable for many non-metallic minerals, where technology is less sophisticated and where the production can be sold on the domestic market.

Governments have attempted to remove the obstacles to private sector growth in mining. Although developing country governments do not have the same means at their disposal as governments in developed countries, where support to domestic mining in various forms, ranging from ambitious government exploration programmes through favourable pricing of inputs to financial assistance under regional

development schemes, may be provided (Organisation for Economic Co-operation and Development, 1994, pp. 11-16), they have nevertheless attempted to implement policies supportive of domestic mining.

As regards the general economic environment, reforms under-way in many developing countries aim at facilitating private enterprise and removing distortions caused by previous policies. Technological upgrading and development of human resources are promoted by governments, partly through technical assistance schemes, often with the help of international organizations.

Access to risk capital would be facilitated by lower rates of inflation and resulting lower nominal interest rates, which are objectives in most structural adjustment programmes. Some countries have chosen to support the development of domestic mining enterprises through subsidized credit, but these schemes have generally not been very successful. The failure of the *Banco Minero* in Peru, which was mainly financing small mining companies and had to cease its activities in 1990 when a large number of its clients became unable to service their loans as a result of low silver prices (UNCTAD, 1993, p. 36), may serve as an illustration of the dangers inherent in the establishment of specialized mining banks, which will inevitably have an undiversified asset portfolio and consequently a high exposure to price risks.

Government regulations that hamper marketing are being reviewed and their impact is becoming less important in many countries. State-owned companies have successfully assisted with the marketing of metals in some countries.

Government support to exploration and exploration carried out by governments with a view to identifying potential deposits is still an activity on a relatively modest scale in most developing countries, although it holds out promise for the growth of domestic private sector companies. This is the case particularly since many of the potential deposits thus identified may be too small to merit the interest of large international companies, but may be feasible to develop on a more modest scale.

Finally, it should be noted that one reason why the task of promoting private enterprise in the mineral sector deserves to be taken seriously by developing country governments is that, in spite of the obstacles mentioned, it may be easier to achieve success in this sector than through other possible diversification strategies. Expansion of manufacturing output, for instance, may require skill levels and infrastructure that are not present in many countries, while a reasonably good quality mineral deposit will usually be able to carry the cost of the acquisition of skills and of the establishment of the necessary infrastructure.[20]

5.2. Small-scale and artisanal mining

Several attempts have been made to arrive at a universal definition of small-scale mining in terms of output, employment, capital used, etc.[21] While these attempts may help to clear up statistical ambiguities, governments will usually know small-scale mining when they see it, and they are likely to have a good idea of the segment of the mining industry that should be the focus of any specific policies directed at small-scale mining, and to construct their definitions accordingly.

Small-scale mining is commonly divided into formal small-scale mining companies and artisanal mining. The distinction between formal companies and artisanal mining is not always clear, however. Artisanal mining often leads to the establishment of formal enterprises, whether in the form of cooperatives or traditional firms. Indeed, many deposits that were later developed into large mines were originally discovered by artisanal miners. Holloway, 1986, notes that "in Zimbabwe, of the 4,000 or so gold mines that have existed there, only a handful were found by geological inference; the majority were indicated to prospectors by local people, frequently in exchange for a blanket".

While small-scale mining, however defined, accounts for a relatively small portion of total mine output, perhaps 10 per cent of the global value of metal ore production (Holloway, 1986), it accounts for a large proportion of world production of some minerals, particularly gold, precious and semi-precious stones, and building materials such as dimension stone and crushed rock. Its importance to individual developing countries can also be considerable, in particular in terms of foreign exchange and employment generation. In India, for example, some 3,000 small-scale mines account for about 50 per cent of non-fuel mineral production, involving a workforce of about 300,000 (Jennings, 1994, p. 11). In the Philippines, between 400,000 and 500,000 people are estimated to be engaged in small-scale gold mining (Dhar, 1994, p. 122). *Garimpeiros* in Brazil have accounted for 85 per cent of national gold production and 60 per cent of tin production in recent years (May, 1991, p. 20).

Artisanal mining poses specific and growing problems to governments. Increasing poverty, overpopulation and underemployment have caused increasing numbers of people in developing countries to turn to artisanal mining for their livelihood or for supplementary cash income. While the experience in several countries such as Brazil and some African countries demonstrates that there is a strong link between generally worsening economic conditions and increasing poverty on the one hand and the growth of artisanal mining on the other, the surge in this mining has in some cases had more direct causes such as the dismissal of workers from large mining companies as part of rationalization efforts. In Bolivia, for instance, all but 7,000 of the state-owned tin mining company COMIBOL's 27,000 employees were made redundant in the mid-1980s. The workers dismissed subsequently set up small-scale cooperatives mining tin and selling it to COMIBOL. (Auty and Warhurst, 1993, p. 23). Table 6 sets out some estimates for artisanal mining in sub-Saharan African countries.

The expansion of artisanal mining has in many cases taken governments by surprise, often occurring in countries or regions with no previous history of mining and without specific provisions regulating artisanal mining in the mining legislation. The miners have often encroached on mining rights held by formal mining companies as well as on land held by other land users, and this has sometimes led to conflicts and violence. With their usually primitive techniques, artisanal miners are unable to extract low-grade ores. Consequently, they may "high-grade" a deposit, thus making commercial mining impossible. In countries with overvalued currencies and foreign exchange regulations, smuggling of gold and gemstones leads to loss of foreign exchange (and usually to loss of potential income for the miners). The lack of legal status for the artisanal miners has usually also led to destructive environmental practices, including siltation of rivers and pollution from mercury used to extract gold, and hazards to the health and safety of workers. Finally, the lack of government authority in mining areas has led to high crime rates and deplorable social and health conditions.

Table 6. Estimated importance of artisanal mining in sub-Saharan Africa

Country	Main minerals	Production volume (tons gold or thousand carats diamonds)	Production value (million US$)	Employment (thousands)[a]
Angola	Diamonds	1 000-1 500	200-300	30
Burkina Faso	Gold	3-4	45	60
Burundi	Gold, tin			10
Central African Republic	Diamonds	0.5	5	10
Ethiopia	Gold			10
Ghana	Diamonds	450	13	5-10
	Gold	1	7	10-20
Guinea	Diamonds	100	20	30
	Gold	7-10	80	20-30
Madagascar	Gold	2-3		5-10
Mali	Gold	2-3	25	100
Namibia	Tin, semi-precious stones			1
Niger	Gold	1	12	15
Rwanda	Tin			5-10
Senegal	Gold	2	25	3
Sierra Leone	Diamonds	500	200	75-100
	Gold	1	12	25-40
Tanzania	Gold	1.5-5	35	20-30
Zaire	Diamonds	>12 000	>200	300
	Gold	4	45	150
Zambia	Gemstones		>200	15-30
Zimbabwe	Gold, chromite			30

Source: World Bank, 1992, p. 43.

[a] Including seasonal employment.

Governments have attempted to deal with the problems posed by artisanal mining in a variety of ways. Some have attempted to uphold the rule of law by force, in general with little success. Attempts to

regulate the activity by legalizing it and extending technical and other assistance to the miners have generally been more successful. The measures used by governments to this end can be divided into five categories: creation of a specific small-scale mining regime; establishment of marketing services; technical assistance and extension services, including provision of equipment and processing services; financial assistance; and organizational measures.

A number of countries have chosen to introduce specific provisions for small-scale and artisanal mining into their mining legislation. Such provisions (used, for instance, in Eritrea, India, Indonesia, Morocco, Peru, the Philippines, Tanzania and Zimbabwe) usually aim at ensuring that small-scale miners have title to their deposits through a simplified system of claims and at resolving conflicts with larger-scale mining. They attempt to take into account the particular characteristics of small-scale miners, who are often illiterate and whose operations cannot support the costs of the normal system of registering claims. In some cases, however, as when mining is of the "gold rush" type, involving thousands of artisanal miners working the same deposit, attempts to provide individual titles to the miners are doomed to failure. In such cases, the government (as, for instance, in Brazil, Ghana and Venezuela) may opt for special procedures setting aside an area for artisanal mining.

Marketing of products from small-scale and artisanal mining often takes place through informal, sometimes illegal, channels, with the products being sold to smugglers for hard currency (or national currency at a black market rate). In countries with overvalued currencies and a foreign exchange shortage, miners are clearly not interested in marketing exportable products through regular channels, receiving payment in national currency at the official rate of exchange, sometimes with the government taking part of the proceeds by way of taxes or a controlled price for the product. Several governments, having found that little revenue was collected this way and that the smuggling of gold and gemstones gave rise to other forms of criminality and lawlessness, have introduced instead a system whereby miners are paid the international market price, either in foreign exchange or in national currency at a favourable rate of exchange. In Brazil, the Government has even paid prices higher than world market rates in local currency to encourage *garimpeiros* to give up smuggling (Kumar and Amaratunga, 1994). In some cases, governments have also set up purchasing offices close to the mining areas to facilitate marketing, or have authorized commercial banks to purchase gold on sight, as in Zimbabwe (Holloway, 1986). Zimbabwe has also introduced a system aimed at stabilizing gold miners' revenues. Under this system, gold producers are assured a guaranteed floor price. When the international price is higher than the floor price, 25 per cent of the price difference has to be paid to the Reserve Bank of Zimbabwe to cover expenses under the floor price scheme. The policy has stimulated the formalization of some of the previously illegal gold mining operations (UNCTAD, 1995a, p. 18).

Technical assistance and extension services are provided to small-scale miners by a number of governments. In addition to training miners in the identification of minerals and in simple ore processing techniques, technical assistance has often focused on areas such as environmental management and workers' health and safety. Among the more successful schemes should be mentioned the ones in Chile, Morocco, Nicaragua, Zambia and Zimbabwe. In a few countries, notably Nicaragua and Zimbabwe, governments have also made available processing equipment or established processing centres.

Governments have also attempted to assist with the organization of miners into cooperatives or

companies, it being perceived that a more formal organization would reduce problems of crime and conflicts between miners and other population groups. Indonesia, Nicaragua and Zimbabwe are examples of countries where governments have tried to encourage the establishment of mining cooperatives. This approach has had mixed success, in particular for gold and gemstone mining, since the high value of the products makes cheating fellow cooperative members very tempting. For low-value minerals, such as chromite, which has been mined by cooperatives in Zimbabwe since 1980, cooperatives have proved to be more successful.

Finally, in some countries, governments have extended financial support or accorded favourable taxation treatment to small-scale mining. Lower taxation rates or even exemption from taxation altogether may not constitute a large financial sacrifice for governments, given the problems of collecting taxes from small-scale miners and the risk that taxation would drive miners into illegality with its attendant problems. In Peru, lower taxation rates for small-scale miners and access to favourable loans have both been tried. However, as mentioned above, the specialized bank set up for the latter purpose, the *Banco Minero*, had to cease its activities in 1990, when a large number of its clients became unable to service their loans as a result of low silver prices (UNCTAD, 1993, p. 36).

In conclusion, it should be emphasized that the problems associated with artisanal mining will not be solved without action by the government concerned. However, experience seems to show that attempts to organize artisanal miners and solve the problems using a top-down approach are likely to fail. Reforms have to be based on the active engagement of the miners themselves. A first step towards achieving this engagement, hopefully leading eventually to formalization of artisanal activity, is to accord artisanal miners legal status and secure title to the deposits they work.

III. Mineral resource management

1. Environmental management

Few mining-related issues have attracted as much attention in recent years as the environmental impact of mining. It is easy to understand why the environmental consequences of mining have attracted so much attention and why - at least in the view of mining companies - such disproportionately little notice has been taken of the progress made in reducing negative environmental effects. While environmental degradation from other causes is often invisible to the naked eye or spread out over large areas so that it is less noticeable, the highly localized environmental impact of mining is often dramatic and obvious.[22] Recent events that could have had extremely serious consequences, such as the collapse of tailings dams in Guyana and the Philippines, have resulted in additional attention being focused on the environmental impacts of mining. For the general public it is difficult to believe that a large hole in the ground does not necessarily mean eternal devastation of the landscape or that substances which they have repeatedly been told are detrimental to human health, wildlife and vegetation, such as copper, lead and sulphur, can be mined without escaping to the environment in harmful quantities.

This said, however, it has to be recognized that mining has been and can be the cause of major environmental degradation in the absence of remedial measures. Governments anxious to ensure that mining contributes to the development of their countries have to be able to reassure the general public that policies are in place to deal not only with the environmental impact of new projects but also with past environmental neglect.

The environmental impacts of mining and mineral processing operations are summarized in box 2.

Methods for reducing the environmental impact of mining and metallurgical operations have improved considerably over the last couple of decades. At the mining stage, methods for rehabilitating mined-out areas to the original or new land uses have been developed and are applied in most new mining projects. Similarly, releases of effluents to surface water bodies or to groundwater are controlled and reduced through judicious planning at the very beginning of mining projects.

While changes in environmental legislation have certainly been an important factor in the changes in practice, it must also be recognized that the attitudes of mining companies to environmental protection have changed considerably over the last years. There is growing evidence that at least large international mining companies have made environmental quality an integrated element of their corporate policies. Many mining companies have implemented environmental management systems and several also carry out internal environmental audits, and in some cases have initiated such audits by external auditors.[23] The change that has taken place in corporate thinking about the environment was illustrated by the creation in 1991 of the International Council on Metals and the Environment. This is an industry group consisting of most of the world's largest mining and metals companies that promotes the development and implementation of sound environmental and health policies and practices to ensure the safe production, use, recycling and disposal of metals.

Box 2. Environmental impacts of mining and mineral processing

1. Surface water pollution

Soluble contaminants in domestic or agricultural use waters from release of mine and processing water or leakage from waste deposits

Deposition of solids on agricultural land and in shallow sea zones

Withdrawal of water for industrial purposes

Alteration of aquatic flora and fauna, including destruction of fish species and accumulation of toxic elements in fish

Sand deposition in river channels and shallow sea zones

2. Underground water pollution

Soluble contaminants in wells, springs etc. resulting from leakage from waste heaps and mine water

Natural water sources drying up as a consequence of water table lowering

3. Air pollution

Dust blown on inhabited, agricultural lands

Accumulation in plants of toxic elements carried by dust

Acidification of water bodies and soil resulting from SO_2 emissions

Damage to buildings from SO_2 emissions

4. Solid waste

Hazards related to lack of stability of waste deposits

Land disturbance

Withdrawal of agricultural land

5. Excavation

Loss of fauna and flora habitats

Land subsidence due to underground mining

6. Noise and vibration

Effects on human health

Damage to buildings

Source: Based on United Nations Environment Programme, 1991, p. 26.

There are several reasons for the change in attitudes. The most important may be the pressure of public opinion. Companies are anxious to maintain their reputation as "good corporate citizens" and dislike being identified in the mass media as polluters. They also realize that as public opinion evolves, environmental standards are likely to become more stringent everywhere and that, even in countries with "soft" environmental requirements, conditions are likely to evolve towards more stringent standards in the future. Unlike more "footloose" industries, mining companies are tied for very long periods of time to their deposits and they cannot close down their operations and move elsewhere in response to a change in legislation.[24] For this reason, and since it is usually considerably less costly to take environmental

precautions at the beginning of a project than to add modifications later, mining companies prefer to anticipate future regulations rather than adapt to them as they occur. Accordingly, companies often take environmental control measures that are more ambitious than required by existing legislation.

Second, conditionalities aimed at ensuring good environmental practices are increasingly being required by international financial institutions and by commercial banks (Warhurst, 1992). Given the increased importance of loan financing in large mining projects, companies are naturally anxious to heed the advice of their financiers.

Third, environmental control measures in new projects usually do not entail major cost increases and may even improve production economies.[25]

Government regulations for environmental management in mining are relatively recent in most countries and, indeed, do not exist in some developing countries. Despite this short history of regulation, however, approaches have evolved considerably.

Most governments have made the "Polluter Pays Principle" (PPP) an integral part of their environmental policies. According to this principle "the polluter should bear the expenses of carrying out pollution prevention and control measures decided by public authorities to ensure that the environment is in an acceptable state. In other words, the cost of these measures should be reflected in the cost of goods and services which cause pollution in production and/or consumption". (Organisation for Economic Co-operation and Development, 1975, pp. 12-13). The arguments for the principle derive from allocation and equity considerations. If a production activity is accompanied by disutilities affecting one or more economic agents, such as pollution, a discrepancy arises between the private cost of the activity and the corresponding social cost. The effect causing this discrepancy is called a "negative external effect". Misallocation of resources results from the existence of such effects. First, since consumers do not pay the full social costs of pollution, pollution-intensive goods are underpriced relative to other goods, and hence overconsumed and overproduced. The economy fails to achieve *allocative efficiency*. Second, producing firms, to the extent they can, will substitute environmental resources, which for them are free, for labour, capital and other inputs, for which they must pay. This results in lower *production efficiency*. Finally, if producing firms are charged the full social costs for the environmental resources they consume, they have strong incentives to develop and adopt new technologies that have less negative effects on the environment. If they are not required to pay for their pollution, however, they have no incentive to develop new technologies. This results in lower *dynamic efficiency* (Tilton, 1994, pp. 61-62).

The PPP aims to improve economic efficiency in the three ways just mentioned by internalizing social costs so that they are taken into account by producers. When applying instruments for this purpose, the question of sharing the cost arises. This problem of cost sharing calls for equity as well as efficiency; it appears reasonable that everyone must assume responsibility for the damage he or she causes, and if an environmental policy redistributes incomes unfairly, corrective measures may have to be taken. Although the demands of equity are not economic in themselves, they have to be given consideration (Organisation for Economic Co-operation and Development, 1975, p. 25). It should be noted that the PPP, as usually understood, is not a principle of compensation for damage caused by pollution. If a country decides that, above and beyond the costs of controlling pollution, polluters should compensate pollutees for the damage

which would result from residual pollution, this measure is not in contradiction with the PPP, but the PPP does not make this additional measure obligatory (Organisation for Economic Co-operation and Development, 1975, p. 6).

The instruments available to governments for influencing environmental practices in the mining and metals industries are often divided into three categories:

- administrative regulation ("command and control");
- information and education;
- economic instruments.

"Command and control" policies are representative of the early era of environmental regulation, but they still dominate the approach to environmental regulation in many countries. These policies are characterized by a reliance on predetermined environmental standards which have to be observed by mine operators. The standards are often general in nature, applying to all industries and all parts of the country. The government's role is to establish the standards and to enforce them through monitoring of operations and levying of penalties on operators that do not observe them. Standards may classified as follows (Jha and Teixeira, 1994, p. 12):

- Ambient standards: determine the permitted concentration of pollutants in a given medium (air, water or soil);
- Emission standards: set maximum levels of pollution releases, by plant, industry or region;
- Technology standards: determine the technology to be used in the production process;
- Performance standards: specify pollution release per unit of output from a given plant;
- Product standards: specify the physical or chemical properties of a product.

As far as mining and metallurgical operations are concerned, governments rely mainly on emission standards and performance standards, with technology standards being found too inflexible. Increasingly, however, governments have found general standards to be inefficient, since they require all polluters to reduce their emissions to the same level (whether in absolute terms or in terms of emissions per unit of output), regardless of the cost of pollution reduction and the absorbing capacity of the environment. Accordingly, they have often opted for emission limits determined on an individual basis for operations.[26] Although this approach requires a greater degree of sophistication on the part of regulators, it increases flexibility and avoids both under-regulation and over-regulation.

While there is no doubt that administrative regulation has to a certain extent been successful in improving environmental quality, in particular in developed countries, the situation in developing countries is less clear. In many cases, regulations have proved to be legally or practically unenforceable, technically difficult to monitor and generally to have an insufficient deterrent effect. Enforcement problems often result

from shortages of adequately trained staff and equipment (UNCTAD, 1995c, pp. 77-90). The practice of borrowing standards that have been established in developed countries has led to problems in many cases where standards did not sufficiently take into account local climatic, ecological or cultural characteristics.[27] Such standards also entail high bureaucratic costs and substantial informational requirements as well as problems of sociocultural acceptance.

Many governments also see information and education as an important part of their environmental policies. Elements of this approach include training of operators, in particular smaller ones who do not have easy access to the technology required and who may be unaware both of environmental impacts and of methods to alleviate them. Information and education are elements of a less confrontational and more cooperative approach than traditional "command and control" policies. The change in corporate attitudes described earlier has encouraged the development of cooperative approaches whereby regulators and operators of mines attempt to arrive at mutually acceptable solutions to environmental problems, taking into account both the need to minimize environmental damage and the circumstances of the individual operation. While such approaches may require a great deal of sophistication and flexibility on the part of both parties, they often result in less environmental damage and lower costs than would otherwise have been the case.

Economic instruments are receiving increasing attention from governments as a potentially more effective way of internalizing the social cost of environmental damage than administrative regulation, which is seen as excessively rigid and too blunt an instrument. Since administrative regulation necessarily implies that polluters have to reduce pollution according to a predetermined standard, and since polluters are likely to face very different costs of abatement, there is no assurance that optimum reduction of pollution will be achieved[28] or that the amount of pollution reduction per monetary unit spent on it will be maximized. Examples of economic instruments include charges or taxes on pollution, subsidies and marketable pollution permits.[29] At the United Nations Conference on Environment and Development in Rio de Janeiro in 1992 governments agreed to promote the use of economic instruments.[30] In practice, economic instruments have been very little used for mining, and where applied, it has usually been under legislation not confined to mining, such as the use of marketable pollution permits under the Clean Air Act by metallurgical companies in the United States (Mining Journal, 1992).

There are some examples of economic instruments not directly aimed at internalizing environmental costs but rather at promoting pollution control measures. These include tax incentives such as accelerated depreciation for pollution control equipment. While these instruments are likely to contribute to reductions in pollution, they are not very cost-effective from the government's point of view.[31] Furthermore, they may provide an incentive to companies to invest in "end-of-pipe" technology, that is, to treat emissions rather than to prevent pollution from occurring in the first place through appropriate process design. The latter would be preferable from the point of view of maximizing pollution reduction in relation to cost, but would provide no tax advantage.

Several arguments are put forward as to why the use of economic instruments has not developed more rapidly in developing countries, both in general and specifically for mining. (The application of such instruments in developed countries is also in its early stages, although some systems are now in use.) In general, governments find it difficult to establish the "right" rates of taxation and fees, and they are sensitive to public opinion which might interpret economic instruments as allowing polluters to buy the right to pollute.

The first argument would appear to be based on the assumption that the imposition of fees and the like would in principle require more knowledge than the imposition of administratively enforced limits on pollution. It could be argued, however, that if the information is good enough for applying administrative limits, it should be good enough for allowing the use of taxes or fees. In practice, economic instruments may prove to be easier to administer and enforce. This is particularly because they may be more flexible than alternative approaches, since they allow the operator to select the most appropriate technology to reduce pollution to the point where the pollution tax or charge is equal to the marginal cost of abatement. The second argument is of course politically valid, but might be better dealt with through information and education. It should also be noted that economic instruments such as pollution charges or taxes may be a source of revenue for the government.

As regards mining specifically, it could be argued that many of its environmental impacts, for instance the disturbance of natural ecosystems, are difficult to measure and that economic instruments are therefore difficult to use. While it is certainly true that mining does not have all the characteristics of the theoretical polluting industry that responds to a pollution charge by reducing pollution by the optimal amount, other economic instruments can be used to provide operators with an incentive to minimize environmental damage. Examples of such instruments could be charges proportional to the area disturbed, which might be designed to escalate over time. Furthermore, pollution charges or similar instruments could be used for those types of environmental damage for which they are suited. It would appear that they could have an important role to play, particularly in reducing pollution from mineral and metal processing.

The most common economic instrument used to influence environmental management in mining is financial assurance for rehabilitation of mine sites.[32] Financial assurance schemes could be termed a "hybrid" instrument of environmental policy, encompassing aspects of both economic instruments and administrative regulation. Financial assurances typically require mining companies to guarantee financial responsibility for reclamation of mine sites. There are a number of specific financial vehicles and mechanisms grouped within the broad category of financial assurance, including several types of bonding, trust funds and insurance programmes. Standard financial assurance tools and mechanisms are intended to ensure that a normal range of costs associated with reclamation and closure of mines will be paid for by the mine owner or operator, either directly or through some alternative mechanism which guarantees their financial responsibility. These schemes have been extensively used in Canada and the United States as well as in some developing countries, notably Malaysia. Several other developing countries have recently introduced similar schemes or are about to do so. For financial assurance mechanisms to be successfully used, there must be a financial industry capable of providing these services. This industry must also be monitored and regulated, something which may be difficult in many developing countries. The importance of adequate regulation is illustrated by the experience in the United States, where many of the firms which provided financial assurances went bankrupt themselves, leaving governments and taxpayers with the financial responsibility (Anderson, 1995, p. 71). Furthermore, the additional costs of purchasing bonds or insurance, as well as the costs of engineering to higher environmental standards, may threaten the economic viability of small mines.

A subject which is often referred to in the context of environmental management, although the connection between the issues that give rise to the discussion and the environment may be tenuous, is the relationship between mining operations and local communities. Attention has been drawn to this subject by events such as reported massacres on Yanamomo Indians in Brazil by artisanal gold miners[33] and by the

rebellion on the island of Bougainville in the North Solomons Province of Papua New Guinea.[34] The interests of local communities, which are often isolated and may have little political power, have sometimes been jeopardized by mineral development projects. Such projects have led to environmental degradation, displacements of populations, reduced possibilities of exercising traditional occupations such as hunting and fishing, and conflicts between local inhabitants and immigrants drawn to the region by the mineral development. While some densely populated developing countries, such as India, have long experience of this problem and have evolved instruments for dealing with it (Dhar and Sexena, 1992), others are still attempting to formulate mechanisms that ensure local participation in the process leading up to a decision whether to approve mineral development projects, and if so, on what conditions.

2. Sustainability in mineral resource use

The issue of sustainability in the exploitation of mineral resources arises from the argument that the people alive today should not limit the production and consumption choices of future generations by using up "too much" of existing mineral resources. This implies that the income from the exploitation of a mineral deposit should be invested in other forms of capital in such a way that the present value of future return on that capital equals the present value of the mineral deposit, that is, the natural resource capital should be replaced by an equal amount of other forms of capital.[35]

Following the emergence of the concept of sustainable development, there has been a debate in recent years among economists on how to ensure sustainability in resource use. A large part of this debate has focused on the fact that national income accounts do not measure the use of natural resources.[36] It is argued that just as depreciation of man-made capital is reflected in Net National Product (NNP), so should the decline in stocks of natural resources be taken into account, since that decline reduces their availability in the future, and since otherwise society's total capital stock would be exaggerated. It is further argued that the resulting adjustment could lead to a dramatic downwards revision of NNP[37] - an illustration of the fact that economic growth as conventionally measured has been achieved at the cost of depleting the natural resource base and reducing future growth, and that, consequently, measures need to be taken to ensure the sustainability of economic growth, with this generally implying changes in production and consumption patterns.

While it is not the intention here to discuss in detail how depletion of mineral resources should be measured and how they should best be reflected in national accounts, some observations arising from recent work on the subject may nevertheless be useful in providing a perspective on the issues and on their implications for policy formulation in the area of mineral resources.

It should first be noted that while commercial natural resources are measured directly in national accounts, in the sense that the value-added associated with their exploitation is measured in national income, the economic value of these resources as assets appears only implicitly. Resource rents show up as a portion of operating surplus for the resource sectors, but are not explicitly measured. Consequently, the value of economic depreciation of a deposit as a result of exploitation is not measured either, which means that resource depletion does not enter into the calculation of net product.

The United Nations has drawn up guidelines for the establishment of "satellite" accounts for natural resources and the environment. These accounts are parallel and linked to the standard accounts (United Nations, 1993). One of these accounts is the balance sheet for subsoil assets. An example of this appears in table 7. The table shows the value of subsoil assets for Papua New Guinea in 1988, including depletion, resource discoveries ("other volume changes") and revaluation due to price changes. Underlying this balance sheet is a set of accounts in physical terms detailing the stocks and flows of individual mineral

Table 7. Papua New Guinea: Balance sheet for subsoil assets, 1988 (million kina)

Assets	**Value**
Opening stocks	3 683.7
Depletion	- 106.3
Other volume changes	175.6
Revaluation	-2 168.6
Closing stocks	1 584.4

Source: Bartelmus et al., 1993.

While the principle of natural resource accounts is easy to understand, the methods used to establish them are less self-evident. The physical volume of stocks is measured by proven reserves, a measure which is sensitive to price changes. It is agreed that reserves should be valued at the resource rent per unit, since the rent is what remains of the value of production after accounting for the returns to labour and "normal" returns to capital. However, two approaches to value resource depletion have been proposed. The first argues that "from the annual earnings from sale, an income portion has to be identified capable of being spent on consumption, the remainder, a capital element, should be set aside year after year to be invested in order to create a perpetual stream of income that would sustain the same level of "true" income, both during the life of the resource as well as after the resource has been exhausted" (El Serafy, 1989, p. 13). The income portion, or *user cost*, is the value of the depletion of the resource. The other approach, the *net price* method, amounts to using the full value of current resource rents as the value of depletion (Repetto et al., 1989). The two approaches can yield significantly different results, arising mainly from the difference in the relative weight accorded to current depletion and new discoveries in relation to the total stock of resources.[38]

While data problems limit the usefulness of natural resource accounts as quantitative indicators of welfare or economic growth, the techniques described may, however, be useful as pedagogical tools that may help focus political attention on the need to replace natural resource assets with other types of capital in order to achieve economically sustainable development.

3. Acquisition and dissemination of mineral resource information.

As already mentioned, the availability of basic geological information can be of crucial importance to the development of the mineral sector. The task of compiling this information is usually identified as a government responsibility, to be carried out through an agency such as a geological survey.

The main function of the geological survey is usually considered to be the preparation of public geological maps.[39] The basis for the maps is usually topographical maps, normally supplemented by aerial photography and satellite images. While the latter types of data provide useful up-to-date information on topography, the information on vegetation contained in them can also sometimes indicate the existence of mineralized zones. The topographical data are often complemented with data from airborne geophysical surveys, which may directly or indirectly indicate mineralizations, but also provide data on fault lines, geohydrology etc., which are useful as clues for exploration. Following the collection and compilation of cartographical and airborne data, a ground reconnaissance is carried out. In addition to data actually collected at the time of mapping, other information such as previous reports of exploration campaigns and geological descriptions prepared as documentation for mining rights applications is usually drawn upon

Geological maps are useful as a basis for exploration, particularly at the initial stage when promising areas for detailed exploration are identified, since they normally include not only the map itself but also an accompanying description and interpretation of the geology, often supplemented with data from geophysical or geochemical surveys. Geological maps and other geological information are used for several other purposes in addition to exploration, including general land use planning and design of infrastructure.

Geological surveys in some countries also engage in exploration. In most cases, the purpose of such exploration is not to identify and evaluate commercial ore deposits, but to provide explorers with a preliminary indication of sites that should be subject to more detailed investigation. Particularly in countries which for various reasons have found it difficult to attract investment in exploration and mining, descriptions of potential deposits can be a useful method of attracting such investment.

Geological surveys often also provide laboratory and other geoscientific services to mining enterprises, especially to small-scale miners. Since alternative suppliers of these kinds of services are scarce in many developing countries, the geological survey can have an important role to play.

The cost of acquiring mineral resource information is relatively easy to quantify, whereas the benefits are often difficult to define and may be highly uncertain or take a long time to materialize. For this reason, geological surveys in developing countries are usually underfunded and suffer from a lack of equipment and personnel.[40] The shortage of funds may have serious consequences for the availability of geological information, not only because geological maps are unavailable or obsolete, but also because opportunities to acquire information are lost. The quality of geological survey activities is often directly related to how well obligations on the part of exploring and mining companies to provide detailed reports are enforced. Most countries require companies to provide detailed reports on their activities, including detailed geological documentation. Such information can be extremely useful to future explorers and, as already mentioned, constitutes one of the inputs to geological mapping. However, reporting obligations are often not enforced, and even when enforced, reports may in practice be inaccessible owing to lack of funds for classification, systemization and even physical storage.

Notes

1. Although concern over the security of supply of mineral raw materials has diminished in developed countries, several countries still maintain programmes and policies aimed at furthering this objective. Several European governments, including those of France, Germany, Italy, Spain and the United Kingdom, support in various ways exploration by national companies in other countries. The governments of Germany and Japan provide direct or indirect financial support to companies investing in mining operations in other countries (Organisation for Economic Co-operation and Development, 1994, p. 21). "Strategic" or other non-commercial stockpiling of minerals has decreased in importance, and stockpiles are now only held by the governments of Japan and the United States, with Sweden and the United Kingdom having disposed of their stockpiles. (Organisation for Economic Co-operation and Development, 1994, pp. 21-22; UNCTAD, 1986; 1988, annex).

2. Among countries with any significant mining, the regime of non-separation of rights or "common law" regime, under which underground rights are held by the surface landowner, prevails in Ireland, the United Kingdom and the United States (although gold and silver are excluded in the former two countries). In developing countries where it was used it has generally been abandoned in favour of the "regalian" principle, that is the separation of underground and surface rights. It should be noted, however, that the rights to deposits of some non-metallic minerals, particularly basic construction materials such as stone, sand and gravel, belong to the landowner in many countries.

3. According to a list compiled in February 1994 by the Centre for Petroleum and Mineral Law and Policy, University of Dundee, United Kingdom, quoted in UNCTAD, 1994b, p. 300.

4. According to a recent survey of 42 large international mining companies, their annual exploration expenditure in current US dollars increased from 448.4 million in 1985 to 899.8 million in 1990, and fell slightly to 757.2 million US$ in 1992 (Raw Materials Group, 1994). Among 32 major mining companies surveyed in 1989, all but one included gold among their exploration targets (Johnson, 1990, p. 180).

5. See Oman, 1989, pp. 33-74, for a review of the role of the new forms of investment in the mining and metals industries.

6. Gold loans, i.e., loans denominated in gold, are often used to reduce the price risk when establishing gold mines.

7. On the difficulties of achieving an efficient centralized screening process for foreign investment, it is noted, however, by one author that "only certain types of administrations were able to overcome the pressures that emanated from the bargaining activities of subunits of government and the resistance of screening units to changes in their mode of operation. A necessary, if not a sufficient, condition of fundamental change in screening functions was that central administrations had to be particularly determined to attract foreign investment, and they had to be strong enough to offset the countervailing pressures they were likely to encounter" (Wint, 1992, pp. 1524-1525).

8. This type of tax is payable only when the realized net present value of a project becomes positive, while other taxes may be triggered before resource rent is being realized (Emerson, 1982).

9. For a relatively detailed overview of mining taxation systems in several countries, see Coopers & Lybrand, 1991.

10. The *Canadian Exploration Incentive Program* (CEIP), which was discontinued in 1990, reimbursed 30 per cent of exploration costs to companies. The *Ontario Mineral Incentive Program* (OMIP) still provides grants of 30 per cent of exploration expenses up to a maximum of C$ 150,000 (Brewer and Vance, 1991; Organisation for Economic Co-operation and Development, 1994, p. 58).

11. Through the system of flow-through shares, which was discontinued in 1990, Canadian share holders in companies that carried out exploration but had no offsetting income against which to deduct exploration expenses, could deduct the exploration expenses themselves. They could also benefit from the Canadian Exploration Incentive Program (see note 9) (Brewer and Vance, 1991).

12. See Brown and Faber, 1977, p. 60, for an exhaustive list of different types of royalties and quasi royalties.

13. Nationalizations of mining enterprises in some developing countries took place considerably earlier than the wave of nationalizations in the 1970s. For instance, tin mining was nationalized in 1952 in Bolivia (where, however, it was mainly domestically owned) and in 1950 and 1958 in Indonesia (Radetzki, 1985, p. 70). In India, new investment in coal and lignite production was identified as an exclusive responsibility of the State in 1948, and most important metals were included in the same category in 1956 (Ghose, 1989). The Brazilian iron ore company CVRD, which is 51 per cent state-owned, was established in 1942 as a result of agreements between the governments of Brazil, the United Kingdom and the United States. In exchange for permission to set up military bases and for the supply of raw materials, the latter two governments extended financial and technical assistance and gave the Brazilian Government the properties of two iron ore mining companies (Soares da Rocha, 1989).

14. The data in the table, which are from a report based on a study prepared for UNCTAD by the Raw Materials Group of Sweden, refer to control rather than ownership. For a detailed description of the method used to measure control, see UNCTAD, 1994c, pp. 51-59. An analysis on the basis of ownership, with production shares allocated to enterprises on the basis of their equity holdings, shows very similar results, except that in some cases the figures for state ownership are higher than those for state control (Ericsson and Tegen, 1989).

15. See Chang and Singh, 1993, for a critical review of the literature on this subject.

16. See Radetzki, 1985, for one of the few attempts to systematically assess the validity of at least some of the characteristics often attributed to state-owned mining enterprises, in particular their alleged tendency to be less responsive to market changes.

17. In countries where a state-owned mining enterprise is of critical economic importance and where non-economic objectives become predominant, this may lead to concentration on a clientelist redistribution of rent in the form of both income and social services. Improving the efficiency of such a company may not be possible without the political and economic transformation of the country (see UNCTAD, 1994d).

18. See Harvey and Jenkins, 1994, for a discussion of the combined effects of high and variable inflation and nominal interest rates on borrowers in African countries.

19. In contrast, the existence of specialized stock exchanges for "junior" mining companies in Canada has probably been a major factor in the positive development of this industry segment in that country.

20. A forthcoming UNCTAD publication will address the issue of diversification in mineral-dependent countries.

21. The most elaborate definition of a small-scale mine, resulting from the 1987 United Nations Seminar on Small Scale Mining in Developing Countries, reads as follows: "One that produces less than 50,000 tonnes per year or 200 tonnes per day, has a capital investment of less than US$ 1 million, annual revenue of below US$ 1.5 million, employs under 40 persons and has a life of below 5 years" (United Nations, 1987).

22. It is interesting to note the very small relative size of the areas affected by mining. For instance, over the period 1930-1980, only 0.25 per cent of the total land area of the United States was used for surface mining, disposal of wastes from surface and underground mines, and disposal of wastes from mineral beneficiation and further processing. Coal mining accounted for about half of this land, with mining of non-metallic minerals accounting for about two-fifths and of metallic minerals about one-tenth. Some 47 per cent of the land affected by mining and waste disposal had been reclaimed by the end of that period (Johnson and Paone, 1982).

23. Balkau, 1993, provides an introduction to environmental auditing in the mining industry.

24. While the costs of environmental control measures required by legislation may vary considerably among countries, there is no evidence that mining companies are attracted to countries with less ambitious environmental regulations (see table 2 in chapter II). For a general review of studies on the impact on trade of differences in environmental costs, see Dean, 1991. A recent analysis by the UNCTAD secretariat (UNCTAD, 1994e, paras 75-79) of industries with relatively high pollution abatement costs (operating costs 2 per cent or more of value of shipments, including iron and steel production and basic metals industries but not mining, however) shows that the share of intra-

OECD trade in these sectors decreased slightly from 1980/82 to 1990/92 and that the share of OECD imports in these sectors from developing countries (except for European Union imports) and countries in transition increased. In some of the sectors, however, the share of intra-OECD trade increased. While the trends are consistent with the industrial relocation hypothesis, this could equally well reflect a normal pattern of industrialization whereby the industries concerned grow at a higher rate initially. Nevertheless, there is evidence that in some cases, environmental regulations may lead to the relocation of mining and metallurgical industries. Thus, the closure of 29 secondary lead smelters in the United States in the latter half of the 1980s is attributed to more stringent regulation of air pollution (Mining Journal, 1991).

25. Warhurst, 1992, cites several examples of reduced operating costs and/or increased recovery of useful products resulting from improved environmental control measures, and makes the observation that the more dynamic firms innovate by building into the new generation of technology lower costs of both production and pollution control. In general, the costs of environmental control measures of course vary significantly from project to project. For most projects, however, the costs are likely to be relatively low. A recent survey by the Metals Economics Group of 105 gold projects of 54 companies found that environmental costs accounted for 14.1 per cent of capital costs. The share fell to 9.6 per cent if one particularly high-cost project was excluded. Environmental operating costs, including pollution control, monitoring, permit maintenance and reclamation concurrent with mining, accounted for on average 2.7 per cent of total operating costs, with reclamation accounting for a fifth. Reclamation after mining corresponded to on average 4.2 per cent of total life-of-mine capital costs (quoted in Mining Journal, 1994a).

26. Another reason why general standards may be inappropriate is that the undisturbed groundwater close to ore deposits that have not been mined can be naturally acidic and contain concentrations of metals that are far above general standards (Runnels et al., 1992). In Chile, standards were established using the standards set by the United States Environmental Protection Agency. However, some of the rivers in northern Chile have a base level of metallic elements that is higher than the standard, thus making the standard unenforceable (Lagos, 1994, pp. 91-92). High concentrations of metals in groundwater close to an ore deposit are identified through geochemical surveys and used as one of the tools for exploration.

27. See note 26.

28. The optimum amount of pollution reduction is achieved when the marginal cost of reducing pollution is equal to the marginal social cost of pollution.

29. For a description and discussion of these instruments, see UNCTAD, 1991, paras 82-92, and de Castro, 1994, pp. 25-36. For a summary overview of instruments used in OECD countries, see Barde and Owens, 1996.

30. Principle 16 of the Rio Declaration adopted by the United Nations Conference on Environment and Development in Rio de Janeiro on 14 June 1992 states: "National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment"(United Nations, 1992).

31. See Lloyd, 1992, for a discussion of these aspects in the context of taxation in France.

32. See Anderson, 1995, and Intarapravich and Clark, 1994, for discussions of financial assurance schemes for rehabilitation of mine sites.

33. See May, 1991, pp. 24-30, for a review of the recent history and origins of conflicts between Indians and *garimpeiros* in the Brazilian Amazon.

34. In 1988, an armed rebellion against the central government broke out in Bougainville. The dispute arose out of the adverse effects resulting from the operations of Bougainville Copper Pty. Ltd., which was mining a large copper deposit on the island. The grievances of the local population included destruction of the environment resulting in damage to fisheries and agriculture, displacement of the population and insufficient compensation. In 1990, the mine was closed down, and there is at present no prospect of its reopening. For a discussion of the complex roots of the

conflict, see Thompson, 1991.

35. This assumes full substitutability between natural resource capital and man-made capital, which may not be strictly correct, but which is a reasonable approximation for realistic time periods (although strict environmentalists may not agree).

36. For a discussion of this issue as it relates to mineral resources, see Hamilton, 1994; Hartwick, 1990; Mikesell, 1994; and Solow, 1993.

37. A calculation of "Net Domestic Product" (NDP) for Indonesia, derived by subtracting estimates of net natural resource depletion for three sectors (petroleum, timber and soils) from Gross Domestic Product (GDP) resulted in an average annual NDP growth rate of 4.0 per cent from 1971 to 1984, as compared with a GDP growth rate of 7.1 per cent for the same period (Repetto et al., 1989, p. 6).

38. A study of sustainable income from seven non-fuel minerals and petroleum in Brazil over the period from 1970 to 1988 yielded results ranging from -16,000 per cent in 1974 to +9,000 per cent in 1972 of conventionally calculated income for the net price method and 86.7 per cent (1974) to 97.9 per cent (1980 and 1988) for the user cost method (at a discount rate of 15 per cent). The difference was due both to differing impacts of resource discoveries and to the existence of very large reserves of some minerals (Frickmann Young and Serôa da Motta, 1994).

39. See Otto, 1995, for a detailed overview of the activities of geological surveys, based on a survey of such organizations in 45 countries.

40. Otto, 1995, reports that in recent years, funding constraints have obliged geological surveys in many countries to cease carrying out major functions and that there are also examples of privatization of parts of geological survey activities.

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