



Mining in Brazil and the global economy

By Phillip Crowson

The demand for mineral products is driven and shaped by the structure, location, and trend of overall economic activity. Changes in the world's economic centre of gravity are having deep seated effects on mineral markets. So too are the far reaching political changes of recent years. The climate has swung in favour of private investment in mineral projects within a liberalised legal and fiscal framework. In this article Phillip Crowson argues that foreign involvement in mineral ventures has become widely acceptable as being better able to deliver the fruits of economic progress to all stakeholders than the previous inward looking nationalism. Brazil cannot remain aloof from the broad politico-economic forces that are shaping the world minerals industry.

This paper was presented to the First International Symposium on Mining & Development, July 1995, Campinas, Brazil.

Phillip Crowson is chief economist of the RTZ Corporation and editor of *Minerals Handbook*. RTZ Limited, 6 St. James's Square, London SW1Y4LD.

This paper first describes Brazil's place in the global minerals industry. It then looks at some of the forces that drive demand for Brazil's mineral products. Whereas these are mainly outside Brazil's control, the country can shape its own destiny as a minerals supplier. The paper discusses some of the main determinants of investment in minerals exploration, extraction, and first stage processing, whether by domestic, or by foreign companies. To the extent that investors can freely choose between competing projects, they will go to where the risk/reward ratios are most favourable, both geographically and industrially. Brazil's investment regime, broadly considered, has not maintained its competitiveness against a widening range of countries throughout the world and more specifically in Latin America.

Brazil's place in the global minerals industry

A country's mineral endowment is dictated by the nature of its geology and its terrain, rather than by its size alone. Nonetheless, it would be surprising if Brazil did not have a sizeable and diversified minerals industry, as it covers one-sixteenth of the world's land area. Estimates of mineral resources and reserves are governed as much by the economics and practicalities of minerals extraction as by the physical presence of ore. Large, known and even accessible, deposits of minerals may not be economically exploitable with existing technology. The degree to which countries have been geologically mapped and explored with modern techniques varies widely. For these reasons estimates of production probably give a more objective measure of a country's relative importance in the minerals economy than comparisons based on reserves.

The following table compares Brazil's minerals intensity with that of Australia and Canada. In terms of land area, Australia is about 10 per cent smaller than Brazil, and Canada is 17 per cent larger.

The measure used is the ratio of each country's share of global mine production in 1992 to its share of global land area. Thus a ratio of one means that a country's share of world mine output is the same as its share of the world's land area. The table covers a wide range of metallic and non metallic minerals. The figures for three products, aluminium, silicon, and ferrosilicon, which are highly energy intensive, are based on output of metal rather than of on mine production, but these are exceptions to the general rule.

The table brings out both the comparably broad spread of each country's minerals output, and the lopsided nature of that spread. In value terms Brazil's mineral production is much smaller than that of the other two countries. Brazil and Australia share common strengths, such as aluminium, iron ore, and manganese. Brazil is, however, but poorly endowed with precious and non-ferrous metals, when compared with the other two countries. Tin is the exception, and Brazil has a strong presence there, and in other heavy metals, such as niobium and tantalum. In fertiliser minerals, Brazil lags well behind Canada in potash and sulphur, but it no more phosphate-deficient than the others. The patterns of Brazil's mineral resources are reflected in some of its trade policies, and not always to good effect. Each of the three countries' shares of world output and population falls substantially short of their shares of land area. Their role as global suppliers of minerals and mineral products is thus greater than their mineral intensities, as defined, might suggest. The next table shows a fuller picture for Brazil. It covers all those minerals where Brazil's share of world output equals or exceeds its share of global GDP, as estimated by the World Bank. The first column shows the absolute shares of world output in 1992 for the different products. The second reproduces the measure of mineral intensity given in the earlier table. The third and fourth columns relate Brazil's shares of

Table 1. Brazil's comparative minerals intensity

Ratios of shares of global production in 1992 to shares of global land area.

	Brazil	Australia	Canada
Bauxite	1.4	6.6	–
Aluminium	1.0	1.1	1.4
Asbestos	1.1	2.4	–
Beryllium	1.6	–	–
Chromium	0.5	–	–
Cobalt	0.3	1.1	1.4
Copper	0.1	1.1	–
Gold	0.5	1.9	1.0
Graphite	0.7	0.3	–
Industrial Diamonds	6.7	–	–
Iron Ore	3.1	2.5	0.6–
Kaolin	0.5	–	–
Lead	..	3.4	1.6
Lithium	0.1	2.8	1.0
Manganese	1.6	1.5	–
Molybdenum	–	–	1.2
Nickel	0.4	1.1	2.9
Niobium	13.4	0.1	2.1
Phosphate	0.2	0.3	..
Platinum group	–	..	0.5
Potash	0.1	–	4.1
Rare earth metals	0.4	1.1	–
Silicon	2.2	0.8	0.2
Ferrosilicon	0.8	0.1	0.1
Silver	–	1.6	1.2
Sulphur	–	–	1.9
Talc	0.9	0.4	0.2
Tantalum	1.4	4.7	0.9
Tin	2.5	0.7	–
Titanium minerals	0.2	5.5	2.2
Uranium	–	1.2	3.6
Zinc	0.3	2.5	2.5
Zircon	0.4	7.2	–

Sources: Minerals Handbook 1994 – 95 P. Crowson – Stockton Press. United Nations General Statistical Yearbook.

world production respectively to the country's shares of global population and world GDP. These measures better bring out Brazil's comparative strengths in the minerals arena, and by omission its weaknesses.

To round off this Section, it is important to recognise that the minerals indus-

try is usually capital intensive, and employs relatively little labour. Although modern civilisation could not survive without minerals, mining and quarrying typically account for modest shares of the world's total gross product. In Brazil's case the value added in mining and quarrying provides only just over

1.4 per cent of the national gross domestic product.

The determinants of demand

Demand for a country's domestically produced minerals and metals is driven by a combination of internal requirements, comparative advantage, and external consumption. Even where products are supplied entirely to domestic markets, the end users are competing either with imports or in overseas markets for what they produce. For many minerals, and especially construction materials, transport costs greatly restrict the geographical reach of the market. Many large volume, low priced industrial minerals fall into the same category. There is little, if any, international trade, and markets are not just domestic, but often merely local.

Even where international trade is economically feasible, mineral-rich countries can only access world markets on a sustainable basis if they can supply them profitably. Comparisons of shares of world reserves, and even the data on production, discussed earlier, leave out the all important relationship between prices and costs. That a country ostensibly has a share of world reserves which substantially exceeds its share of global production, is of little moment, if it is a relatively high cost producer. Successive Brazilian governments have seemingly ignored this important economic dimension of minerals supply. For example, domestic high cost production of base metals has been encouraged by tariff barriers and other impediments to the import of low cost products from overseas. Import substitution, no matter the cost, was long pursued as an appropriate strategy for economic development, not just in Brazil, but throughout most of Latin America. Whatever the merits of such an approach might be for manufacturing industry, and they are highly debatable, it is patently absurd for a heavily populated country, with a broad manufacturing capability, to force up the cost of its mineral

Table 2. Brazil's share of world minerals output and different measures of its intensity

	Minerals intensity measures			
	World output	Land area ¹	Population ²	GDP ³
Bauxite	9	1.4	3.1	5.6
Aluminium	6	1.0	2.2	4.0
Asbestos	7	1.1	2.5	4.6
Beryllium	10	1.6	3.5	6.5
Chrome	3	0.5	1.1	2.0
Cobalt	2	0.3	0.6	1.2
Gold	3	0.5	1.2	2.2
Graphite	5	0.7	1.6	2.9
Industrial diamonds	2	0.3	0.6	1.0
Iron ore	19	3.1	6.7	12.3
Kaolin	3	0.5	1.2	2.2
Manganese	10	1.6	3.6	6.5
Nickel	2	0.4	0.9	1.6
Niobium	84	13.4	29.4	53.7
Rare earth metals	2	0.4	0.8	1.5
Silicon	14	2.2	4.8	8.7
Ferrosilicon	5	0.8	1.8	3.3
Talc	5	0.9	1.9	3.5
Tantalum	9	1.4	3.0	5.5
Tin	16	2.5	5.5	10.1
Zinc	2	0.3	0.7	1.3
Zircon	2	0.4	0.8	1.4

Notes: 1. Ratio of share of world output to share of global land area. 2. Ratio of share of world output Share of World Population. 3. Ratio of share of world output to Share of World GDP in 1992.

Sources: UN General Statistical Yearbook. Minerals Handbook 1994 – 95. World Development Report

raw materials through onerous tariffs. Such a policy, which was widely pursued in the former Soviet Union, can often subtract rather than add value.

Heavily protected mineral development, and first stage metal processing have fortunately accounted for only a modest share of Brazil's production. This has naturally focused on those products in which Brazil does possess comparative economic advantage. In the case of iron ore, early development was assisted by Australia's mistaken maintenance of an export ban to conserve domestic re-

serves long after any justification had passed.

Granted Brazil's international competitiveness, demand for its mineral products is driven by global economic activity. This is highlighted by the following charts. Demand for iron ore, Brazil's major mineral export, is governed by world steel production, which in turn moves in step with industrial output.

Figure 1 (Steel production and industrial production) compares annual changes in the Western World's production of crude steel, and in the industrial coun-

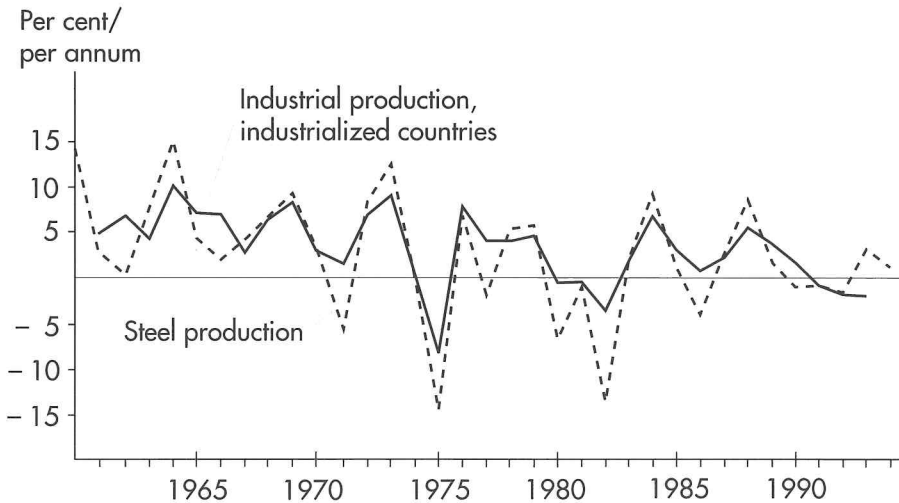
tries' industrial output since 1960. There has been a close correspondence, but with steel production showing greater cyclical volatility. In recent years, steel output has benefited from the industrial growth of the developing countries, especially in the Asia-Pacific Region, and the previously close relationship may have loosened. Brazil's exports of iron ore have fluctuated with the Western World's crude steel production, but with even larger cyclical swings.

Naturally differential rates of change in the main centres of steel production, and in Brazil's major markets are important. So too is competition, both on price and volume between the main iron ore supplying countries. These factors modify, but do not overthrow the basic relationship.

As with iron ore and steel, so with aluminium, where Brazil has risen to become the world's sixth largest producing nation. There has been a close correspondence between Western World consumption of primary aluminium and the industrial output of the industrial countries.

Aluminium differs from iron ore in that world prices are determined in a terminal market, the London Metal Exchange, rather than contractually through bilateral discussions between the major producers and their customers. Prices of iron ore lag behind movements in economic activity, whereas those of aluminium tend to lead. They are affected by speculative influences, broadly defined, as well as by underlying economic activity. Brazilian producers of aluminium, and of most other minerals, are primarily price takers. Yet even in aluminium they have at times influenced world markets. For example, large and rising Brazilian exports of aluminium between 1989 and 1993 contributed to global excess supplies and rising LME inventories, which in turn reduced prices. In iron ore, Brazil's price setting role is greater and more direct, but even that is restricted by overseas competition.

Figure 1. Steel production and industrial production



The next chart, Figure 4, shows how prices of non-ferrous metals and of minerals have moved since 1980.

It emphasises yet again the volatile nature of the global markets faced by Brazilian producers. Only internationally competitive producers can properly cope with this volatility.

The determinants of investment

Naturally the existence of large, accessible, and potentially low cost, ore deposits is a necessary component of competitiveness. It is not, however, sufficient. Ex-

ploration to discover and delineate such ore deposits and investment to develop them, will only take place if those involved can achieve sufficiently attractive rates of return. Whereas, in the 1960s and 1970s, much mineral production was in the hands of state owned companies, their share has greatly contracted, and it will shrink further. Heavy competing claims on limited tax revenues, the tendency of state owned companies to bureaucratic rigidity and inefficiency, and changing political philosophies have caused general aversion to direct state in-

volvement in productive activities. Deregulation, liberalisation, and privatisation are now the prescribed treatments for many economic ills.

Brazil has some large and well managed domestic companies, who invest not only within Brazil, but also overseas. Nonetheless, they are not able to compete on equal terms. Environmental regulations, and competing claims on land use, are common concerns for all mineral-rich countries. They are outside the scope of this paper. Where low volume, high unit value minerals, such as tin, gemstones and gold, are involved, particularly in alluvial settings, the larger mining companies are inhibited by the activities of prospectors and artisanal miners. Unregulated garimpeiro mining can not only cause severe environmental degradation, but it usually involves wasteful and inefficient mining practices. It dissipates the wealth created by mining, and hinders the accumulation of capital. Such artisanal mining, often illegally, is not a specifically Brazilian problem. It also occurs in many African and Asian countries, and was typical of the early gold rushes of Australia, Canada, and the United States. Its extensive scale in Brazil has, however, matched the country's geographical size.

That specific problem aside, Brazil has lagged behind its mineral-rich rivals, in its attitudes to foreign investment, and in its tax regime. Domestic companies can possibly obtain the latest technology through licensing agreements, but they are not always able to tap overseas capital markets on acceptable terms. Direct investment by foreign mining companies gives Brazil access to additional managerial and technical resources, and to overseas capital in the most efficient manner possible. With the vast political changes of the past few years, international mining companies have an increasingly wide choice of countries in which to explore. Naturally they will concentrate their activities in those countries where the potential rewards for their shareholders are greatest relative to the foreseeable risks.

Figure 2. Steel production and Brazil's iron ore exports

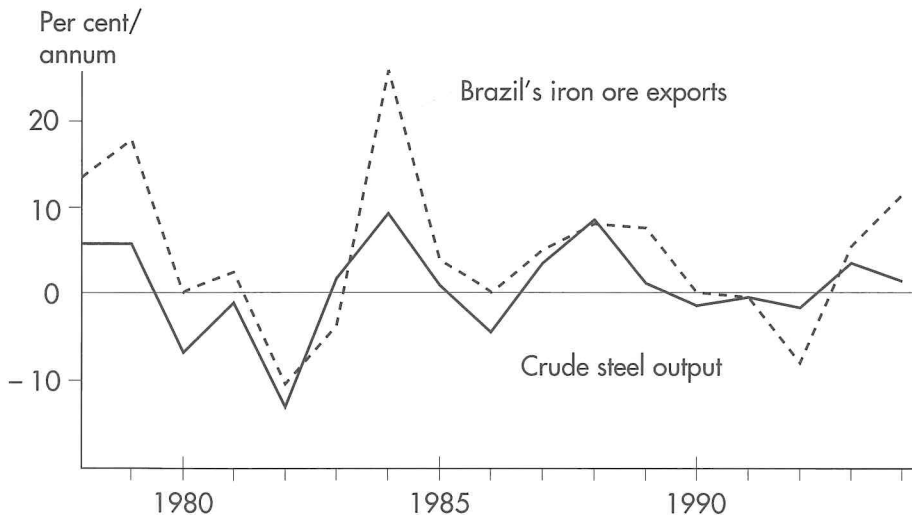
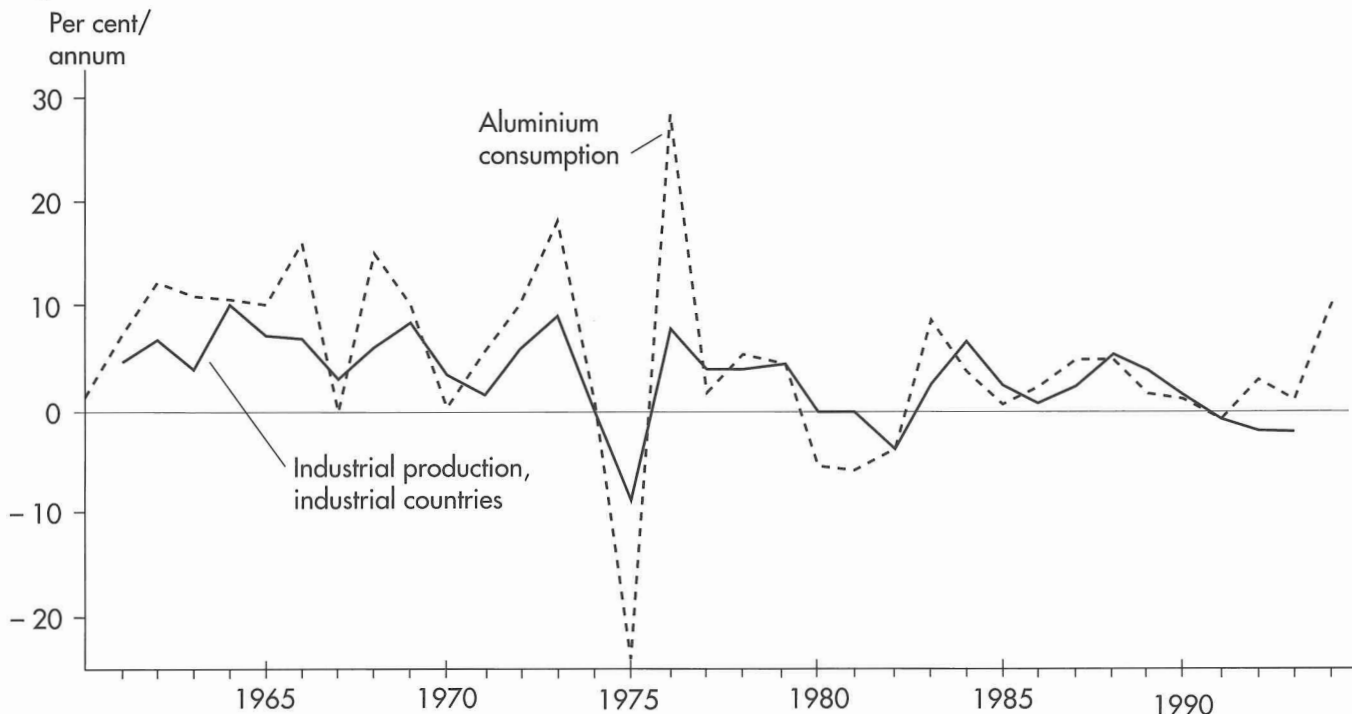


Figure 3. Aluminium consumption and industrial production



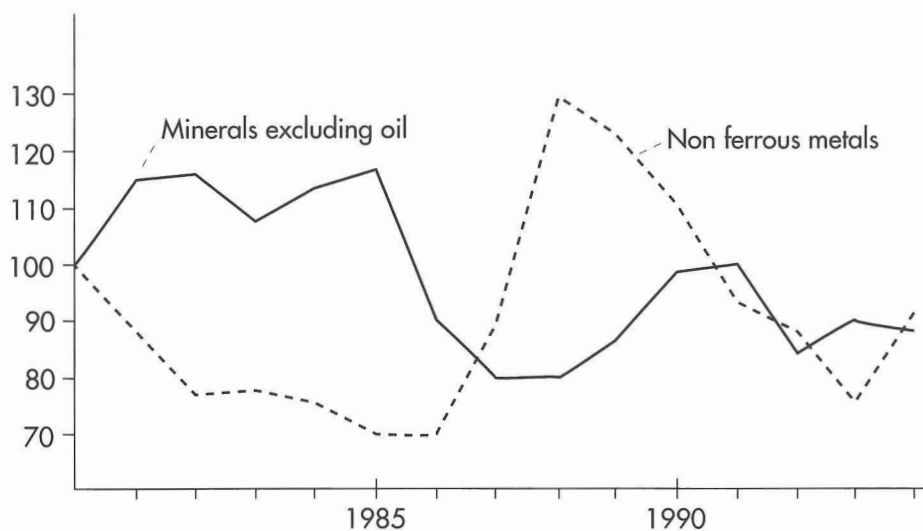
Brazil falls well down the international league table in that regard.

The result has been that Latin America's minerals exploration boom of the 1990s has largely bypassed Brazil. According to the data collected by the Canadian-based Metals Economics Group, exploration spending in Brazil last year

amounted to only just over 3 per cent of a global \$2 billion. This includes the spending of large groups, such as CVRD, but not that of local private groups, or many junior companies. Although there may be some understatement, that would apply elsewhere, and it is unlikely to distort the overall conclusion.

Quite apart from a chequered macroeconomic history, that has included rampant inflation and a volatile exchange rate regime, Brazil's main hindrances to inward investment in the mining industry have been the direct result of conscious policy. The restriction of foreign ownership of minerals exploitation below 50 per cent was a self inflicted wound. Few other countries now impose such restrictions, which were a widely used instrument of the natural resources nationalism of the 1970s. The activities of foreign companies can be adequately regulated through the fiscal system, and commercial policies without any recourse to controls on ownership, or even less on management, which stop the geese laying any eggs, golden or otherwise. National security is seldom served by letting mineral-rich ground lie fallow. Minerals in the ground are largely worthless until they are extracted and processed. Many companies and countries have found that their failure to develop a promising deposit expeditiously has left it beached on the shores of technical progress and eco-

Figure 4. Prices of minerals and metals



conomic change. All too often competing companies elsewhere, with different views or time horizons, will step into any breach, and the time for development will never be ripe. Certainly, developed mineral deposits can earn economic rents which can often be sizeable. It is often forgotten, however, that rents should be assessed over the economic life of a deposit after allowing for the full costs of extraction and processing. Those costs include those of closure and ultimate rehabilitation, as well as competitive rewards to all factors of production, including capital. Those factors additionally include the managerial and technical resources committed to ensure that the deposit is mined as efficiently and competitively as possible. Combinations of such resources in efficient companies, domestic or foreign, are in practice much scarcer than undeveloped mineral deposits. That good mining industry management is globally scarce makes Brazil's require-

ment for effective management to be exercised by the controlling Brazilian partner in a mining project unduly restrictive.

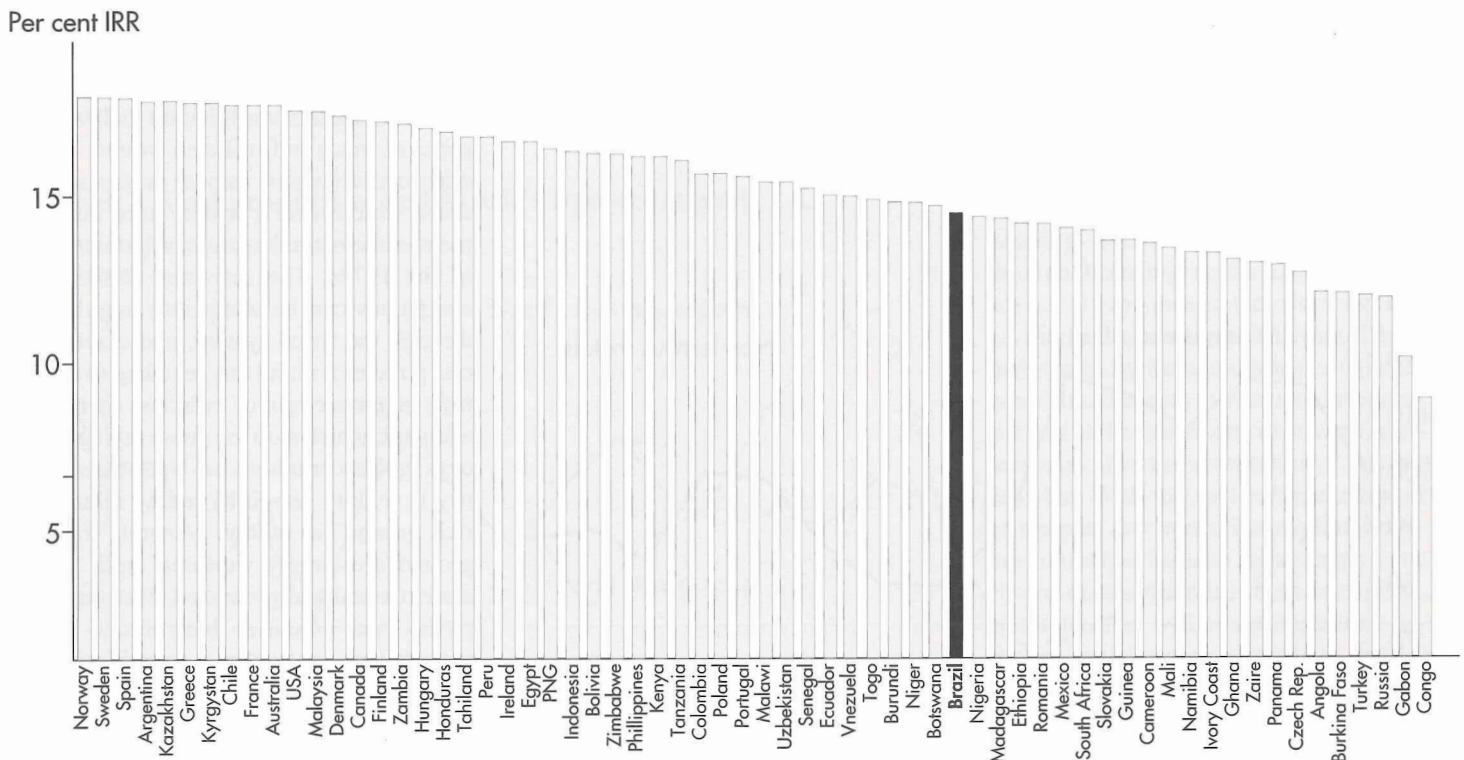
The abundance of deposits, both absolutely and relative to managerial resources, sets a limit on any country's ability to tax its mining industry. Domestic companies will compare the overall tax rates on mining with those paid both in other domestic activities, such as manufacturing and construction, and also with those they would incur on overseas investment. Foreign investors will compare international rates. The Seventeenth Century French Statesman, Colbert, described the art of taxation as consisting of "so plucking the goose as to obtain the largest amount of feathers with the least possible amount of hissing". Looking at the mining industry today, he would have added "and without the goose flying off elsewhere!". Mining companies pay regard to the full range of taxes of all types paid, and to effective rather than nominal rates.

They are concerned with the returns to their shareholders in their domestic jurisdictions, wherever those might be. Different tax regimes can dramatically affect relative rates of return, even for identical projects. That is shown by the next chart which subjects a real gold project to the tax systems of a wide range of countries.

The underlying pre tax cash flows for a specific open pit gold mine take account of capital expenditure, production volumes, metal prices and operating costs. The calculation of tax allows for different rates of profits tax, tax depreciation rates, withholding taxes, royalties, tax holidays or low initial rates, and any carry forward of losses. The comparisons are for the financial returns to a UK-based company, and would be slightly different for a company domiciled elsewhere.

As an important side issue, profits and income related taxes are economically superior to taxes based on production or

Figure 5. Post-tax rates of return with different tax regimes



turnover. Those are directly analogous to operating costs. They lower the attractiveness of marginal projects and reduce the size of economic reserves. That can lead to less investment, and in smaller and shorter lived mines, than would take place under alternative tax systems.

Brazil does not come out of the comparisons in the chart in a particularly favourable light. Indeed, the country's relative position is probably worse for non-gold projects. Many competing countries do not impose the royalties on other minerals that they levy on gold, whereas Brazilian royalties on other minerals are in some instances higher than on gold. The comparisons also take no account of Brazil's payroll taxes and social security charges which are amongst the world's highest. Certainly many factors other than the tax burden influence a project's overall rate of return, and hence the decisions on where and whether to invest. The tax system is, however, one of the very few variables that is totally within a government's control, and that can be swiftly altered.

One of the main reasons advanced for limiting foreign ownership and for production based rather than profits related taxes is that mining companies are otherwise difficult to control. It is asserted that tax inspectors are no match for corporate accountants, and that companies can manipulate where they earn their taxable profits to the host country's disadvantage. Both assertions may have been true in previous decades, but seldom, if ever, today. Personal computers and improved professional education have put paid to the first charge. The second was largely grounded in concerns about transfer pricing between local subsidiaries and their foreign parents. Where that occurred, it sprang from a different motive for overseas investment in resource projects than generally prevails today.

These changed motives also have a bearing on the earlier discussion about ownership and control. Typically, much investment in overseas mineral projects,

especially by North American companies, was to gain access to raw materials on preferential terms. Investments were closely linked to downstream processing plants and consumer industries overseas, usually in the investor's home country. Most of these links were broken by the nationalisations of the 1950s to 1970s, and by structural changes in global supply/demand patterns. Today's major mining companies are largely profit, rather than raw materials, seeking. They will invest wherever they can use their specific skills to achieve good financial returns for their shareholders. Not only does that eliminate the scope for transfer pricing, but it also emphasises that the mere existence of known or potential ore deposits is not an adequate inducement to invest. If the potential returns are unattractive, the mining companies can simply choose not to invest. That was often a luxury denied to their predecessors, who required raw materials.

Concluding comments

By the same token no country has to open up its minerals sector to foreign investment. It should, however, be fully aware of the potentially heavy costs involved in delaying the development of known mineral deposits and in restricting the role of foreign direct investment.

Brazil today has a large and well diversified minerals sector, which has achieved a degree of self sustaining growth. The pace of growth and its profitability are largely dictated by what happens in the global market place for minerals and metals, rather than by the domestic economy. Equally, Brazil has not attracted a share of global exploration and development expenditure in keeping with its known mineral resources, let alone with its vast untapped potential. If that is because of a conscious policy decision, all well and good. All too often, however, policies that are introduced for strictly domestic reasons, can have in-

ternational ramifications which are either overlooked, or are greatly underestimated. Regardless of their wishes, countries are effectively competing for limited supplies of capital and of managerial and technical expertise. Without indulging in senseless competitive leapfrogging to better the terms and conditions offered elsewhere, they can ensure that they keep with the mainstream rather than paddle their own way up a stagnant backwater. ■