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THE ROLE OF FOREIGN DIRECT INVESTMENT IN BRAZILIAN MINING

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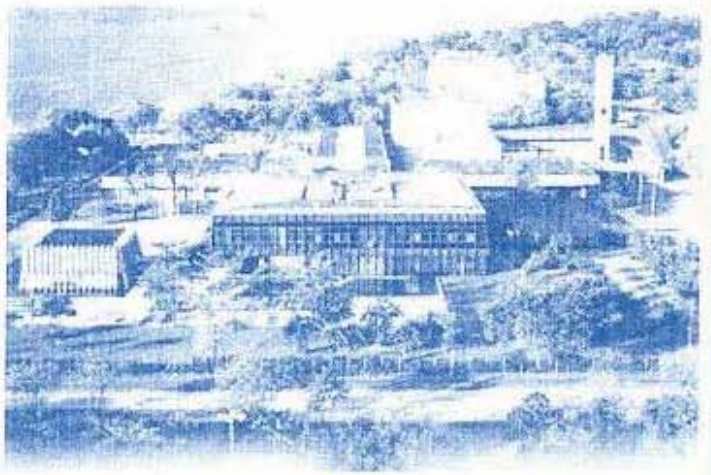

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RESUMO

Este trabalho trata de algumas das principais questões relativas ao papel que o investimento estrangeiro direto desempenhou na mineração brasileira nos últimos 20 anos. O texto sugere que a investigação das características e determinantes dos investimentos estrangeiros no Brasil, juntamente com um maior conhecimento da política nacional voltada para o setor mineral, representa um dos principais caminhos na direção de um maior entendimento das potencialidades do setor. Conclui também que a adoção de práticas de desenvolvimento sustentável e a promoção de inovações tecnológicas nacionais possam evitar o antigo "modelo de enclave" de desenvolvimento mineral.

Palavras-Chave: Indústria Mineral, Brasil, Investimento Estrangeiro Direto, Desenvolvimento Sustentável, Geografia Industrial.

ABSTRACT

This book tackles some of the main issues concerning the role of foreign direct investment in Brazilian mining during the past two decades. It suggests, among other things, that competition from other countries is reducing Brazilian attractiveness as an investment location. The investigation of the characteristics and determinants of foreign investment in Brazil, together with greater knowledge of the framework for mining laid down by the government, represents the main line of action in order to enhance Brazilian mining sector attractiviness. In the conclusion it is suggested that one interesting way to attract more investment into domestic mining is to comply with Sustainable Development practices and promote industrial upgrading together with greater and more positive social impacts, avoiding the old-fashioned "enclave model" of mining development.

Keywords: Mining Industry, Brazil, Foreign Direct Investment, Sustainable Development, International Business, Development Studies, Industrial Geography.

must be viewed as one type (among numerous others) of foreign investment. This is clear when undertaking studies regarding the consequences of privatisation (which is not the scope of this paper); the diversity of the foreign investment phenomena (and its typologies) will be better clarified in the remaining sections of this text when the importance of New Forms of Investment (NFI), of loans, of finance for the importation of equipment (or other needed products, technologies, services or resources), will be considered.

This text attempts to investigate some of the characteristics and determinants of foreign investment in Brazilian mining over the period between 1978 until 1998. Although the country's mining industry is an old and established economic activity, Brazil is not described as being a 'mining economy'[1]. Brazil is usually described as being an 'industrial economy'. However, it is recognised that a large part of its industry is based on the exploitation of natural resources. Of the natural resources, agribusiness is the most important in terms of its economic presence, but mining and its related activities (such as metallurgy and heavy-metallurgy, chemicals and petrochemicals) are also arguably very important for the national economy.

Brazil has traditionally ranked high in FDI flows into developing countries, for example: 5th in 1994 (US$ 3 billion), 4th in 1995 (US$ 4.8 bi), 2nd in 1996 (US$ 9.5 bi). In 1996 the Brazilian economy absorbed around 2.7% of total world direct investment. This corresponds to around half its share in total world direct investment flows observed in the early 1970s but around three times as much as its participation in the late 1980s (see Table 1). However, our main concern in this text is to know the importance of FDI in mining and to answer basic questions

[1] Auty (1995: 183, 184) writes that "The mineral economies are defined by Nankani (1979) as those developing countries which generate at least 40 per cent of their export and 10 per cent of their GDP from minerals". This author also indicates that there are two main types of mineral economies, i.e., the "oil exporters" (e.g. Ecuador and Venezuela), and the "ore exporters" (e.g. Bolivia, Chile and Peru).

such as: "Do increased FDI flows have a positive impact on the sector's trade and technological performance?" and "Is there a renewed wave of FDI for mining in Brazil in the 1990s?"

To link issues of foreign investment and mining in Brazil we have to consider the following range of inter-related issues: (a) the general role of FDI in Less Developed Countries-LDCs, (b) the general role of FDI in mining, (c) the impacts that FDI has generated over trade, and (d) the impacts of FDI over technology. The discussion of these issues will then allow us to form specific hypotheses to be examined.

Table 1 - Total World FDI and Brazil's Share, 1970-1996

Period	Brazil/Total World FDI (%)	Total World FDI (US$ billion)
1970 - 1975	5.09	19.85
1976 - 1980	6.29	43.26
1981 - 1985	4.38	47.98
1986 - 1990	1.20	169.66
1991 - 1995	1.32	245.70
1996	2.72	346.80

Source: UNCTAD, World Investment Report [US$ 1995 constant values].

The discussions on foreign investment in Brazil takes us to consider some related issues such as 'portfolio investment'. This is relevant in order to try to understand some of the most important characteristics of foreign investment in Brazil. This is also particularly relevant for discussions concentrating on the period since the beginning of the 1990s when it is noticed a situation of "increasing portfolio diversification by foreign firms and institutional investors" (Baumann, 1998: 2). With regards to Portfolio Investment Flows-PIF, "the opening up of the [Brazilian] economy to international capital flows had a turning-point in 1991 [as the result of the policy changes of 1991], represented basically by Annex IV to Resolution 1289/87 which allowed foreign investors to operate in domestic stock exchanges, coupled to larger facilities to attract foreign resources via bonuses, notes and other means[4] ..." (Baumann op cit, p. 7).

Tables 3, 4, 5 and 6 provides evidence of how much change the main sectors of the Brazilian economy underwent during the 1990s, and the extent with which they are controlled by national private capital, foreign capital, and Brazilian State capital - which provide data for discussions concerning where international capital is being invested (assets), and the proportion of these investments as compared to local capital (private and State), i.e. the "tri-pé"[5] by sector in Brazil. In some sectors - such as transport equipment and auto-industry, metal products, machinery and electrical and electronic goods, Information Technology (IT), pharmaceuticals - (MNEs), play a *leading role*, determining most of the value-added and taking the decisions regarding investment; whereas in another group of sectors - such as food and beverages and commodities -

Sweden), CASE and CATERPILLAR (from USA), LIEBHERR and SIEMENS (from Germany).

[4] The first bond issuance's were made by large State-owned firms, such as PETROBRAS, CVRD and BNDES. In 1991 they corresponded to 56% of total issuance's authorised by the Central Bank. By 1993 that share had already been reduced to 19%.

[5] For information on the "tri-pé" or the "triple alliance" see Evans (1979, 1982, 1983, 1985).

MNEs play a *supporting role*, often operating in association with local firms. One important feature for understanding business arrangements in Brazil is to contemplate how the economy is controlled by each of the members of the "tri-pé".

Table 3 - The "triplet" by sector in Brazil, 1993 (*)

	SECTORS	National	Foreign	State
	National Predominance			
1	Agro-industry (including animal raising)	100	0	0
2	Commerce, retailer (= "varejista")	100	0	0
3	Building and civil construction	100	0	0
4	Heavy building ("construção pesada")	100	0	0
5	Vehicle distribution	100	0	0
6	Clothes manufacturing ("confecções")	94	6	0
7	Heavy-metallurgy ("siderurgia")	94	6	0
8	Fertilisers	91	9	0
9	Wood and furniture	90	10	0
10	Textile	90	10	0
11	Commerce, wholesale (="atacadista")	81	19	0
12	Paper and cellulose	81	19	0
13	Supermarkets	75	25	0
14	Hotels	74	26	0
15	Transport services	73	1	26
16	Electro-electronics	67	33	0
17	Non-metallic minerals	67	33	0
18	Food	63	37	0
19	Transport materials	49	44	7
20	Metallurgy	49	44	7
	Foreign Predominance			
1	Auto-industry & parts	6	94	0
2	Hygiene, sanitary and cleaning products	10	90	0
3	Pharmaceuticals	23	77	0
4	I.T. ("informática")	32	67	1
5	Plastics and rubbers	41	59	0
6	Beverage and tobacco	45	55	0
7	Machines and equipments	44	56	0
8	Oil distribution	23	45	32
	State Predominance			
1	Public services and utilities	0	0	100
2	Chemicals and petrochemicals	23	11	66
3	Mining	31	6	63

Source: Exame ("Melhores e Maiores"), August 1994: 46.

(*): The participation (%) of state-owned enterprises (or the State), foreign, and national private capital in the main sectors of the Brazilian economy; considering the sales of the 20 largest corporations in each of the 31 listed sectors.

important sectors that until recently were state owned - mining and telecommunications. The state today holds significant stakes only in two areas, public services and chemicals & petrochemicals, and some relevant stakes in two other sectors: computer technologies (Information Technology-IT) and foreign commerce.

Table 6 - The "triplet" by sector in Brazil, 1997-1998 (*)

	SECTORS	National 1997 ; 1998	Foreign 1997 ; 1998	State 1997 ; 1998
	National Predominance			
1	Building and civil construction	97 ; 96	3 ; 4	0 ; 0
2	Transport services	96 ; 96	2 ; 4	2 ; 0
3	Beverages	85 ; 85	15 ; 15	0 ; 0
4	Clothing and textiles	87 ; 84	13 ; 16	0 ; 0
5	Mining	85 ; 83	12 ; 15	3 ; 2
6	Paper and cellulose	82 ; 82	18 ; 18	0 ; 0
7	Services	0 ; 78	0 ; 9	0 ; 13
8	Metallurgy [1]	76 ; 72	24 ; 28	0 ; 0
9	Construction material	71 ; 66	29 ; 34	0 ; 0
10	Commerce, retailer ("varejista")	74 ; 62	25 ; 37	1 ; 1
11	Commerce, wholesale [2]	47 ; 46	34 ; 35	19 ; 19
	Foreign Predominance			
1	Auto-industry and parts	5 ; 7	95 ; 93	0 ; 0
2	Hygiene, cleaning and sanitary	13 ; 11	87 ; 89	0 ; 0
3	Electro-electronics	52 ; 21	48 ; 79	0 ; 0
4	Telecomunications	2 ; 24	0 ; 75	98 ; 1
5	Pharmaceuticals	21 ; 25	79 ; 75	0 ; 0
6	Mechanical sector	55 ; 27	45 ; 73	0 ; 0
7	I.T. & computors ("informatica")	17 ; 19	81 ; 67	2 ; 14
8	Plastics and rubber	38 ; 37	62 ; 63	0 ; 0
9	Food	43 ; 44	57 ; 56	0 ; 0
	State Predominance			
1	Public services	10 ; 21	7 ; 14	83 ; 65
2	Chemicals and petrochemicals	22 ; 20	22 ; 25	56 ; 55

Source: Exame ("Melhores e Maiores"), June 1999: 11.

(*): Participation (in %) of the sales of the state, foreign and private national enterprises in the total sales of the largest enterprises whithin each of the listed sectors.

[1]: Includes metallurgy and heavy-metallurgy; [2]: Includes wholesale ("atacadista") and foreign commerce.

The importance of foreign participation is greater today in Brazil in a range of sectors. "Since 1995 it was noticed a growth in the participation of foreign enterprises and foreign players in the list of 550 largest companies registered in Brazil (including private and state companies): from 170 foreign companies in 1997 growing to 209 in 1998. Foreign participation today represents 42% of the largest companies in Brazil, the greatest participation level in all of the 26 years of "Melhores & Maiores" (*Exame*) records. To this numeric participation growth corresponds an even more impressive growth of the parcel in total sales of the largest 550 registered enterprises - foreign enterprises were responsible for 43.5% of sales in 1998, going beyond the 1975 historic record of 41.8%" (*Exame*, June 1999, p. 13-4).

The sectors with large (dominant) stakes under foreign control today in Brazil are auto-industry, hygiene (and cleaning and cosmetics), pharmaceutical, information technology, plastics and rubbers, food, and very importantly in recent years, electro-electronics, telecommunications, and mechanical industries. These last three sectors are probably going to influence very decisively the growth of foreign participation in other sectors with (still) minority foreign control such as metallurgy, commerce, textiles, beverages, building & construction materials, chemicals, and also mining. For a better understanding of future scenarios for foreign participation in the Brazilian market a comprehension of how and why foreign investment takes place is needed.

Considerations of how and why external investment happens, and one of its main agents - the multinationals[6] - must now be cited. Schoenberger (1989: 91) writes: "The study of multinational corporations came of age during the period of US dominance of an expanding global economy. In this context, explanations of the determinants of foreign direct investment -

[6] In this text we will use the terms Multinational Enterprises (MNEs), Multinational Corporations (MNCs) and Transnational Corporations (TNCs) interchangeably, with the same meaning.

why firms invest abroad - focused to a great extent on questions of market power. Firms moved abroad to exploit (or defend) their oligopolistic or 'ownership' advantages in foreign markets, including proprietary technology, greater resources and product differentiation (Caves, 1971, 1974, 1982; Dunning, 1971, 1974, 1981; Hymer, 1976; Kindleberger, 1970; Kindleberger and Audretsch, 1983; Vernon, 1966, 1974). Alternatively, it was argued that firms invest abroad to maximise efficiency by internalising trade within the firms (Buckley and Casson, 1976; Teece, 1981). Both lines of analysis implicitly suggest that direct investment will be oriented principally to major market areas, hence, in all likelihood, other developed countries".

Dunning (1993: 54-7) describes some of the reasons prompting firms to undertake FDI, and distinguishes between four main types of production financed by such investment activities, i.e. (a) natural resource seekers, (b) market seekers, (c) efficiency seekers, and (d) strategic asset or capability seekers. This same author (op cit, p. 142) also lists other related motives for FDI; and they are: for growth of markets; for the protection of a global competitive position (in the case of FDI in oligopolistic sectors); because of the availability of indigenous resources and capabilities; for the avoidance of cross-border transportation and other transfer costs; to sustain or advance a firm's competitive position; for the acquisition of technology and markets; and also, as one of the steps towards globalisation of business.

The development model used by Brazil in previous years, mainly since 1990-1991, has been one which is trying to promote greater international exposure and one where opening the economy had been one of the main priorities. However, this is now showing serious structural limitations. The overall growth of the national economy has recently shown signs of decline (with the R$ crisis of 1998-99) as the exposure to international markets has steadily grown, and that private investment did not (at least yet) bring all the benefits that were expected and predicted by most of those favourable to liberalisation and more liberal policies. Private investment is showing signs of

weakness and this is reflected in national and international bourses (with stock exchange fluctuations and instability). Greater understanding of 'how' and 'why' external investment take place will provide the basis for furthering our discussions.

The idea of the "triad" composed of the USA, the European Union, and Japan as the main markets for business activities and which invest and absorb the greater portion of international foreign investment is now more evident. Although this is really what happens - most investment in the world is originated and directed to the members of the *triad*[7] or to 'First World' countries - there is still some space for "emerging economies" to obtain a share of this available external capital. In Latin America, countries such as Argentina, Brazil and Mexico were relatively important in absorbing foreign investment, particularly during the last decade or so. In the specific case of Brazil it may be argued that the interests of external capital was directed according to the two main reasons already described above: (a) to exploit and/or defend oligopolistic or ownership advantages (including proprietary technology and its related matters such as brand name, use of equipment, etc.), and (b) to maximise efficiency by internalising trade within the firm.

The general role of FDI in LDCs is to promote and/or own or control productive ventures in LDCs (via MNEs operations and business links) that will bring economic rewards for the investors, i.e. by unlocking opportunities in the international and domestic markets (export-import[8]). As a consequence of this, business links between LDCs and the international economy are promoted (e.g. via access to capital resources and international capital movements). FDI will be placed in LDCs if there is some type of advantage to be exploited in these countries. For example, if there are (a) country-specific or locational advantages (e.g. such as iron-ore in Brazil), (b)

[7] UN, 1992 describes the dominant position of the developed countries as both sources of, and recipients of, FDI (and the special position of the 'Triad'). See also K. Ohmae, 1985.

[8] Trade characteristics will affect balance of payment issues.

industry- or market-specific advantages (e.g. the importance of the Brazilian metallurgical industry for Mercosur and South American broader industrial development), (c) firm-specific or technological advantages (e.g. as in the application of technology that is well developed by some MNE but is not produced by indigenous firms within the host-country domestic market[9]).

The effects that FDI exert over LDCs trade patterns (exports-imports) are diverse and include impacts over their own capacity to create or take advantage of market opportunities in the domestic (host country) productive sector. Extractive or industrial activities will progress (or not) depending on their comparative advantages in relation to prices, the labour market and also their supply-capacities and transport & distribution capabilities. Trade opportunities are intimately dependent on technology. The questions of "What are the major impacts that FDI has generated over trade?" and "What are the impacts that FDI has generated over technology?" are part of this discussion of the relationship between trade, FDI and technology (section 3 will extend a little more on these issues so that the influence and importance of FDI in Brazil is better understood).

How are economic activities arranged in Brazil and who is in control? There is a clear integration of some local industries with the 'MNEs/foreign capital' model of capital accumulation. This is very clear in some sectors, such as the auto-industry (already cited above as having a 'direct'/'leading' foreign participation). In other sectors, such as the mining industry this is not so obvious - and here it may be advocated an 'indirect'/'supporting' foreign participation through the provision of technology, machinery, equipment, loans, finance, contracts for the provision of part of the production, direct investment, etc. There are more complex relations between national and foreign capital in the latter cases (mentioned as *supporting foreign*

[9] For example: some specialist equipment to be used for controlling and/or mitigating impacts on the environment such as chemical pollution.

participation). The next section will consider the particular case of the mining sector.

3. THE SCALE OF FDI IN THE BRAZILIAN MINING SECTOR

3.1 First considerations

The main role of FDI in mining is to provide profit for investors via the production and trade of mineral commodities. There are four main reason stimulating FDI in mineral resources (apart from the obvious reason of the consumption needs of society). First, locational rigidities with regards to where minerals are found (the possession of mineral reserves). Second, the fact that by investing in a greater number of locations investors spread their risks and possibly maximise their conditions for promoting better levels of profit and/or by promoting greater competition (what would result in better allocation of resources and cost-minimisation). Third, the promotion of internalisation of operations via corporate control (which is supposed to reduce costs and promote greater security of supply and greater control over supply-chain management for downstream consumers). Fourth, technological issues, i.e. in cases where the provision of technology, engineering processes, equipment, etc. are essential for developing mining ventures, and where these technologies are only available through the development of businesses or agreements with foreign investors.

The general structure of FDI into Brazilian mining during the past decades is depicted in Table 7 where we may observe that despite the growth of the Value of Mineral Production in Brazil (the VPM-PMB[10]; considering the industry as a whole and including metallic minerals, non-metallic, gemstones, and also energy minerals such as oil, gas and coal), and also despite the growth in FDI in the Brazilian economy, there was no relevant growth in FDI specifically in mining. In fact, with respect to FDI

[10] VPM-PMB: Valor da Produção Mineral/Produção Mineral Brasileira.

and mining alone, a significant decline is noticed when the 1970s and early 1980s are compared with the 1990s. As for total FDI in Brazil in relation to GDP (b/a), 1975 and 1980 were important years, while from 1985 until 1995 there was a period of depression, and from 1996 on it was noticed another period where foreign inflows started to be a little more significant again.

Table 7 - Long-run evolution of FDI stock in Brazil and Brazilian mining (US$ million)

Year	GDP (a)	Total FDI (b)	FDI in mining (c)	VPM [1] (d)	(b)/(a) %	(c)/(b) %	(d)/(a) %	(c)/(d) %
1970	106,409	510	25.3	5,831	0.48	4.96	5.48	0.43
1975	137,272	2,700	66.7	5,200	1.97	2.47	3.79	1.28
1980	250,315	3,050	51.4	7,700	1.22	1.69	3.08	0.67
1985	210,844	1,348	21.0	11,100	0.64	1.56	5.26	0.19
1990	440,201	748	6.1	13,018	0.17	0.82	2.96	0.05
1995	717,164	3,285	10.6	13,539	0.46	0.32	1.89	0.06
1996	775,400	9,580	29.5	13,848	1.24	0.31	1.79	0.21
1997	805,700	17,864	12.4	14,600	2.22	0.07	1.81	0.08
1998	803,400	26,100	9.5	14,800	3.25	0.04	1.84	0.06
1999 (e)	800,000	21,500	10.0	15,000	2.69	0.05	1.87	0.07

Source: Arthur Andersen Langston Clark; *Brasil Mineral* (several issues); W. Baer (1995); Banco Central do Brasil (BACEN); R. Bielschowsky (1999); CEPAL/ECLAC (*Economic Survey of Latin America and The Caribbean 1995-1996* ; *Anuario Estadistico de América Latina y El Caribe 1996*); DNPM (see: www.dnpm.gov.br); The Economist Group (E.I.U.); FGV (*Conjuntura Econômica*); *Gazeta Mercantil*; Instituto de Relaciones Europeas - Latino Americanas (IRELA, Madrid); Inter-American Development Bank (IADB); L. A. C. Lago (1987); UNCTAD (*World Investment Report*); Instituto Brasileiro de Geografia e Estatística (IBGE).

[1]: VPM indicates the Value of Mineral Production of the Brazilian Mineral Industry (VPM-PMB).

Obs.: All values (GDP, total FDI, FDI in mining) are based on Constant 1995 US Dollars (using the USA consumer price index deflator, 1995 adjusted US$ IPC); FDI here is the 'conventional FDI' (see main text for explanation); Estimated (e) values for 1999.

As for the proportion of total FDI in Brazilian mining[11] in relation to total FDI in Brazil (c/b), it is very clear that investors were more interested in mining ventures in the 1970s and 1980s but for the 1990s mining got out of their "menu" (their portfolio) as other sectors (and other countries) proved to be more interesting. From 1990 onwards, this decline is very noticeable (reaching proportions between 0.04 to 0.07 for the 1997-1999 period). And even knowing that the VPM-PMB presented growth for the overall period between 1970 and 1998, the value of mining in relation to total Brazilian GDP (d/a) also showed a decline, with mining reducing its importance for the national economy from levels between 3 to 5% for the 1970-1985 period, going then to 2.96% in 1990, and then declining further to around 1.8% for the 1995-1998 period.

Total FDI in Brazilian mining as a proportion of value of production (c/d, see Table 7) was never too high, and recent data for 1997 and 1998 shows that this will probably remain at low levels (between 0.06% to 0.08%). It must be noticed that measuring the performance of the mining industry (or even of the Brazilian economy as a whole), by analysing the importance and levels of FDI is a tricky business as for Brazilian mining (and also for Brazil) FDI was not always the most important parameter. For example, taking 1980 as an example, it is known that FDI represented only 30% of total investments (i.e. % of total net inflow of capital resources into Brazil) during that year and the remaining 70% was due to debt, portfolio investments and other 'indirect' contractual arrangements (e.g. joint-ventures where capital was made available for importing equipment) and stock exchange operations. The 1990s show a similar pattern where FDI is just part (and definitively not the most important part) of total net capital inflows into Brazil.

FDI here is considered as the "conventional FDI" (as already mentioned before in section 1). In Table 7 one observation that is important to make is that from 1970 up until 1996 privatisation

[11] Total FDI in Brazilian mining considers here item "c" (FDI in mining Tabel 7) as total FDI in geological prospecting and mineral exploration & research.

was not an important element of FDI; this changed in 1997 when CVRD was privatised and the FDI value for this year include the privatisation of this major company. For total FDI in Brazil as a whole, mainly from 1995 onwards, FDI values grew significantly as privatisation was included in FDI accounts. As one of the most important examples of this large participation of privatisation in total FDI we may cite the year of 1998 that presented around US$ 26 billion of FDI thanks largely to the US$ 19 billion privatisation of telecommunications company TELEBRAS.

Dr. Juarez Fontana dos Santos (personal communication) considers that when studying investments and FDI in the Brazilian mining sector we must be very cautious about using the available data provided by the DNPM or any other source (including the mining companies themselves) as most information serve only as an indication of what may be taking place. "The DNPM make no distinction between risk investment (mineral prospecting and geological research) and investment in development and implantation of mines. The companies of the mining sector themselves help even further in making statistics even more confusing by considering as operational costs what should be considered as pre-investments risk costs". Dr. Francisco R. Chaves Fernandes (Economist from CETEM) also advance considerations concerning the problem in data collection and statistical analysis for the mining industry in Brazil (Fernandes, 1997).

One additional element of confusion is that the DNPM considers the entire mining industry when calculating the VPM-PMB but data on FDI is not collected at all (i.e. is not part of the *Anuário Mineral Brasileiro-AMB/Brazilian Mineral Yearbook*), or when it is collected, it usually considers only investments in the metallic sub-sector - not mentioning what goes on in other sub-sectors due to several circumstances, as e.g.: the oil & gas sector statistics are the 'monopoly' of PETROBRAS; the gemstones sector operates largely in the "underground" or 'non-official' (informal) sector; the non-metallic sector is mostly controlled by domestic players and it is also largely informal

with much activity for the construction sector being undertaken with no tight control; the water sector is only recently organising itself and statistics on water resources and water companies are inexistent in a long-term basis. Methodological problems are also another element of complication in understanding what goes on in the mining sector as data collection, when existent, was undertaken by different groups of people using different systems of accounting and diverse methodologies.

The FDI into Latin American mining for the past 10 years was more concentrated in copper & gold. The 'Andean countries' were the most important locations for these businesses, with Chile as its main representative. With respect specifically to Brazil, since 1990, mining has shown a general decline in total investments, mainly foreign (see Table 8), and also in mineral exploration (geological prospecting). Table 9 shows that "it was mainly Brazil which lost its attractiveness as an investment location. Traditionally by far the most important recipient of FDI inflows in the [Latin American] region, Brazil saw its share of these inflows dwindle to about 12% during 1991-1995" (Nunnenkamp, 1997: 54-5). Foreign agents decided to drastically reduce their investments due to a combination of six main factors described below.

Table 8 - Investments in mineral exploration and research in Brazil, 1982 – 1996
(in US$ 1,000 of 1996 and %)

Year	Investments by Brazilian private initiative	Investments by Brazilian SOEs	Foreign investments	Total investments
1982	94.751 ; 35.83%	75.878 ; 28.69%	93.805 ; 35.47%	264.434
1983	57.959 ; 35.85%	48.650 ; 30.09%	55.081 ; 34.06%	161.690
1984	69.198 ; 32.93%	43.420 ; 20.67%	97.486 ; 46.40%	210.104
1985	34.603 ; 23.70%	41.591 ; 28.49%	69.804 ; 47.81%	145.998
1986	50.059 ; 47.18%	17.859 ; 16.83%	38.189 ; 35.99%	106.107
1987	47.012 ; 29.21%	29.368 ; 18.25%	84.560 ; 52.54%	160.940
1988	56.661 ; 35.13%	40.372 ; 25.03%	64.262 ; 39.84%	161.295
1989	38.805 ; 35.24%	52.948 ; 48.08%	18.368 ; 16.68%	110.121
1990	20.509 ; 34.47%	33.831 ; 56.86%	05.162 ; 08.67%	059.502
1991	17.150 ; 32.29%	30.130 ; 56.73%	05.831 ; 10.98%	053.110
1992	23.013 ; 33.46%	35.205 ; 51.19%	10.559 ; 15.35%	068.777
1993	22.499 ; 33.99%	41.646 ; 62.92%	02.043 ; 03.09%	066.189
1994	20.796 ; 27.86%	43.877 ; 58.78%	09.972 ; 13.36%	074.645
1995	23.907 ; 31.50%	41.348 ; 54.49%	10.629 ; 14.01%	075.884
1996	16.211 ; 17.96%	44.482 ; 49.27%	29.587 ; 32.77%	090.279

Source: DNPM/SIPEM, by Fontana dos Santos.

Table 9 - FDI flows to major Latin American countries as a share of total flows to the region, 1980-1995 (in percentage)

1980 - 1985		1986 - 1990		1991 - 1995	
Brazil	33%	Mexico	29%	Mexico	27%
Mexico	22%	Brazil	15%	Argentina	17%
Argentina	9%	Argentina	10%	Brazil	12%
Colombia	8%	Colombia	5%	Chile	7%
Chile	4%	Chile	4%	Colombia	5%
Venezuela	2%	Venezuela	2%	Venezuela	4%
Others	22%	Others	36%	Others	28%

Source: UNCTAD, In: Nunnenkamp, 1997: 55.

First, the 1988 Constitutional restrictions worked as a disincentive for greater FDI flows into Brazil in a time when other countries such as Mexico, Argentina, Chile and Peru were promoting their mining sector in a more aggressive manner in order to attract greater levels of investment from abroad. Second, adding to this scenario there was also the problem of economic recession and high inflation in Brazil as the period

from 1988 up until 1994 was a very difficult one which also included political uncertainties. The election of Cardoso to the presidency brought some stability for Brazil as a whole, but the mining sector was not a priority of his government and major decisions concerning the role and future of mining were postponed. In 1995 the already mentioned Constitutional restrictions were abolished and a recovery for mining was expected, but this really never took place. The privatisation of CVRD in 1997 was another indication that the Government wanted to promote more private initiative participation; what actually happened was that CVRD changed to private hands, but apart from this ownership change, nothing else of much significance happened in the mining sector as a whole.

Third, with respect to taxation, Brazil has a complex system of Federal, state and municipal taxes including taxation over turnover (ICMS, COFINS/FINSOCIAL, PIS/PASEP, CFEM) and taxation over profits (CSOC, IRPJ, AEIR, ILL), which turns Brazil into a less competitive country according to the DNPM (Vale et al, 1992; Braz, 1993). The PPDSM (1994) suggests that Brazilian fiscal procedures should be simplified, as one of the main problems of the national taxation system is its large number of taxes and contributions, and also the lack of consistent public policy with respect to fiscal management. Fourth, adding to this complicated tax system we also have the case of demarcation of Amerindian reserves in the Amazon region: this brings a degree of uncertainty to mining as this reduces the areas available for mineral developments, and investors may perceive that this is limiting their abilities to find and produce new mines. Fifth, uncertainties relating to the regulation of "garimpeiro" activities also have the potential to affect the work of foreign investors and foreign companies as their measurements of 'risk' goes against Brazilian developments due to fears of losing good areas and large sections of land for informal miners.

Sixth, to complement our discussion of some of the main factors why foreign agents decided to reduce their investments in Brazil, it is always important to know that there are attractive

projects and attractive opportunities elsewhere. Brazil is certainly not as attractive for the development of mining ventures as it once was. Apart from the motives exposed above, the fact now is that more and more during the 1990s the most developed economies of the world are increasingly looking forward to develop businesses among themselves and also that mining is not a sector that is attracting much attention. Mining is also redirecting itself to more developed countries - with increasingly greater importance to Australia, Canada and the USA. The transition of communist USSR to capitalist Russia also affected world mining as Russia recently (mainly during the 1990-95 period) directed greater volumes of mineral commodities to the global and European markets (differently from the communist period when it absorbed most of its production domestically).

Reasons such as political risk and policy environment among LDCs - i.e. macroeconomic conditions, trade rights, foreign exchange rates, regulatory conditions (e.g. dealing with access to land, licensing criteria, mineral legislation, government royalty), fiscal environment (mainly with respect to the tax code, profit-related taxes and profit remittances), and institutional factors (for example, the support that key institutions such as the Ministry of Mines or the national Geological Survey can provide) - determine the degree with which one country's competitiveness compares with other countries. This is probably why, when observing where geological 'exploration & development programmes' expenditures were taking place, it was noticed that "from 1980 to 1989 some US$ 2.5 to US$ 3 billion per year was spent on exploration, with 85% to 90% coming from private sources. Of that sum, US$ 600 million was spent in Canada, US$ 560 m in Australia, US$ 360 m in the United States, US$ 300 m in Latin America, US$ 200 in Asia, US$ 180 m in South Africa, and US$ 100 m elsewhere" (E&Mj, 1994: 14). It is clear from this data that only three First World countries (Canada, Australia and USA) received around 50% of the total expenditures for the 1980-1989 period.

Tables 7, 8 and 9, by providing the volume and scale of foreign investment in Brazilian mining since the 1970s (and to an extent comparing this to other Latin American countries), together with Tables 10 and 11 and with textual information provided in this chapter, allow us to have a more comprehensive view of the state of investments in Brazilian mining in the past 20 years. This helps to explore issues relating to the qualitative and quantitative assessment of the scale of FDI in the Brazilian mining sector, i.e. the facts & prospects about FDI and Brazilian mining. This provides relevant indications concerning the main facts of FDI in Brazilian mining and also indicates main prospects for the future.

Table 10 - Investments in Brazilian mining, annual averages (US$ million and %) for investments in mineral research and geological prospecting

	1978-85 US$ m	1978-85 %	1986-89 US$ m	1986-90 %	1990-94 US$ m	1990-94 %	1995 US$ m	1995%
State [1]	36.7	27.39	34.7	56.51	34.1	37.23	40.1	54.41
Local [2]	45.9	34.25	20.6	33.55	46.8	51.09	23.2	31.48
Foreign	51.4	38.36	6.1	9.94	10.7	11.68	10.4	14.11
Total	134.0	100	61.4	100	91.6	100	73.7	100

Source: BNDES, 1997 (Relato Setorial n. 6/Área de Operações Industriais 2).

[1]: Brazilian State capital; [2]: Brazilian (national) private capital.

Table 11 - Investments in Brazilian mining, annual averages (US$ million) for investments in the implantation and expansion of mines, and mineral extraction and production

Period	1978-85	1986-89	1990-94	1995	1996
Total (*)	544.0	636.0	310.0	480.8	589.7

Source: BNDES, 1997 (Relato Setorial n. 6/Área de Operações Industriais 2).

(*): indicates the total of State, local and foreign capital.

In order to analyse the scale of FDI in the Brazilian mining sector we must recognise the distinction between (and the relevance of) investments in (a) mineral [geological] prospecting, i.e. *mineral exploration*, and (b) mineral [mining] production, i.e. *mineral exploitation*. The first will be conditioned mainly by the need (or not) to expand the 'reserve base' of mineral commodities. The second will be conditioned mainly to the levels of short-term consumption of mineral commodities. Of course these are inter-linked issues, but, for example, taking the case of iron ore in Brazil, there is no immediate need (or even medium-term need) to invest in mineral 'exploration' for the expansion of the reserve-base for this metal. However, there is a need to invest in mineral exploration for several other minerals.

This is due to the fact that large reserves are available for 'exploitation' of iron ore in Brazil, but several other minerals are in need of more research in order to *transform resources into reserves*. This 'transformation' of resources into reserves is highly dependent on the conditions of mineral trade and technology, and this includes considering the way international commodity markets work, the importance of some major stock and commodity exchanges and also the activities of MNEs. Supply, demand and prices of minerals all depend on these players and also on the way distribution systems, transportation and logistics are arranged, and which equipment, machinery and engineering processes are used.

The major impacts that FDI has generated over mineral trade resulted in, first, more developed trade structures, where the international commodity market is closely monitored (and to an extent controlled) by a few stock exchanges (such as, for example, the London Metal Echange-LME[12] in the UK, the Vancouver Stock Excahnge-VSE[13] and the Toronto Stock

[12] LME: http://www.lme.co.uk

[13] VSE: http://www.vse.com

Exchange-TSE[14] in Canada - all with significant international influence and power), and also a small number of MNEs (with market concentration usually stimulated by high degrees of integration in order to have greater control over prices and supply of minerals). Second, more developed trade and distribution systems of mineral resources where a greater number of mineral suppliers promoted wider options for the consumers of these resources. This was also one result of the impacts caused by FDI. Third, FDI has also led to increased reliance on foreign technology, equipment and machinery due to the closer relations between investors and host country players. Fourth, a certain preference for the promotion of "big business" due to foreign investment being mostly allocated to 'world class mineral deposits' which has as one of its main characteristics the condition to generate large-scale and high-volume production. The main results of these four impacts or consequences of FDI were basically that of cost reduction and greater control of supply for the purchase of most mineral commodities during the last 15 to 20 years.

The impacts that FDI has generated over technology are diverse and expressed in issues of: transportation and logistics; energy-use & process technology; geological and mineral resources evaluation methods; metallurgical processing; product research leading to 'differentiation'-'diversification' innovations and 'purpose-made'-'performance-built' products with advanced design technologies and/or the discovery of new uses and applications for a range of minerals. If a wider definition of technology is used, where it is included *project co-ordination and managerial "technologies"*, as e.g. with the use of sophisticated cash-flow studies, budgetary project management, industrial organisation tools, cost-benefit analysis and risk analysis, much more can be said about the influence of FDI in host and home countries.

[14] TSE: http://www.telenium.ca/TSE/index

Technological implications caused by FDI and also by other types of arrangements with foreign agents such as the acceptance of loans or joint-venture contracts that poses conditions on the use of equipment and engineering processes that need to be imported or need licensing (or that require some form of royalty payment) for the use of developed-country technologies and/or industrial systems which is something that typically affects industrial activities. One example is transportation and logistics use of imported conveyor-belt systems for carrying ores from mines to ports or loading areas; a second example is process technologies, such as the C.I.P. gold technology, that require a diverse range of specialised equipment that are not produced in Brazil (and if they are, their operations are usually controlled by MNEs). Several geological and mineral resources evaluation methods currently in use were originally developed in other countries, and are used to carry out work in Brazil (for example, those with American, Canadian, German, Swedish participation, and many metallurgical processing technologies require the importation of equipment).

Adding to this already complicated scenario we have the characteristics of the main international scenario for commodity investment - emphasising structural or other changes in the aluminium, iron & steel, and gold markets. In the case of aluminium a condition of "reverse migration" is noticed in the pattern of the aluminium industrial activities where investments are now in the 1990s (as opposed to the 1970s and 1980s) going preferably to more developed economies and away from less developed countries. In the case of the iron & steel sub-sectors, it is observed that more and more of these operations are to a greater extent subjected to what goes on with the auto-industry in Brazil, which is mainly a foreign-controlled industry, which dictates the amounts of steel to be used in their plants according to the plans of the international car markets. The case of gold is particularly sensitive due to the diminishing economic importance of this metal in recent years. Gold is losing much of its attractiveness for investors, the price is low, and several countries are selling (or planing to sell) large parts of their reserves accumulated in their Central Banks.

All this adds to the already slow pace of evolution of the mining sector in Brazil in the late 1980s and all through the 1990s, something that is apparent as "old" projects are now being referred as "new" projects (the case of Salobo Copper-Gold project in the Amazon region being a typical case of this "rejuvenating" process). With respect to the importance of the Amazon region for the future of mining in Brazil, one of the main location for new developments will certainly be that of the CVRD's "North System" where plans abound, both private and State, for the creation of new ventures in sub-sectors such as steel, aluminium, gold, copper and many others. All these activities will need large sums of money to be developed and foreign investment is considered to be essential for this "new stage" in Brazilian mining.

However, recent data by Bielschowsky (1999) indicates a continuity of the relatively small importance of foreign-owned mining in the Brazilian economy[15]. This author indicated that the share (%) of FDI stock for 1995 (for minerals & oil) was equivalent to only 1.1% of the total, and that the share of FDI flows into the minerals & oil sector was only of 1.6% for the 1996-97 period. When considering the share of the minerals & oil sector in the overall Brazilian fixed capital investment (as a % of GDP), a decline is observed from around 1.1% to 1.2% for the 1971-80 and 1981-89 periods to only around 0.5% for the 1990-94 and 1995-97 periods. The behaviour of MNEs is classified as "stagnant" for the 1995-98 period, and it is considered that the 1999-2003 period will be characterised by a situation of "lack of interest" when taking into account the expected participation of MNEs in Brazilian mining (although for the oil sub-sector it is expected "fast growth, possibly through partnerships with PETROBRAS" for the 1999-2003 period).

The low levels of foreign investment in Brazilian mining since 1990 were partially compensated by investments undertaken by

[15] Considered only on the basis of the importance of FDI for the 'extractive' sector; not including 'mining-related' activities and also not including loans and other forms of investment.

CVRD's transnational partners[16] for financing the expansion of *productive capacities*[17] in the country. This explains the continuing and even progressive importance of CVRD in maintaining (and even increasing) its high participation levels in the total Brazilian mineral production. The behaviour of CVRD alone may determine much of what can happen in Brazilian mining in the near and medium future (including considerations on the composition of investment and the distribution of power in domestic mining). The influence of CVRD and of the other major domestic iron-ore producers (MBR, SAMARCO, FERTECO, SAMITRI) is essential for understanding the role of foreign capital and trade of minerals in Brazil.

The influence and importance of foreign capital to raw materials concern directly with the commodity needs of investor's countries. Several commodities are traded internationally and this constitutes one of the oldest forms of business. The presence of money or loan capital ('credit') from foreign sources in the international mining industry show different patterns according to different periods. During the 1950s, for example, 'credit' capital from external sources and MNEs themselves were dominant in international mining. During the 1960s and 1970s, a period of *nationalisation*, foreign participation was not viewed as "ideal" in the raw materials industries from LDCs. The late 1970s and early 1980s was a period of transition and of acceptance of finance from abroad in most of the periphery. The 1980s showed the fragility of this process (of borrowing, of availability of international finance capital) when the debt crisis came to existence. The 1990s is searching for new forms of "adaptation" and "acceptance" (a new "contract" to be made) for 'credit' capital from abroad.

If we are going to answer the question: "Is there a renewed wave of FDI for mining in Brazil in the 1990s?", we must

[16] CVRD's *transnational partners* through portfolio investment, loans, minority holdings, mineral-supply contracts, agreements with equipment suppliers and suppliers of technological and/or engineering processing systems.

[17] But not research or risk investment.

consider answering "no". However, if we rephrase the question as: "Is there a willingness for a renewed wave of (*potential*) FDI for mining in Brazil?" - then the answer could be "yes", but mostly considering the oil & gas sub-sector and/or the "paramineral" sectors (e.g. environmental technologies). The times of panic of supply of the 1960s and 1970s[18] were important for developing international links for mining activities in Brazil. The transition period of the 1980s was, to an extent, a period of continuity of the foreign participation in the ventures undertaken during previous decades (and of strengthening of foreign participation in the iron-ore sub-sector). The no shortage times of the 1990s provides increased possibilities for furthering internationalisation of the most competitive sub-sectors. Liberalisation and privatisation of domestic productive sectors (even if the privatised companies fall under national control), is assumed to generate the appropriate conditions for a new wave of FDI in mining and mineral-related industries in Brazil[19].

While financial management in Brazil is very developed and to a great extent able to cope with the high degrees of complexity of the global market, industrial operations were usually considered to be "out of date", or "lagging behind" when compared with the standards of the developed world. Mainly since 1990 Brazil is undertaking (or attempting to) a process of "picking-up" and "modernisation" in order to tackle this problem of its relative backwardness in relation to its industrial and technological apparatus. Here resides great opportunities and risks for both domestic and foreign firms. As the domestic players working with their own (indigenous) technological capabilities are still not well positioned (or not well organised) to compete with international players, this indicates a trend towards a greater reliance on foreign participation in industrial activities. This participation is to be materialised through greater use of, for example, foreign suppliers of equipment, technology, engineering processes, quality programs, etc.

[18] As the 'Club of Rome' predicted a gloomy scenario for global shortages of resources.

[19] These issues will be furthered in section 3.4.

The perspectives for this in the national mining industry indicates that FDI may exert a greater impact over technology. Indications of this may be highlighted by analysing some important sub-sectors such as: (a) iron-ore, where improvements and greater participation of FDI are supposed to take place in transportation and logistics technology (in the management of the delivery of high-volume production), (b) bauxite-aluminium, with energy-use & process technology (in vertically integrated stages of production), (c) gold, with 'gold-specific' geological evaluation & metallurgical processing technologies (in gold producing operations of all sizes - but which will particularly impact more on medium-sized projects), (d) metallurgical products of steel and aluminium, with important impacts on product 'differentiation'-'diversification' and 'purpose-made'-'performance-built' technologies (in higher-value niche markets for higher-quality metal products requiring more complex and more advanced design technologies)[20].

The study of the scale of FDI in Brazilian mining allows us to discuss the ways by which FDI flows affected national trade and technological performance (the examination of the question: "Do increased FDI flows have a positive impact on the mining sector's trade and technological performance?"). The following sub-sections will examine these issues.

3.2 Trade performance

The performance of Brazilian trade (trade balance, imports-exports) points towards a relative greater importance for the commodities sector in the 1980s and the 1990s (even knowing that the mining sector is presenting a performance that is below expectations: even with relatively poor results and poor performance during most of the 1990s).

A trend analysis for Brazil is provided in Bielschowsky & Stumpo (1995: 162-3) where it is considered, among other

[20] Examples (case-studies) of these sub-sectors are provided in **section 5**.

things, that: "In the 1980s, TNCs contributed not only to the adverse trends observed in the country - low investment levels and relative technological backwardness - but also to the positive ones, especially those associated with the expansion of exports. In the 1990s, TNCs are taking a very active part in the adjustment process and are thereby reinforcing a trend that appears to be leading to the preservation and modernisation of Brazil's industrial complex. During the 1980s, when the approach taken was a fairly "passive" one, one of the basic factors was the increase in the proportion of total output, and especially of exports of manufactures, accounted for by the intermediate goods sectors - largely the result of a series of investments that were originally intended for the domestic market. These investments formed part of an investment cycle which begun in the mid-1970s and matured in the early 1980s. Foreign capital was a very active partner in these investments and played a leading role in the aluminium industry (ALCAN, ALCOA, BILLITON/SHELL) and a supporting one in petrochemicals (RHONE-POULENC, DOW CHEMICALS, DUPONT, BAYER, HOECHST), wood pulp (CHAMPION, ARACRUZ/BRITISH TOBACCO, CENIBRA/MITSUBISHI), and iron and steel (MANNESMAN and BELGO-MINEIRA, with Japanese investors in TUBARÃO and in USIMINAS)".

The changes that were partly promoted by the presence of foreign capital in Brazil are very clear when reading Machado (1989: 187), as this author provides two tables indicating the radical changes which occurred in the Brazilian exports structure for the mineral sector between 1943 and 1985 (see Tables 12 and 13). While quartz represented 42.3% of exports of the mining sector in 1943 (and iron-ore had almost no importance at all during that time), in 1985 iron ore was responsible for 87.6% of the total share of exported mineral commodities. These changes were largely directed by opportunities in the international market for iron ore - which in turn were stimulated by important inflows of foreign capital into this sub-sector in Brazil.

Table 12 - Brazilian exports of the mining sector in 1943, main minerals and participation (%) in the total exported

Mineral/Sub-sector	%
Quartz	42.3 %
Diamonds	23.7 %
Manganese	8.8 %
Gemstones	5.5 %
Iron ore	3.8 %
"Pig iron"	3.3 %
Mica	2.6 %
Coal	1.0 %
Rutile	1.0 %
Carbonates	0.6 %
Zirconium	0.3 %
Other minerals and ores	7.1 %

Source: Souza, 1944; In: Machado, 1989: 187.

Table 13 - Brazilian exports of the mining sector in 1985, main minerals and participation (%) in the total exported

Mineral/Sub-sector	%
Iron ore	87.6 %
Bauxite	5.1 %
Manganese	2.0 %
Gemstones	1.2 %
Kaolin	1.0 %
Magnesite	1.0 %
Other minerals and ores	2.7 %

Source: Machado, 1989: 187.

Trade performance is highly influenced by what Bartlett & Ghoshal (1989: 89; also in Dicken, 1992: 193-4) discuss as globally integrated structures, i.e. "some firms are now moving towards a globally integrated network structure in which increasingly specialised units [distributed, specialised resources and capabilities] world-wide are linked into an integrated network of operations[21] that enables them to achieve their multidimensional strategic objectives of efficiency, responsiveness, and innovation ... The strength of this configuration springs from its fundamental characteristics: dispersion, specialisation, and interdependence [with large

[21] Complex process of co-ordination and co-operation in an environment of shared decision making.

flows of components, products, resources, people and information among interdependent units]". This means that MNEs and other enterprises in general are now better organised, from a functional point of view, for foreign investment (what includes FDI).

However, for trade to achieve better performance, a clearer international institutional infrastructure is needed (e.g. with regards to legislation, country-company relations), and clearer policies and regulations for companies and governments. In an article concerning the growing interdependence between TNCs and government, for example, Stopford (1994: 53, 73-4) argued that "the rapid growth of *foreign direct investment* (FDI) has brought the transnational corporation centre-stage in the international political economy. FDI has significantly increased the economic interdependence of nations and has made key factors of production more mobile. To support the development of national capacity for intelligent bargaining and to provide some form of insurance against welfare and other shocks, the global economy needs a stronger international polity to foster greater clarity, consistency and credibility in policy development. Progress will only be made possible by strong States that understand the new competitive realities and that are prepared to develop the needed new resources. Markets alone are unlikely to assist those processes".

The effort of the Brazilian government in promoting a clearer legislative framework for trade was demonstrated in 1996 via Law 9279. This law brings Brazilian legislation into line with the Trade Related Aspects of Intellectual Property Rights-TRIPS, established by the World Trade Organisation-WTO. The law regulated rights and duties pertaining to intellectual and also industrial property via the granting of patents on inventions and utility models, registration of industrial designs, trade marks and innovations. Known as the Patents Law, it is supposed to foster innovation by securing a share in the economic gains derived from the exploitation of a patent. This will probably bring the trade performance of the mineral sector even closer to its technological performance.

3.3 Technological performance

Probably the greatest challenge for technological improvement in the performance of the mining and mineral-related sectors is that of environmental protection. Environmental protection challenges must take under consideration the interaction between the environment and mineral resources exploration, exploitation, use, recycling, energy consumption, pollution, etc. For this purpose a series of procedures can be followed, such as working within a framework that applies some "tools for environmental planning and management" (Sánchez, 1995: 157): such as Environmental Impact Assessment (EIA), Risk Assessment (RA), Environmental Auditing (EA), Environmental Management Systems (EMS), and Life Cycle Assessment (LCA). Warhurst (1995) points to those problems such as "pollution prevention" and "waste management" and argues that "pollution prevention *a priori* requires that change is made to either the technology or organisation of the production process, or both".

These changes in technology and/or organisation "requires, to differing degrees, the development of new technological and managerial capabilities within the firm, technological alliances with equipment suppliers and collaboration with R&D organisations ... the successful implementation of pollution prevention will require that regulatory approaches are underpinned by technology policy mechanisms designed both to stimulate technological innovation and best-practice in environmental management within firms, and to encourage the commercialisation and diffusion of these innovations across the boundaries of firms and nations" (Warhurst, 1995: 282).

Another important technological challenge to be tackled is that of increasing the geological knowledge of Brazilian territory. This challenge is to be promoted by technological and scientific activities that help increase geological-mineralogical knowledge and which promotes a better framework for mining activities (developing 'mineral resources' until their stage of 'mineral reserves' ready for extraction). Most developed countries are

prepared to finance these activities through the public sector. Brazil went through a phase when the public sector was more active in financing projects that were important for the natural resources sector, such as the well known case multidisciplinary RADAM[22] project (that included mining) which was set up in the early 1970s. The 1980s saw a relative "neglect" to most natural resources projects and in the 1990s projects are to a great extent dependent of external participation or foreign investment.

Due to the large land area of Brazil, the government and its specialised agencies has been always short of accurate information with respect to the resource potential of the national territory. For areas such as the Amazon - largely unpopulated and unknown, of difficult access - the government did not yet obtain the minimum information that is commonly considered necessary for national planning objectives, something essential to establish a long range planning programme to improve natural resource knowledge (including geological) and land use (including mining activities). This concern is supposed to be partially addressed through a high-tech mega-project that the Brazilian Government is promoting, the "Sistema de Vigilância da Amazônia-SIVAM" (the Amazon Surveillance System), designed to obtain multi-purpose monitoring of the entire Amazonian region, encompassing several activities - from detection of mineral resources, action of *garimpeiros* and mining companies, deforestation, biological resources (flora and fauna), and other activities such as identifying cocaine merchants operating illegal airstrips and working with drug distribution.

The SIVAM is counting with ERICSSON's 'Erieye Airbourne Early Warning and Control' system (knowned as ERIEYE or AEWC), which has been selected by Brazil for use in the Amazon region as a long-range and high-performance system that can be installed in relatively small commercial and/or military turbo-prop aircrafts. The system is able to detect small aircrafts at a range of up to 350 km. Five ERIEYE systems

[22] Radar Imagery Project in the Amazon Region (RADAM).

worth US$ 145 million have been ordered (in June 1997) for use in the SIVAM (www.ericsson.com).

Technological performance issues were dealt with Law 8661 of 1993. This law was designed to boost the technical capacity of Brazilian industrial enterprises through a project called Industrial Technological Development Programme-PDTI. The main provisions of this law are (a) to promote partial deduction of corporate investments in S&T from tax due, (b) promotion of technological management as an essential, non-transferable corporate activity, and (c) as an incentive to develop enterprises' own technology programmes with the contracting and participation of third parties (with priority being given to co-operation schemes between companies and R&D institutions). Fiscal incentives include a reduction of up to eight per cent on income tax due to the government for investment in R&D, and exemption from tax on industrial products, charges on machinery, equipment and other instruments purchased for use with R&D initiatives.

The impact of foreign firms in the Brazilian market is expected to show a strong pace of growth if a wider definition of technology is used, including managerial and/or environmental techniques, with intense use of project co-ordination and managerial "technologies", as e.g. with very detailed cash-flow analysis and studies, with budgetary project management, more advanced accountancy systems, new industrial organisation processes, cost-benefit analysis using complex mathematical models and advanced IT capabilities, use of ISO total quality systems management tools, and environmental technologies such as those dealing with waste, recycling and pollution. The increasing use of international "best-practice" standards is supposed to improve the competitiveness of Brazilian industry, to further its international integration and trade relations in world markets, and also to enlarge the share of foreign participation in the Brazilian domestic market (for more detailed information on some of these issues see Souza, 1995 and PwC, 1999).

4. THE REASONS FOR SHIFTS IN THE PATTERN OF FDI OVER THE PAST TWENTY YEARS

4.1 First considerations

The main purpose of this section is to outline the reasons for shifts in the pattern of FDI over the past twenty years, but in particular to pay attention to the role of regulatory changes that were introduced in 1988 and 1995. This means analysing FDI and Brazilian economic policy and uncovering their relationships.

We will start by providing a brief view of the international circumstances that affected mining since the 1960s. The 1960s and 1970s can be described as a period of "panic of supply" for mineral commodities. This is explained and was reflected partly by the nationalisation of mining in several countries (e.g. Mexico in 1961, Chile from 1965 to 1971, Zambia and Zaire in the late 1960s), and with this, the consequent creation of several State Owned Enterprises (SOEs) and certain "government arrangements" (or producer arrangements) such as the CIPEC[23] (this was established between Chile, Peru, Zaire and Zambia in 1967). These developments posed a degree of uncertainty to most of the 'free-market-oriented' countries of the First World, partly by the expectations caused by the predictions of the Club of Rome (regarding the quick depletion of several, if not most, non-renewable resources), partly by the effects of the energy crisis of 1973 and 1979.

One very important historical event in Latin America during the year of 1971, that would bring important consequences as how the region (and particularly its mining sector), was to be viewed internationally, was the nationalisation of foreign

[23] CIPEC: Conseil International des Pays Exportateurs de Cuivre.

copper-producing companies in Chile. The Chilean Government took-over these mining enterprises on the 12th of May that year. The nationalisation of the iron-ore industry in Venezuela (following the Chilean example), was another blow to the role of MNEs and FDI in Latin American mining. The 1980s was a period of transition (from nationalisation's to open markets), but also a period of declining commodity prices, a period of weakening bargaining power for commodity producers (even more for those LDCs with large debts). The 1980s were characteristically a period of 'structural adjustment', of debt re-negotiation, of reduced autonomy of the State for Third World countries under the directions of the IMF and the World Bank.

"From the mid 1980s onwards the process [of nationalisation and creation of SOEs] has been reversed. Existing mines have been privatised, mining codes liberalised, tax regimes made more accommodating and foreign investment welcomed. The accessible reserves have consequently expanded, particularly in Latin America. A country's legislative framework is, however, only one aspect of its accessibility [of resources for profitable mining]. The administrative system may be too chaotic or corrupt, or the political system too unstable to attract investment. Potentially profitable ore deposits will then languish as resources" (P. Crowson, In: *Mining Journal*, no. 8519, 1999: 10). The 1990s, as a consequence, is showing itself to be favourable to a situation of a renewed wave of FDI, a period of "no shortages" of commodities and "no shortages" of countries where to invest. Due to this, there is an extensive list of countries that "liberalised" their economies, their laws and their business activities.

Since 1995, when the Brazilian Government abolished the Constitutional restrictions imposed by the 1988 Constitution (restrictions related to foreign participation on mining), there is an expectation of increased interest by part of international investors. The 'Salobo Metais', a composition by CVRD with AAC, MITSUBISHI and IFC is expected to invest US$ 1.5 billion for the development of a copper-gold deposit in Pará state; RIO TINTO is expected to spend US$ 230 million in its new nickel

project at Serra da Fortaleza in Minas Gerais state; INCO from Canada will probably invest some US$ 200 million for a nickel mine; ECHO BAY (via SANTA ELINA) is expected to spend US$ 300 million for the development of gold mines in Mato Grosso and Goiás states. CVRD, RIO TINTO, and AAC are also expected to spend an additional US$ 500 million to guarantee expansion of its gold mines.

When the issue is FDI and economic policy, the main drive for furthering private investments and private initiative was the deregulation of the economy, with an increasingly more outward looking vein by actively seeking greater insertion into the world economy by welcoming private initiative. Reforms have been made (and other new projects are under consideration) to dynamise the economy and make it more efficient in order to allow it to be increasingly tied to world trade and global capital flows. The government had in the past decade dedicated efforts in order to re-examine and re-evaluate its activities with a view to change the way State institutions work. This has to a large extent been based on the provision of more attractive conditions for private investors to take advantage of opportunities within the national economy. And this was done to a good degree by promoting privatisation, and to some extent by exposing the economy to greater imports levels.

The increasing liberalisation of the economy has tried to combine efforts to keep inflation under control (and avoid devaluation of the currency), to keep high levels of international reserves, to best manage the balance of trade and not allow the external debt/GDP ratio to increase (which raises a concern of increased vulnerability to foreign forces). The macroeconomic planning was supposed to be one of the most important "fronts of control" of the economy. This also included (and still includes) cutbacks in public spending and export promotion as some of the ways by which the economy could be stabilised and prepare itself for achieving higher growth levels.

In order to tackle more systematically the issues relating to the reasons for shifts in the pattern of FDI over the past twenty

years this section will be divided into sub-sections dealing with government policy, and the specific cases of aluminium, gold, iron & steel, and energy sub-sectors.

4.2 Government policy

In the specific case of government policies for the mining industry, the most important reasons for changes and shifts in the patterns of FDI since the 1960s were: the 1967 Mining Code (Executive Law n. 227 dated February 28, 1967); the 1988 Constitution; the publication of the DNPM Development Plan of 1994 (PPDSM, 1994; the "Plano Plurianual para o Desenvolvimento do Setor Mineral"); the 1995 Constitutional Amendment number 6 (six)[24] (of 15th of August); the 1996 document "Mining in Brazil: Basic Information for the Investor" by the National Department of Mineral Production (DNPM, 1996); and, the 1997 privatisation of CVRD. These developments concentrate on the State's capacities to act on areas in which the main guidelines and priorities for developing and promoting the mining sector in Brazil were put to practice. The consequences of these policies were mainly characterised by two distinct and opposing commitments - to open up mining to foreign players (as in 1967), to restrict foreign players mining abilities (as in 1988), and again to open up mining (1995, 1996, to the present date).

It is important to view these issues listed above as part of a historical process that had been influenced by previous plans and government initiatives. More specifically, we refer to the 1972 Brazilian First National Plan for Development ("Primeiro Plano Nacional de Desenvolvimento", the PND-I), and the Decree of 11th October 1972 ("Decreto-Lei" n. 1240) through which the government prepared the concession of incentives to export minerals that were abundant in Brazil. Another Decree ("Decreto" no. 71248 of 13th October 1972) instituted the incentives for the mining industry and for those industries that

[24] This Amendment revoked article 171 of the 1988 Constitution.

worked with the transformation (e.g. beneficiation) of primary mineral products that were scarce and needed in Brazil (promoting import-substitution within the mining industry), and hence trying to foster private initiative (national and foreign) to develop domestic mining so that importation of minerals could be reduced and national production increased.

The 1988 Brazilian Federal Constitution, in its Article 171, defines what is a "Brazilian enterprise of national capital" as that one where "the effective control is under the direct or indirect titularity of individuals residents in Brazil or under control of enterprises regulated by internal public rights, understanding the effective control of enterprises the titularity of the majority voting capital and also the exercise of decision power to administrate its activities". The relevance of this Art. 171 is due to the fact that in Article 176 (first paragraph), is said that: "The research and extraction of mineral resources will only take place with the authorisation of the Government of Brazil, respecting the national interest, by Brazilians or Brazilian enterprise of national capital ...". It was then prohibited the research and extraction of minerals by Brazilian enterprises of foreign capital - what was similar to the 1937 Brazilian Constitution from the time of the "Estado Novo".

The 1988 Constitution also was responsible for extinguishing the 'IUM mineral tax' ("Imposto Único sobre Minerais", or IUM)[25], that was substituted by the 'ICMS tax' ("Imposto sobre Circulação de Mercadorias e sobre Prestação de Serviços") according to Article 155. The main purpose of the IUM, a taxation exclusive for mining, was to link the economic activities directly to their origin, to their source. This was thought to bring about a series of advantages for the municipalities developing mining ventures, and for some local-state mining enterprises ("entidades estaduais de mineração"). The mining sector had in the past the conditions to monitor if its own tax [the IUM] was effective and if it was being channelled (or not) to the places where mining activities were located, e.g. through the provision of infrastructure or other types of incentives for the sector.

In the framework of the new legislation (from 1988 on), it is up to the government administration (state or municipal), at their discretion, to direct more (or less) resources to incentive (or not) the growth of the mineral sector. The power that was once embodied in the sector through the IUM (controlled by the Federal Government via the Senate, "Receita Federal" and Ministry of Mines) is now in the hands of administrative agents not directly linked to mining. With the promulgation of the 1988 Constitution the control of mineral taxation went from the Federal sphere (IUM) to the state sphere via the Conselho de Política Fazendária-CONFAZ. The most important incentives given directly to the mining sector by the Federal Government after 1988 were those including the exemption of Income Tax ("Imposto de Renda", IRPJ) for projects developed in the SUDENE and SUDAM regions, and the special incentive regime for the Programa Grande Carajás (PGC) in the states of Pará, Tocantins and Maranhão.

The cancellation of the IUM and the adoption of the ICMS meant that mining was now subjected to the same taxation system of all other economic activities, it was no more a 'special case'. The changes in the taxation system resulted in some observers considering that (see Melo, 1990)[26] "the high levels of taxation over Brazilian mining, that includes 53 taxes and other contributions, is considered one of the main reasons for the low interest of investors for this sector". One of the main concerns expressed by Melo (op cit) was that the IUM was a tax calculated over company results, and that the problem with the ICMS was that it is calculated over production - and this resulted in growth of what was collected by the government.

[25] The IUM was created by Law 4425 of 1964 (that also created the 'National Fund for Mining' or 'Fundo Nacional de Mineração', the FNMin).

[26] Melo, C. C. (1990) "Tributação e política cambial são desafios aos mineradores", *Minérios/Extração e Processamento*, v. 14, n. 160, p. 21-3 (June) [São Paulo: Publicações Industriais Brasileiras].

Braz (1993: 1-7) considered that with the elimination of the IUM and the inclusion of mining in the ICMS capacity, the 1988 Constitution considered the mining sector under the same taxation system of other national economic activities, what resulted was that, except for the case of the 'financial compensation tax' (Compensação Financeira pela Exploração de Recursos Minerais-CFEM), which is not particularly a major taxation burden, mining was not having a disadvantageous treatment when compared to other economic sectors. The matters of taxation inadequacy or confusing tax systems is not something specific to the mining sector, it affects the Brazilian economy as a whole.

We will now provide a view of the main taxes (Federal, state, municipal) that are applied to the mining sector in Brazil. This illustrates very clearly the main pieces of legislation that regulates mining sector activities and influences foreign players ventures and, as a result of this, their desirability to further participate with greater or smaller levels of FDI. As it may be seen, government policies in recent years could be divided into three main periods, the 1987-1988 period (when the new Constitution was being elaborated and written), the 1989-1994 period (of transition, marked by political turmoil and economic liberalisation), and the post-1995 period (that corresponds to the Fernando Henrique Cardoso presidency).

Taxation over turnover:

- ICMS: This is a state tax (value added tax). It is generated from operations of merchandise circulation and services. This tax is based on the principle of 'selectivity', i.e. it is applied according to local state policies (where local government can choose to charge more or less depending on the importance of the activity and in accordance to local priorities - a case by case approach for negotiations). The revenues generated via the ICMS have the following destination: 75% for the state collecting it, and 25% for the municipalities where

the corresponding activity was undertaken. The main rules for the ICMS were first established through the "Conselho de Política Fazendária" (CONFAZ), through the Convênio n. 66 of 14th December 1988.

- COFINS/FINSOCIAL: This 'Fund for Social Investment' is built by charging a 2% contribution over turnover of mining enterprises (basically with the intention to finance social security projects and programmes). Exports are exempt of this contribution.

The main legislation for the COFINS-FINSOCIAL is: Article 195 (I, paragraph 6) of the 1988 Constitution; Law 7611 of 1987; Law 7738 of 1989; Law 7787 of 1989; Law 7894 of 1989 (altered by Law 8147 of 1990); Law 8114 of 1990; Law 8177 of 1991; Law 8212 of 1991; Law ("Lei Complementar") n. 70 of 1991 (following orientation given in Article 155, paragraph 3, of the 1988 Constitution); Law 8398 of 1992; Decree-Law 1940 of 1982 (altered by Law 7611 of 1987 and Law 7787 of 1989 and by Decree-Law 2397 of 1987); Decree 1030 of 1993; Declaratory Act 01 of 1991; Normative Instruction of the Director of the Federal Revenue 03 of 1992; Declaratory Act CST-02 of 1992; Provisional Measure 725 of 1995; Normative Instruction 21 of 1995; Provisional Measure 1025 of 1995.

- PIS/PASEP: This 'Program for Social Insertion' tax, created in 1970, was originally designed to promote the welfare of employees in the context of the enterprise development. Moreover, 1988 Constitutional regulations gave a different purpose for the PIS, and now at least 40% of its resources should be used for finance programmes of economic development; while other attributions include providing an extra annual payment of one minimum salary for employees earning less than two minimum wages, and to finance unemployment benefits. The contributions for the PIS are of 0.65% of company turnover (total operational revenues).

The PIS-PASEP is regulated by: Law 7714 of 1988; Law 8177 of 1991; Law 8398 of 1992; Law 9004 of 1995; Decree-Law 2397 of 1987; Decree-Law 2445 of 1988 (altered by Decree-Law 2449 of 1988; Complementary Laws 07 and 08 of 1970; Normative Instruction of the Director of the Federal Revenue 03 of 1992; Normative Instruction of the Secretary of the Federal Revenue 21 of 1995; Declaratory Act CST-02 of 1992; Provisional Measure 725 of 1994; Provisional Measures 1025 and 1026 of 1995.

- CFEM: The 'Financial Contribution for the Exploration of Mineral Resources' tax, that was forecast in Article 20 (IX, first paragraph) of the 1988 Constitution, was regulated through Law 7990 of 28th December 1989, and complemented by Law 8001 of 13th March 1990. This legislation guarantees to the states and municipalities, and also to Federal administration agencies, the participation in the results of mineral exploration in the territories under their control via a 'financial compensation' system. The base for its calculation is net turnover[27] resulting from the sale of the mineral product under consideration (considered in its last stage of beneficiation, but before its industrial transformation). Different mineral commodities have different levels of taxation, and for example, gold have a 1% aliquot charge over net turnover (iron 2%, and aluminium 3%)[28].

The main legislation regulating the CFEM comprises of (apart from those already mentioned): Normative Instruction n. 83 of 23rd May 1990; Decree 01 of 11th January 1991; Decree

[27] Net turnover is calculated by subtracting from the total of sales revenues the amount of taxation due over the commercialisation of the mineral product, the expenses of transport and also expenses of insurance.

[28] Gold was treated in two different ways by the 1988 Constitution. It can be considered as (a) financial asset or an exchange instrument, when it is exclusively subjected to the Federal IOF tax, with a 1% charge over turnover, and also gold may be considered as (b) merchandise, when it is subject to the ICMS, of local state competence, regulated by Law 7766 of 1989.

n. 1 of 11th December 1991; Edict ("Portaria/DNPM") n. 6 of 6th July 1992; and

Law n. 8876 of 1994 (Article 3).

The resulting CFEM proceeds are distributed as follows: 65% for the mineral producing municipality, 23% for the state where production is being carried out, and 12% for the Federal Government (being shared among the DNPM and the Brazilian Federal Agency for the Environment-IBAMA).

Taxation over profits:

- CSOC: 'Social Contribution' tax. Was created to finance social security expenditures. Rates are equivalent to around 9% to 10% of profits (before income tax is paid).

The main legislation for CSOC: Law 1598 of 1977; Law 7689 of 1988 (altered by: Law 7856 of 1989; Law 7988 of 1989; Law 8034 of 1990; Law 8114 of 1990); Law 8383 of 1991; Law 8541 of 1995; Decree-Law 2413 of 1988 (altered by Law 7988 of 1989); Decree-Law 2426 of 1988 (altered by Law 7856 of 1989 and Law 8114 of 1990); Decree 85.450 of 1980 (revoked by Decree 1041 of 1994); Normative Instruction SRF 198 of 1988; Normative Instruction 38 (Departamento da Receita Federal) of 1991; Portaria 468 of 1991; Resolution of the Federal Senate 11 of 1995.

- IRPJ: 'Income Tax for Companies'. The basic working rate for this tax is of around 25% over 'taxable profit' ("lucro tributável"). These include mainly deductions relating to costs, indirect taxes, depreciation, amortisation, expenses with non-capitalised research, and "quota de exaustão real".

The main legislation for the IRPJ is: Law 7714 of 1988; Law 7988 of 1989; Law 8167 of 1991; Law 8034 of 1990; Law 8383

of 1991; Law 8541 of 1995; Decree-Law 2397 of 1987; Decree-Law 2413 of 1988 (altered by Law 7988 of 1989); Law 2426 of 1988 (altered by Law 7856 of 1989); Law 8114 of 1990; Decree 85450 of 1980 (revoked by Decree 1041 of 1994).

- AEIR: 'Additional local-state Income Tax'. The 1988 Constitution (Article 155, II) created this tax for the government of local states, and it reaches up to 5% over the income tax paid to the Federal Government for individuals, or up to 5% over profits for companies. This non-compulsory tax may be used as an instrument for fiscal incentive in order to attract new investments (and it is administered by the states locally, that determine its values from 0 up to 5%).

- ILL: 'Tax over Net Profits'. The shareholders, partners and owners of enterprises are subject to a taxation of 8% over net profits at the end of the legal year-base. This tax charged independently of profits being distributed or capitalised (it is not deductible from the income tax). Regulated by Law 7713 of 1988.

A study of the effects of taxation in the national mining sector was published by the DNPM (Vale et al, 1992), and concluded that with the changes promoted by the 1988 Constitution, the number of taxes over mining grew with the creation of the CFEM; and also that, even knowing of the methodological complications of proceeding international comparisons, when Brazil is compared to other countries it was considered that the level of taxation in Brazil was higher than that of other important mineral producing countries. The PPDSM (1994) also considers that taxation should not be a determining factor for mineral international competitiveness, be it in the form of excessively heavy taxation, be it in the form of excessively promoting the subsidisation of the industry. The PPDSM suggests that fiscal procedures should be simplified, both, for internal and for external (exports) transactions.

One of the main problems of the Brazilian taxation system is its large number of taxes and contributions. Not only this is a problem, but also the fact that several of these taxes were created with the intention to alleviate social problems (the revenues were supposed to be used for social matters). But in reality, what actually happens is that society at large is forgotten and the money from taxes is used to cover excess expenditures and to cover part of the national budget, which in principle is not what was supposed to happen. One of the main problems in Brazil is the lack of consistent public policy with what to do (and how to do) with respect to its fiscal management. This problem is complicated by the fact that most of the time Brazil is also subject to weaknesses in its monetary management as well. Public administration is always proving to be inefficient, complicated and confusing[29] - and this is reflected by the wealth of laws that are in several cases elaborated to change some previously determined course of action, usually harming organisation and stability.

Mackenzie (1998) considers that: "From the perspective of corporate investment strategy for mineral exploration and mine development, the ranges of mining tax criteria associated with the ten selected South American nations [Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, French Guyana, Guyana, Peru, Venezuela] are found to compare favourably with the eight selected Australian and Canadian jurisdictions [Northern Territory, Queensland, South Australia, Western Australia, British Columbia, Manitoba, Ontario, Quebec]. In fact, the stronger South American tax competitors - particularly Chile and Brazil - have a decided edge on their global rivals. Nevertheless, there is much scope for improving the efficiency of mining tax policies in South America, particularly with respect to the harmful consequences of regressive revenue-based royalties. For example, our analysis demonstrates that between 14% and 35% of the potentially economic deposits discovered

[29] In the case of mining, the lawyer William Freire points out that the Law 7990 of 1989 (that created the CFEM tax) is against Constitutional principles, violating its Article 155 (third paragraph); In Freire (1996: 222). The Government was able to create laws that go against Constitutional principles.

are rendered uneconomic by the existing South American tax systems. Realisation of the full economic potential of South America's great mineral wealth will require progressive reforms in mining taxation".

Competitiveness based on taxation positions can also be explained by the fact that several companies do not pay tax. Rose (1999: 3) explains this by citing that: "Major companies in Brazil who *pay all their taxes* are estimated to pay on average some 43% revenues in taxes and "contributions". But according to the head of the Federal Tax Service half of Brazil's 530 largest firms [what includes many MNEs] pay no tax at all - having either good lawyers, good accountants or political cover".

Since 1995 a number of changes have been introduced to the 1988 Constitution, reducing or eliminating several constraints to FDI flows into Brazil. Among the most important measures were: (a) suppression of the constitutional definition of Brazilian firms of domestic capital, so that all firms based in the country are to be considered domestic, with the important consequences of improving the access to official credit and are allowed to exploit mineral resources as well as electric power supply; (b) private firms are now allowed to participate in the distribution of urban gas; (c) private firms are allowed to participate in the oil industry, competing with PETROBRAS; (d) foreign firms are allowed to participate in domestic navigation; (e) the constitutional reform dropped the prohibition to private firms to participate in the telecommunication business; (f) differentiation between domestic and foreign-owned capital in the financial sector was eliminated, both: in terms of limits to the participation in financial institutions and for taxation purposes.

In light of constitutional rights, the legal framework for mining activity states that mineral resources may only be explored and mined under the authorisation or concession regimes stipulated by the Federal Government. This might be pursued by a Brazilian citizen or incorporated under the Brazilian law by a company which has its head office and administration in Brazil,

the mining product ownership being guaranteed to the concessionaire. Exploration will always be authorised for a fixed period. Exploration and mining concession may not be assigned or transferred, wholly or partially, without prior consent by the Federal Government (i.e. responsible for legislating on mineral deposits, mines, other mineral resources and metallurgy). The systems for exploration and exploitation of mineral resources and reserves in Brazil are defined and regulated by the 1967 Mining Code and its regulations and corresponding legislation, which still prevail with the amendments and innovations introduced by laws subsequent to the 1988 Constitution enactment.

One of the main changes promoted in mining in recent years was the publication of Law n. 9249 (of December 1995), which stipulates new legislation for income tax. The basic legislation on foreign capital in Brazil are consolidated in Law n. 4131 (of 1962) and Law n. 4390 (of 1964), and regulated by Decree 55762 of 1965 - complemented by the 1995 Law n. 9249 quoted above. For purpose of law, the concept of foreign capital is explained as assets, machinery and equipment received in Brazil from overseas, invested in the country and destined for producing assets and services. Financial or monetary resources brought into Brazil (for investment in the economic activity) belonging to individuals or companies whose holders reside abroad (or have their head office overseas), are also considered foreign capital. Because the definition of foreign capital is too broad, it is hard to evaluate its inflow and its importance for the domestic economy.

The creation of the National Privatisation Programme (PND) under Law n. 8031 of April 1990, constitutes one of the main steps towards promoting private investment in Brazil. Although the participation of foreign players was important in many sectors, and although President Cardoso started promoting the PND more aggressively from 1994 on, eager to see more inflow of capital into the Brazilian economy, the PND was not a success (considering foreign capital) for the mining sector. This was mainly due to the government's biggest trump card, which

was CVRD, and this enterprise did not attract the desired interest of foreign capital. Although the privatisation of CVRD has been an important landmark in the privatisation programme, the resulting revenue from its privatisation totalled around US$ 3.3 billion, or 19.1% of the total of US$ 17.3 billion collected via the PND from April 1990 until May 1997 (see Table 14), when CVRD went to local national players.

Table 14 - PND (*), share per sector and corresponding values in US$ billion (considering the period from April 1990 to May 1997 inclusive)

Sector	Share (%)	Value
Steel	32.2 %	5.56
Mining	19.1 %	3.30
Electricity	16.7 %	2.89
Petrochemicals	15.6 %	2.70
Railways	8.5 %	1.47
Fertilizers	2.4 %	0.42
Others	5.4 %	0.96
Total	100%	17.3

Source: BNDES, 1997; ANDIMA, 1997

(*) Brazilian Privatisation Programme (PND)

4.3 The case of aluminium

In the specific case of the aluminium sector in the 1990s it is considered that influx of FDI in Brazil was reduced due to the large amounts of aluminium sold by CIS (ex-USSR) to European and North American markets mainly until 1995 - which contributed as well to depressed international prices for the metal, which, in turn influenced several producers to drastically reduce or cancel new investments for the upgrading of the capacity of installations. Regarding FDI in the Brazilian mining industry, the main projects and interests for the members of the aluminium sector claim that the foundations of the aluminium industry are related with the economic availability of bauxite and of energy. This points now not for new projects in Brazil, but for new projects elsewhere, in other "more attractive" regions (USA today, for example, is considered a better environment for mining-related business than Brazil when considering new developments and projects for the aluminium industry).

The end of the 1990s is seeing a certain "migration" of industrial activities moving towards the opposite direction to that during the past three decades, i.e. now activities are going from the 'emerging markets' towards the 'developed countries' ["reverse migration"]. In the specific case of ALCOA, for example, it is observed that during the past few years (the years of the 1990s) this company has directed its investments to the European region (e.g. Hungary, Italy, and more recently Spain). Several European countries are able today to produce energy at lower prices than several emerging market countries (including Brazil). Bauxite, in the case of the European countries, is usually bought from Africa (e.g. Guinea). It is also relevant to remember that between 1991 and 1995 the ex-USSR was selling off a large amount of mineral commodities and mineral products (including bauxite, alumina and aluminium) that were in most cases bought by European countries. This made the European market very attractive for businesses in the aluminium sector during the 1990s (at least until 1995), promoting the enlargement of European industrial productive capacity in this sector.

The North American market is also gaining greater importance and one event which is certainly going to bring several changes to this market (and to the world market as well) is the merger agreement between ALCOA and REYNOLDS (Reynolds Metals Company) of August 18 (1999), where ALCOA will acquire all outstanding shares of REYNOLDS in a tax free stock-for-stock transaction. ALCOA president Mr. Alain J. P. Belda said that "The new company will be better positioned to address the ongoing globalisation of the metals industry and the new competitive landscape this is creating. It will permit the greater efficiencies and cost reductions required by an environment that has seen the lowest prices in many years for our commodity products"(www.alcoa.com/news/latest/merge).

Série Estudos e Documentos, Rio de Janeiro, n.46, 2000

4.4 The gold sub-sector

In the specific case of gold, the characteristics of recent investment plans in Brazilian mining is clearly showing a high degree of concentration on the preference for gold exploration (see Table 15 for main producers in 1996). The importance of this metal is confirmed by a number of foreign companies interested in developing business in this sector, e.g. BARRICK GOLD, ECHO BAY, NEWMONT, PLACER DOME, TECK Corporation. There is also interest by part of 'junior companies' from Canada and USA. Of the 15 companies listed in the Vancouver Stock Exchange (VSE) in Canada that have interests in Brazilian mining (see Table 16), ten are only interested in gold (and in two other cases gold interests are shared with diamond).

Table 15 - Main industrial gold producers in Brazil, 1996

Companies	Production (kg of gold)	% of industrial production
CVRD	18,010.00	38.12 %
Morro Velho-MMV/Anglo American (*)	7,400.00	15.66 %
Rio Paracatu-RPM/Rio Tinto (*)	5,150.00	10.90 %
Serra Grande/Crixas-MSG /Anglo American (*)	3,870.00	08.19 %
São Bento-SBM/Eldorado (*)	3,130.00	06.62 %
Jacobina-JMC/Anglo American (*)	1,318.00	02.79 %
Santa Elina-MSE/Echo Bay (*)	800.00	01.69 %
Others	7,568.00	16.03 %
Total industrial production (IP)	47,246.00	100 % (IP)
"Garimpo" production (GP) (**)	17,000.00	100 % (GP)
TOTAL (IP) + (GP)	64,246.00	100% (IP) + (GP)

(*) Indicates foreign control;
(**) Values for "garimpo" are estimated.

Source: *Brasil Mineral*/DNPM

Table 16 - Listed companies in the Vancouver Stock Exchange with interests in Brazil, 1997 (in alphabetical order of company names)

	Company	Interests
1	America Mineral Fields Inc.	Diamonds
2	Canabrava Diamond Corporation	Diamonds
3	Consolidated Dencam Development Corp.	Gold
4	Deplet Resources Ltd.	Gold
5	Diagem International Corp.	Gold/Diamond
6	Econ Ventures Ltd.	Gold
7	Golden Palm Resources Ltd.	Gold
8	Highgrade Ventures Ltd.	Diamond/Gold
9	Lysander Gold Corporation	Gold
10	Madison Energy Corp.	Beryle/Feldspar/Columbite
11	Ourominas Minerals Inc.	Gold
12	Serena Resources Ltd.	Gold
13	South Duval Gold Corp.	Gold
14	Tapajos Gold Inc.	Gold
15	Vannessa Ventures Ltd.	Gold

Source: *Minério & Minerales*, 1997/Docegeo/Unicamp (http://www.vse.com).

Known gold reserves in Brazil are not impressive if compared with countries such as South Africa or the USA. However, this is the case due to lack of geological studies and surveys. This situation is mostly due to low levels of investment than to geological potential. 'Resources' may be extensive, but they are still largely unknown; they still need to be *transformed* into 'reserves'. This "transformation" is made with investment. Because CVRD is the company with years of accumulated geological knowledge of several parts of Brazil - due to the work undertaken by DOCEGEO (CVRD's subsidiary for mineral exploration), it is thought that most of 'proven resources' (= reserves) of gold are in the hands of this company. Probably CVRD controls today around 350 to 450 tonnes of gold

reserves. But if CVRD wishes to substantially increase its production - as it is said that the company's target for its gold production for the year 2000 is of 31 tonnes - and reach higher levels in the international ranking, much has still to be made to increase gold reserves.

Gold production in Brazil will have two main fronts for development in the next decade, (a) gold from the Amazonian region and/or (b) gold as a by-product of other ores. The case for gold exploitation from mines with other ores is really important to mention. As gold alone can be a riskier venture, companies will be more prepared to discover and exploit mines with two [or more] minerals. This is the case, for example, of developments such as the 'Salobo Project' in Pará state and the 'Chapada deposit' in Goiás. The Salobo project is a partnership between CVRD and MMV (the main shareholders of MMV are Banco Bozano-Simonsen and AAC). This is a business that is being researched in order to produce 8 tonnes of gold per year together with copper exploitation. The Chapada deposit is a partnership between Mineração Santa Elina (MSE) and the Canadian company Echo Bay Mines (EBM) in order to study the viability of production of copper associated with gold. This deposit could produce, per year, 60 thousand tonnes of copper concentrate and 6 tonnes of gold.

4.5 Iron & steel sub-sector

The iron & steel sub-sector represent very well the relationship between productive capacities, the domestic market and international capital. The large integrated groups that produce steel in Brazil, i.e. CSN, USIMINAS, CST, COSIPA, AÇOMINAS, COSIGUA, BELGO-MINEIRA, ACESITA and MANNESMAN (listed in decreasing order of importance considering their participation in total productive capacities for the 1991-95 period), even if only subjected to minority direct foreign participation in their ownership structure[30], e.g. 6.7% of

[30] *Apart from MANNESMAN that is under majority German control.*

CSN belongs to Citybank, 18.5% of USIMINAS is under Nippon's control from Japan. CST has 10.3% of its shares under Japanese control and other 1.6% belongs to California Steel, BELGO-MINEIRA has 9.28% under direct control of foreign shareholders (see Table 17), they are mainly manufacturers of steel products that have a high share of their production destined to the auto-industry and auto-parts sector in Brazil (which is mainly foreign-owned) or to export markets. The auto-industry in Brazil is mainly represented by FIAT, FORD, GENERAL MOTORS, VOLKSWAGEN, MERCEDES-BENS, VOLVO and SCANIA. The domestic consumption of steel in Brazil is highly conditioned to the needs of these MNEs and to their business activities and strategies.

Table 17 - Companies of the steel sector in Brazil - shareholding structure, 1997

Company	Shareholders
CSN	-Grupo Vicunha (13.9%) -Previ (*) (10.9%) -Bradesco (10.9%) -CBS (10%) -Docenave (9.9%) -Clube de Investimentos CSN (9.5%) -Citybank (6.7%) -Itau (1.8%) -Emasa (1.1%) -Others (25.3%)
USIMINAS	-Nippon Usiminas (18.5%) -Clube de Investimentos e Caixa Empreg. Usiminas (18.1%) -CVRD (15.5%) -Previ (*) (15%) -Valia (7.7%) -Distribuidores de Aço (5.1%) -Camargo Corrêa (4.3%) -Others (15.8%)
CST	-ACESITA (29.3%) -CVRD (22.7%) -Japanese Shareholders (10.3%) -Funssest/CIEST - Clube de Empregados (3.4%) -California Steel (1.6%) -Others (32.7%)

Source: Brasil Mineral.

(*): Previ: Caixa de Previdência dos Funcionários do Banco do Brasil.

(**): Sistel: Fundação Telebrás Seguridade Social.

(***): Petros: Fundação Petrobras de Seguridade Social.

Table 17 - Companies of the steel sector in Brazil - shareholding structure, 1997 (cont.)

Company	Shareholders
COSIPA	-USIMINAS (49.8%) -Clube de Investimentos Empregados Cosipa-CIEC (13.5%) -Bozano (12.4%) -Brastubo (11.9%) -Fundação Cosipa Seguridade Social-FEMCO (5.2%) -INDA (4.1%) -Others (3.1%)
AÇOMINAS	-Clube Particip. Acionária dos Empreg. da Açominas-CEA (19.98%) -Cia. Mineira Particip. Industr. e Comerc.-CMPIC (17.17%) -Agropecuária Senhor do Bonfim (10%) -Banco de Crédito Nacional (10%) -Banco Crédito Real de Minas Gerais (9.89%) -Aços Villares (6.21%) -Açominas-Ações em Tesouraria (5.62%) -Banco do Estado de Minas Gerais (5.06%) -CVRD/Docenave (5%) -Banco Real (3.8%) -União Comércio e Participações (2.55%) -Others (4.72%)
COSIGUA	-Grupo Gerdau (100%)
BELGO-MINEIRA	-SIDARFIN S.A. (19.72%) -Previ (*) (10.69%) -ARBED S.A. (10.64%) -Grupo Bradesco (7.7%) -Centrus (7.3%) -Assoc. Benef. Empreg. Belgo-Mineira-ABEBM (5.1%) -Assoc. Assist. Belgo-Mineira-AABM (4.5%) -Other national shareholders (25.07%) -Other foreign shareholders (9.28%)
ACESITA	-Previ (*) (23.94%) -Sistel (**) (16.16%) -Petros (***) (8.19%) -Previ-Banerj (2.31%) -Inst. Segurd. Social Correios e Telégr.-ISSCT (1.26%) -Real Grandeza Fundação Prev. Assit. Social-RGFPAS (1.25%) -Clube Investimentos Empreg. Acesita-CIGA (0.04%) -Others (45.95%)
MANNESMANN	-Mannesmannrören-Werke AG (76%) -Others (24%)

Source: Brasil Mineral

(*): Previ: Caixa de Previdência dos Funcionários do Banco do Brasil.

(**): Sistel: Fundação Telebrás Seguridade Social.

(***): Petros: Fundação Petrobrás de Seguridade Social.

The most important change in the steel and metallurgical sector was its privatisation between 1991[31] and 1993 under the National Privatisation Programme (PND). Through the PND the Brazilian Government transferred eight steel companies to private owners. They were: USIMINAS, COSINOR, AÇOS FINOS PIRATINI, CST, ACESITA, CSN, COSIPA, and AÇOMINAS, which represented around 70% of total domestic production capacity. Privatisation, in the words of the government, was termed *decentralised ownership in the steel sector*. The resulting scenario of this decentralisation of ownership is shown in Table 18. Decentralisation of ownership, productivity and profitability gains, and also the promotion of private businesses (by taking the State out of these activities), is what the Government aimed for. The Government also had similar plans for the mining industry (what was indicated by the privatisation of CVRD).

Table 18 - The Decentralisation of ownership of the steel sector in Brazil - shareholder structure after privatisation (after September 1993)

Shareholders	Per cent holdings
Financial Institutions	28%
Steel Sector Groups	18%
Employees	16%
Foreign Investors	9%
Pension Funds	8%
Domestic Investors	8%
Clients	7%
Suppliers	6%

Source: BNDES

Table 18 shows that as a result of decentralisation of ownership, foreign investors now control (directly) around 9% of holdings (after September 1993). However, it is difficult to know the real dimension and real importance of foreign capital after the changes promoted by privatisation as there is also an

[31] *The privatisation of the steel sector really started in 1988; but it is a convention to consider the year of 1991 because it was only from then on (starting with USIMINAS) that the most important companies were privatised.*

indirect participation of foreign capital through financial institutions, the steel sector itself, clients, and suppliers.

CSN exemplifies very well the new stage of foreign participation in the metallurgical industry in Brazil. In July 1997, for example, CSN began the construction of a 230 megawatt co-generation thermoelectric power plant at the Presidente Vargas Steelworks. The plant will be powered by gas which is produced as a by-product of the steel production process that is currently being burned off into the atmosphere and lost. The cost of the plant was budgeted as being around US$ 300 million and is supposed to begin operations by December 1999. The plant represents an important step towards CSN's energy self-sufficiency since it will be responsible for generating approximately 50% of the steel mill's estimated energy requirements by the year 2000. SIEMENS A. G. of Germany and SIEMENS Ltda. of Brazil are constructing the power plant on a turn key basis.

Another example of this 'new stage of foreign participation' is CSN. This Brazilian steel producer announced in May 26 (1998) the formation of a new company called GALVASUD to be formed as the result of joint efforts between CSN (51% stake) and THYSSEN (Thyssen Krupp Stahl A. G. of Germany with a 49% stake). The primary objective of this new company is to supply the automotive sector (destined for the production of automobile chassis) in Brazil and also other MERCOSUL countries. The project will require investments totalling more than US$ 250 million, with industrial plants installed in Rio de Janeiro state and operations scheduled to begin in the year 2000. The new company will operate a hot dip steel galvanising line, as well as units for the production of blanks (pre-cut sheets of different formats). GALVASUD will also utilise latest generation laser welding technology developed by THYSSEN[32].

[32] A strategic alliance between CSN and THYSSEN began in 1997 with the signing of a technology assistance contract in the field of tin plate for the packaging industry.

4.6 FDI and the energy sector

The search for raw materials and their markets is not something simple and straightforward, several factors have to be taken into consideration - and one important factor is that relating to energy (power use) as studied by Furtado & Suslick (1995) and by Suslick & Proença (1995). They refer to some of the major changes that have occurred in the metals industry in the LDCs over the past 25 years. This period allows for the evaluation of the impact of the energy crisis and the changes in the pattern of economic growth, associated with changes in energy and metal production and consumption profile in the developing and developed countries.

LDCs and developed countries depict (up until 1995) a clear divergent pattern after the two oil-shocks (1973-74 and 1979-80) when the intensity of energy is analysed. These groups of countries reacted in quite different ways after the impacts caused by the two oil shocks. The LDCs followed the track of using technologies that were *energy intensive*, while the more developed countries took an opposite approach, i.e. towards the use of technologies less intensive and less demanding in the use of energy[33]. This unevenness in the energy consumption between developed and less developed countries have to be considered for the understanding future trends relating to trade, finance, environmental issues, the use of technology, and also, with possible repercussion in all these aspects - FDI.

This cited unevenness in the types of approaches relating to energy systems (the different modes for considering industrial energy use) will result in a diverse pattern of power (energy, electricity) production and use (the amount generated and its levels of consumption for mineral-commodity production). This refers to one relatively new type (more recent in its appearance) of uneven development among countries when considering the production modes and technologies of the industrial sectors.

[33] Studies of this kind are open to issues of competitiveness analysis.

This unevenness in relation to 'energy systems' means that developed countries are producing and using new methods and new technologies (what comes with more modern equipment) for raw materials exploration, exploitation and processing. New methods that are less demanding with regards to energy consumption.

The less developed countries (LDCs) are, in several cases, still using older methods for raw materials exploration, exploitation and processing - which implies the use of older technologies (more demanding in energy consumption). Richer countries were able to improve and modernise their industrial processes, systems, technologies, while poorer countries need more "support" for acquiring or renewing their processes, equipment and industrial apparatus. This "support" could come in the form of FDI in the productive sector - for the promotion of industrial modernisation and updating. It seems that since 1996-1997 industries in Brazil are trying to improve their operations (general infrastructure, engineering and technology) and their energy systems, and that greater foreign participation is taking place in this renewal & upgrading process. In sub-section 5.3 the case of ALCAN is quoted together with its activities and plans to improve its energy usage productivity. The case of ALUMAR (jointly owned by ALCOA and BILLITON), is also mentioned.

The Brazilian Ministry of Mines and Energy (MME) produced a study of the 'Chacarteristics of the Brazilian Energy Development' for the 1970-1998 period and concluded that "The Electrical Sector more than quintupled its installed generation capacity during the 1970-1998 period. In December 1998 it had 65.2 GW in operation (including auto producers) proportional to 91% hydraulic generation and 9% thermal and nuclear generation. The installed hydraulic generation capacity of 56.8 GW, as of 31st-Dec.-1998 represented approximately 22% of Brazil's total potential hydraulics". During the period between the 1970s until 1992 a growth-trend was noticed in the participation of the energy-intensive industries (in the consumption of industrial energy). "A great part of this growth

was a consequence of the Metallurgy expansion, which targeted the external market (the export of steel, ferroalloys and aluminium, from 1980 to 1992, increased from 2.3 to approximately 13 million tonnes). " Since 1995-1996, although, "Brazil is placing a higher value on its own industrial products with less energy consumption" (http://www.mme.gov.br/Sen/dadhist/CARAC, 5 pages).

4.7 Closing remarks

When evaluating the performance of the Brazilian mining industry over the past 20 to 25 years, it is seen that the industry underperformed (even knowing that in general terms it grew). This underperformance is considered to have taken place as growth was not at the level that could be achieved if a clear mining policy was in operation: i.e. a 'plan'; one that not only needed to be a written & documented (as it was), but also that could be implemented in practice. Until the 1988 Constitution was published, the objectives of Brazilian mining were to *promote intense and immediate use of known mineral resources and the enlargement of the knowledge related to the national mineral/geological resource-base*. These objectives were not fully accomplished. The opening up of mining to private initiative (national and foreign), during the period before 1988, did not show the desired results; and the new Constitution, by promoting changes that to a certain degree restricted foreign participation and "nationalised" mining (what lasted until 1995), brought an even more confusing environment, making it more complicated to established global objectives for the adoption of a mining policy framework that could work more coherently with the needs of the domestic economy. This brought up a period of reduced FDI.

The 1990s can be seen as a period of preparation for a renewed wave of foreign investment and participation. MNEs and foreign investors are now building (or trying to build) a better and more organised framework to work in a much friendlier environment where there could be the return of the 'FDI model' with denationalisation/privatisation. The reconstructed

environment of the world economy with the presence and regulation of the WTO, the Uruguay Round of GATT, and several countries competing with each other for shares of global investment proposes to work towards building up this friendly environment and under a multilateral framework for FDI in a "consensus-building process" (see Brewer & Young, 1995). In order for Brazil to succeed in obtaining higher levels of FDI inflows, it is now possible to argue that domestic regulatory changes and national economic policy will have to follow more and more the changes promoted at the global level.

5. THE CONTRIBUTION OF SHIFTS IN FDI TO THE SECTOR'S DEVELOPMENT

5.1 Opening *remarks*

In order to provide concrete evidence for the discussion on the contribution of shifts in FDI to the mining sector's development, we will expand on those four issues cited at the end of section 3.1 (the 'First considerations' on the scale of FDI in the Brazilian mining sector). This will contribute towards a better understanding of the issues of capital goods imports, indigenous technological development and export performance (which will be considered in this section). These four main case studies are:

a. Iron ore and transportation and logistics technology.

b. Bauxite-alumina-aluminium and energy use and process technology.

c. Gold and advanced metallurgical processing technologies.

d. The metallurgy of aluminium and steel for cans.

5.2 Iron ore and transportation and logistics technology

The case of Minerações Brasileiras Reunidas (MBR), the second largest producer of iron-ore in Brazil (only after CVRD) is a good example of the importance of better transportation systems and logistic technologies. MBR is going through a phase of new investments in these areas in order to enhance its productivity. The main objective is to produce more with greater efficiency on the delivery side of its mines. These plans are important now in a time when some of MBR's mines are heading towards exhaustion and new mines are being brought

into operation. There are plans for investing around US$ 360 million during the 1998-2009 period and this includes investing in a complex system of transport facilities - from mine to processing plants, then to railway, and from there to port facilities and installations.

Nowadays MBR produces around 26 million tonnes per year of processed ores and their plans are to reach levels of 32 million tonnes per year in the year 2004. This will have to be made during a period of 'transition' from old mines with declining reserves to the new mines already under development. The Águas Claras and Mutuca mines are giving way to new mines such as Tamanduá and Capitão do Mato, while the already established mines of Pico and Capão Xavier are going to continue to be important producers. The new installations at Vargem Grande are being built for mineral treatment (expected to be completed by 2001 or 2002), and while the Mutuca mine is going to resume its reserves, the site will still be used for mineral processing (mainly for ores originated from Capão Xavier).

These changes are being made not only due to geological conditions but they are also included in the strategic plan for transportation and logistics of MBR. Nowadays the ore produced in Pico mine is directed to the Andaime Terminal, where it is then directed to the Ferrovia do Aço Railway. The production from Águas Claras mine is delivered from its own terminal (which is to be closed soon). The production from Mutuca mine flows from a third terminal called Olhos D'água. In the near future all the ore produced in Pico and Vargem Grande mines will be delivered via the Andaime Terminal, whilst only the production from Capão Xavier mine will use the Olhos D'água Terminal. This will bring important logistical gains, as the distances of transportation will be reduced and the Ferrovia do Aço Railway will be used more extensively (which will bring more economical benefits).

For many years the transportation grid and systems that were in use posed a degree of constraint to MBR production

and operations. Because of the need to change, MBR started to depend on the support of the company MRS Logística (that operates the local railway grid) and is also investing in order to upgrade the operational conditions of local rail transports (improving the regularity of ore flows from mine to port). Because MBR does not operate a single mine, but a complex of mines located in different areas, transportation and logistics have to be well planned and well integrated in a way that transport costs can minimise total operational costs. MRS Logística is being successful in bringing down tariff costs due to its more efficient use of the rail grid.

This is also a reason why MBR is building the Vargem Grande treatment plant near the Pico mine (located only around 4 kilometres from the Andaime Terminal). This is all part of the new structure of transportation that will also include long distance transportation of ore by conveyor belts between mines, mineral processing plants and railway terminals. New plans for transportation and logistics started mainly as a result of the successful 1996 bid of US$ 980 million by MBR in gaining the rights for operating the Southeast grid of the 'Rede Ferroviária Federal' (RFFSA). MRS Logística was then created in order to control this local grid of rail operations (MBR is a shareholder of this enterprise controlling around 33% of its capital). These are the main reasons behind recent improvements and new investment plans in the transportation and logistics area - that will bring more efficient channels for the distribution of ores (unprocessed and processed) within the Minas Gerais, São Paulo and Rio de Janeiro states.

MBR is part of the CAEMI Group (CAEMI Mineração e Metalurgia S.A.) and it also has Japanese shareholders. The new plans and new investments can be attributed to recent changes in the shareholding structure which ended by promoting a new managerial structure whereby the Japanese shareholders now have a stronger position in the destiny of MBR. These changes have been taking place since 1997 when MITSUI acquired 40% of the shares of CAEMI and provided around US$ 290 million for new investments and for covering

short-term outstanding debts. It can be said that the greater Japanese participation in CAEMI will promote the strengthening of MBR not only by improving its transportation system but also by bringing into Brazil new technologies and new equipment to support these new plans and improvements.

5.3 Bauxite-alumina-aluminium and energy use and process technology

The case of ALCAN is relevant for understanding the relations between foreign capital and industrial operations in Brazil. Recent changes in ALCAN are bringing into Brazil new concepts for managing the aluminium industry such as Full Business Potential (FBP) and Economic Value Added (EVA). The FBP is a process where it is possible to better understand the procedures to be adopted in order to maximise the return in invested capital based on operational and non-operational criteria. Among these we have 'operational excellency', 'new technologies' and 'client satisfaction'. The EVA concept consists of financial measures for business management - what it aims to bring is greater security in the decision-making process of companies when dealing with the use of capital and also by building the path for a permanent growth of financial results.

The Economic Value Added (EVA) is being advocated as a good performance measurement system, as it encourages managers to act as owners (motivated by EVA-based bonus payments). EVA refers to the amount of earning generated above and beyond the cost of the invested capital used to generate those earnings. The rational is that it is supposed to encourage investments in, for example, R&D and training. This is the case as R&D and training are to be classed as 'investments' instead of being traditionally treated as 'expenses'. This helps businesses to encourage long-term performance (as investments are being made in strategic areas with a longer timescale).

In accordance with these new procedures for tackling businesses, the new objectives for the aluminium operations of ALCAN in Brazil - for primary aluminium, packaging, laminated products - competitiveness will depend to a great extent on new supply of energy for the Ouro Preto factory (in order to make viable the primary aluminium operations as a competitive source of metal for ALCAN Brazil). Other targets for ALCAN in Brazil are to continually improve its sources and its energy supply providers; and to consider to operate and manage its own energy generators; and to participate in consortiums to provide extra electrical energy, and also to improve the engineering of its smelters in order to reduce energy consumption and increase working productivity.

The competitiveness of the aluminium sector is highly dependent on the availability, price and performance offered by its bauxite mines and also electric energy. *Minérios/Minerales* (vol. 18, n. 210, April 1996, p. 33) state that "the cost of energy utilised in the production of aluminium was of US$ 14/mwh in 1980, and this figure increased to US$ 27/mwh in 1989". BNDES data indicated that the price of energy for the 1990-1994 period (for the Northeast and Southeast regions of Brazil) oscillated between 26 and 30 US$/mwh, what is superior to the world average and affected negatively the competitiveness of companies of the aluminium sector.

When considering the effects of energy prices over production, there is an important distinction to be made, as the North region of Brazil (the Amazonia) still has an advantageous position compared to the rest of the country. The average price of electric energy in the North is of 10 US$/mwh. The power (electric energy) provided for the Amazonian region is supplied by TUCURUI via ELETRONORTE, that allows for a tariff benefit to be conceded to the companies of the region through long-term contracts that will expire in the year 2004. The aluminium sector enterprises in this region - ALBRAS (51% CVRD and 49% Japanese investors via NIPPON) and ALUMAR (joint-venture between ALCOA and BILLITON) - all take advantage of these contracts.

ALCAN does not benefit from this lower price as its industrial plants are not in the Amazon region: four are in the Southeast (one in Ouro Preto, Minas Gerais state, and three in São Paulo state: Mauá, Pindamonhangaba, and Utinga), and one is in the Northeast region in Aratu, Bahia state. Although paying higher prices for its energy needs, ALCAN is still investing in Brazil and its 1998 investments were divided as follows: US$ 124 thousand in technological research, US$ 169 million in expansion of productive capacity, US$ 5,101 million for the acquisition of equipment, and US$ 4,355 million in environmental projects. This illustrates the commitment of ALCAN in further developing and improving process technologies in its industrial plants.

Improvements in ALCAN's technological systems & processes are under way in order to enhance productivity and expand production volumes. Main efforts are being directed to process controls and automation, to cold mill lamination (cold rolling equipment), recycling and refusion (melting of scrap material), and to the preparation of aluminium plate (flat-rolled products). This involves also a closer relationship with equipment suppliers (e.g. German SIEMENS, Swedish Asea Brown Boveri-ABB, Austrian EBNER) and with other ALCAN plants around the world (e.g. North American plants such as Logan and Oswego in USA). This allows for new technologies to be implemented in ALCAN Brazil.

The case of BILLITON from the UK is also interesting. BILLITON holds interests in the ALUMAR refining & smelting complex (through its Brazilian branch Billiton Metais S.A.). The ALUMAR facility is an integrated alumina refinery and aluminium smelter complex located close to the city of São Luis in the Northeast of Brazil. ALUMAR has a number of competitive advantages, including a power (energy) contract which is linked to the LME price for aluminium, and also has a generally low labour costs structure and energy efficient smelters that use state-of-the-art technology. BILLITON operates ALUMAR together with ALCOA (which provides technical and managerial services). This joint-venture was

formed to build the ALUMAR facility which started production in 1984.

The ALUMAR alumina refinery is owned by ALCOA (54%), BILLITON (36%), and ALCAN (10%). The ALUMAR aluminium smelter is owned by ALCOA (53.66%) and BILLITON (46.34%). Each member of the consortium finances and supplies its own raw materials and receives its proportionate share of production, which is then marketed independently. The refinery was originally designed with a capacity of 500,000 tonnes per annum of alumina and, since 1984, the capacity has more than doubled. With respect to technology it is important here to point out that the ALUMAR smelter has 608 pots - whose design is based on ALCOA'a technology - with total production capacity of 365,000 tonnes per annum (the smelter produces aluminium mainly in the form of ingots for export).

5.4 Gold and advanced metallurgical processing technologies

In the case of technologically-advanced productive processes we may mention the case of CVRD's Fazenda Brasileiro mine in Bahia state. The metallurgical process and the plant used in this mine "was planned to recover gold from *primary ore* by the hydrometallurgical 'carbon-in-pulp' (C. I. P.) process with an expected recovery index of 90%. The first-stage gravimetric cycle comprises crushing and milling, followed by cycloning and jigging. After this stage the mill product (80% of bulk volume) is directed to the thickener and its underflow (50% solids) is pumped to pre-aeration and cyanide solution addition tanks. The gold in solution and the pulp resulting from leaching are pumped into carbon tanks for the gold adsorption stage. Gold-enriched carbon goes to a desorption (elution) unit. The impregnated solution is then pumped to electrolytic cells and than the gold is electro-deposited on steel wool cathodes which are removed from the cells when saturated. Saturated cathodes are acid washed in order to dissolve impurities. The concentrate obtained is filtered, dried and melted in induction

furnaces. The gold bullion is afterwards sent to refineries" (Victorasso et al 1991: 9).

As CVRD is investing in more sophisticated industrial processes, as in the case of the North American C.I.P. process, this requires more investment in industrial automation (and this is exemplified in the case of the controlled addition of cyanide solutions undertaken in *real-time*). This clearly indicates that the organised (formal) sector of Brazilian mining is promoting more advanced solutions for their operations and that there will probably be more opportunities for suppliers of these cited mining and metallurgical operational systems. The 1990s are showing a general decline in informal gold mining and the pursuit of qualified industrial mining.

It is important to remember that informal ("garimpeiro") gold production in Brazil is declining. And this is happening partly because the 'easy-to-find' and 'easy-to-exploit' gold deposits are more and more something of the past. Nowadays the mineral deposits that are available are those that are profitable when using industrial operations and plants for their recovery. Mineral deposits can no longer be exploited by primitive processes of 'no' or 'low' technology (as it happens with the "garimpo"). The low gold prices are another stimulus for the organised industrial mining that have to find more advanced systems and processes for mineral exploitation (that are more competitive and with greater operational efficiency). This requires up-to-date technologies and equipment.

As the primitive production of "garimpo" is declining in Brazil, and at a time when gold prices are also declining, it is still possible to increase production when companies use modern technologies. This is the case of Rio Paracatu Mineração (RPM) in Minas Gerais states, a company of the Rio Tinto group (UK-Australia). RPM was able to increase its gold production from 4959 kg in 1997 to 5544 kg in 1998, and this was possible by using the most modern technologies in gold exploitation and processing.

Another case where technology was one of the main factors for increasing production is that of São Bento Mineração (SBM) in Minas Gerais state. SBM belongs to Eldorado Gold Corporation from North America and its Brazilian operation includes an underground mine and a processing plant with a range of processes including comminution of rocks, flotation, and even an advanced bacteriological oxidisation process designed specially for gold production. For this type of mining to be possible, a high level of investment in equipment, infrastructure, engineering and environmental planning is required. In 1998 alone it was invested in SBM around US$ 303,000 in geological research, US$ 1,368,000 in expansion of mine capacity, US$ 2,062,000 with new equipment, US$ 3,828,000 with infrastructure, and US$ 164,000 with environmental projects. SBM produced 2999 kg of gold in 1997 and 3527 kg in 1998.

5.5 The metallurgy of aluminium and steel for cans[34]

For a specific study on the importance of aluminium and steel sub-sector in Brazil we will consider the use of these metallurgical products in the fabrication of cans for the soft-drink and beer (beverages) sector in Brazil. The beverage sector also use other materials as drinks 'containers' (e.g. bottles made of glass and polyethylene terephthalate-PET), however we will concentrate our attention on aluminium and flandres sheets - used to produce aluminium and steel cans. In Brazil and in South America the use of aluminium cans is greater than those made of steel (similarly to the North American market). In Europe and Japan the use of steel for can fabrication is greater than North and South America.

[34] I would like to thank the manager of the Mining and Metallurgy sector of BNDES, Dr. Maria Lucia Amarante de Andrade for information on metallic beverage packaging; also important was conference information from *Aluminium South America 1999* (São Paulo, September 1-3; DMG Exhibition Group) and information from the Associação Brasileira do Aluminio-ABAL.

In the case of Brazil there is a high concentration of the supply of aluminium and steel sheets for the production of cans for beverages in general, and on the fabrication of cans for other uses. Using 1996 data (only for Brazil) the consumption of cans for beverages is around 6 billion cans (almost all of them aluminium made). The main domestic producers are ANC, BALL, CROWN CORK, LATASA, and METALIC. METALIC (with one producing plant) is the only producer of steel cans while all the others produce aluminium cans; ANC having three plants, BALL and CROWN CORK with two plants each, and LATASA with four industrial plants.

There are several aspects affecting the competitiveness of aluminium and steel cans, amongst them are: cost of technology, cost of raw materials, commercialisation and marketing, and recycling. If considering only raw materials, steel cans have an edge over aluminium cans due to the higher price of aluminium. But in most aspects, the preferred and more widely used material in Brazil is aluminium. One important indication of this preference for aluminium is the expansion of the ALCAN factory (producer of aluminium sheets for the packaging sector) in Pindamonhangaba in São Paulo state. ALCAN is in fact the only producer of aluminium for the packaging sector in Brazil (which produced 88 thousand tonnes of aluminium sheets in 1997). The production capacity of the ALCAN plant in Pindamonhangaba is being expanded from 150 thousand tonnes per year to 200 thousand t/y with "investments of US$ 350 million for the 1996-1999 period for expansion and modernisation" (*Brasil Mineral*, n. 171, 1999, p. 34).

With respect to the production of cans, this involves automated processes requiring large investments in machinery and high-performance equipment and technology. The estimated cost for producing one thousand cans in Brazil is something between US$ 65 to US$ 85 (with variations amongst the different producers). The production of modern two-piece metallic packaging for beverages (soft drinks, beers and carbonated drinks) started in 1990 in Brazil when REYNOLDS from USA opened the LATASA factory in Pouso Alegre in Minas

Gerais state. LATASA is an association between REYNOLDS (33.6%), BRADESCO (33.6%), J. P. MORGAN (11.8%), and the general public (21%). LATASA is the largest producer of cans for the beverage sector in South America with six factories, four in Brazil, one in Argentina and one in Chile (with total production capacity of 7.9 billion cans per year, and of this total 6.5 billion cans per year are produced only in Brazil).

The LATASA plants in Brazil are located in Pouso Alegre-MG (the first to be built, with a capacity to produce 2.4 billion cans per year), in Santa Cruz (Rio de Janeiro state, with 1.7 billion cans per year of capacity), Jacarei (São Paulo state, with yearly capacity of 1.6 billion cans), and Recife (Pernambuco state, production capacity of 750 million cans per year). In addition to these plants LATASA also developed a can recycling program, and operates since March 1996 the 'Centro de Refusão', a smelting plant in Pindamonhangaba-SP that recovers the metal contained in used cans and re-uses for newly fabricated cans. The initial capacity of this smelting plant was of 21 thousand tonnes per year of scrap metal from cans; the planned capacity is to reach 42 thousand tonnes per year of scrap metal recovery (what is equivalent to around 2.6 billion cans per year).

The remaining beverage can producers in Brazil have only one industrial plant and they are: American National Can-ANC, a subsidiary of PECHINEY, with a plant in Extrema in the state of Rio Grande do Sul which began operations in 1996 (with capacity of 2.2 billion cans per year); PETROPAR, a joint-venture with CROWN CORK, with a factory in Cabreúva in São Paulo state which began operations in 1996 (with productive capacity of 1.5 billion cans per year); LATAPACK BALL, a joint-venture between Mariani Group (BBM) and BALL METALS Corporation from USA, with a plant in the city of Jacarei-SP, which began operations in 1997 (with productive capacity of 1.5 billion cans per year); and METALIC, a company that belongs to the Steinbruch family (controlled by the VICUNHA Group) which counts on technical support from Companhia Siderurgica Nacional (CSN). METALIC operates an industrial plant in

Fortaleza, capital of Ceará state, and have the capacity to produce 700 million cans per year (it commenced in September 1997).

METALIC is the only one of these companies that works with steel cans. All the others opted for using aluminium. The predominance of aluminium is very clear as 94% of cans are made of this material while only 6% are made of steel. METALIC is also the only one of these companies that is predominantly Brazilian, but even though, it uses technology contracted through PAC International Inc. (from North America). Its main equipment and machinery were also imported.

We must stress the important consideration that all can producers in Brazil use foreign technology. LATASA using technology from REYNOLDS; ANC from PECHINEY; LATAPACK from BALL; PETROPAR from CROWN CORK; and METALIC from PAC International. The significant growth in production of cans for the beverages sector may be attributed to the growth in investments in this sector and also to the entry of world-class players such as REYNOLDS METALS (USA), CROWN CORK & SEAL (UK), PECHINEY (France), and BALL Corporation. This brought to Brazil the condition to produce (1996-1997 data) around 10 to 12 billion cans per year.

One of the major implications of these associations and joint-ventures with foreign companies, is that the Brazilian industry is needing, more and more during the 1990s, greater presence of technologies, equipment, industrial & automation systems, and engineering processes from other countries (mainly from the developed world). This includes, for the case of the production of aluminium and steel cans: production technologies (e.g. for sheet metal), aluminium and steel products for factory equipment, automation and information technology control systems, scrap reutilisation and treatment-recycling technologies, environmental & pollution control systems (clean technology), etc.

5.6 Issues of capital goods imports

The contribution of shifts in FDI to the mining sector's development will now be explored under the particular view of capital goods imports. With respect to business relations for the capital goods sector, and more specifically to those aspects concerning the importation of industrial equipment for Brazil, Macedo (1996: 23-4), researching data for the analysis of the performance of the Brazilian economy, and more specifically dealing with the production of capital goods and consumer goods, provides data indicating that there was a situation of growth in the "participation of imported equipment as a share of total amount of machines and equipment acquired" in Brazil (see Table 19). This provides an indication of the important external (international) influence over domestic (Brazilian) industrialisation (this is a relevant issue for the analysis of the mineral-metallurgical industries in Brazil).

Table 19 - Imports participation as a share (%) of the total amount of machines and equipment acquired in Brazil, 1990 - 1995

Year	1990	1991	1992	1993	1994	1995
Imports share (%)	10.55	16.55	18.58	18.69	19.58	24.64

Source: IBGE. Diretoria de Pesquisas (Departamento de Contas Nacionais), in: Macedo, 1996, p. 24.

In more general terms, for the entire national economy, Brazil's international trade has witnessed major changes in the 1993-1996 period. Contrasting with almost two decades of continuous trade surpluses, for the last two of those years imports topped exports. Total exports increased by US$ 9.1 billion over the 1993 – 1996 period, whereas imports rose by US$ 28 billion in the same period (Table 20 and 21). Notice the sharp growth in imports of capital goods and raw materials from 1993 to 1996.

Table 20 - Brazil, exports (free on board values, US$ million)

Year	Basic products	Semi - Manufactured [1]	Manufactured [1]	Total US$ m	As GDP %
1993	9,357	5,540	23,758	38,655	6.3
1994	11,058	6,983	25,594	43,545	6.7
1995	10,969	9,146	26,391	46,506	6.9
1996	11,900	8,612	27,235	47,747	6.9

Source: Banco Central do Brasil [US$ 1995 constant values].

[1]: Industrialised products.

Table 21 - Brazil, imports (free on board values, US$ million)

Year	Durables [1]	Non-Durables [1]	Raw materials	Fuel and lubricants	Capital goods	Total US$ m	As GDP %
1993	1,761	1,449	12,863	4,094	5,089	25,256	4.1
1994	3,129	2,410	15,607	4,356	7,576	33,078	5.1
1995	6,088	4,828	22,393	5,217	11,330	49,856	7.4
1996	4,568	5,151	24,635	6,227	12,704	53,286	7.7

Source: Banco Central do Brasil [US$ 1995 constant values]

[1]: Consumer goods.

Industrial and foreign trade policy in Brazil are now based on the targets set by the Pluriannual Plan 1996-1999. This provides today the basic guidelines for national's industrial policy and also foreign trade policy. Amongst the main aims are (the achievement of some basic objectives): to foster private investments (both national and foreign) through tax reductions on inputs and capital goods for domestic industry, providing support, for example, in importing technology in order to allow for greater S&T developments to take place in the country. This is supposed to improve and provide the basic means of strengthening the Brazilian Quality and Productivity Programme-PBQP, designed to develop quality and productivity by promoting better standards in metrology, technical regulation, and certification (e.g. ISO series).

5.7 Indigenous technological development

The contribution of shifts in FDI to the mining sector's development will now be explored under the particular view of indigenous technological development. The development of indigenous technology for the mining industry in Brazil is mostly carried out by the oil sub-sector through PETROBRAS. Some technology is also carried out in the steel and metallurgical sector (e.g. CSN, USIMINAS). The iron ore sub-sector is also responsible for some innovation, mainly CVRD, MBR, SAMARCO and SAMITRI. Overall the development of technology is not very expressive, and in several cases it is associated with foreign initiative derived from information, knowledge, services, equipment, intellectual properties and patents from MNEs or other foreign agents.

There is a centre specifically built for developing technology for the mining industry which is the Centre for Mineral Technology-CETEM in Rio de Janeiro. CETEM is, however, usually constrained by its budgetary limitations, which also affects its capacity to deliver to its own staff the kind of technological advancement that they deserve (in advanced stages of scientific research). What should possibly happen, in order to promote a better framework for technological innovations to be developed and applied, is a greater degree of articulation between mining and other sectors, mostly with metallurgy, metal products, mechanical machinery and equipment, research institutions, etc.; the understanding of the mining industry as a chain of inter-dependent sectors, and also the promotion of a greater collaboration between levels of government (e.g. via local state mining companies providing technical solutions for mineral extraction; via the CETEM and CPRM providing a range of advanced services in geological information, mineral technology and R&D).

Technological development in Brazil is still limited in most areas of knowledge and of industry. One way of understanding this is by considering S&T, R&D, innovations and patents. "Patenting is a measure of the strength of the science base as it

is designed to protect intellectual property arising from R&D when it comes to potential application. As expected in developing countries, fewer patents have been granted to residents than to foreigners (Table 22). Patents granted to residents in Brazil in 1995 accounted for 19.8% of the total" (Bogliolo, 1998: 17-8). Amongst the most outstanding sectors where new patents played an important role were 'primary metals' and 'electronic equipment and components'. Investments in S&T in Brazil are highly concentrated in mega corporations, with MNEs and foreign agents playing a major role; with domestic companies and agents playing a marginal or less important role.

Table 22 - Patents granted in selected countries to resident and foreign applicants

Country	Year	Resident	% (Resident)	Foreign	% (Foreign)	Total
USA	1993	53,236	54.1 %	45,107	45.9 %	98,343
Canada	1994	853	7.3 %	10,789	92.7 %	11,641
Brazil	1995	526	19.8 %	2,134	80.2 %	2,660
Argentina	1994	448	21.0 %	1,682	79.0 %	2,130
Mexico	1995	230	6.5 %	3,308	93.5 %	3,538
Chile	1992	42	9.2 %	414	90.8 %	456

Source: MCT/INPI (National [Brazilian] Industrial Property Institute); RICYT/CYTED (1990-95). In: Bogliolo (1998: 18)

Considering the country's S&T capability, Brazil is classified as having an "incomplete" system of technological development"[35]. "In the context of Latin America, Brazil is the front-runner, with R&D representing 0.88% of GDP, followed by Chile (with 0.78%), Colombia (0.62%), Mexico (0.40%), and Venezuela (0.34%), considering the per cent (%) of their respective GDP figures. Although Brazil has made a tremendous effort to increase its spending on R&D, total outlay

[35] Germany, USA and Japan, for example, are classified as being "mature system"; Canada, Spain and Italy as having an "intermediate system" for technological development.

rising from US$ 3.3 billion in 1992 to almost US$ 6 billion in 1995, average expenditure per capital, despite being 2.5 times the average for other South American countries, is still three times less than the outlay in Spain, eight times less than in Canada and seventeen times less than in the USA (Table 23).

Table 23 - Total R&D expenditure in selected countries

Country	Year	Total in US$ million	US$ per capita
USA	1993	165,849	664.0
Canada	1994	9,452	323.0
Spain	1994	4,464	114.0
Brazil	1995	5,957	38.5
Chile	1995	398	28.4
Argentina	1994	873	25.5
Venezuela	1995	372	17.2
Mexico	1993	1,130	13.4
Colombia	1994	286	8.6

Source: MCT/CNPq (1990-95); RICYT/CYTED (1990-95); In: Bogliolo (1998: 15)

Spendings on technological advancement in Brazil lags well behind the level of expenditure in developed economies. North American companies invest an average three per cent of their income in R&D whereas the figure for Brazilian firms stands at around 1.2%. Whereas the average of the business enterprise R&D self-financing in OECD countries rose from 82.4% in 1991 to 84.9% in 1995, in Brazil its share dropped from 97.2% to 90.9% over the same period. The Government participation in supporting R&D in the business enterprise sector inched up from 2.8% to 3.0% over the same period. Although the Brazilian Government has recently opened many credit lines for funding R&D in the business enterprise sector[36], there has been weak

[36] Through the: Financing Agency for Studies and Projects-FINEP; National Scientific and Technological Development Council-CNPq; Ministry of Science and Technology-MCT; National Economic and Social Development Bank-BNDES; Bank of Northeastern Brazil-BNB; and Bank of Brasil-BB.

demand for loans from official credit lines as instruments for promoting S&T. A survey carried out in 1997 by the National Confederation of Industry-CNI and the Ministry of Science and Technology-MCT has revealed that, on average, more than 70% of the companies surveyed are unaware of the existence of Government instruments for promoting technological capability (Bogliolo, 1998: 37).

5.8 Export performance

The contribution of shifts in FDI to the mining sector's development will now be explored under the particular view of export performance. The performance of the export of minerals from 1978 to 1992 is provided in Table 24. The value of mineral production in Brazil (VPM-PMB) in 1992 was around US$ 6 billion (excluding oil & gas), which places Brazil among the 5 most important mineral producers of the Western world. Five commodity groups - iron, gold, granite, limestone and bauxite - represented almost 70% of the total value of production. It is convenient to note that this cited VPM-PMB refers exclusively to the production of raw materials and concentrates, and does not include semi-transformed products such as aluminium ingots ("lingotes de aluminio"), pig-iron ("ferro gusa") or metallurgical products.

Table 24 - Value of the Brazilian mineral production and of the national exports of primary mineral commodities, 1978-1992 (US$ million)

Year	Value of mineral production (VPM) [1]	Value of mineral exports [2]
1978	5,159	2,512
1979	5,027	2,846
1980	5,641	3,083
1981	5,509	3,164
1982	5,370	2,933
1983	4,708	2,474
1984	4,629	2,536
1985	4,867	2,475
1986	5,063	2,395
1987	5,536	2,278
1988	6,580	2,660
1989	9,975	2,965
1990	8,164	3,058
1991	5,876	3,135
1992	6,017	2,683
Total	88,121	41,197

Source: PPDSM/DNPM-DIPEN (1994: 5).

Obs : The values for mineral production here presented excludes oil & gas; using 1992 constant values.

[1]: VPM in US$ F.O.B./Mine; [2]: Exports (considering only primary raw materials, i.e. minerals and concentrates only) in US$ C.I.F.

When mining is tied up with the more advanced stages of industry and industrial transformation, the participation of the mineral sector in the Brazilian economy as a whole assume greater importance, responding for around 30% of industrial production and of Brazilian exports. Nevertheless, although mining is important for the performance of industry and of exports, two negative factors are bringing about a gloomy perspective in relation to the future of Brazilian mining: (a) the sharp fall in mineral exploration investments (prospecting and research), and (b) the signs of stagnation of the Brazilian mineral production (PMB) during the last decade (PPDSM, 1994: 4).

The diagnosis of the PPDSM report (1994: 63) considering new directions for the Brazilian external commerce for mining include "enhancing the participation of mineral commodities in the external commerce sector, and indicates that it is necessary to reduce the excessive taxation duties ("carga tributária") and incentive Brazilian Mineral Production (PMB). The lack of incentives for domestic mining and the heavy taxation commitments that overload exports inhibits investment in this sector, and places exported Brazilian mineral commodities at a disadvantage in relation to the international markets. Knowing that the GATT [WTO] agreement allows for fiscal exemption of taxes and tariffs, and that this practice is broadly adopted by several mineral producing countries, it is recommended that Brazil starts making full use of this condition in order to promote exports".

5.9 Some FDI opportunities and possibilities in Brazilian mining

This section will briefly list some of the new possible areas for foreign investment in mineral or mineral-related sectors.

Opportunities in the energy sector:

Important opportunities for future FDI in Brazil includes the energy sector, mainly with gas. This is the expectation for the medium-term in order to reduce the degree of the Brazilian reliance on hydro-power electric generation (together with the large-scale venture to bring gas from Bolivia - already under development). The "gasoduto Bolivia-Brasil" is a project for Brazilian consumption of Bolivian natural gas that is scheduled to be completed (linking the Bolivian city of Rio Grande with Porto Alegre in the South of Brazil) during the first months of the year 2000. This will make available for consumption amounts of gas ranging around 30 million cubic meters per day. It is said that this will "revolutionise" the energy sector in Brazil.

Opportunities with CVRD's North System and in the Amazon region:

When considering opportunities for investment, the possibilities for FDI, CVRD's "North System" and other opportunities in the Amazon region need to be mentioned. With respect specifically to mining and CVRD, see Table 25. With respect to 'other business opportunities', see Table 26. This vision of good opportunities in the Amazon region is shared by CPRM. The management of the Brazilian Geological Survey considers that mining is the best activity to promote the occupation and development of the Amazon region; and that foreign capital is a fundamental element so that Brazil has the chance to enlarge its mineral production (its "mineral frontier"), and also, as a result of this growth, make possible the increasing presence of international investment.

Table 25 - Selected mineral reserves under control of CVRD - only those from the "North System" (data in 1,000 tonnes)

Minerals	Pará State	Piauí State	Maranhão State	Tocantins State	Total "North System"	% Over Total Brazilian Reserves
Bauxite	2,097,668	-	-	-	2,097,668	79.7
Copper	1,296,224	-	-	-	1,296,224	76.7
Gypsum	580,823	3,444	56,085	651	641,003	68.1
Quartz	63,238	-	-	-	63,238	53.7
Kaolin	816,799	5,196	-	-	821,995	49.6
Iron ore	17,625,174	-	-	-	17,625,174	46.5
Manganese	89,673	-	-	-	89,673	27.4
Nickel	80,725	20,008	-	-	100,733	26.4
Marble	-	120,085	-	-	120,085	9.7
Limestone	1,521,077	205,548	358,657	74,055	2,159,337	2.6

Source: CVRD - SUPOC

Table 26 - Some of the business opportunities in the Amazon region

Sectors for Business	Sub-sectors with greater possibilities
Agro & Foodstuff industries	-Vegetable oils (crude and refined), margarine, other co-products derived from soya and cotton -Meats (animal raising) -Milk (and derived products) -Fish & Crustacea (from sea and river) -Tropical fruits (fresh, juices, etc.)
Forest activities	-Wood & Cellulose -Reforestation (industrial plantations)
Metallurgy & Metal-Mechanical industries	-Steel and steel products -Aluminium and its products -Transport Equipment -Agricultural Machinery
Other businesses based on primary production (raw materials)	-Drugs & Medicine industries -Chemical plants -Leather and other animal skin products -Textile & Clothing -Drinks & Beverages -Perfumes

Source: CVRD.

Opportunities with mineral-related ventures:

Possibly the most important opportunities here are those of heavy-metallurgy. For example, as part of an expansion project undertaken by CSN, a new steel production plant is planned for Ceará state in association with the North American company NUCOR. Investments of around US$ 700 million are becoming available so that the new plant can start production of around 1.2 million tonnes of steel per year in the year 2000.

When dealing more closely with the importance of the auto-industry for heavy industry and heavy-metallurgy in Brazil, the

case of CSN's increasing interests in searching for more participation on the supply of products for car fabrication is interesting to mention. CSN plans to increase its production of galvanised steel so that more of this steel-type can take part in the total composition of materials that are used for the auto-industry in Brazil. This is the case as European cars have even up to 50% to 60% of their parts made of galvanised steel - while the Brazilian cars have only around 15% to 20% of this material. This shows that important opportunities are available by getting closer to the (possible/predicted) future needs of car makers. These plans will increase the amount of steel supplied by CSN to the auto plants from around 25% (1997 figures) to around 40% (estimated figures for the near to medium future).

USIMINAS is a good example for its high degrees of business-dependence on the auto-industry sector - ranging around 30% of its sales (1995-1996 figures) for auto-assemblers and auto-parts enterprises (the most important sector for its sales). This is forecast to increase for the 1997-2000 period due to new planned expansion of productive capacities directly related with steel products to be used by FIAT (in its Minas Gerais auto plant). The considerations are that USIMINAS is counting with an expanding panorama for truck production in Brazil that would back large amounts of its production until at least the year 2005.

Opportunities with the gemstones sector:

There are interesting opportunities mainly in Bahia, Goiás and Minas Gerais. In the case of Bahia, the main precious stones are emeralds, amethysts and quartz - but there are also good perspectives to develop businesses with topaz, diamonds, ruby, feldspar and aquamarine. Goiás appears to be particularly good for several types of quartz, emeralds and also tourmalines. In the case of Minas Gerais state, CPRM is developing gemological studies in the Eastern part of the state, the "Projeto Leste/MG". This is being undertaken together with the Minas Gerais state Secretary of Mines & Energy (SEME-

MG), and encompasses the *gemological province* along the region of Governador Valadares and Teófilo Otoni (which includes several other municipalities). This is considered to be one of the richest regions with precious stones in the country (with a great diversity of stones specimens).

Opportunities with the environmental sector:

The opportunities in this sector are mainly related to the use of equipment and technology. Equipment needs for production and environmental management in the mineral and mineral-related sectors is increasingly being considered within a global perspective and involving global corporations. This requires greater use of specialised equipment with sophisticated engineering and technology. Opportunities are also being created through the greater use of international standards of production and industrial organisation such as ISO certification series (e.g. 9000 and 14000) and Environmental Management Systems-EMSs procedures and tools (which includes environmental impact assessment, life cycle assessment).

To summarise, there is an increasing tendency in Brazil (and more since 1990), as observed in the mineral sector, of elaborating business strategies that are global with respect to the adoption of international standards and certification, and to use imported equipment for managing and operating industrial processes and technologies and related aspects such as pollution control and mitigation. This is opening up great business opportunities for suppliers of equipment, technology and industrial processes for the sector (including oil & gas and metallurgical companies). This is promoting an increasing pattern of international integration of Brazilian enterprises.

6. CONCLUDING REMARKS

The case for a renewed wave of FDI in Brazilian mining seems unlikely in the short-term. This is because, what Brazil is offering today to investors are mineral *resources*. Investors prefer to put their money on mineral *reserves*, i.e. mineral deposits already defined and which require less effort and less capital to be transformed into productive mines. It appears that in South America other countries such as Chile, Peru, Argentina, Colombia and Bolivia, are proving to be more effective in attracting foreign capital as these countries are offering a ready-made "menu" of better defined mineral deposits and mineral projects. These countries are providing more complete details of their geological-mineralogical-metallurgical characteristics and also are very competitive with respect to their economic conditions affecting and regulating mining and its related activities.

Changes in Brazilian mining, that would allow for a better definition of mineral deposits (bringing more complete knowledge of its main operational and economic characteristics), will only come in the medium to long term; and only if some action is taken now or as soon as possible. Nowadays, the industry is being restructured and there is little consensus of what will happen in the short term. The need for action is great and the Government is now dealing with issues that should promote changes. This is the case of the National Mining Agency (ANM) that is under consideration by the Central Government. Depending on the outcomes, changes could be made so that, for example, the DNPM can be transformed into a more effective actor for regulating mining; or the DNPM could even be extinguished and taken over by the ANM. The outcome is still uncertain.

The future of investments (which includes FDI) in Brazilian mining and related industries appears to be more likely linked with the Amazon region, to heavy-metallurgy and mainly to the

oil & gas sector. Indications are pointing towards this scenario. The main supporting evidences for this includes the increasing interest of CVRD to concentrate more and more of its activities in the Amazonia in general (and on the Carajás region in particular); the propaganda promoted by CPRM assuming that the best way to develop the Amazon is through mining; the prospects for enlarging productive capacity for the national steel industry in order to increase its participation in supplying the MNEs of the auto-industry sector; the huge infrastructural changes taking place within the energy sector in Brazil (which is taking more businesses to develop, for example, the gas sector); and environmental-related technologies for mining, recycling, pollution control and mitigation, industrial effluent and sanitation plants, etc.

Taking under consideration the large diversity of forces and impulses that influence Brazilian development - with some forces arising from the way the world economy functions, other forces being the result of domestic (internal) characteristics - some components of State behaviour in Brazil must be considered. These components will be determinant in reordering and rearranging the economy in two main ways: through a type of '*autochthonous* development', or through increased foreign participation (including FDI) in the local market (e.g. with privatisation), a type of '*allochthonous* development'. These components affecting the management of national businesses are supposed to provide new directions for industry by providing new systems or new approaches to natural resources management.

In the mining sector these industrial and managerial considerations are important for the understanding of, for example, how pollution control systems will be administered, and the implications this will bring in terms of the use of equipment and technology. Also important are accounting issues and standards (that will affect how companies are organised and thus affect their chances for being recipients of new investments). PriceWaterhouse Coopers-PwC is working within this sector and they consider (PwC, 1999) that a move

towards international comparability through the harmonisation of accounting standards world-wide is needed. PwC also support the introduction of a mining specific standard by the International Accounting Standards Committee-IASC. This will possibly provide a clearer environment for investments (and also greater need for consultancy work to establish new accounting standards).

Additionally, some important questions to be posed for further research include:

-"Enhancing membership relations within Mercosur countries may be a possible way forward in promoting a better framework for developing complementary mining activities amongst these countries? ... and also for establishing a clearer environment for foreign investment flows from the developed world?";

- "How should government policy be managed in order to promote greater inflows of FDI?";

- "How can local state activities be better synchronised with Federal (central) government policy directives?"

- For the year 2000 onwards, will we have greater importance given to: -"International business and the internationalisation-globalisation model of development?", -"Growth of FDI together with sustainable development?", - "Various sectors and industries of the Brazilian economy developing at the same time and in a more integrated manner?".

It has been shown that the weakening support for the Brazilian mining industry by part of the financial community since mainly 1988 was the result of a certain lack of consistent Government initiative for the mining sector, that was also reflected in the State's decreasing importance and efficiency to maintain a framework of institutional support that could take the country out of a situation of "mineral stagnation" (as production levels did not show signs of any significant growth). The late

1980s and early 1990s may be considered as a period of stagnation of production levels - in part due to regulatory changes (with the restrictions to the participation of foreign capital introduced in 1988); in part as there was no significant growth in domestic consumption; in part due to the decreasing investments in domestic mineral exploration; in part due to over-supply at the international level which decreased demand for minerals and also affected prices (falling prices).

From the mid-1990s, starting with the Cardoso government and constitutional changes that allowed once again greater foreign participation in Brazilian mining, the country goes through a short phase of increased domestic consumption - to an extent that affected the mining industry in those sub-sectors important to the construction industry such as cement and non-metallic minerals (that experimented a brief growth). However, excess of supply of minerals at the international level and also a generalised period of international crisis (e.g. Asia, Russia, Brazil) meant that a full recovery was still postponed for times to come. This resulted in no substantial flow of FDI into mining in recent years and, as a consequence of this, it is still not possible to know if FDI flows have (or will have) a positive impact on the sector's trade and technological performance.

One thing is certain, new technological developments - e.g. those related to recycling, to the reduction of materials' use (for example: with miniaturisation, processes that reduce the use of metals and materials), substitution, "new materials", engineering innovations - will increasingly impact over mineral production and trade (over the performance of the materials industries). These new technological developments (that assumed greater importance for industry and innovation since the late 1980s) may explain the low levels of FDI in mining as this sector (at least in Brazil) is increasingly using other sources for capital, for example, loans, mineral supply contracts, credit and programmes for acquisition of equipment. The fact that minerals are no longer "strategic" means that the most important industries are increasingly more towards the end of the supply-chain and that mining is more and more just a simple provider

of commodities. This explains the way the aluminium industry works, and also explains why the iron and gold sub-sectors (or the metallic minerals sectors in general) are increasingly integrating themselves with metal producers through the use of more sophisticated metallurgical processes.

This is resulting in a greater corporate concentration in favour of large MNEs that are prepared to increase their market domination via their own technological innovation capabilities. This is very clear not through FDI, but through: technology contracts; provision of engineering and consultancy services; increasing importance of computerised production systems and automation (requiring advanced hard- and soft-ware); use of more sophisticated equipment for optimisation of production processes; economy of energy and materials and labour; and also, for environmental control and pollution mitigation. This is affecting the domestic economy due to the consequent growth of capital goods imports (or also the growing reliance on equipment producers that, although established in Brazil, are in most cases controlled by multinationals). Indigenous technological development is increasingly dependent on external agents and their technologies.

The study of the diversity of investment types, of NFI, loans, joint-ventures, etc., as seen in this text (in the case of Brazil), shows that FDI have to be viewed as only one of a diverse range of forms (or types) of investment; and that FDI in Brazilian mining was in most cases just a small parcel of total investments in the sector. In fact FDI may even be considered as marginal and not very important for the development of Brazilian mining as a whole (considering the past 2 decades). The Government and the sector aspires to obtain greater FDI inflows and there are some opportunities and possibilities for these developments that may be explored by international capital, multinationals and local players.

Mining 'per se' is today a relatively uninteresting business. For mining to be more interesting (and to attract FDI), it needs to be linked to more advanced stages of the production chain; it

needs to be useful for industry, by providing higher-quality, lower-cost commodities that may be "adjusted" (with regard to its technological specifications, performance parameters, physical & chemical characteristics), according to the demands of other 'user industries'. Mining is having to adjust itself by using more sophisticated engineering processes, by making products with greater 'quality content' (with use of ISO series and EMS tools), and by increasing the use of automation and design technologies.

This text indicates that the volume of foreign direct investment in Brazilian mining is very small - and has suffered a clear decline for the period analysed (since the 1970s). The past 25 years has shown that other forms of investment, and not FDI, were more representative for the domestic mining sector of Brazil as a whole. In order for Brazil to attract more investment much will have to be done, and this text tries to offer some directions (or opinions). In very broad terms we could consider here that, even knowing that we are living in a time of lower prices for commodities in general, it is necessary to expand Brazilian production into other sub-sectors - and this should be undertaken both horizontally and also vertically [horizontal and vertical integration]. Only proceeding in these directions we will be able to diversify into other minerals and also to promote the development that will take us to advance industry and knowledge into other parts of the supply-demand chain.

In terms of supply-chain of mineral commodities, mining enterprises will need to enhance their capabilities of planning and advancing businesses in order for them to be able to explore, exploit, process and distribute goods more effectively and they will also need to use higher technological standards with better qualified labour. More and more we can observe that cost and quality (e.g. characteristics of mineral products) of production are the main issues for the mining sector. A supply-chain management approach could help in promoting more effective supply flows. Investments will be attracted and

directed towards the companies and countries that are using and applying these new ideas and principles.

We should follow more closely, if we want to attract more investment, the new practices of Sustainable Development, i.e. stimulate businesses to comply with the basic principles of the 'Agenda 21' and also stimulate the use of Environmental Planning & Management (EPM) 'tools' such as ISO, Environmental Management Systems and Life Cycle Assessment. The extractive industries world-wide will follow more and more a path of development that will require greater S&T and R&D applications for resource surveillance and mineral reserve definition in order to promote the exploitation of minerals & ores in accordance to methods and procedures which increasingly requires the use of world-class mineral operations, techniques and processes, and in accordance to a framework where all the 'natural resources' (not only mineral) are viewed in conjunction in order to take the best choices of which resources to protect and which resources to exploit.

7. BRIEF 'HISTORY OF MINING':

1950s: -MNEs: Period of growth for multinationals; International capital growing in importance and influence. -Post-war: restructuring and investment in several countries. ∧ Various commodity sectors are developing. [No idea of 'sustainable development'].
1960s & 1970s: -Countries are 'taking over': nationalisation and SOEs. -Times of 'panic of supply' for most commodities. -In Brazil: State (national) capital in mining is strongly represented by CVRD (having a leading role in the development of the domestic iron & steel industry). ∧ Iron & Steel is probably the most important sector.
late 1970s & early 1980s: -Transition period: LDCs starting again to accept external participation in domestic ventures. -Oil crisis: 1973-74 and 1979-80. -In Brazil: Foreign capital & technology played a leading role in the development of the aluminium industry. ∧ Aluminium is probably the most important sector.
1980s: -Period of transition continues: strengthening of foreign participation in the domestic market. -Debt crisis: starting with Mexico in 1982. -Economic crisis in Brazil and consequent raising unemployment creates "Serra Pelada" and the figure of the "garimpos" and of "garimpeiros" are harsh realities of Brazilian mining (mainly in gold, tin and precious stones production). ∧ Gold is probably the most important sector.
1990s: -Period of 'adaptation' to new economic realities: liberalisation & privatisation. -Times of 'no shortage' of commodities. -Business and managerial re-structuring (new methods, procedures and tools). -Trend towards greater internationalisation in industry in general. [Idea of 'sustainable development' exists]. ∧ Some commodities sectors are developing (e.g. gas sector increasingly important); various "paramineral" and industrial sectors are coming to existence and growing strong, e.g. environmental services, industrial certification (quality, health & safety, ISO, EMS), recycling.
2000 onwards:? -Greater importance of international business and the internationalisation-globalisation model of development? -Growth of FDI? ∧ Various sectors and industries developing at the same time in a greater range of countries?
Acronyms used: CVRD: Companhia Vale do Rio Doce (Brazil's largest mining company); EMS: Environmental Management Systems; FDI: Foreign Direct Investment; ISO: International Standardisation Organisation; LDCs: Less Developed Countries; MNEs: Multinational Enterprises; SOEs: State Owned Enterprises.

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GLOSSARY OF TERMS AND EXPRESSIONS

alloy: a substance with metallic properties composed of two or more chemical elements of which at least one is a metal.

alumina: Aluminium oxide produced from *bauxite* ore. It is a white powdery material that looks like granulated sugar. Alumina is smelted and refined to produce aluminium metal.

aluminium/aluminium metal: Aluminium metal is produced through the reduction of the alumina in electrolytic cells.

base metals: e.g. copper, lead, molybdenum, zinc.

bauxite: Aluminium hydroxide (the basic ore that contains aluminium). The ore occurs in various forms and usually contains various mixtures of aluminosilicates, iron oxides and other impurities. Bauxite is used to produce *alumina*, which in its turn is used to produce *aluminium metal*.

Brazilian Government: includes three levels of government: Federal, state, and local (or municipalities).

Central Government of Brazil: The Presidency, Ministries, Treasury, Central Bank and Social Security.

cold mill: The equipment on which a metal is rolled into sheet or foil by passing it through pairs of rollers under pressure. In cold rolling, the incoming metal is normally at room temperature.

cut-off grade: The cut-off grade is the lowest grade, or metal content, of the rock leaving the mine that can be treated as ore rather than waste.

engineered product: A metal fabricated product that has been mechanically altered to create special properties for specific purposes; forgings and extrusions are examples of engineered products.

extractive industries: Industries that derive their principal raw materials from the earth, e.g. mining companies.

extrusion: The process of shaping material by forcing it to flow through a shaped opening in a die.

fabricate: To work a material into a finished state by machining, forming or joining.

flat-rolled products: Metal plate, sheet or foil products made by passing ingot through pairs of rolls. By moving the rolls closer together and passing the ingot between them, the thickness is reduced and the length is increased.

foil (e.g. aluminium foil): A flat-rolled product, rectangular in cross section, of thickness from 0.006" to 0.00025".

foreign direct investment: Direct 'risk' investment; often involves foreign control of the production process and marketing strategy, the use of brand names marks and patents, and the use of new (relative to local) technologies (either embodied in equipment or as knowledge of techniques and processes).

forging: A metal part worked to pre-determined shape by one or more processes such as hammering, pressing or rolling.

garimpo/garimpeiro: name given to the 'informal mining' (not done by organised companies) in Brazil; 'garimpo' refers to the place, 'garimpeiro' to the person.

ingot: A cast form suitable for re-melting or fabricating. An ingot may take many forms: some may be 15 meters long and weigh 15 tons, others are notched or specially shaped for stacking and handling.

London Metal Exchange (LME): The international trading body that aims to facilitate the world-wide open market buying and selling of metals.

metric ton (mt): A unit of mass and weight equal to 1,000 kilograms.

mill products: Metal that has been fabricated into an intermediate form before being made into a finished product. The most common metal fabricating processes are rolling, extruding, forging and casting (e.g. aluminium sheet, a mill product, is used to make beverage cans, a finished product).

mineral deposit is regarded as being any individualised mass of mineral or fossil substance, either occurring above or below the surface, with economic value.

mineral exploration: The performing of work necessary to define a mineral deposit, its evaluation and the determination of its economic feasibility.

PET: Polyethylene terephthalate: a plastic commonly used to make bottles for beverages.

pig-iron: Iron in "pigs" or rough bars; the crude iron produced in the blast furnace and cast into "pigs" which are used for making steel, cast-iron or wrought-iron. Composition varies according to the ores used, the smelting practice and the intended usage. Principal impurities are carbon, silicon, manganese, sulphur and phosphorus.

plate (e.g. aluminium or steel plate): A flat-rolled product, rectangular in cross section, of thickness not less than 0.250".

portfolio investment: Portfolio investment is often dealt with as mostly short-term flows, responsive to international differences in interest rates and exchange rates (arbitrage), and highly sensitive to domestic regulations and tax structure. In Brazil the Central Bank considers as portfolio investment: (a) foreign

capital invested in depository receipts and (b) foreign capital invested in securities issued by residents and traded in the domestic financial market. This distinction allows for a separate analysis of both types of foreign investment ['portfolio' and 'FDI'] (Baumann, 1998: 7). Acronyms used: **Portfolio Investment Flows-PIF** and **Portfolio Direct Investment-PDI** [see also entry for 'foreign direct investment'].

'Portfolio' indicates the promotion of businesses in a range of investments and assets. The main reason for promoting a varied portfolio of financial securities is to achieve the maximum possible return on investment (looking for favourable levels of interests and/or dividends, and capital gains, from holding the selected securities). 'Portfolio investment' implies the collection of financial securities such as shares and bonds by investors. Typically investors would want to hold a number of different financial securities to spread their risk, and would seek a "mix" of financial securities: (a) some offering high short-term dividend payments, (b) other offering long-term capital appreciation as their market prices rise, (c) other offering medium-term rewards. Additionally, investors may plan to hold various types of financial securities which have a particular maturity structure so that they can achieve a predetermined pattern of cash flows. The attractiveness is that the risk attached to a portfolio is usually less than the weighted average risk of each individual investment.

precious metals: e.g. gold, platinum, silver.

reserve: A reserve represent that portion of the resource that has been more precisely measured and which is, or might be, available for production over a specified time period (P. Crowson, in *Mining Journal*, February 19, 1999, p. 5). [see also 'resource'].

resource: A resource is simply the identified or probable physical presence of minerals in the Earth, which may or may not be exploitable economically with presently available technology (P. Crowson, in: *Mining Journal*, February 19, 1999,

p. 5). It is said that "resources must be continuously reassessed in the light of new geological knowledge, of progress in science and technology, and of shifts in economic and political conditions" (USGS, in P. Crowson op cit). "In short, it is necessary to assess both the physical characteristics of resources, the social and political feasibility of mining them, and the potential profitability of extracting and marketing them. None of these attributes can be precisely measured, or is fixed for all time, except when a mineral deposit has been fully mined out" (Crowson, 1999). [cf. with 'reserve'].

services sectors (of the economy): These include electricity, telecommunications, railways, consultancy companies, etc.

sheet (e.g. aluminium or steel sheet): A metallurgical rolled product, flat or coiled, rectangular in cross section, with thickness less than 0.250" but not less than 0.006".

smelt: To fuse or melt ore in order to extract or refine the metal it contains.

supply-chain: In the mining context, the *supply-chain* concept indicates "all the capabilities to plan, source, process and distribute goods, services and end-products" (*Mining Journal*, March 26, 1999, p. 224). The good management of supply-chains potentially enables companies to reduce total mining costs. In essence, the supply-chain concept promotes the idea and the need for Supply-Chain Management (SCM), and this implies the search for the most effective co-ordination of supply flows.

"triplet": Concept of the 'triple-alliance' between multinationals, the State and the local (national) private capital (Evans, 1979 studied the Brazilian case and considers the inter-relationships between these 'partners' in working the Brazilian economy - a framework for analysing foreign capital, State capital, and private local capital). The editors of the Brazilian journal *Exame* (see for example the 1999 edition of "Melhores & Maiores") also use the term "tri-pé" for indicating the percentage of capital in

hands of each of these main participants (the Brazilian State, Foreign players, and private national capital).

world-class mineral deposit: Defined as those deposits possessing a large tonnage and amenable to being mined over a long life at low cost, and with the capability of maintaining superior profitability, even during the bottom of the business cycle. [see 'world-class mineral operation'].

world-class mineral operations (or **projects, ventures**): Defined as those operations (or projects, ventures) possessing superior quality, profitability and capability as a whole, i.e. considering the 'deposit', the 'industrial plant', the 'business' as a whole (not just parts of it). [see 'world-class mineral deposit'].

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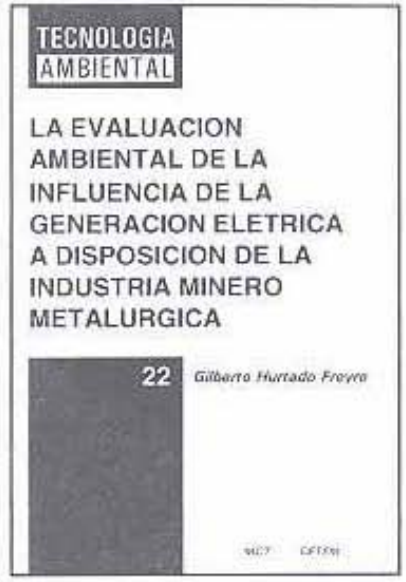

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