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JAPANESE - PERUVIAN MINING BUSINESS ARRANGEMENT

by

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ABSTRACT

From the viewpoints of the comparative advantages of resource-rich but relatively capital-poor Peru, and resource-poor but relatively capital-rich Japan, some rules and criteria are proposed to establish the successful trade of mineral and capital between two countries through good mining business arrangements.

For the proposed joint venture project between the Peruvian state corporation and a Japanese mining consortium, an economic evaluation based on constant dollar analysis has been made under the most likely conditions (the "base case"). Selected negotiable terms including zinc sales price, smelting and refining cost, and debt-equity ratio have been examined using sensitivity analysis to isolate changes in Peruvian government revenue and Japanese capital outflow.

The results indicate that zinc price is the most important of the three parameters in terms of cash flow analysis. Also, the zinc price parameter has the greatest impact on Peruvian government revenue and Japanese capital outflow.

For this most important parameter, the numerical approach has been adopted to narrow the range of acceptable

zinc prices. The minimum DCFROR for the Japanese mining consortium and the limit of an annual remittance of dividend or net profit equivalent to 20 percent of investment will play an important role in establishing a reasonable range of the zinc price in negotiations.

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1. INTRODUCTION

Nations are motivated to engage in direct investment in developing countries for a variety of reasons. Kojima (1978) distinguished between trade-oriented and anti-trade-oriented activities of multinational enterprises. The current Japanese investment has been trade-oriented and designed to complement Japan's comparative trade advantage. On the other hand, many foreign investments by U.S. firms have been made to protect an oligopolistic position in world markets, and, in response to trade barriers, have transferred activities from those in which they have a comparative advantage to those in which they have a disadvantage. Japanese strategy for investing in mineral resources in developing countries strikes many Americans as strange. Characteristics of the strategy are peculiar to Japan: group investment consortiums and high debt-equity ratio. These characteristic features will be clarified in this paper through the mining business arrangements between mineral-rich but relatively capital-poor Peru and mineral-poor but relatively capital-rich Japan.

Japan's demand for mineral resources has grown enormously in recent years with the dramatic growth of the

nation's industry and the concomitant increase in mineral consumption. Since Japan is poorly endowed with natural resources, she has inevitably grown more dependent on foreign sources. Hence, from the viewpoint of mineral strategy, it is vital for Japan to establish a captive source of overseas minerals.

On the other hand, the development of mineral resources plays a very significant role in economic development of developing countries. The government of Japan has thus been exerting every effort in pursuing its program of bilateral technical cooperation for mineral exploration in developing countries within the framework of its overall economic cooperation program.

In response to a request from the government of Peru, the government of Japan started collaborative mineral exploration projects in Peru 12 years ago. As the result of recent exploration (1979-1981), a promising zinc deposit has been discovered: 2 million tons with a zinc grade of 15 percent. Peru has a large, well-documented potential for mine development, but this nation has been unable to attract foreign investments over the past decade because of the heavy tax-oriented mining policy of its military government. Now, with a newly elected civilian government and new mining legislation on the books, Peru is seeking

foreign investment.

The purpose of this study is to examine the mining business arrangements between Japan and Peru through the development of the newly discovered zinc deposit, arrangements that will benefit both countries. It will be assumed that the Peruvian government will accept the involvement of a Japanese mining consortium in mine development activities in Peru. The problems to be clarified are :

1) Recognition of each country's position in mineral resources.

2) Goals of the Peruvian government and Japanese side in the negotiation of mine development agreements.

3) Constraints of the New 1981 General Mining Law in Peru and isolation of major issues.

4) Establishment of most likely organizational model and conditions for mine development (the "base case").

5) Options for terms of agreement using numerical evaluation.

The terms for negotiation can be classified in two areas: 1) measurable terms, and 2) unmeasurable terms or terms difficult to measure. The measurable terms comprise various taxes, government ownership, zinc sales price, smelting and refining cost, and debt-equity ratio.

Unmeasurable terms are characterized by economic welfare for Peru: forward linkages and backward linkages. Among these terms, negotiable and measurable terms such as zinc sales price, smelting and refining cost, and debt-equity ratio have been specifically discussed by using sensitivity analysis to isolate changes in Peruvian government revenue and Japanese capital outflow.

2. PERUVIAN MINERAL ENDOWMENT AND MINERAL POLICY

Peru is a nation blessed with abundant mineral resources including gold, silver, copper, lead, zinc and iron ore. Currently, the mining industry accounts for about 10 percent of Peru's GDP (gross domestic production) and employs about 2 percent of the total work force. The GDP is subject to international price fluctuations and world demand.

Although the contribution of the mining industry to the Peruvian economy seems low from the standpoint of GDP and employment, it is highly important in terms of the country's international balance of payments. For example, exports of mineral products, excluding oil, accounted for 43.3 percent of total exports in 1981; that figure rises to 65 percent when oil is included. The income from foreign exchange is then available for repayment of foreign loans and the purchase of machinery and capital goods needed for domestic development. This income is an important source of funds for the modernization of Peru.

The wealth of mineral resources in Peru has remained relatively undeveloped, partly because Peru lacks both capital and technology, and partly because of the inaccessibility of the high Andes, a valuable treasury of

mineral resources. Metal Bulletin Handbook(1982) reports that in 1981 Peru ranked sixth in world copper production (327,600 tons/year); fifth in lead (187,000 tons/year) and in zinc (497,000 tons/year); and third in silver (42 million oz). Peru has the potential for a higher rating in mineral production because of its proven reserves. Table 1 illustrates Peru's 1981 mining production, its mining potential, and world mining potential. As Inga (1981) pointed out, Peru's production is certainly lower than its mining potential, which suggests that there is much room for improvement in Peru's production rank in the international metal market.

Complicating factors in the development of Peru's mineral industry have been caused by changes in government policy toward mining occurring since World War II. Policy has alternated between a foreign investment orientation and a heavy tax orientation. The change in the country's mineral policy can be divided roughly into three periods: the first, 1950-1968, was characterized by a new liberal mining code favoring foreign investment; the second, 1969-1980, was characterized by the direct participation of the state corporation in the mining industry and counteraction of multinational mining companies by the Peruvian military government; and the third, 1981 to

Table 1 MINERAL POTENTIAL AND PRODUCTION IN PERU

(unit: thousand metric tons)

Mineral	World Potential	Peruvian Potential (%)	Peruvian Production Share (%)
Antimony	8,709	440 (5.0)	1.13
Bismuth	212	41 (19.6)	17.30
Copper	698,600	103,000 (14.7)	4.50
Iron	400,000,000	3,130,000 (0.78)	1.10
Mercury	430	35 (8.22)	0.56
Molybdenum	33,300	976 (2.93)	0.94
Gold	150	2 (1.3)	0.27
Silver	425	69 (16.1)	13.30
Lead	550,000	12,000 (2.17)	5.40
Tungsten	3,742	82 (2.19)	2.41
Zinc	353,840	25,810 (7.29)	6.70

Source: Guillermo Florez, " Mining Investment Opportunities in Peru ", CENTROMIN, 1981

present, has been characterized by the election of a civilian government and enactment of the New Peruvian General Mining Law No.109.

During the first period (1950-1968), the Peruvian government sought to provide a liberal commercial and financial climate through the abolition of currency regulations, allowance of regular profit remittances by foreign companies, and establishment of individual sectorial incentives. The first sectorial law was the 1950 Mining Code which substantially altered the taxation system, abolished export taxes on mine production, established a generous depletion allowance, exempted mining machinery and equipment from import duties, and established a mechanism through which "marginal deposits" would be subject to lowered income tax rates throughout the amortization period. The overall result of these various provisions of the 1950 Code, combined with the nearly simultaneous abolition of currency restrictions in Peru, offered the potential investor a powerful set of incentives: lowered taxes, no export tax, tax stability guaranteed for 25 years, a generous depletion allowance, and exemption from import duties.

The second period (1969-1980) was characterized by the establishment of a military government and increased

nationalism, which left no room for the existence of the powerful multinational mining companies which had operated in Peru during the first period. During that first period, Peru was largely dominated by the multinational mining companies called the foreign "Big Three" (Southern Peru Copper, Cerro de Pasco, and Marcona) which helped to discover and develop most of the large mineral deposits. Policy declarations of the Peruvian Revolutionary government, however, made it clear that the era of the foreign firms was over. Concessions granted to foreign mining firms to explore, mine, and develop Peru's huge mineral deposits were no longer available. The General Mining Law, enacted on June 9, 1971, and the explanatory regulations which followed, gave the Peruvian government a wide range of powers over the industry, and established the direct involvement of the state through Minero Peru, the state mining company.

In the third period (1981 to present), the Peruvian government has been trying to call foreign firms' attention to mine investment. The New General Mining Law No.109, adopted on June 13, 1981, by the newly-elected civilian government is clearly oriented toward attracting foreign and national investment. The new law is directed to:

1) Improvement of earnings in the mining industry.

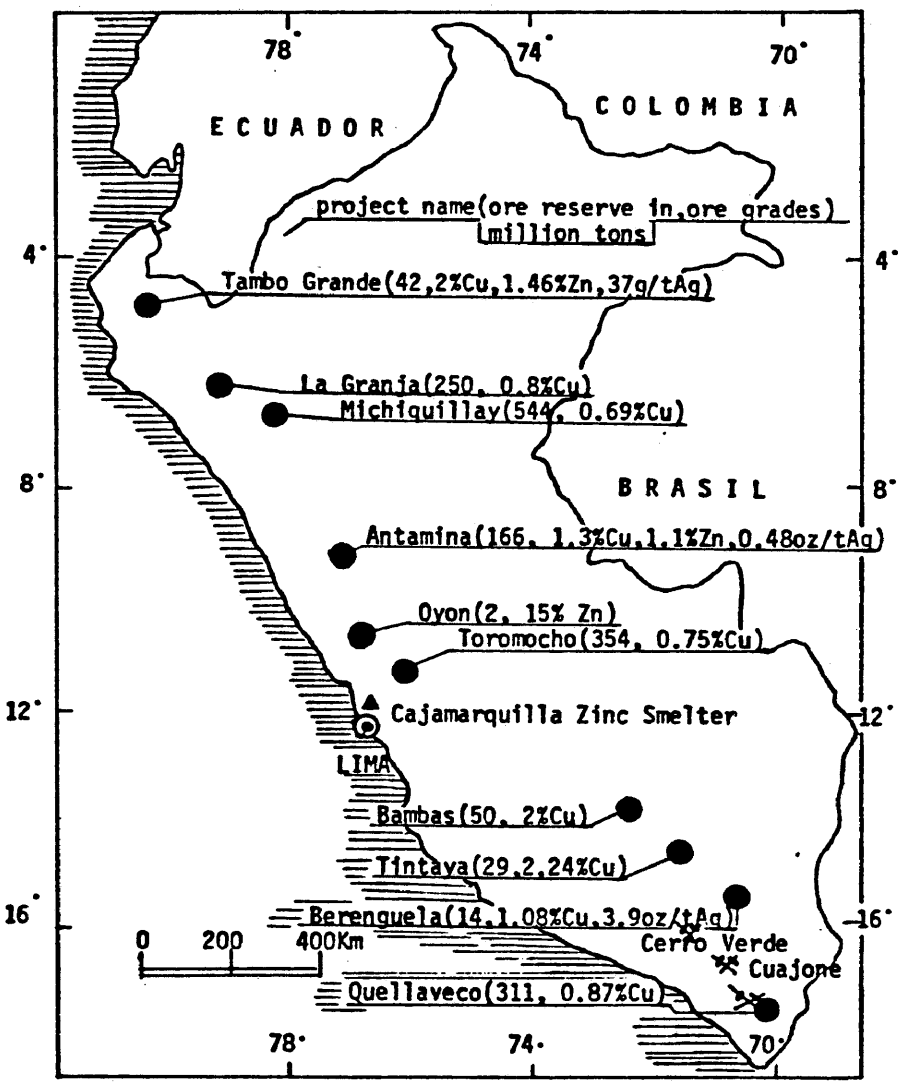
2) Infusion of foreign funds into Peru's economy.

3) Revitalization of the mining industry, or recovery from the stagnation of mining output during the military government regime.

4) Setting a strategy for future expansion and development of promising deposits.

Thus, the Peruvian government has been confronted with a dilemma. If the government eliminates foreign investor sharing of the resource rent entirely or establishes conditions that keep out foreign investment, it cannot maximize its revenues from the mining industry. If the government offers excessively attractive terms to foreign investors, the government may lose the next election (1985) or be overthrown by a military coup.

At present, Peru has many mine development projects and expansion plans for existing mines and smelters, but almost all these projects were identified 10 years ago. These projects, as shown in Figure 1, remain undeveloped in spite of their high profitability because of the previous military government's unreasonably high tax policy and exclusion of multinational mining companies. During the second period (1969-1980), no more than two projects among many big projects were put into production: Cuajone by Southern Peru Copper, and Cerro Verde by Minero Peru. It



Source: Compiled by the author from " Ministerio de Energia Y Minas (1981) "

Figure 1 MINE DEVELOPMENT PROJECTS BY THE PERUVIAN GOVERNMENT

is, as Suratgar (1982) noted, a device which is of key importance in the efforts of the Peruvian government to fund the huge new projects upon which they may have to embark in order to create employment and earn essential foreign exchange. The newly-elected civilian government firmly recognized that direct foreign investments are indispensable for revitalization of the mining industry.

3. JAPAN'S MINERAL RESOURCE DEPENDENCY AND MINERAL POLICY

Japan's demand for mineral resources has grown enormously in recent years because of the dramatic growth of the nation's industry and the concomitant increase in mineral consumption. Among the non-Communist countries, Japan is now second only to the United States in the consumption of basic industrial resources such as petroleum, copper, lead, zinc, aluminum, nickel, and crude steel. Japanese industry consumes more than 10 percent of world consumption: more specifically (1980 figures), petroleum, 10 percent; copper, 14 percent; lead, 10 percent; zinc, 17 percent; aluminum, 11 percent; nickel, 17 percent; and crude steel, 11 percent.

Unlike Peru, however, Japan's mineral resources are nearly depleted. Consequently, Japan has grown increasingly dependent on foreign mineral sources as is illustrated in Table 2. Japan's dependence on overseas supplies of bauxite and iron ores was almost 100 percent in 1980. Even for minerals such as lead and zinc, her dependency was 73 percent and 61 percent respectively in 1980. The decline in the output of established domestic mines has compelled the industry to undertake ever deeper, higher risk, and more costly exploration. This declining

Table 2 MINERAL PRODUCTION AND IMPORT-DEPENDENCE OF JAPAN IN 1981

(unit: metric tons)

Mineral	Production (a)	Import (b)	Total (a+b)	Dependence (b/a+b)
Bauxite	-	4,352,440	4,352,440	100 %
Chrome	13,600	743,937	757,537	98 %
Copper	51,500	3,338,326	3,389,826	98 %
Iron	450	123,361,846	123,362,296	100 %
Lead	47,000	125,000	172,000	73 %
Manganese	78,000	2,481,856	2,559,856	97 %
Molybdenum	200	16,290	16,490	99 %
Zinc	242,000	381,000	623,000	61 %

Source: Compiled by the author from " Metal Bulletin Handbook (1982) "

potential and profitability in domestic mining operations has compromised and restricted the ability of Japanese mining companies to pursue new and high risk ventures at home. In addition, these difficult conditions have been exacerbated by the need to comply with costly environmental controls designed to reduce the pollution and destruction of the natural environment that is often associated with mining operations. Hence, Japan's dependency on overseas natural resources will increase even more in the future.

Faced with severe problems, the Japanese government has undertaken a number of measures to assist the mining industry. Current Japanese mineral policy includes:

1) Acceleration of domestic exploration though survey and low interest loans.

2) Establishment of buffer stocks through stockpiling.

3) Financial assistance to Japanese mining companies undertaking direct investment into promising foreign projects.

There are many nations wishing to develop new mines to earn foreign currency for economic development. For the development of mineral resources, as Geiger (1982) noted, foreign direct investment through multinational enterprises continues to play an essential part due to various factors such as rising capital requirements, the need for

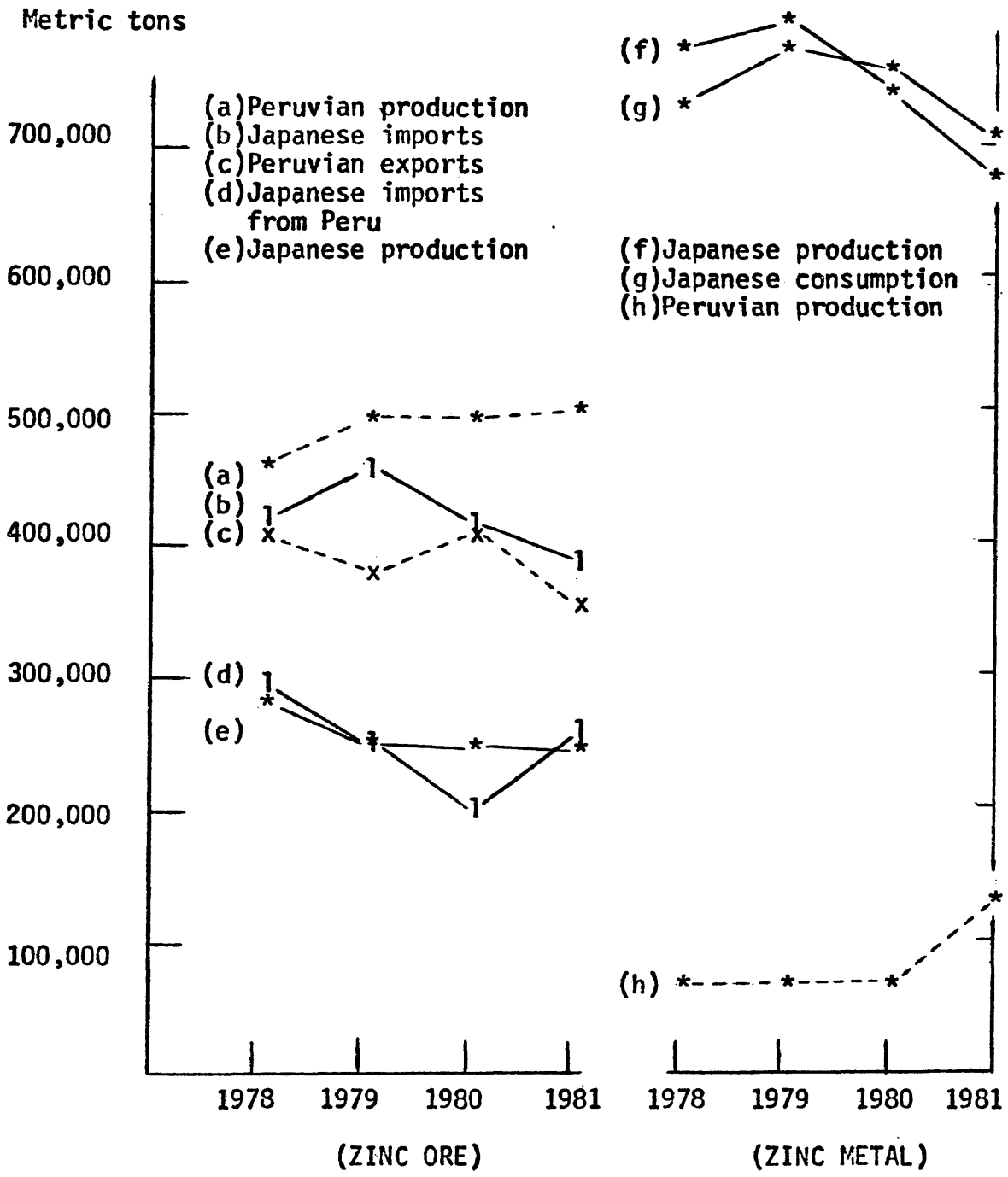
technological know-how in exploitation, and for an adequate distribution network. The large Japanese market will be an important outlet for resource-rich but capital-poor developing countries. In full recognition of the above facts, the Japanese government subsidizes, through the Metal Mining Agency of Japan (MMAJ), half the cost of exploratory drilling and tunneling and two-thirds of other exploration work for Japanese mining companies in their foreign exploration ventures. Recently, in recognition of the increase of such cases as Japanese mining and exploration companies join in the exploration projects executed by foreign mining companies, the Government subsidizes Japanese mining companies through MMAJ up to 50 percent of their expenditure on exploration activities. MMAJ also finances and invests in exploration projects undertaken by Japanese companies for copper, lead, zinc, manganese, nickel, bauxite, tungsten, molybdenum, chromite, manganese nodules and uranium. MMAJ guarantees the liabilities of Japanese companies who obtain financing from Japanese city banks for developing new copper, lead, zinc, manganese, nickel, bauxite, chromite and uranium mines in foreign countries. The maximum guarantee available is 80 percent of the total borrowed from financial institutions, for which a guarantee fee of 0.4 percent per annum is

charged. The Japanese government has also been exerting every effort in pursuing its program of collaborative mineral exploration and regional development plans for mining areas in developing countries. These are executed on a grant basis within the framework of the overall economic cooperation program of the Japanese government.

4. JAPANESE-PERUVIAN MINERAL RESOURCE RELATIONSHIP

Relations between Japan and Peru are close, especially in the field of mineral resources. For example, Japan's imports in 1981 from Peru included 68,872 tons of copper metal (21 percent of Japan's total imports of copper metal); 54,825 tons of lead ore (21 percent); 12,040 tons of lead metal (17 percent); 2,409,801 troy oz of silver metal (17 percent), 137 tons of tungsten ore (6 percent), and 252,462 tons of zinc ore (29 percent). According to Metal Bulletin Handbook (1982), 72 percent of Peru's 1981 exports of zinc ore were shipped to Japan. Japan's imports of zinc metal from Peru, however, were negligible until 1981. As is illustrated in Figure 2, Peru's production of zinc metal was very low compared with its large production of zinc ore. Peru's production of zinc metal was 66,000 tons at the most in 1980, but doubled in 1981 because of the construction of the Cajamarquilla smelter which has annual capacity of 100,000 tons. It is predicted that the Peruvian government will adopt a policy of exporting zinc in the form of metal, as it does with copper.

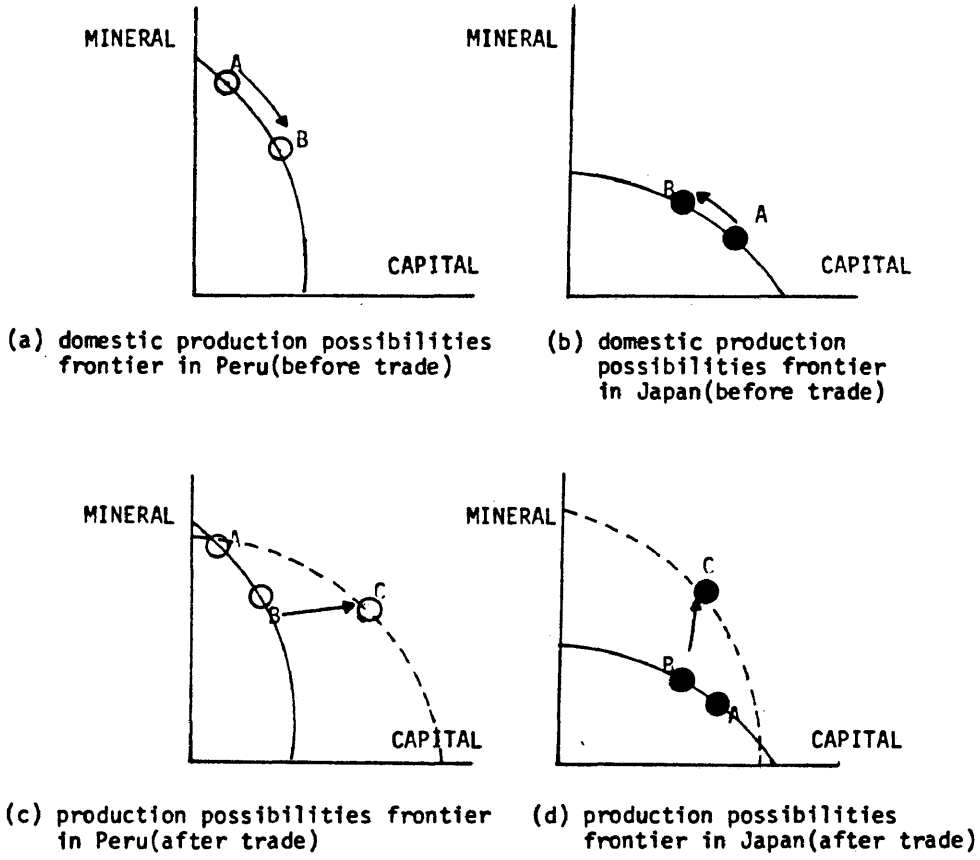
From an examination of mining situations in Peru and Japan, we can define Peru as resource-rich but relatively capital-poor, and Japan as resource-poor but relatively



Source: Compiled by the author from " Metal Bulletin Handbook (1982) "

Figure 2 PRODUCTION, CONSUMPTION, IMPORT AND EXPORT OF ZINC ORE AND METAL IN PERU AND JAPAN

capital-rich. Each country has an opposite advantage and disadvantage that can be alleviated to the benefit of both by trading minerals for capital through the establishment of a good mining business arrangement. International trade will enable each country to improve its relatively poor production factors by the exchange of minerals for capital. The gains from this kind of trade are, in relation to the production possibilities frontier, graphically shown in Figure 3. The trade enables both countries to move beyond the production possibilities frontier and to realize more than they would be able to produce on their own. The capital (foreign currency) gains from trade accruing to Peru and the mineral gains from trade accruing to Japan are depicted to show the move beyond each country's domestic production frontier. By developing their own resources, each country may be able to move from A to B. However, specialization induced by international trade between mineral and foreign currency enables each nation to move from A or B to C, extending its domestic production possibilities frontier. It follows that the fundamental reason for establishing a mining business between Peru and Japan should be the assurance of an increase in foreign currency for Peru and an increase in mineral supply for Japan.



(a) domestic production possibilities frontier in Peru(before trade)

(b) domestic production possibilities frontier in Japan(before trade)

(c) production possibilities frontier in Peru(after trade)

(d) production possibilities frontier in Japan(after trade)

Figure 3 COMPARATIVE ADVANTAGES AND GAINS FROM TRADE IN PERU AND JAPAN

Two questions arise: what is the optimal or economically efficient trade arrangement between Peru and Japan? Is there any measurement of the optimality of trade? Assuming a two-good (mineral and capital) and two nations (Peru and Japan) international economy, economic efficiency in exchange or trade can be achieved only when the marginal rate of substitution between mineral and capital for Peru equals the marginal rate of substitution between mineral and capital for Japan. But, how can the marginal rate of substitution be measured? In many cases, it will not be a simple trade between mineral and capital because the mineral will be obtained from the "develop and import" investments of the Japanese mining consortium. From the Japanese viewpoint, the economic justification is that the investment should produce a positive return and that a captive source of supply should be established. Hence, the Japanese side is satisfied if these conditions are achieved. On the other hand, from the Peruvian viewpoint, the economic justification is that the Peruvian government should increase its intake of foreign currency through taxes and profits in the name of all Peruvian citizens. The greater the Peruvian revenue, the more the Peruvian side will be satisfied. Thus, the mining business arrangements between Peru and Japan will be most successful

if negotiable terms satisfy the following conditions:

For Japan:

1) The establishment of a steady mineral supply

2) The ability to maximize return to equity

For Peru:

1) The ability to maximize revenue through taxes and return to equity

These conditions call for a measurement to evaluate the degree of Peruvian and Japanese satisfaction. The concept of retained value provides an indicator of the Peruvian shares of benefits from natural resource projects. According to Gillis(1982), movements in the ratio of retained value to gross national resource exports are indicative of host country performance in capturing larger shares of resource rent over time. Retained value can be defined as the total of all revenues from natural resource projects retained in the host country. But, retained value calculation involves indeterminate factors such as labor income for host country workers employed, proportion of income of expatriate workers spent locally, domestic procurement of goods and services and import content of domestic procurement, especially at the stage of preliminary feasibility study. Also, there are two money flows in retained value: one is to local workers and the

local area, and the other is to government directly.

Instead of retained value, we can introduce Peruvian government revenue as shown below because of its simple measurement and direct revenue for Peruvian government through mine development:

PGR = Kd + Td

where:

PGR = Peruvian government revenue

Kd = Capital income

Td = Income through various taxes

Peruvian government revenue can be shown in absolute terms, but will play an important role as a measurement of Peruvian satisfaction for the mine development project, and, in addition, will be a useful tool for altering the negotiable issues within the framework of a specific mine development project. Gillis (1982) noted that "non-tax benefits sought by host countries, such as employment, regional development and transfer technology, will tend to be relatively insignificant in developing countries owing primarily to the marked capital intensive and import intensity of modern extractive operations." Government revenue is, in general, by far the largest component of retained value as shown in case studies by Brodsky and

Sampson (1980).

On the other hand, Japan has succeeded in procuring mineral resources under the "develop and import" arrangement on the basis of long-term loans and purchase contracts rather than through direct investment. This arrangement is characterized, as clarified by Ozawa (1977), by the systems-focused group investment. This group investment plays an important risk-sharing function because large-scale investments, common in mine development projects, call for huge amounts of capital outlay involving extremely high risks. Yet the linkage-sharing function played by group investment appears to be a positive and unique characteristic of Japan's systems-focused strategy for extractive ventures overseas. In general, the group investment consists of mining firms, banks, equipment-producing firms, trading companies, and mineral-purchasing firms. Hence, the Japanese capital outflow can be measured as follows:

$$JKO = Cf - Kf - If - Pf$$

where:

JKO = Japanese capital outflow

Cf = Cost for zinc purchase

Kf = Capital income

If = Interest cost on loan

Pf = Profits for equipment export

This capital outflow will provide a tool for measuring the degree of satisfaction for overall economic evaluation, assuming that all mineral products obtained from the project will be exported to Japan.

5. DESCRIPTION OF THE PROJECT FOR CASE STUDY

In the belief that the development of mineral resources plays a significant role in the economic development of developing countries, the government of Japan has been exerting every effort in pursuing a bilateral technical cooperation program for mineral exploration and in providing regional plans for mining areas in developing countries. Implementation of these cooperative projects is expected to facilitate the economic "take off" of developing countries and to strengthen their technical capability.

In response to the requests from the Peruvian government, the collaborative mineral exploration projects have been ongoing in Peru since 1970. Three collaborative mineral exploration projects have been completed and one project is in progress and going well. Through these projects, promising deposits have been discovered in Michiquillay (544 million tons with grade of 0.69 percent of Cu) and Oyon(2 million tons with grade of 15 percent of Zn).

The Oyon project is selected here as a case study because it is small enough to develop from the viewpoint of capital expenditure. There are a number of large-scale

porphyry copper deposits awaiting development in Peru as is shown in Figure 1. However, the development of low-grade copper deposits sometimes requires huge capital expenditures ranging from $300 million to $600 million, a difficult financial barrier for the Peruvian state corporation. From the standpoint of initial capital expenditure for relatively capital-poor countries, there is a big advantage in mining small but high grade deposits like Oyon.

The Oyon project lies 100 kilometers north of Lima, the capital of Peru (see Figure 4). The area is located at an upland of 4,600 to 5,000 meters above sea level in the Cordillera Occidental, a main mountain range in the western Andes. The inhabitants are mainly Indio who have lived in villages in the basins along the valleys since Inca times. They are self-sufficient, sustaining themselves through old-fashioned farming methods and by breeding cattle. Geologically speaking, the project area belongs to the Polymetallic Sub-province of the Andean Plateau in the metallogenic province of Western Andes. Modern metal mines such as Raura (1,100 tons/day), Uchucchacua (200 tons/day) and Chanca (200 tons/day) are operating in the neighboring area. Although each is a small producer, the mines sustain more than 10,000 persons including employees' families.

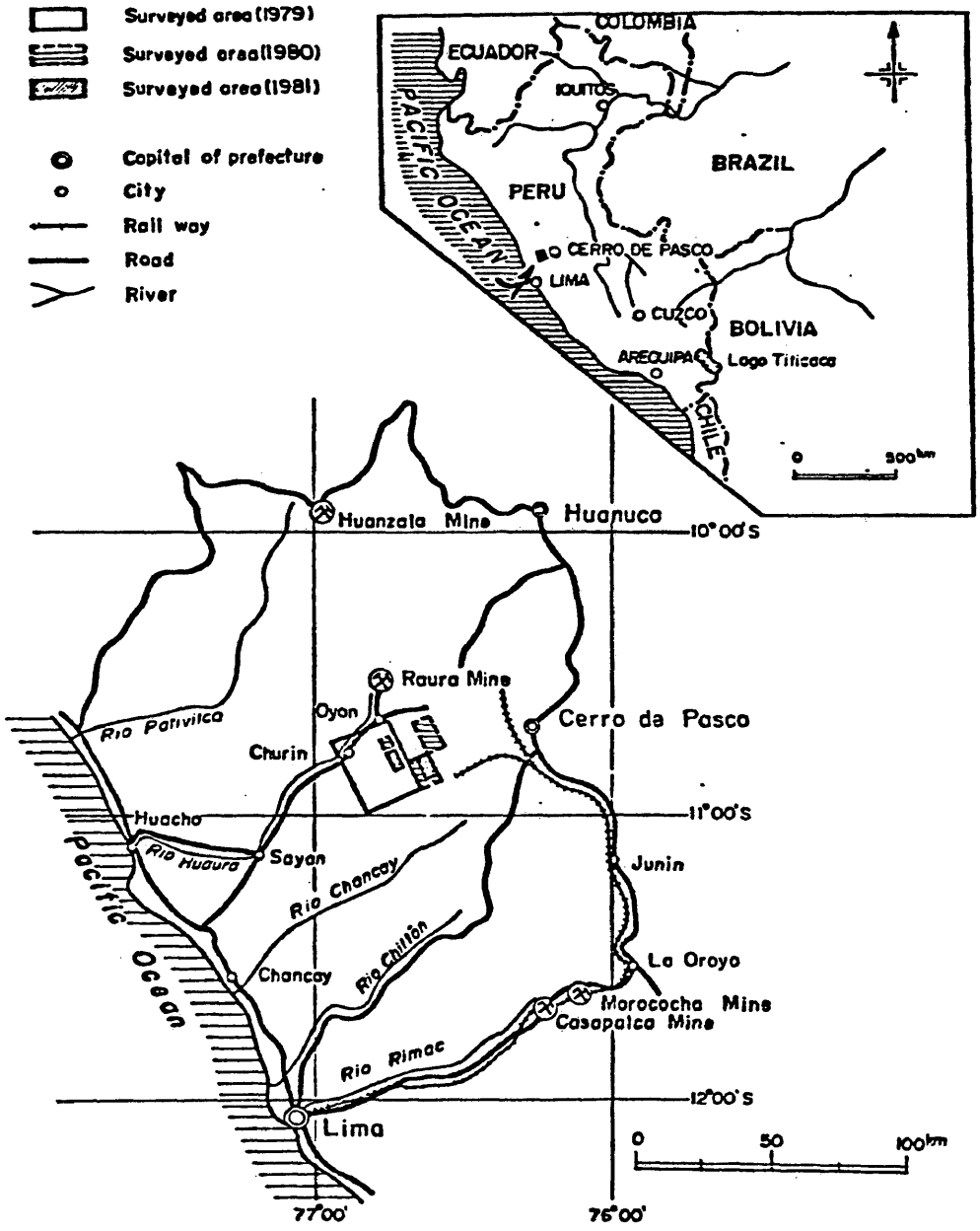


Figure 4 INDEX MAP OF OYON PROJECT

Development of the mines is a core of industrial activity that provides stable earnings to the communities which are located in the steep mountain range.

In the project area, several mineralized zones and indications were recently discovered as the result of the three-year(1979-1981) exploration executed by the Japanese and Peruvian governments. Geological survey was adopted to narrow down the promising areas. For the selected and prosperous areas, detailed geological survey, geophysical prospecting, and drilling exploration were added. The IP (induced polarization) method was applied to 15 measuring lines totaling 35.9 kilometers and the EM (electromagnetic) method to 10 lines totaling 13 kilometers. Drilling was done at 11 localities for 12 holes with the total length of 2,700 meters. In synthesizing results of aforesaid works, stratigraphy, geological structure, nature of igneous activity, relationship between geological structure and mineralization, and characteristics of mineralized showing were established. Distinct geophysical anomalies discovered were followed up by drilling, and high-grade lead-zinc massive sulfide orebody and high-grade copper-zinc skarn orebody were detected at several horizons between 100 meters and 200 meters from the surface.

These exploration activities have clarified that

mineralization extends discontinuously about 12 kilometers with an average width of 5 meters ranging from 4 to 30 percent in Zinc grade. Although this exploration has been continued by drilling and tunneling, the results obtained until now suggest that a promising zinc deposit has been discovered, roughly estimated to be 2 million tons with zinc grade of 15 percent.

6. MINE DEVELOPMENT ORGANIZATION

6.1. NEGOTIATION GOALS OF PERU AND JAPAN

Assuming that the zinc deposit discovered in Peru can be developed economically, a mine development contract must be negotiated between Peruvian and Japanese sides. In this section the conditions generally desired by Peru and Japan will be set forth and then modified in light of conflicting interests.

In negotiating a mine development contract, conflicts can be anticipated based on the goals of each side. As Mikesell (1975), Bosson and Varon (1977), Walde (1978), and Zorn (1980) pointed out, the objectives of the mineral-rich Peruvian side are thought to be:

1) to maximize Peruvian government revenue through taxes in order to earn foreign exchange,

2) to maximize return to equity from mining operations,

3) to avoid relinquishing any rights to control over company policies and operations, such as marketing, hiring, and foreign exchange, and

4) to maximize the contribution of the mine operation to the economic welfare and development in Peru through the increase in employment, the purchase of local goods and

services, and the provision of infrastructure and social services.

These objectives differ from, and may conflict with, the development goals of the Japanese side. As Radetzki (1980) mentioned, the more dependent the Peruvian side is on foreign factors, the more it will have to subordinate itself to foreign wishes, and the less freedom it will be able to exercise in choosing and executing policies to satisfy national objectives.

On the other hand, the major objectives of the Japanese side deserve emphasis:

1) to establish the steady mineral supply at favorable prices to satisfy the national needs,

2) to maximize the rate of return to equity over the mine life,

3) to assure complete freedom for management, production, marketing and financial operations, and

4) to guarantee against expropriation or demands for contract negotiation during the life of the agreement.

It is apparent that there are several conflicting interests among the objectives of both sides. However, congruous, common interests among their objectives can be found:

1) Availability or development of zinc deposits will

contribute not only to Peruvian prosperity but also to Japanese economy because the two countries have a complementary affinity; a mineral-rich but short-capital country and a mineral-poor but capital-rich country.

2) Hence, a corollary of the rule is that any conflicts should be considered or discussed based on what Mikesell (1975) called "joint maximizing solutions"; that is, those that do not increase the share of one party at the expense of the total revenue pie.

3) Needless to say, the Japanese side should abide by the laws and regulations of Peru.

The goals of the two sides in negotiation may be narrowed by some constraints derived from the organization model for mine development and from the Peruvian New General Mining Law No. 109.

6.2. ORGANIZATION MODEL

In equity-based cooperation between multinational companies and the host government, a distinct trend from wholly-owned subsidiaries to joint venture forms has been perceptible in the last twenty years (Walde, 1978). Walde mentions that the trend can be ascribed to the general notion of "partnership", but more so to the objective of involving a greater number of parties in a mining project,

thus reducing the financial burden and the economic risk. Especially, joint ventures with a host government are advantageous in that they reduce the political risks inherent in natural resources investments.

The mine development by joint venture with the Peruvian government will probably occur for the Oyon project because it was discovered by collaborative exploration between the state institute (Instituto Geologico Minero Y Metalurgico: INGEMET) and the Metal Mining Agency of Japan (MMAJ). At the stage when mine development begins, however, this project should be undertaken by the Peruvian state corporation (Minero Peru) and the Japanese private mining consortium (Overseas Mineral Resources Development Co.(OMRD)) because neither INGEMET nor MMAJ has the right to develop a mine. Hence, it may be reasonable to assume that the zinc deposit discovered in Peru will be developed in joint venture form between Minero Peru and OMRD.

In view of the Peruvian mineral endowment, economic environment, and the New General Mining Law No. 109, current mining policy in Peru can be summarized as emphasizing the following:

1) increasing the rate of production by introducting foreign investment, and

2) increasing the value added by using the

Cajamarquilla smelter.

Current mining policy in Japan can be summarized as emphasizing the following:

1) assisting the Japanese mining industry through the promotion of foreign exploration and development, and

2) reducing its vulnerability by maintaining captive sources of supply.

In due consideration of both country's mining policies, the likely organization model for mine development should be based on the following:

1) The Peruvian authority to enter mine development agreements should be vested by the Peruvian government in a state corporation (Minero Peru).

2) The Japanese authority to enter into a mine development agreement should be vested in the Japanese private mining consortium (OMRD) under the supervision of the Japanese government.

3) In accordance with Peruvian national policy, Minero Peru has at least 25 percent equity capital in Peru-Japan Joint Venture Company (PJC), the locally incorporated company that will carry out the actual operations on behalf of Minero Peru and OMRD. The balance of equity should be owned by OMRD.

4) In order to increase value added in Peru, smelting

and refining should be made an operation of the Cajamarquilla Plant owned by Minero Peru. This plant was constructed in 1981 under the policy of putting value added in Peru. Its capacity is 100,000 tons/year of zinc metal.

5) All of borrowing money should be from OMRD Affiliates because of low interest rates and the ease of borrowing as compared with Peruvian financial institutions.

6) In order to reduce Japanese vulnerability by maintaining captive sources, zinc sales should be the province of the Japanese side, with all zinc metal exported to affiliated parties in Japan.

The organization model for mine development shown in Figure 5 diagrams the relationships among the parties involved in the agreements-- smelting and refining agreement, loan agreement, and zinc sales agreement. In negotiation of the mine development contract between Minero Peru and OMRD, all three agreements must be discussed and conflicting issues resolved.

For the Peruvian side, a careful definition of "affiliate" is vital for several reasons. As Gillis and Wells (1980) clarified, in the absence of an adequate definition, the scope for substantial tax revenue loss from interest payments to affiliates is rather large, and a defective definition of affiliate increases the chances

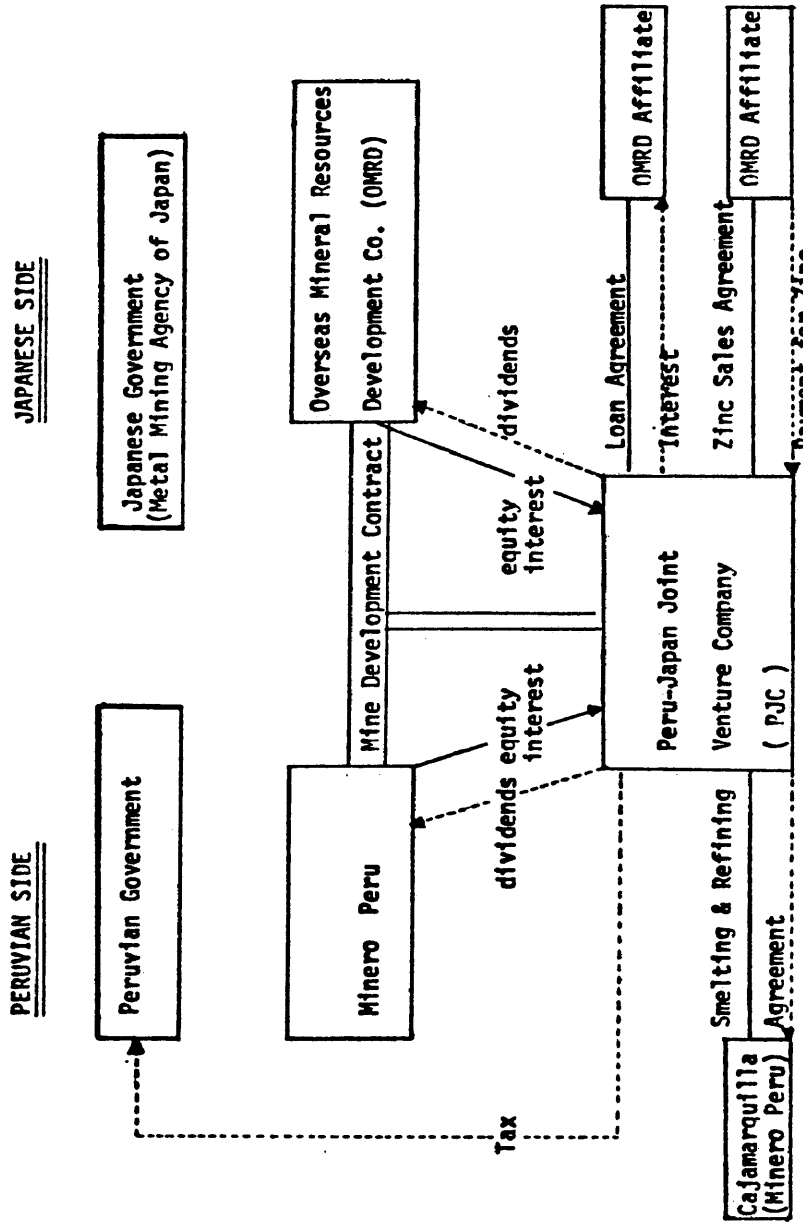


Figure 5 ORGANIZATION MODEL FOR MINE DEVELOPMENT

that the Peruvian government will lose significant amounts of tax revenues through various other "transfer pricing" devices. In the case of the United States and European countries, affiliates are usually easy to identify, but this is not always the case with Japanese firms, owing to the complex maze of affiliations among Japanese banks and major firms on the one hand, and between major firms on the other. In consequence, "affiliate firm" cannot be defined by either shareholder or management control in the case of Japanese firms. Here, "Japanese affiliate firm" should be tentatively defined as the "inter-keiretsu groups" in Japanese oligopolistic industrial groups such as Mitsui, Mitsubishi and Sumitomo.

7. ARRANGEMENTS FOR MINE DEVELOPMENT

7.1. SOME CONSTRAINTS FROM THE PERUVIAN NEW 1981 GENERAL MINING LAW

There are Peruvian laws and regulations which involve some constraints for negotiations between Minero Peru and OMRD. With the adoption of the New 1981 General Mining Law No. 109, the following considerations will be crucial to the negotiations:

1) Elimination of the state monopoly on refining and trading of metals. The export marketing monopoly of Minero Peru Commercial (MINPECO) has been abolished, but it retains the right to be marketing agent for the wholly state-owned Centromin and Minero Peru.

2) Abolishment of the 17.5 percent ad valorem export levy.

3) The concept of special mining enterprise, in which the state must have at least 25 percent of the equity capital, has been made more flexible by allowing other state concerns and banks, besides Minero Peru, to participate in the state portion of the equity.

4) Special tax concessions for new projects will be made equal for both state-related and purely private companies.

5) For new mine development and expansion projects, income tax can be reduced by contract by up to one-third for the payback period plus five years.

6) An investment tax credit equivalent to 40 percent of income taxes has been established. The mining tax credit enables investments to be credited against income taxes for the year in which they are made, with the possibility of carrying forward the unused portion of the credit for another three years.

7) For new mine development, tax stability will be granted for 10 years beginning from the first-year operation. Tax stability for the payback period plus 5 years is also granted if a mining company installs or expands processing plants of more than 20 percent of its capacity.

8) According to Resolution No.002-NG-81-EFC/35, CONITE (Comision National De Inversiones Y Tecnologias Extranjeros), the government body in charge of granting permission for foreign direct investment and registration, promises an maximum annual remittance of dividend or net profit equivalent to 20 percent of investment.

More specifically, measurable terms for the economic evaluation can be defined as follows:

1) Import tax: 20 percent of the price will be

imposed.

2) Income: equivalent to total volume of production times the price.

3) Export tax: Decree 33 progressively abolishes the 17.5 percent ad valorem export levy introduced in 1976. Beginning July 1, 1983, export tax was reduced to five percent of total sales value for big mining companies and two to three percent for small to medium mining companies.

4) Operating cost: cost necessary for labor, supplies, power, etc.

5) Depreciation: depreciation is allowed at the rate of 100 percent investments in machinery, equipment, installations, and housing made in each fiscal year up to 300 UIT. Larger investments for the same purpose up to 900 UIT may be amortized at the annual rate of 20 percent, except in such cases where the customary rates allow higher amortizations.

6) Net income: net income is defined as income less export tax, operating cost, depreciation, and interest.

7) Mining community: the article concerning Mining community cannot be found in the New 1981 General Mining Law, but according to the 1971 General Mining Law,Mining community is defined as a private legal entity organized to represent the total number of workers who work for the

company and to encourage them to participate in the ownership, management, and profits earned by the company. Mining companies are to deduct, free of taxes, 10 percent of their net income; 4 percent as "liquid participation" for Peruvian workers and 6 percent for "property participation" by Peruvian workers. The 4 percent is to go to a worker's cooperative and the 6 percent is to be invested as shares in the company held by the workers. Once the workers have shares, they would be guaranteed one representative on the board of directors. Workers' representation on the board, therefore, is to be in proportion to equity ownership.

8) Research and Development: one percent of net income should be financed to the Peruvian research and development institute (INGEMET).

9) Taxable income: taxable income equals income less Mining community and research and development.

10) Income tax: income tax is based on the profitability of an operation with a maximum income tax rate of 55 percent. With Peruvian income tax, the unit of imposed tribute, U.I.T. (Unidad Impositiva Tributaria), plays an important role for calculating income tax. Presumably, U.I.T. will be revised annually by the government. In 1982, U.I.T.equaled 600,000 soles. The tax

rate schedule is listed below:

from 0 to 150 UIT.....30 percent

from 150 to 1,500 UIT.40 percent

from 1,500 to 3,000...50 percent

more than 3,000 UIT...55 percent

11) Net profit: net profit is defined as the difference between taxable income and income tax.

12) Net Cash Flow: net cash flow is equal to net profit plus depreciation less total investments made during the year.

The calculation method for net cash flow based on the Peruvian tax system is summarized in Table 3.

7.2. ISOLATION OF MAJOR ISSUES

As Radetzki (1978) pointed out, wholly state-owned Minero Peru will be interested in promoting broader goals than those pursued by OMRD, which probably will make it harder to narrow down the issues and to identify the areas of possible compromise. Therefore, negotiations between Minero Peru and OMRD should be based on the measurable terms. The terms for negotiation can be classified into two groups; 1) measurable terms and 2) unmeasurable terms or terms difficult to measure. The measurable terms will consist of import tax, export tax, depreciation, mining

Table 3 TYPICAL CASH FLOW CALCULATION BASED ON THE NEW 1981 GENERAL MINING LAW

Income	
- Export tax (2.5 % of income)	
- Operating cost	
- Depreciation	
- Interest	
Net income (A)	
- Liquid participation for Peruvian workers	(4 % of A)
- Property participation by Peruvian workers	(6 % of A)
- R & D for INGEMET	(1 % of A)
Taxable income	
- Tax (according to U.I.T.)	
Net profit	
+ Depreciation	
- Capital cost	
+ Borrowed money	
- Principal payment	
Net Cash Flow	

community, R & D, income tax, government ownership, debt-equity ratio, smelting and refining charges, and zinc sales price. On the other hand, unmeasurable terms are characterized by economic welfare for Peru: forward linkages and backward linkages. Among these terms, negotiable and measurable terms will be specifically isolated for further discussion.

It is clear from the previous chapter that negotiable terms are very limited because of the constraints derived from the Peruvian laws and regulations. The measurable terms in regard to taxes are almost fixed, and there is no room for negotiation between Minero Peru and OMRD. It is true that income tax can be reduced by contract up to one-third for the period of recovery of the investment plus five years. But this preferable term for OMRD is effective only when:

1) a new mine development will be started with a capacity of more than 5,000 tons/day, or

2) an existing mine with a capacity of more than 350 tons/day will expand its capacity more than 20 percent.

In the Oyon project, the zinc deposit is too small to produce 5,000 tons/day because its ore reserve is assumed to be only 2 million tons. Therefore attention must be paid to U.I.T. (Unit of Imposed Tribute) for the correct

calculation of income tax. Can U.I.T. be fixed by the U.S. dollar? For example, the average annual exchange rate of the Peruvian sol was 430 soles/$ in 1981, and the U.I.T. for 1982 was 600,000 soles. Then, U.I.T. is expressed by $1,395 (1,395 = 600,000/430). U.I.T. seems to be determined annually in due consideration of Peruvian inflation. So, if U.I.T. is fixed by the U.S. dollar, then, as will be shown later, the dollar can adjust for the inflation problem, and U.I.T. expressed by $1,395 will be available over mine life without any change in U.I.T. value.

Government ownership depends on the budget of the Peruvian government, on how much money Minero Peru and state concerns can provide for the initial capital expenditure. In due consideration of mounting foreign liabilities (422.8 billion soles equivalent to $1 billion in 1981) and of the government finance deficit (416.1 billion soles equivalent to $984 million in 1981), it might be reasonable to suppose that the most likely government ownership will be 25 percent, although it is possible that import tax on equipment from Japan may be used for equity of Minero Peru, and that it depends on the debt-equity ratio of the initial capital expenditure.

In conclusion, it may be that the most important

negotiable and measurable issues are debt-equity ratio, smelting and refining charges, and zinc sales price. Other issues discussed are fixed or negligibly flexible under current circumstances and the constraints of the Peruvian New General Mining Law.

7.3. PROJECT EVALUATION FOR THE BASE CASE

7.3.1. FUNDAMENTAL ISSUES FOR EVALUATION

Before making a project evaluation, there remain several problems to be addressed: (1) Peru's high inflation rate, (2) forecast of zinc price, (3) debt-equity ratio, (4) smelting and refining charges, and (5) optimal mill size and project life.

7.3.1.1. PERU'S HIGH INFLATION RATE

Until 1975, the Peruvian government adopted the monetary policy of keeping the exchange value of Peruvian currency (sol) high instead of cheapening it in order to promote competition of domestic products in the international market. After 1975, however, along with trade deficits, soaring foreign debt and dwindling monetary reserves, the Peruvian government was forced to give up the monetary controls under the pressure of IMF. The exchange rate fell from 38.7 soles/$ in 1974 to 430 soles/$ in 1981. Figure 6

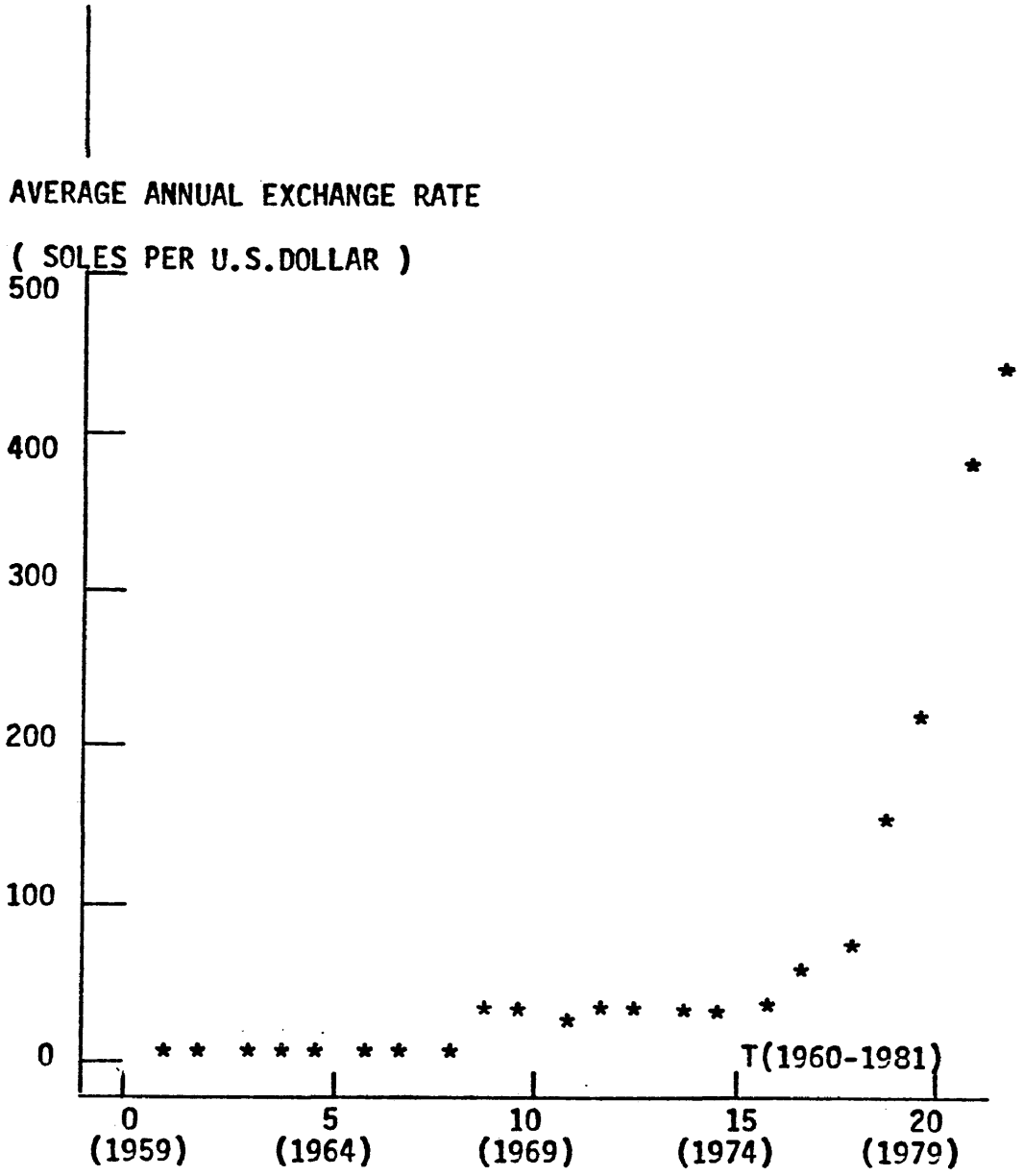


Figure 6 AVERAGE ANNUAL EXCHANGE RATE OF PERUVIAN SOL PER U.S. DOLLAR FROM 1960 TO 1981

shows the change in the average annual exchange rate of the Peruvian sol versus the U.S. dollar from 1960 to 1981. With the fall in the value of Peruvian sol, has come the high inflation typical of many Latin American countries. Figure 7 shows the historical change in Peru's annual consumer price index from 1960 to 1980. The annual consumer price index had risen by only 8 percent annually from 1968 to 1973, but increased more rapidly each year thereafter until the inflation rate reached 70 percent in 1980. The inflation rate in 1981 and 1982 was also at unacceptable levels of 72.3 percent and 78 percent respectively. This is a critical problem facing the current government.

The plot on average annual exchange rate vs. CPI as shown in Figure 8 indicates that there is a strong linear association between two variables; exchange rate and CPI, with a correlation coefficient of 99.6 percent. This fact means that the fall in the value of sol can be measured by the inflation rate, or that the inflation problem in Peru can be excluded by using U.S. dollars.

7.3.1.2. FORECAST OF ZINC PRICE

Historical data of annual Prime Western Zinc Prices expressed by actual prices shows a big gap between before

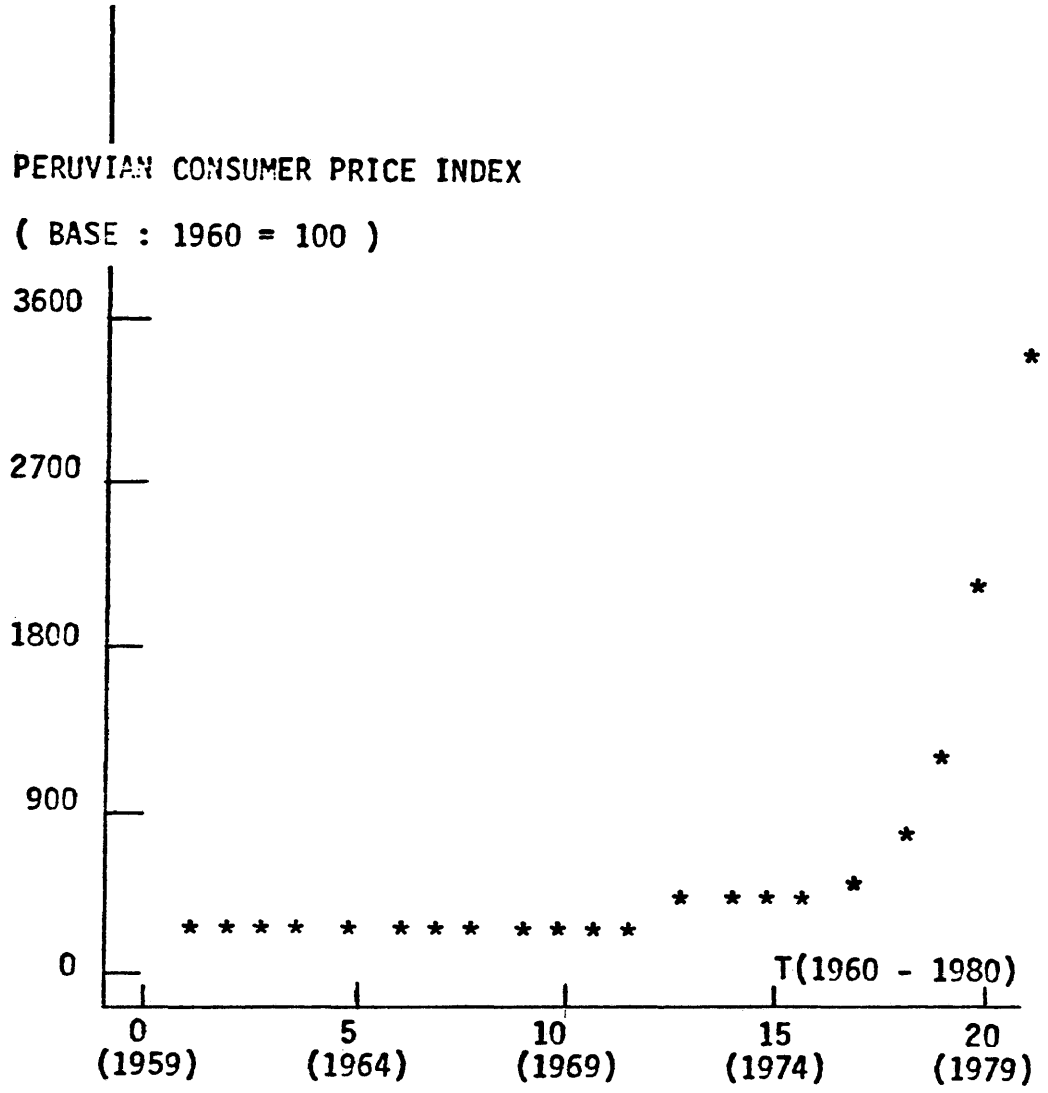


Figure 7 CHANGE IN PERUVIAN CONSUMER PRICE INDEX FROM 1960 TO 1981

THE REGRESSION EQUATION IS R = 9.75 + 0.105 I

COLUMN	COEFFICIENT	ST.DEV.OF COEF.	T-RATIO=COEF/S.D.
-	9.751	2.092	4.66
I	0.104754	0.002144	48.85

ST.DEV. OF R ABOUT REGRESSION LINE IS S=7.876 WITH 19 DEGREE OF FREEDOM

R-SQUARED = 99.2 PERCENT
R-SQUARED = 99.2 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

DUE TO	DF	SS	MS=SS/DF
REGRESSION	1	148018.6	148018.6
RESIDUAL	19	1178.6	62.0

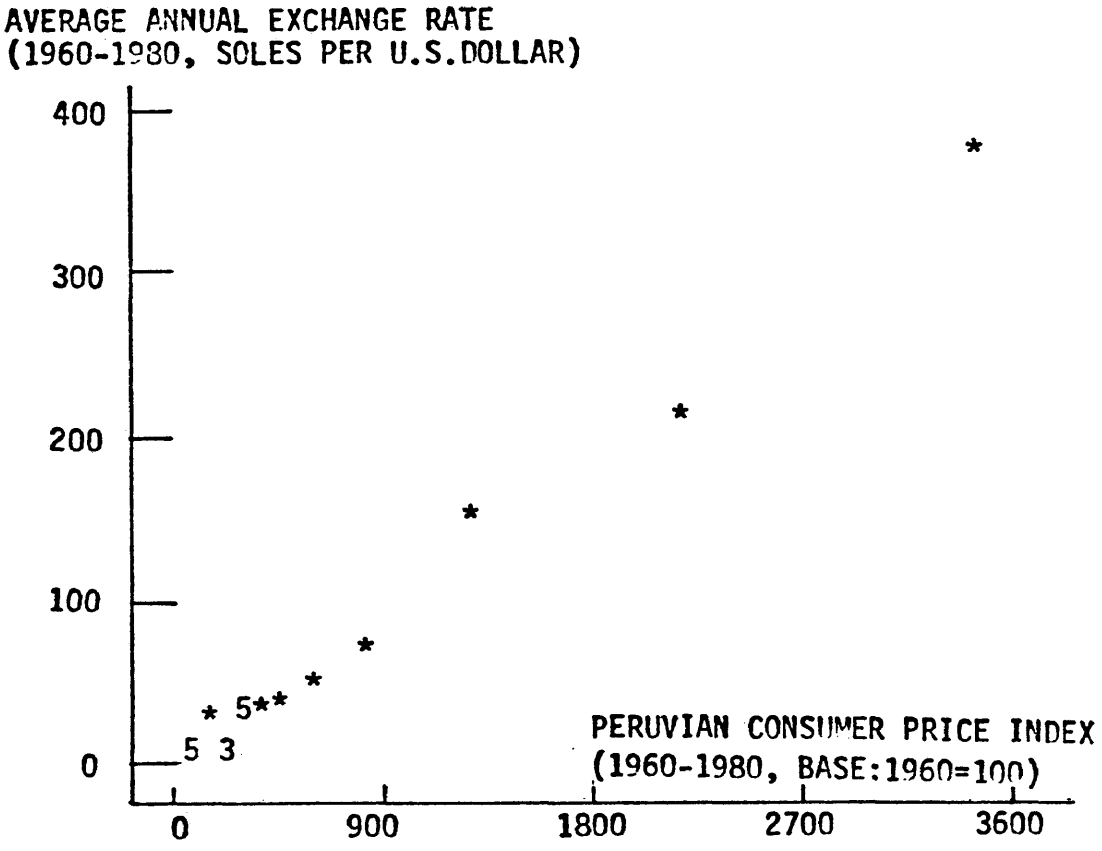


Figure 8 RELATIONSHIP BETWEEN EXCHANGE RATE AND CONSUMER PRICE INDEX FROM 1960 TO 1980

and after the "oil crisis" of 1973 as is illustrated in Figure 9. From 1946 to 1973 the prices are constant or show only moderate fluctuations. After 1973, however, the prices rose more than 30 cents per pound because the Cost of Living Council abolished price controls on December 6, 1973. Figure 10 shows the monthly variation of zinc prices from January 1974 to December 1981, which indicates the cyclical trend. For the project analysis, zinc price will be used by obtaining the average value (37.389 c/lb) between January 1974 and December 1981 on the assumption that a long-term zinc sales agreement can be established. This assumption may be allowed in the case of short mine life like the Oyon project.

7.3.1.3. DEBT-EQUITY RATIO

As pointed out by Faber (1982), the main benefit to an investor who uses borrowed money is that he is able to recover a large share of his original capital investment in the early years of the project. Repayment of loans is superior to dividend income because the dividends are taxed. High level of interest payments on outstanding loans offer similar benefits because interest payments normally qualify as a tax reduction. In the early years, this benefit is likely to be worth substantially more to

THE REGRESSION EQUATION IS
P = 5.08 + 0.762 T

COLUMN	COEFFICIENT	ST.DEV. of COEF.	T-RATIO=COEF/S.D.
-	5.084	2.251	2.26
T	0.7623	0.1061	7.19

THE ST.DEV. OF P ABOUT REGRESSION LINE IS S=6.611 WITH 34 D.F.

R-SQUARED = 60.3 PERCENT
R-SQUARED = 59.1 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

DUE TO	DF	SS	MS=SS/DF
REGRESSION	1	2257.79	2257.79
RESIDUAL	34	1486.13	43.71
TOTAL	35	3743.92	

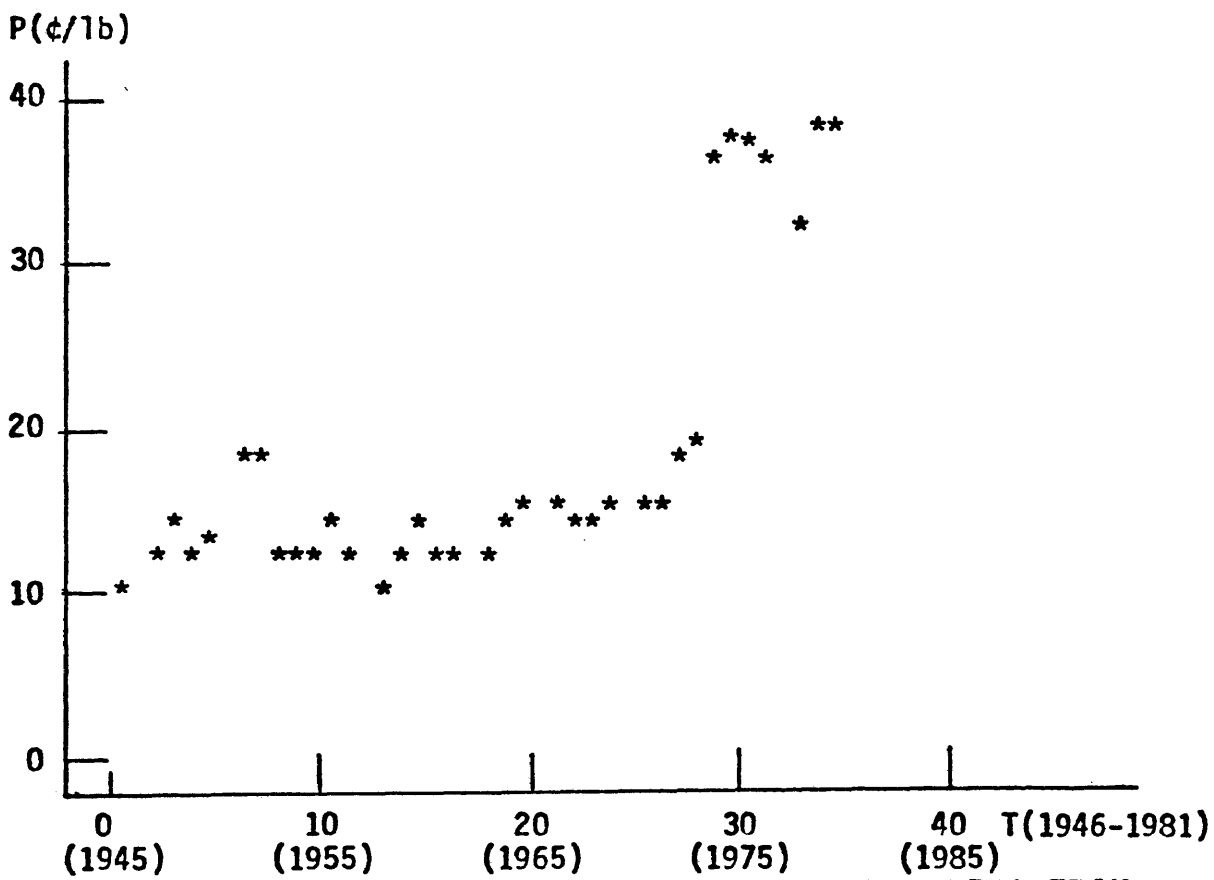


Figure 9 ANNUAL ZINC PRICES OF PRIME WESTERN ZINC FROM 1946 TO 1981

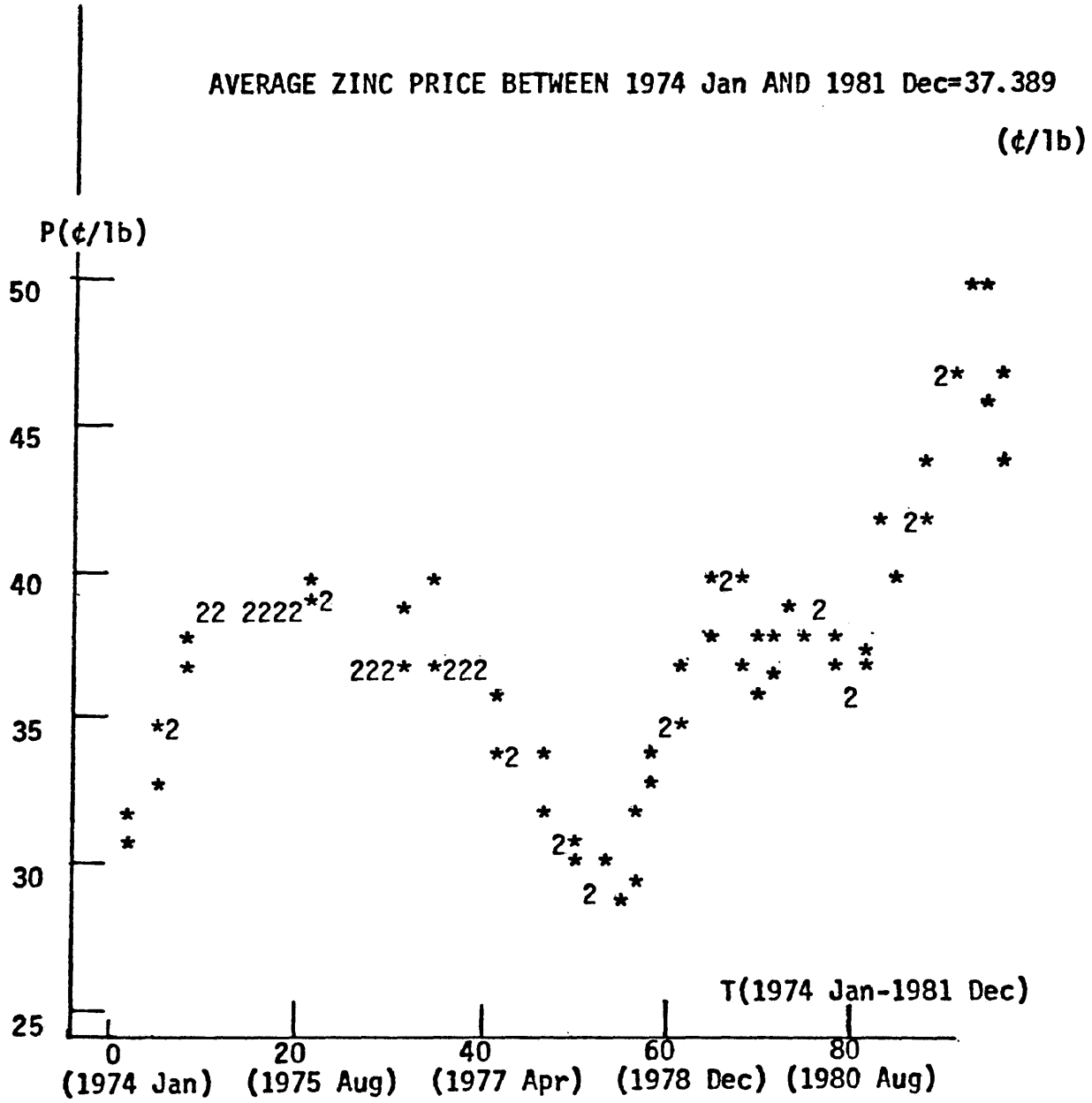


Figure 10 MONTHLY VARIATION OF ZINC PRICES FROM JANUARY 1974 TO DECEMBER 1981

the investor than any interest withholding tax he may have to pay. In short, interest on borrowed money is tax deductible as an operating cost and the distribution of equity investment dollars is spread over all or part of the project life when borrowed money is involved.

According to Gillis (1982), in natural resource projects in developing countries, debt-equity ratios of 3:2 to 3:1 and higher are not uncommon for American-based firms. In contrast, debt-equity ratios of 4:1 and even 6:1 are not rare for Japanese firms operating in developing countries.

Historical data of eight mine development projects involving Japanese firms indicate that debt/(debt+equity) ranges from 68.3 percent to 99.9 percent as is shown in Table 4, which means that the investments of Japanese firms are characterized by a high percentage of borrowed money. In the case of the Mamut project in Malaysia, about $34 million was invested in equipment with zero equity capital. Only $2,000 was invested as equity capital in the Katanga project in Peru. In general, the high percentage of borrowed money observed in investments by Japanese firms may be attributable partly to the risk-sharing function of group investment, and partly to the principal object of resource security which enables Japanese firms to put value added in the refining and smelting process.

Table 4 MINE DEVELOPMENT PROJECTS BY JAPANESE FIRMS (PART 1)

PROJECT NAME	DESCRIPTION OF THE PROJECT	TOTAL CAPITAL EXPENDITURE	CAPITAL OWNED BY JAPANESE FIRMS	CONSTRUCTION PERIOD
MAMUT, MALAYSIA	ore type---porphyry copper reserve----67,401,000 tons grade------0.59 % mill capacity-18,000 t/day	$ 122,291,000	equity----$ 0 loan------$ 88,469,000 equipment-$ 33,822,000 total $122,291,000 debt/(debt+equity)=72.3%	1970-1975
SOROAKO, INDONESIA	ore type---laterite nickel reserve----19,753,000 tons grade------2.26 % mill capacity-16,200 t/day	$ 840,000,000	equity----$ 11,250,000 loan------$ 36,000,000 total $ 47,250,000 debt/(debt+equity)=76.2%	1973-1978
RIO TUBA, PHILIPPINES	ore type---laterite nickel reserve----22,117,000 tons grade------2.2 % mill capacity- 2,000 t/day	$ 27,611,000	equity----$ 881,000 loan------$ 24,176,000 total $ 25,057,000 debt/(debt+equity)=96.5%	1974-1977
KATANGA, PERU	ore type---copper(contact) reserve---- 199,000 tons grade------4.77 % mill capacity- 150 t/day	$ 4,598,000	equity----$ 2,000 loan------$ 4,446,000 total $ 4,448,000 debt/(debt+equity)=99.9%	1973-1974

Table 4 MINE DEVELOPMENT PROJECTS BY JAPANESE FIRMS (PART 2)

PROJECT NAME	DESCRIPTION OF THE PROJECT	TOTAL CAPITAL EXPENDITURE	CAPITAL OWNED BY JAPANESE FIRMS	CONSTRUCTION PERIOD
HUANZALA, PERU	ore type---Cu,Pb,Zn(contact) reserve---- 2,980,000 tons grade------ 0.75 % Cu 4.0 % Pb 10.2 % Zn mill capacity- 1,050 t/day	$ 15,008,000	equity----$ 2,304,000 loan------$ 10,251,000 equipment-$ 2,453,000 --- total $ 15,008,000 debt/(debt+equity)=68.3%	1966-1968
MUSOSHI, ZAIRE	ore type---copper(strata) reserve----55,900,000 tons grade------4.05 % mill capacity- 5,000 t/day	$ 193,572,000	equity----$ 6,000,000 loan------$143,611,000 equipment-$ 43,961,000 --- total $193,572,000 debt/(debt+equity)=74.2%	1969-1972
AKOUTA, NIGER	ore type---uranium(strata) reserve----10,769,000 tons grade------ 0.407 U_3O_8 mill capacity- 2,200 t/day	$ 40,899,000	equity----$ 3,888,000 loan------$ 37,011,000 --- total $ 40,899,000 debt/(debt+equity)=90.5%	1974-1978
QALEH-ZARI, IRAN	ore type---copper(vein) reserve---- 836,000 tons grade------4.12 % mill capacity- 400 t/day	$ 7,371,000	equity----$ 56,000 loan------$ 7,315,000 --- total $ 7,371,000 debt/(debt+equity)=99.2%	1972-1975

Average percentage of debt/(debt+equity) of eight projects shows approximately 80 percent, equivalent to a debt-equity ratio of 4:1. Given the uncertainties for investment in Peru, OMRD will seek to severely limit the equity participation, but it may be reasonable to assume that the debt-equity ratio for the base case will be 4:1.

7.3.1.4. SMELTING AND REFINING CHARGES

The zinc produced in the Oyon project is from zinc sulfide ores with an average zinc content of 15 percent. High-grade concentrate with 60 percent zinc can be obtained from straight-zinc ores through floatation process. The concentrate would be transported to the Cajamarquilla smelter in Lima for refining, producing zinc metal specified as Prime Western zinc.

The operating cost depends on the major factors of geographical location, mineralogic character, and the availability of labor. The operating cost is estimated to be $18.73 per ton of crude ore expressed by 1983 U.S. dollars: mine cost ($4.80/ton), mill cost ($2.24/ton), and smelting and refining cost ($11.69/ton). This cost estimation was made on the basis of the highest case of the existing operating experience data. The smelting and refining cost of $11.69 per ton of crude ore is tentatively

estimated as the most likely case, and hence it will be negotiable with Minero Peru which owns the Cajamarquilla plant.

7.3.1.5. OPTIMAL MILL SIZE AND PROJECT LIFE

Capital function for the various mill sizes can be obtained by using the existing capital cost data for various projects. Figure 11 shows the linear association between capital cost and mill capacity for five underground mine projects in Peru: Tintaya ($270 million for 8,000 tons/day), Antamina ($661 million for 20,000 tons/day), Bambas($301 million for 8,000 tons/day), Corocohuayco ($150 million for 3,000 tons/day), and Tambo Grande ($584 million for 20,000 tons/day).

Net Present Value (NPV) of the project for various mill sizes can be calculated under the premises as illustrated in Table 5. The result of calculating NPV for various mill sizes is summarized in Table 6. The results show that NPV increases along with the increase in mill size until the optimum level is reached, but after that NPV declines as the mill size increases. The maximum profit can be obtained when mill capacity equals 333,333 tons/year as is shown in Figure 12. At this mill capacity, mine life is estimated to be six years, and capital cost is $94,710,000

THE REGRESSION EQUATION IS K(THOUSAND $)=63710 + 27.9 q

COLUMN	COEFFICIENT	ST.DEV. OF COEF.	T-RATIO=Coef/S.D.
-	63710	29938	2.13
q	27.917	2.187	12.77

ST.DEV. OF K ABOUT REGRESSION LINE IS S=33936 WITH 3 D.F.

R-SQUARED = 98.2 PERCENT
R-SQUARED = 97.6 PERCENT, ADJUSTED FOR D.F.

ANALYSIS OF VARIANCE

DUE TO	DF	SS	MS=SS/DF
REGRESSION	1	187667078971	187667078971
RESIDUAL	3	3454933792	1151644587

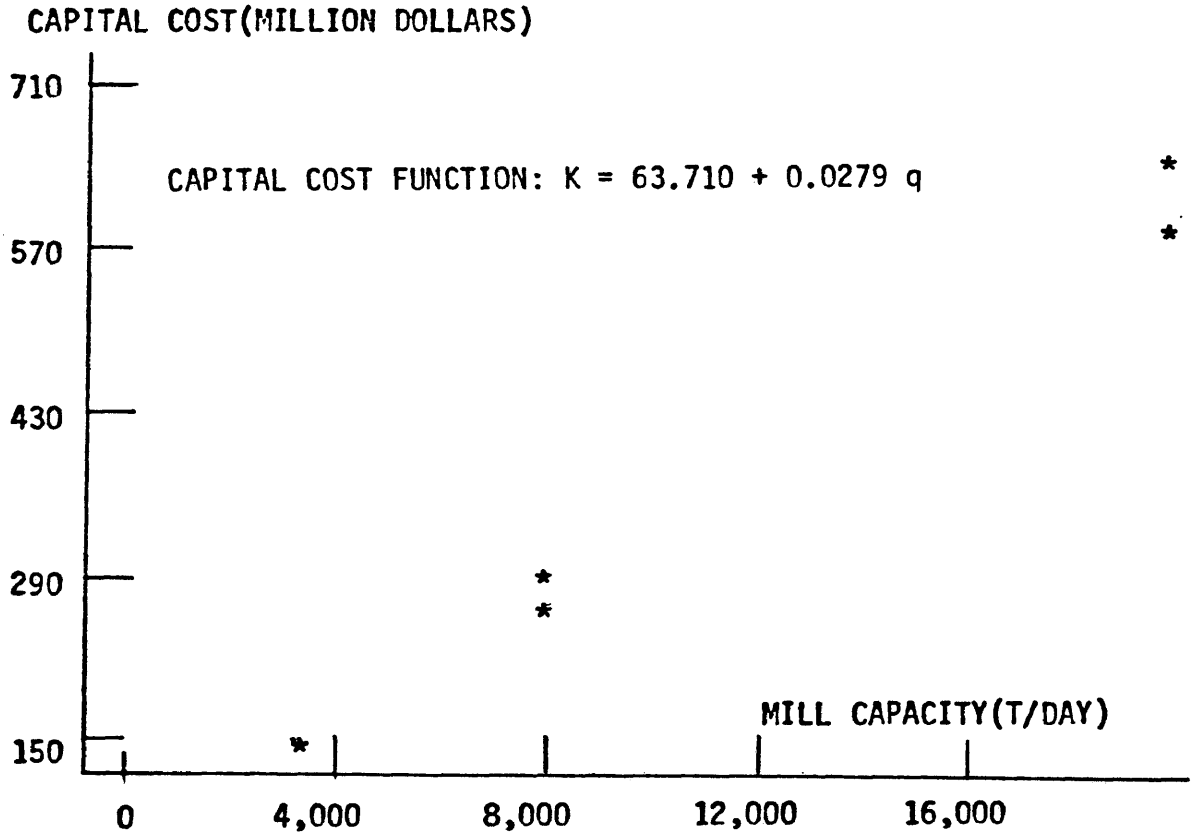


Figure 11 CAPITAL COST FUNCTION OBTAINED FROM THE EXISTING CAPITAL COST DATA

Table 5 PREMISES FOR OBTAINING OPTIMAL MILL SIZE

1) total ore reserve (Q).....2 million tons with average Zn grade of 15 %

2) annual production rate (q).constant

3) mine life (T).....Q/q years

4) price of metal zinc (P)....37.389 ¢/lb = 824.28 $/ton

5) operating cost (C).....18.73 $/ton

6) capital cost (K).....K = 63,710 + 27.9 q/300 (thousand $)

7) working days per year.....300 days/year

8) recovery rate.....90 %

9) discount rate (r).....10 %

10) construction period.....1 year (tentative period for simple calculation)

NPV (thousand $)

$$= \sum_{t=1}^{T} \left(\frac{1}{1+r}\right)^t \text{(gross revenue - total cost)} - K$$

$$= \sum_{t=1}^{T} \left(\frac{1}{1+r}\right)^t (P \times 0.9 \times 0.15q - 18.73q) - (63{,}710 + 27.9q/300)$$

$$= 0.0925478\, q \sum_{t=1}^{T} \left(\frac{1}{1+r}\right)^t - (63{,}710 + 0.093\, q)$$

Table 6 CASE STUDY FOR OBTAINING OPTIMAL MILL SIZE

MINE SIZE (tons/year)	MINE LIFE (years)	$0.0925478q\sum_{t=1}^{T}\left(\frac{1}{1+0.1}\right)^{t}$ (thousand $)	CAPITAL COST (thousand $)	NPV (thousand $)
50,000	40	45,247	68,360	-23,113
100,000	20	78,797	73,010	5,787
133,333	15	93,858	76,110	17,748
200,000	10	113,725	82,310	31,415
222,222	9	118,440	84,377	34,063
250,000	8	123,436	86,960	36,476
285,714	7	128,720	90,281	38,439
333,333	6	134,347	94,710	39,637
400,000	5	140,339	100,910	39,429
500,000	4	146,689	110,210	36,479
1,000,000	2	160,663	156,710	4,000

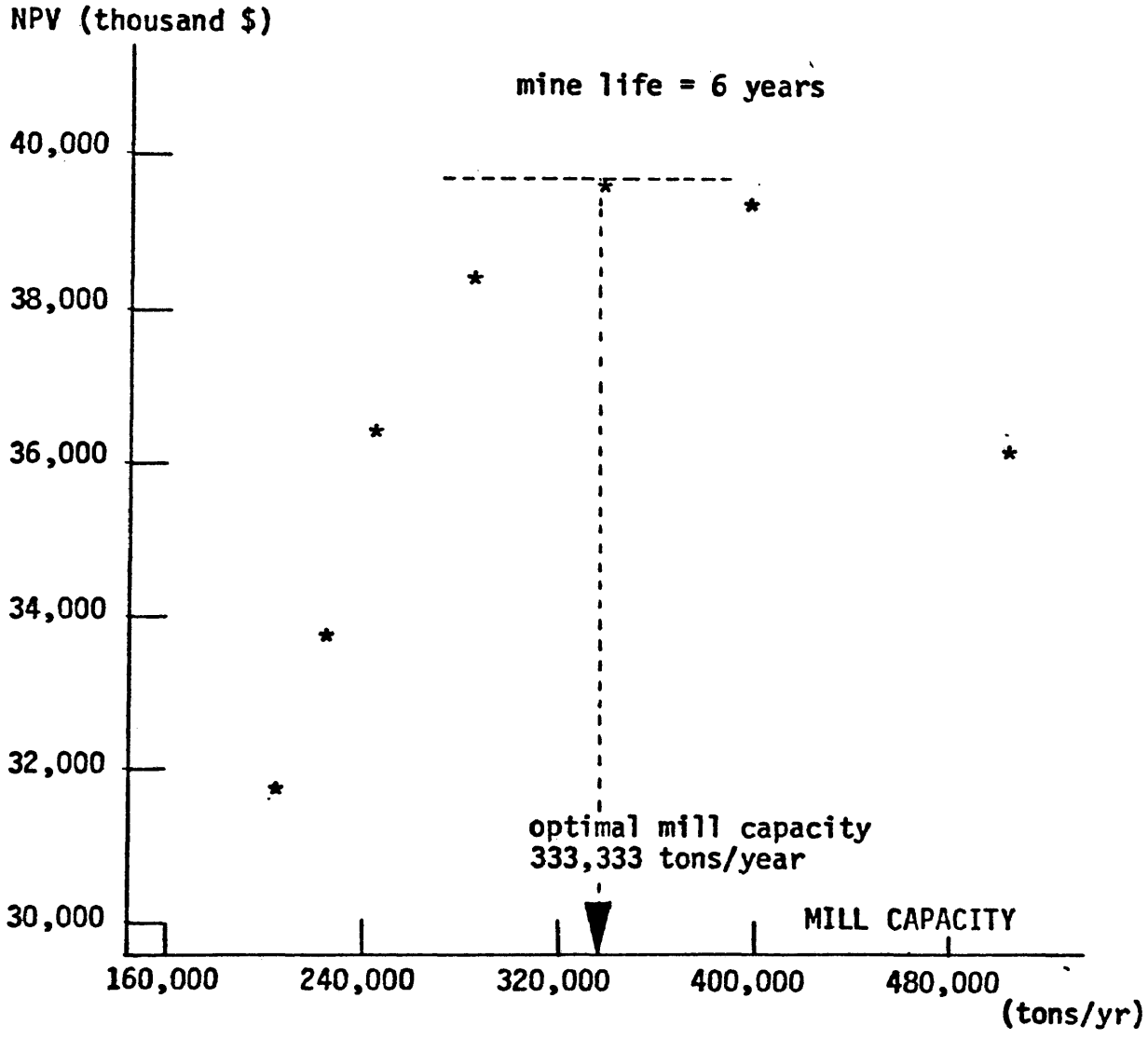


Figure 12 OPTIMAL MILL CAPACITY OBTAINED FROM MAXIMUM NPV

expressed in 1983 U.S. dollars.

7.3.2. PROJECT EVALUATION

The most important considerations for the negotiation between Minero Peru and OMRD will be concerned with the impact upon the cash flow profile of the most likely conditions (the "base case") by changing the critical and negotiable factors. In this sense, establishment of the base case is extremely important. The conditions of the base case have been obtained numerically from the past data, and this information is summarized in Table 7. For the unmeasurable terms and conditions, some premises are necessary for overall economic evaluation. The following are the premises applicable not only to the base case but also to other cases for sensitivity analysis:

1) Exploration cost owned by Japanese and Peruvian governments is to be treated as sunk cost.

2) The total capital expenditure ($94,710,000 in 1983 U.S. dollars) includes depreciable capital of $60,614,000 dollars. Equipment worth $28,413,000 will be brought from Japan.

3) During the two-year construction period (1983-1984) $47,355,000 will be invested annually. Eighty percent of the capital expenditure will be borrowed from Japanese city

Table 7 BASE CASE DATA

Annual production rate	333,000 tons/year
Ore grade	15 % Zn
Recovery rate	90 %
Working days per year	300 days/year
Mine life	6 years
Price of metal zinc including export tax	844.89 $/ton (= 38.32 ¢/lb)
Operating cost	18.73 $/ton, composed of mine cost(4.8 $/ton), mill cost(2.24 $/ton) and smelting & refining cost(11.69 $/ton)
Capital cost	$ 94,710,000 including depreciable capital of $ 60,614,000. Equipment worth $ 28,413,000 will be brought from Japan.
Debt-equity ratio	4 : 1
Interest rate	current interest rate of 9 %(real interest rate of 3 %) with the short maturity loans(5 years)
Construction period	2 years (1983,1984)
Tax rate	tax liability is controled by the New 1981 General Mining Law No. 109

banks (OMRD affiliates) at the current interest rate of 9 percent (inflation-adjusted interest rate of 3 percent). The balance of capital expenditure will be invested by equity capital prepared by Minero Peru and OMRD at a ratio of 1:3.

4) The share of profits between Minero Peru and OMRD should be 1:3, equivalent to the equity capital investment ratio.

5) The expected salvage value is neglected in this project evaluation.

6) All zinc produced will be exported to Japan.

7) The discounted cash flow rate-of-return(DCFROR) should be based on the end of year cash flow assumption.

The first two years (1983-1984) of the project are the construction period. Full production will commence at the beginning of year three (1985). In the Oyon project, the price of zinc is fixed over the project life according to the terms of the long-term contract between the Joint Venture Company and the OMRD affiliate, based on the zinc sales agreement. As mentioned before, any inflation and escalation problems in Peru can be excluded by using U.S. dollars, because the fall in the value of the sol measured by inflation will be compensated for by the change in the exchange rate between the U.S. dollar and the Peruvian sol.

Hence, current dollar ROR (i) will exactly coincide with constant dollar ROR (i') as far as the project in Peru invested and operated by using all equity capital (U.S. dollars) is concerned. For escalated dollar ROR analysis, the factor P/Fi,n does the job that the product of factors P/Ff,n x P/Fi',n does for constant dollar analysis of the same starting escalated dollar values, where i = current dollar ROR, i'= constant dollar ROR, and f = inflation rate:

$$(1/1+i)^n = (1/1+f)^n \times (1/1+i')^n$$

namely, $1+i = (1+f)(1+i')$

In the above equations, current dollar ROR (i) should be equal to constant dollar ROR (i') when there is no inflation (f=0).

In our project, however, the investment involves borrowed money. One key assumption found to be significant is interest rate. The current interest rate of 9 percent, which includes expected inflation, overstates the true cost of money when all analyses have been performed on real cash flows. Every price and cost is measured by the 1983 dollar. Hence, it is imperative that an inflation-adjusted interest rate of 3 percent be used for constant dollar analysis. The DCFROR, based on the end of year cash flow

assumption, has been calculated for the base case as is shown in Table 8.

The result of project evaluation for the base case indicates relatively low DCFROR (13.4 percent), but is satisfactory enough for the Japanese side for the following reasons:

1) This DCFROR (13.4 percent) exceeds the Japanese government bond yield (8.66 percent in 1981).

2) Japanese group investment with well-established business connections plays an important risk-sharing function, and will be able to bring the subordinate profits from equipment export and loan financing, etc. through a mine development project.

3) There is a possibility for OMRD to obtain higher DCFROR by borrowing more money or by borrowing from Japanese governmental agencies at a lower current interest rate-- 7.75 percent per annum from Export-Import Bank of Japan (EXIM), or 6 percent per annum from Overseas Economic Cooperation Fund (OECF).

4) OMRD will be able to borrow the necessary money easily from city banks by using the "Guarantee of Development Loans" system. Specifically, the Metal Mining Agency of Japan guarantees the liabilities of Japanese companies undertaking loans from city banks for developing

Table 8 RESULT OF PROJECT EVALUATION FOR THE BASE CASE (PART 1)

(unit: thousand $)

borrowed money		accrued interest plus principal payment in 1985	
1983	0.8 x 47,355 = 37,884	37,884 x (F/P 3,1) = 39,021	
1984	0.8 x 47,355 = 37,884	37,884 x 1.0 = 37,884	
total	75,768	total	76,905

DCFROR = 13.4 %

	1983	1984	1985	1986	1987	1988	1989	1990
Income *1			37,982	37,982	37,982	37,982	37,982	37,982
Export tax(2.5%)			- 950	- 950	- 950	- 950	- 950	- 950
Operating cost			- 6,237	- 6,237	- 6,237	- 6,237	- 6,237	- 6,237
Depreciation *2			-12,123	-12,123	-12,123	-12,123	-12,123	
Interest			- 2,307	- 1,846	- 1,384	- 923	- 461	
Net income			16,365	16,826	17,288	17,749	18,211	30,795
Liquid participation(4%)			- 655	- 673	- 692	- 710	- 728	- 1,232
Property participation(6%)			- 982	- 1,010	- 1,037	- 1,065	- 1,093	- 1,848
R & D for INGEMET(1%)			- 164	- 168	- 173	- 177	- 182	- 308
Taxable income			14,564	14,975	15,386	15,797	16,208	27,407
Tax *3			- 7,577	- 7,797	- 8,023	- 8,249	- 8,475	-14,634
Net profit			6,993	7,178	7,363	7,548	7,733	12,773
Depreciation			12,123	12,123	12,123	12,123	12,123	
Capital cost *4	-47,355	-47,355						
Borrowed money	37,884	37,884						
Principal payment			-15,381	-15,381	-15,381	-15,381	-15,381	
Net Cash Flow	- 9,471	- 9,471	3,735	3,920	4,105	4,290	4,475	12,773

Table 8 RESULT OF PROJECT EVALUATION FOR THE BASE CASE (PART 2)

*1 Income = zinc price including export tax($824.28/tonx1.025) x mill capacity(333,000 tons/y)
x grade(0.15) x recovery rate(0.9) = $ 37,982,000

*2 Depreciable capital = total capital($94,710,000) x (equipment(0.3) + installation(0.34))
= $ 60,614,000
Depreciation = $ 60,614,000/5 years = $ 12,123,000

*3 Income tax : In Peruvian income tax, U.I.T.(Unidad Impositiva Tributaria) plays an important role for calculating income tax. Presumably, U.I.T. will be published annually by the government in due consideration of inflation. In 1982, 1 U.I.T. equals 600,000 soles and 1 U.S. dollar was equivalent to 430 soles in 1981. Hence, 1 U.I.T.=600,000/430= $ 1,395. This value will be able to fix over mine life, because U.S. dollar can adjust high inflation in Peru.

From 0 to 150 UIT-----30%	150 x$1,395x0.3	= $	62,775
From 150 to 1,500 UIT-----40%	(1,500- 150)x$1,395x0.4	= $	753,300
From 1,500 to 3,000 UIT-----50%	(3,000-1,500)x$1,395x0.5	= $	1,046,250
more than 3,000 UIT-----55%	(x -3,000)x$1,395x0.55 =		
	subtotal		$1,862,325
income tax in 1985	(14,564,000-3,000x1,395)x0.55 + 1,862,325	=	7,570,775
income tax in 1986	(14,975,000-3,000x1,395)x0.55 + 1,862,325	=	7,796,825
income tax in 1987	(15,386,000-3,000x1,395)x0.55 + 1,862,325	=	8,022,875
income tax in 1988	(15,797,000-3,000x1,395)x0.55 + 1,862,325	=	8,248,925
income tax in 1989	(16,208,000-3,000x1,395)x0.55 + 1,862,325	=	8,474,975
income tax in 1990	(27,407,000-3,000x1,395)x0.55 + 1,862,325	=	14,634,425

*4 Capital cost includes import tax for equipment brought from Japan
import tax = equipment cost($ 28,413,000=94,710,000x0.3) x import tax rate(0.2)
= $ 5,682,600
import tax in 1983 = $ 5,682,600/2 = $ 2,841,300
import tax in 1984 = $ 5,682,600/2 = $ 2,841,300

new metal mines of copper, lead, zinc, manganese, nickel, bauxite, chromite and uranium ores in foreign countries. The maximum guarantee available is limited to 80 percent of the total borrowed from financial institutions, and a guarantee fee of 0.4 percent per annum is charged.

Alternative scenarios, in addition to the base case, may be provided for a higher DCFROR: borrowing money at lower interest rate (case 1), exemption from the Mining community (case 2), and reduction of income tax by expanding mill capacity (case 3). The results of these scenarios are shown in Tables 9-11, which indicate a possibility to obtain higher DCFROR of 14.6 percent in case 1; 17.7 percent in case 2; and 21.6 percent in case 3. These alternative scenarios are presented for the reason that higher DCFROR should be pursued within the bounds of possibility. Further discussion will be based on the base case.

7.4. NUMERICAL EVALUATION OF NEGOTIABLE TERMS BY SENSITIVITY ANALYSIS

No matter how comprehensive or sophisticated an investment evaluation may be, uncertainty still remains a factor in the evaluation. The use of quantitative approaches, especially sensitivity analysis, to incorporate

Table 9 RESULT OF PROJECT EVALUATION FOR ALTERNATIVE SCENARIO (CASE 1)

Case 1 : Borrowing money from Export-Import Bank of Japan(EXIM) with current interest rate of 7.75 % per annum(real interest rate of 2 %).

	borrowed money		accrued interest plus principal payment in 1985
1983	0.8 x 47,355 = 37,884		37,884 x (F/P 2,1) = 38,642
1984	0.8 x 47,355 = 37,884		37,884 x 1.0 = 37,884
total		75,768	total 76,526

(unit : thousand $)

DCFROR = 14.6 %

	1983	1984	1985	1986	1987	1988	1989	1990
Income			37,982	37,982	37,982	37,982	37,982	37,982
Export tax(2.5%)			- 950	- 950	- 950	- 950	- 950	- 950
Operating cost			- 6,237	- 6,237	- 6,237	- 6,237	- 6,237	- 6,237
Depreciation			-12,123	-12,123	-12,123	-12,123	-12,123	
Interest			- 1,531	- 1,224	- 918	- 612	- 306	
Net income			17,141	17,448	17,754	18,060	18,366	30,795
Liquid participation(4%)			- 686	- 698	- 710	- 722	- 735	- 1,232
Property participation(6%)			- 1,028	- 1,047	- 1,065	- 1,084	- 1,102	- 1,848
R & D for INGEMET(1%)			- 171	- 174	- 178	- 181	- 184	- 308
Taxable income			15,256	15,529	15,801	16,073	16,345	27,407
Tax			- 7,951	- 8,102	- 8,251	- 8,401	- 8,550	-14,634
Net profit			7,305	7,427	7,550	7,672	7,795	12,773
Depreciation			12,123	12,123	12,123	12,123	12,123	
Capital cost	-47,355	-47,355						
Borrowed money	37,884	37,884						
Principal payment			-15,305	-15,305	-15,305	-15,305	-15,306	
Net Cash Flow	- 9,471	- 9,471	4,123	4,245	4,368	4,490	4,612	12,773

Table 10 RESULT OF PROJECT EVALUATION FOR ALTERNATIVE SCENARIO (CASE 2)

Case 2 : Exemption from the Mining Community.

(unit : thousand $)

DCFROR = 17.7 %

	1983	1984	1985	1986	1987	1988	1989	1990
Income			37,982	37,982	37,982	37,982	37,982	37,982
Export tax(2.5%)			- 950	- 950	- 950	- 950	- 950	- 950
Operating cost			- 6,237	- 6,237	- 6,237	- 6,237	- 6,237	- 6,237
Depreciation			-12,123	-12,123	-12,123	-12,123	-12,123	
Interest			- 2,307	- 1,846	- 1,384	- 923	- 461	
Net income			16,365	16,826	17,288	17,749	18,211	30,795
R & D for INGEMET(1%)			- 164	- 168	- 173	- 177	- 182	- 308
Taxable income			16,201	16,658	17,115	17,572	18,029	30,487
Tax			- 8,471	- 8,722	- 8,974	- 9,225	- 9,477	-16,328
Net profit			7,730	7,936	8,141	8,347	8,552	14,159
Depreciation			12,123	12,123	12,123	12,123	12,123	
Capital cost	-47,355	-47,355						
Borrowed money	37,884	37,884						
Principal payment			-15,381	-15,381	-15,381	-15,381	-15,381	
Net Cash Flow	- 9,471	- 9,471	4,472	4,678	4,883	5,089	5,294	14,159

Table 11 RESULT OF PROJECT EVALUATION FOR ALTERNATIVE SCENARIO (CASE 3)

Case 3 : Reduction of income tax up to one-third by expanding mill capacity from 333,000 tons/yr to 400,000 tons/yr in 1986

cost for expansion = (63,710 + 27.9 x 400,000/300) - (63,710 + 27.9 x 333,000/300)
= 6,231 (unit : thousand $)

production : 333,000 tons/yr in 1985 & 1986, 400,000 tons/yr from 1987 to 1989, and 134,000 tons/yr in 1990.

DCFROR = 21.6 %

	1983	1984	1985	1986	1987	1988	1989	1990
Income			37,982	37,982	45,624	45,624	45,624	15,284
Export tax(2.5%)			- 950	- 950	- 1,141	- 1,141	- 1,141	- 382
Operating cost			- 6,237	- 6,237	- 7,492	- 7,492	- 7,492	- 2,510
Depreciation			-12,123	-12,123	-12,123	-12,123	-12,123	
Interest			- 2,307	- 1,846	- 1,384	- 923	- 461	
Net income			16,365	16,826	23,484	23,945	24,407	12,392
LIquid participation(4%)			- 655	- 673	- 939	- 958	- 976	- 496
Property participation(6%)			- 982	- 1,010	- 1,409	- 1,437	- 1,464	- 744
R & D for INGEMET(1%)			- 164	- 168	- 235	- 239	- 244	- 124
Taxable income			14,564	14,975	20,901	21,311	21,723	11,028
Tax(33.3% from 1987)			- 7,571	- 7,797	- 6,967	- 7,104	- 7,241	- 3,676
Tax credit *1			+ 1,620	+ 1,623				
Reinvestment			- 3,116	- 3,116				
Net profit			5,497	5,685	13,934	14,207	14,482	7,352
Depreciation			12,123	12,123	12,123	12,123	12,123	
Principal payment			-15,381	-15,381	-15,381	-15,381	-15,381	
Net Cash Flow	-9,471	-9,471	2,239	2,427	10,676	10,949	11,224	7,352

*1 Tax credit for reinvestment=reinvestmentxaverage rate of tax(income tax/taxable income) x selectivity index(1.0)

risk and uncertainty into analysis results will help in making better decisions. Stermole (1980) defined sensitivity analysis as a means of evaluating the effects of uncertainty on investment by determining how an investment alternative's profitability varies as the parameters that affect economic evaluation results are varied. Factors affecting the economic viability of a project are not equally important and are usually ranked with respect to their impact on return on investment. In consequence, sensitivity analysis is a means of identifying those critical variables that, if changed, could considerably affect the profitability measure.

Parameters considered here for sensitivity analysis are negotiable terms such as zinc price, smelting and refining cost, and debt-equity ratio.

Figure 13 shows the sensitivity of DCFROR to changes in zinc price from -10 percent to +30 percent, and changes in smelting and refining cost from -30 percent to +30 percent. The lines obtained by least square method indicate that there are strong linear associations between two variables for both cases as shown below:

(a) DCFROR vs. change in zinc price:

$$Y = 13.0 + 0.720X \quad (r = 99.9\%)$$

(b) DCFROR vs. change in smelting and refining cost:

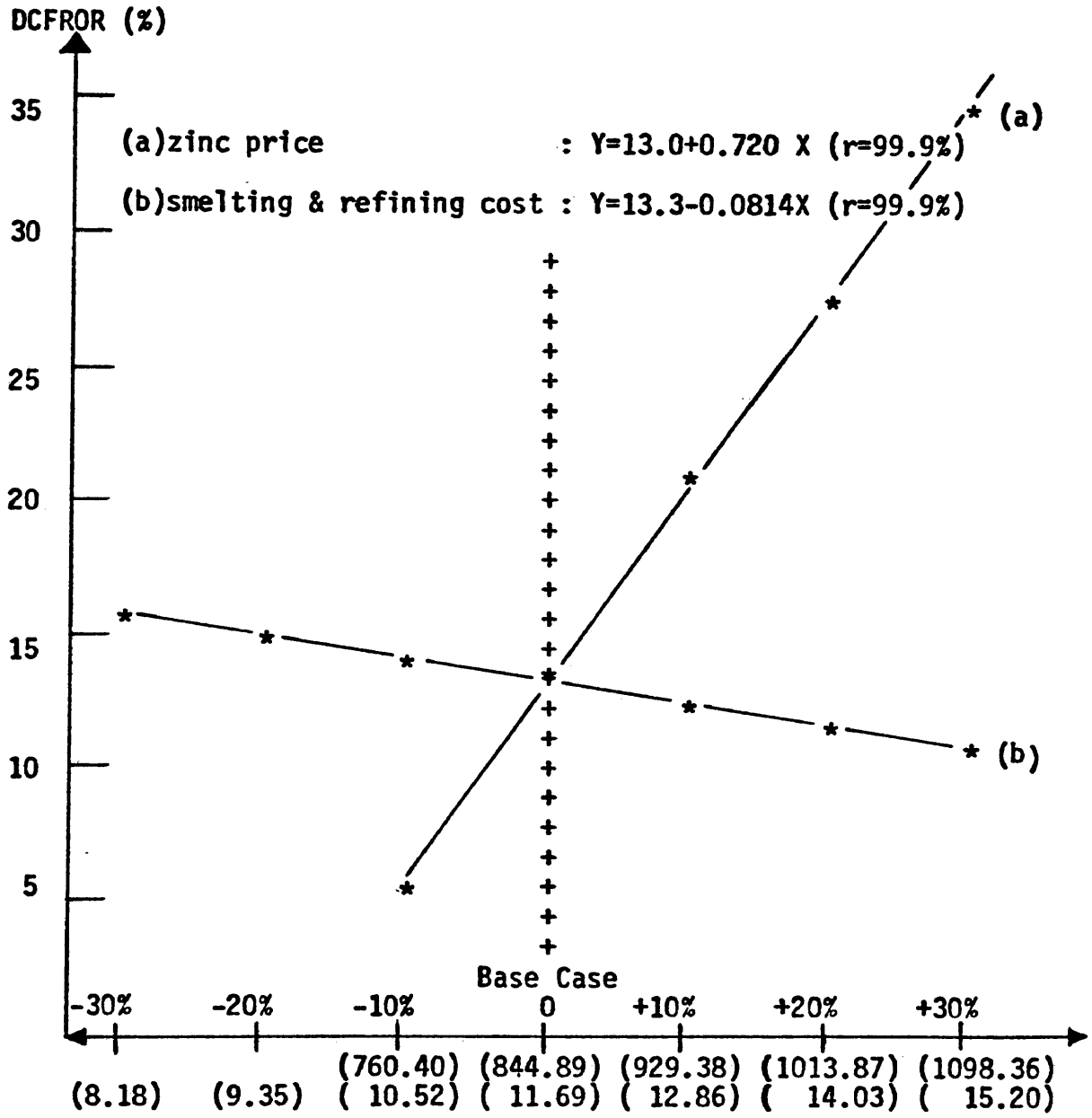


Figure 13 RESULT OF SENSITIVITY ANALYSIS (DCFROR VS ZINC PRICE, AND DCFROR VS SMELTING & REFINING COST)

$$Y = 13.3 - 0.0814X \quad (r = 99.9\%)$$

Since the line with the steeper slope identifies the factor that has greater impact on DCFROR, it may be concluded that zinc price is a much more important factor for negotiation than is the smelting and refining cost.

Figure 14 shows the sensitivity of DCFROR to changes in percentage of borrowed money. There is also a relatively strong linear association between two variables. In this case, DCFROR changes from 7.4 percent to 17.7 percent along with the change in percentage of borrowed money from 50 percent to 88 percent. This change, however, is not so significant as is the change observed in the case of the zinc price. Consequently, we can conclude that zinc price is the most important among the three parameters that go into DCFROR analysis. The zinc sales price will be the most important term in negotiation between Minero Peru and OMRD as far as the profitability of the project is concerned. The higher the zinc price, the greater the project DCFROR will be.

7.5. REVENUE DISTRIBUTION BETWEEN PERU AND JAPAN

Revenue considerations traditionally have had the most significant influence in molding a developing country's objectives in tax policy toward natural resource

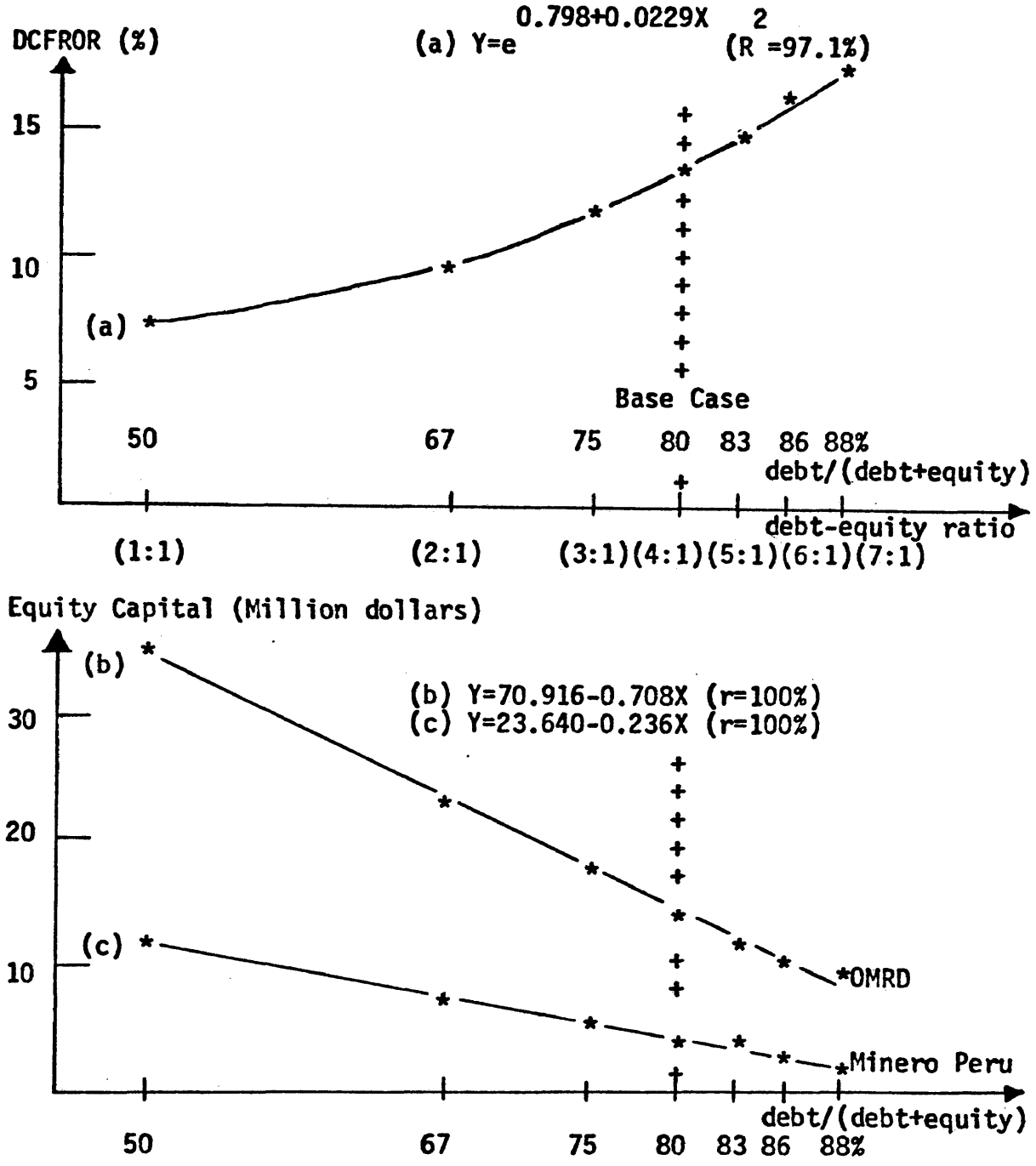


Figure 14 RESULT OF SENSITIVITY ANALYSIS (DCFROR VS DEBT-EQUITY RATIO)

endowments. Virtually no developing country has sought revenue goals to the exclusion of other aims that might be obtained through natural resource taxation. Even in the fifties, many countries were employing resource tax policy to promote domestic processing of natural resources, and by the seventies several nations had begun to view tax policy as one means of controlling social costs involved in resource extraction.

In the case of the joint venture project at stake, the Peruvian government can expect revenue through various taxes, profits, and various payments for host country workers employed and for goods and services in Peru. In this paper, however, only Peruvian revenue from the standpoint of capital income and taxes were considered. Here, capital income will reflect the initial proportions of equity owned by Minero Peru. Table 12 shows that Peruvian government revenue will be $71 million at zero discount rate through mine development, which means that the Peruvian side will receive about $71 million at the expense of losing a resource asset(270,000 tons of zinc metal).

On the other hand, the Japanese side will receive a positive return to equity. This is likely to lead to the incorrect assumption that the Japanese will benefit in two

Table 12 PERUVIAN GOVERNMENT REVENUE AND JAPANESE CAPITAL OUTFLOW FOR THE BASE CASE

(unit: thousand $)

(a) Peruvian Government Revenue (=Kd + Td)-----PV at zero discount rate = $70,892
PV at 10 % discount rate = $41,428

	1983	1984	1985	1986	1987	1988	1989	1990
Kd(capital income)	-2,368	-2,368	934	980	1,026	1,073	1,119	3,193
Td-1(import tax)	2,841	2,841						
Td-2(export tax)			950	950	950	950	950	950
Td-3(R & D for INGEMET)			164	168	173	177	182	308
Td-4(income tax)			7,571	7,797	8,023	8,249	8,475	14,634
total	473	473	9,619	9,895	10,172	10,449	10,726	19,085

(b) Japanese Capital Outflow (=Cf-Kf-If-Pf)----PV at zero discount rate = $204,521
PV at 10 % discount rate = $125,466

	1983	1984	1985	1986	1987	1988	1989	1990
Cf(cost for zinc purchase)	37,982	37,982	37,982	37,982	37,982	37,982	37,982	37,982
Kf(capital income)	7,103	7,103	- 2,801	- 2,940	- 3,079	- 3,218	- 3,356	- 9,580
If(interest cost on loan)			- 2,307	- 1,846	- 1,384	- 923	- 461	
Pf(profit) *1	-2,841	- 2,841						
total	4,262	4,262	32,874	33,196	33,519	33,841	34,165	28,402

*1 Profit by exporting equipment is assumed as follows:
Profit = equipment price ($28,413,000) x profit rate (0.2) = $5,682,600
Profit in 1983 = $5,682,600/2 = $2,841,300 Profit in 1984 = $2,841,300

ways-- possession of the mineral resource and a gain on capital investment. The revenue obtained from this project, however, is attributable to the zinc sales in the Japanese market. In this joint venture project, the Japanese side is characterized by a group investment composed of mining firms, banks, equipment-producing firms, trading companies and zinc-purchasing firms. Therefore, project DCFROR analysis is insufficient, and overall economic evaluation expressed by capital outflow becomes indispensable. Table 12 indicates that Japanese capital outflow for the base case will reach $205 million at zero discount rate for this project. We can say that the Japanese side (OMRD affiliate) will obtain mineral (270,000 tons of zinc metal) at the expense of capital of $205 million. In this sense, it appears that international trade between mineral and capital is successful for the base case. It is impossible, however, to measure each country's degree of satisfaction. For the premises under which this economic evaluation has been made, the Japanese side will feel satisfied only if zinc-purchasing firms make a profit by producing additional value after obtaining the zinc metal because other OMRD affiliates will obtain the positive return to equity and profits through this project. And what about the Peruvian side? Will the Peruvian side

be satisfied with $71 million at the expense of a resource asset? The decision should be left to Peruvian judgment.

Instead, it is necessary to examine the revenue distribution between Peru and Japan for changing the critical parameters such as zinc price, smelting and refining cost and debt-equity ratio. Figures 15-17 show the change in Peruvian government revenue and Japanese capital outflow along with the change in three parameters for two cases of zero discount rate and 10 percent discount rate. With the increase in zinc price, the Peruvian revenue will increase proportionally from $57 million to $113 million at zero discount rate for a change in zinc price from -10 percent to +30 percent. Japanese capital outflow will also increase from $188 million to $253 million under the same conditions, as is shown in Figure 15. With the increase in smelting and refining costs, Peruvian government revenue will decrease from $75 million to $67 million, and Japanese capital outflow will increase from $202 million to $207 million at zero discount rate as is illustrated in Figure 16. A completely opposite tendency from the zinc price case is observed in the case of debt-equity ratio. With the increase in debt-equity ratio, Peruvian revenue will decrease slightly from $73 million at debt-equity ratio 1:1, to $70 million at

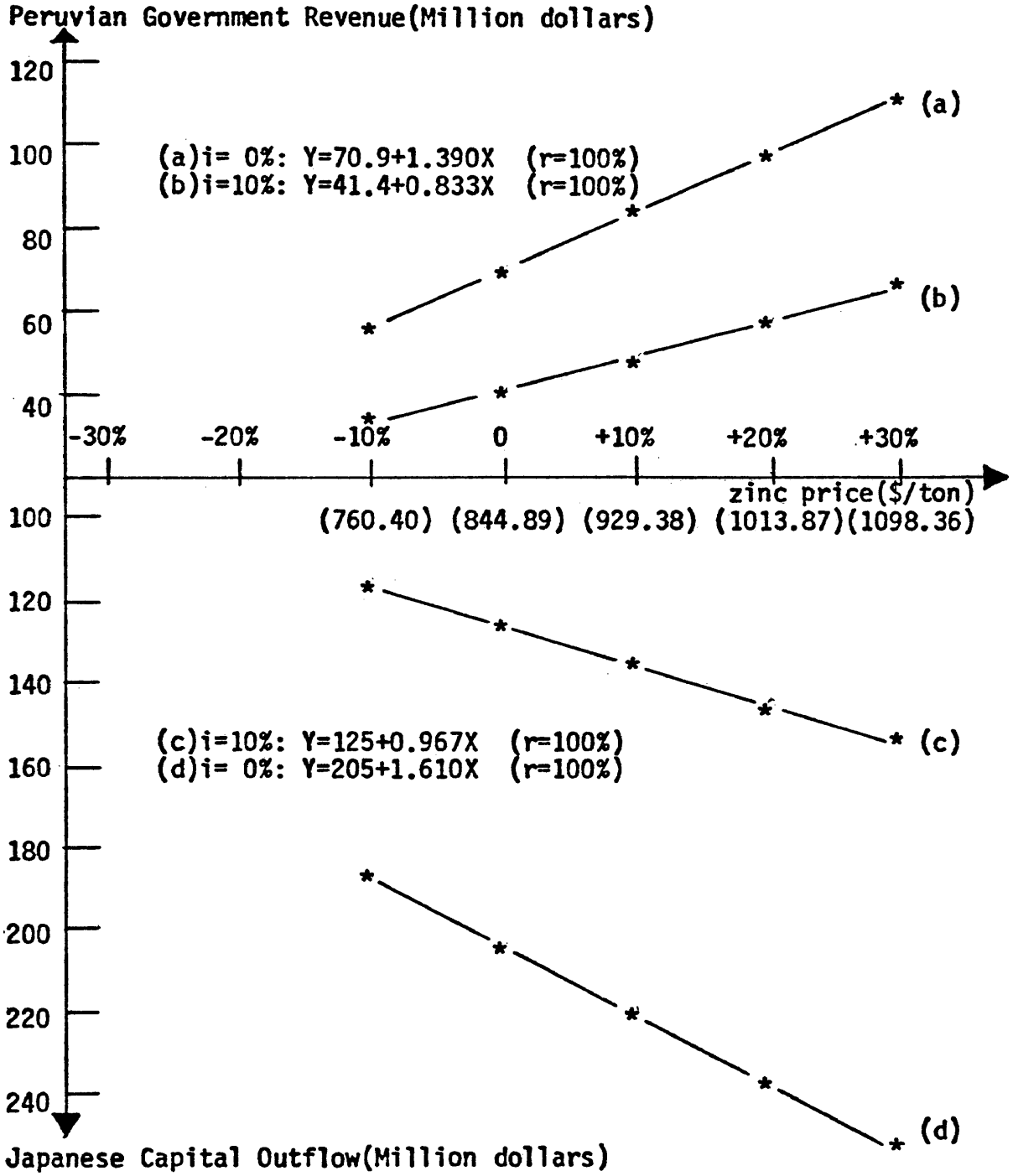


Figure 15 PERUVIAN GOVERNMENT REVENUE AND JAPANESE CAPITAL OUTFLOW FOR THE CHANGE IN ZINC PRICE

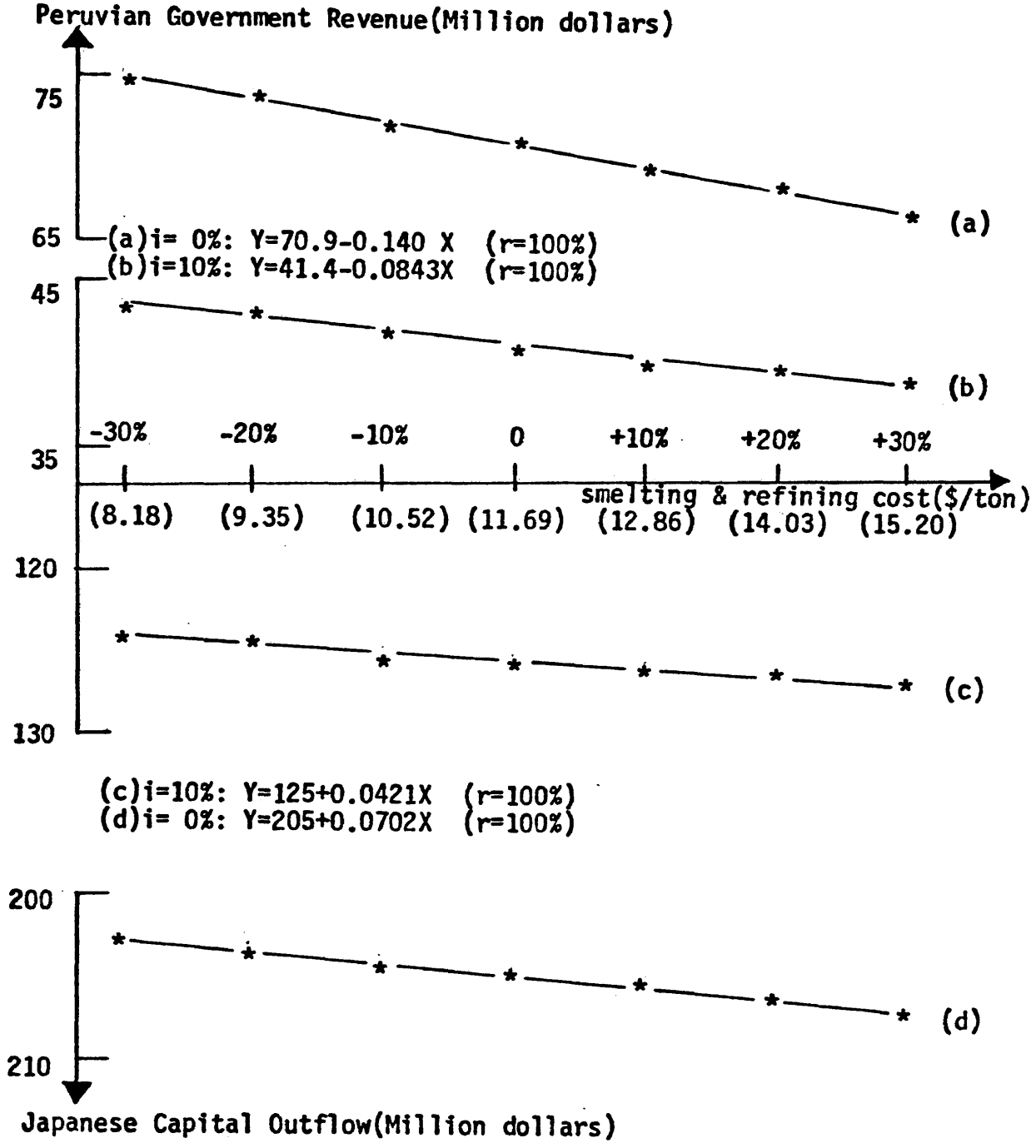


Figure 16 PERUVIAN GOVERNMENT REVENUE AND JAPANESE CAPITAL OUTFLOW FOR THE CHANGE IN SMELTING & REFINING COST

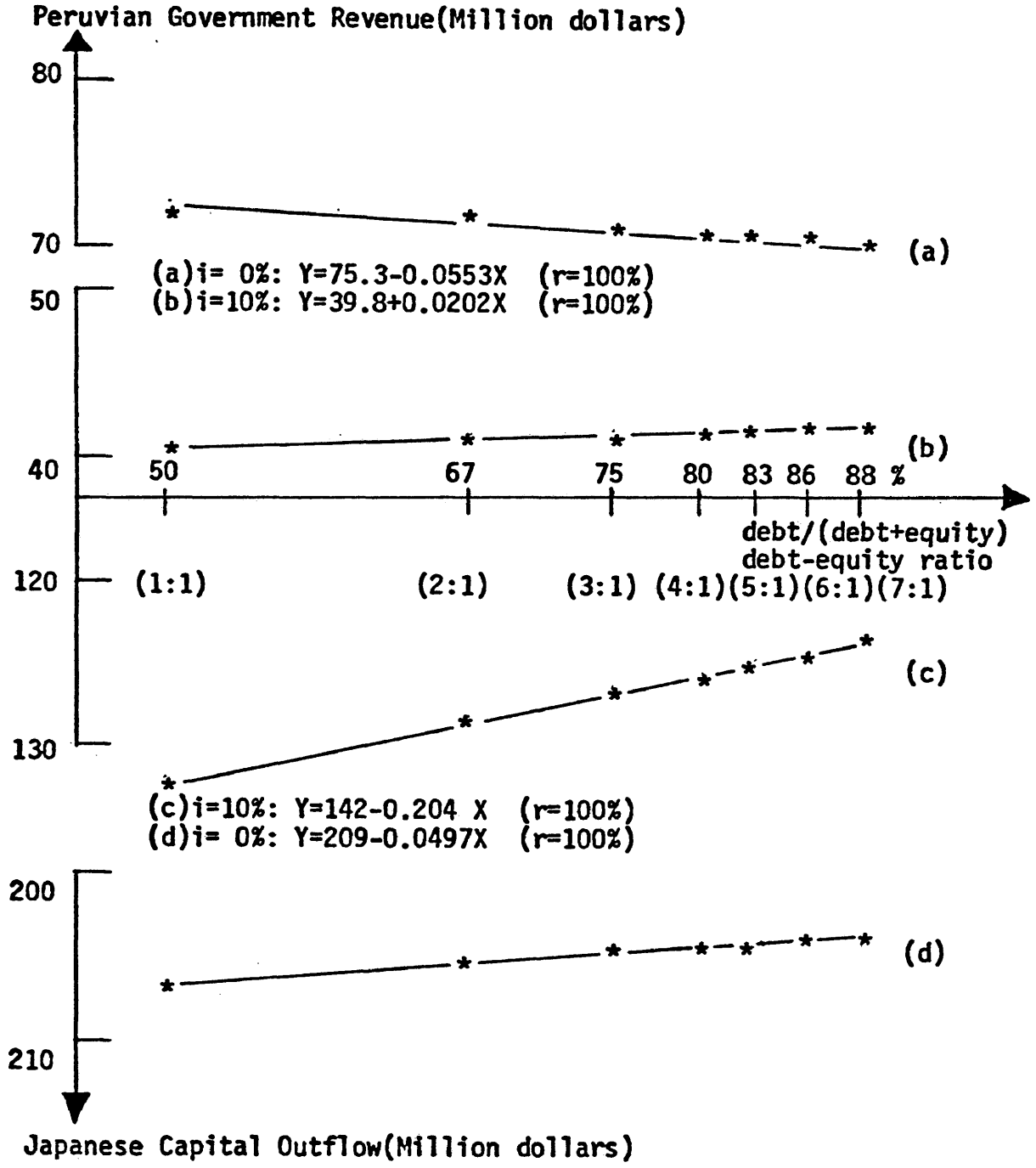


Figure 17 PERUVIAN GOVERNMENT REVENUE AND JAPANESE CAPITAL OUTFLOW FOR THE CHANGE IN DEBT-EQUITY RATIO

debt-equity ratio 7:1, based on zero discount rate.

Exactly the same patterns can be observed at the discount rate of 10 percent except for the debt-equity ratio. The straight lines with high correlation coefficient are obtained by least square method as shown below:

1) at zero discount rate

Peruvian government revenue ($Y million)

$Y = 70.9 + 1.390X$ for the change in zinc price (X)

$Y = 70.9 - 0.140X$ for the change in smelting and refining cost (X)

$Y = 75.3 - 0.0553X$ for the change in percentage of borrowed money (X)

Japanese capital outflow ($Y million)

$Y = 205 + 1.610X$ for the change in zinc price (X)

$Y = 205 + 0.0702X$ for the change in smelting and refining cost (X)

$Y = 209 - 0.0497X$ for the change in percentage of borrowed money (X)

2) at 10 percent discount rate

Peruvian government revenue ($Y million)

$Y = 41.4 + 0.833X$ for the change in zinc price (X)

$Y = 41.4 - 0.0843X$ for the change in smelting and

refining cost (X)

Y = 39.8 + 0.0202X for the change in percentage of borrowed money (X)

Japanese capital outflow ($Y million)

Y = 125 + 0.967X for the change in zinc price (X)

Y = 125 + 0.0421X for the change in smelting and refining cost (X)

Y = 142 - 0.204X for the change in percentage of borrowed money (X)

Since the line with the steepest slope identifies the factor that has the greatest impact on Peruvian government revenue and Japanese capital outflow, we can conclude again that the parameter of zinc price is the most important consideration for both the Peruvian and Japanese sides.

7.6. EVALUATION OF MINE DEVELOPMENT AGREEMENT TERMS

Mine development contract negotiations between Minero Peru and OMRD should end up with an agreement specifying zinc sales price, smelting and refining cost and debt-equity ratio. Namely, the agreements on each of these issues will hold the key to the successful negotiations between the two parties. If such agreements serve numerically as a checklist of provisions and policy considerations and as an illustration of the

interrelationship of various provisions, they will have served an important function in the negotiations between Minero Peru and OMRD.

7.6.1. ZINC SALES AGREEMENT

The Peru-Japan Joint Venture Company shall have the right to export and sell all zinc product specified as Prime Western Zinc after paying the export tax. The long-term sales contracts shall be signed with the OMRD affiliate with the approval of the Peruvian government. The disputable issue in this agreement is the zinc sales price.

As Seidman (1980) pointed out, the national economy becomes particularly sensitive to the fluctuations of an uncertain world market for those mining countries whose minerals contribute an unusually large share of export and tax revenue. The zinc price as a basis for transactions was determined from the data of Prime Western Zinc prices and is assumed to be F.O.B. base. In this sense, there is no bargaining about price level. But, Prime Western Zinc price has fluctuated, so that the problem remains as to whether the initially determined zinc sales price will be appropriate over the mine life. The higher the zinc price, the higher the project DCFROR. DCFROR ranges from 5.3

percent at the zinc price of $740.40/ton (10 percent down from base case) to 34.2 percent at $1,098.36/ton (30 percent up from base case). For Japanese mining firms, the higher the DCFROR, the greater the capital income. However, there is a regulation that constrains the limit of an annual remittance of dividend or net profit equivalent to 20 percent of investment. Hence, OMRD will lose the incentive to negotiate with zinc purchasers in Japan for higher zinc sales prices. The breakeven zinc price at 20 percent DCFROR can be obtained by using the following equation from Figure 13:

$$20 = 13.0 + 0.720X$$

$$X = +9.72\ \%\ (\$927.01/\text{ton})$$

On the other hand, Japanese mining firms will have the minimum DCFROR (the rate of return that can be obtained by investing in alternative projects). For the given minimum DCFROR of 10 percent, the breakeven zinc price can be obtained in the same way:

$$10 = 13.0 + 0.720X$$

$$X = -4.2\ \%\ (\$809.40/\text{ton})$$

The higher the zinc price, the greater the Peruvian government revenue (see Figure 15). Between 10 percent and 20 percent of DCFROR, the Peruvian government revenue will range from $65 million (70.9 - 1.390 x 4.2 = 65.1) to $84

million (70.9 + 1.390 x 9.72 = 84.4). In the same manner, Japanese capital outflow can be calculated for the same range of DCFROR: from $198 million (205 - 1.61 x 4.2 = 198) to $221 million (205 + 1.61 x 9.72 = 220.65) at zero discount rate.

The zinc price will be determined by bargaining, and the stronger side will tend to push it toward the limit of a wide feasible range. Minero Peru will prefer higher zinc prices because the higher prices will generate more government revenue. OMRD, on the otner hand, will have difficulty in deciding because the higher zinc price is acceptable for the mining firms, but the lower price will require smaller capital outflow.

7.6.2. SMELTING AND REFINING AGREEMENT

Assuming that profits from smelter operations shall not be considered, a smelting and refining agreement shall be executed between Minero Peru and the Joint Venture Company. The smelting and refining cost includes the costs directly associated with the operation of the smelter plus total overhead connected with the operations. This cost shall not exceed the charges necessary for transporting the zinc metal from Peru to Japan plus the smelting and refining cost borne by Japanese firms. Because of the relatively

cheap labor cost in Peru and the additional transportation cost from Peru to Japan, it will be economically efficient for the smelting and refining operations to remain in Peru.

OMRD is in a relatively strong bargaining position in regard to this agreement because of the many technologically advanced smelting and refining plants in Japan. If Minero Peru, owner of the Cajamarquilla smelting and refining plant, requests higher charges, OMRD could propose that smelting and refining be transferred to Japan. In that case, the Peruvian government would suffer a loss in tax and capital income revenue.

Smelting and refining cost for the base case was determined by utilizing the existing Peruvian data. The higher the cost from the base case, the lower the DCFROR. DCFROR changes from 15.8 percent at $8.18/ton (30 percent down from base case) to 10.9 percent at $15.20/ton (30 percent up from base case). In considering the limitation of remittance, the breakeven cost for 20 percent DCFROR can be obtained by using the equation in Figure 13:

$$20 = 13.3 - 0.0814X$$

$$X = -82.3\ \% \ (\$2.07/\text{ton})$$

Both Minero Peru and OMRD will accept the lower cost because the lower cost generates larger government revenue for Peru and smaller capital outflow for Japan. Because of

both parties' benefit, the smelting and refining agreement will be the easiest of the three agreements to negotiate. Minero Peru provides the cost for the Cajamarquilla plant operation, and OMRD examines that cost in the light of charges by Japanese smelting and refining firms, including the transportation cost from Lima to Japan.

7.6.3. LOAN AGREEMENT

In the case of Japanese investment, the degree of affiliation among OMRD and banks is sometimes difficult to trace. But, for the purpose of the loan agreement outlined here, interest paid by the Joint Venture Company on loans will be allowed at a deduction from gross income in the calculation of cash flow. Japanese investment is characterized by heavily borrowed money. The debt-equity ratio for the base case was obtained from the historical data of Japanese mine development investment in developing countries.

As is indicated in Figure 14, the higher the debt-equity ratio, the larger the DCFROR. DCFROR ranges from 7.4 percent at debt-equity ratio of 1:1 to 17.7 percent at debt-equity ratio of 7:1. On the other hand, at zero discount rate, the Peruvian government revenue will decrease from $73 million at debt-equity ratio of 1:1 to

$70 million at 7:1. Japanese capital outflow will decrease from $206 million to $204 million under the same conditions. It is disputable, but Minero Peru should recognize the advantages of the smaller initial capital expenditure for a high debt-equity ratio.

8. CONCLUSIONS AND RECOMENDATIONS

8.1 CONCLUSIONS

From the viewpoint of mineral and capital, we can define Peru as a mineral-rich but relatively capital-poor country and Japan as a mineral-poor but relatively capital-rich country. This creates for each country an opposite advantage and disadvantage that can be alleviated, in part, through a successful trade of mineral and capital accomplished by way of a good business arrangement.

As a criterion to measure the Peruvian benefit, the Peruvian government revenue has been introduced as defined below:

PGR (Peruvian government revenue) = Kd (capital income) + Td (income through various taxes)

On the other hand, the Japanese "develop-and-import" arrangement is characterized by the systems-focused group investment. Hence, the Japanese capital outflow for mine development is measured as follows:

JKO (Japanese capital outflow) = Cf (cost for zinc purchase) - Kf (capital income) - If (interest cost) - Rf (profits for equipment-producing firms)

Project DCFROR, Peruvian government revenue and Japanese capital outflow have been calculated for the small zinc

deposit discovered by Japanese and Peruvian governments on the basis of most likely mine development organization and most likely conditions (the "base case").

It is clear that negotiable terms are very limited because of the constraints of Peruvian laws and regulations, and that the most important negotiable issues are zinc sales price, smelting and refining cost and debt-equity ratio. Sensitivity analysis has been made by changing the three important parameters against the base case. The results of sensitivity analysis indicate that the zinc sales price is the most important negotiable issue, not only for project DCFROR but for revenue distribution between Minero Peru and OMRD also. As for smelting and refining cost, both the Peruvian and Japanese sides will accept the lower cost. The lower the smelting and refining cost, the larger the Peruvian government revenue, and the smaller the Japanese capital outflow. Concerning the zinc price and debt-equity ratio, however, disagreement may be predicted between the two parties because of conflicting interests. For example, with higher zinc prices, Peru will benefit from larger the Peruvian government revenue, and Japan will lose through increased capital outflow. Conversely, with a high debt-equity ratio, the Peruvian government will receive less revenue,

and the Japanese will benefit from decreased capital outflow.

For arbitration of this conflict, especially the zinc price, the limitation of remittance and minimum DCFROR for Japanese mining firms will play an important role. According to Resolution No.002-NG-81-EFC/35, CONITE (Comision National De Inversiones Y Technologias Extranjeros), the government body in charge of granting permission for foreign direct investment and registration, promises an annual remittance of dividend or net profit equivalent to 20 percent of investment, which means that OMRD will lose the incentive to increase DCFROR more than approximately 20 percent of DCFROR. Provided 10 percent minimum DCFROR for OMRD, the acceptable zinc price range can be obtained assuming that smelting and refining cost and debt-equity ratio continue as the base case:

Y (DCFROR) = 13.0 + 0.720X (% change of zinc price from the base case)

$10 < Y < 20$

From both equations,

$-4.2\% < X < +9.7\%$

\$809.40/ton < zinc price < \$926.84/ton

From the Peruvian viewpoint, the highest zinc price (\$926.84/ton) will be acceptable, because the higher the

zinc price the higher the revenue. In this case, the Peruvian government revenue will be about $84.4 million at zero discount rate (84.4 = 70.9 + 1.390 x 9.7) and about $49.5 million at 10 percent discount rate (49.5 = 41.4 + 0.833 x 9.7).

The OMRD side, however, will have difficulty in deciding whether DCFROR should be 10 percent or 20 percent in that the higher zinc price (the higher DCFROR) is acceptable to the mining firms, but the lower zinc price (the lower DCFROR) is preferable to the consortium because it entails a smaller capital outflow. Consequently, the zinc sales price will be determined by the bargaining between Japanese mining firms and zinc purchasers in Japan, not by Minero Peru and OMRD.

8.2. RECOMMENDATIONS

Since the zinc sales price is the most significant parameter for project DCFROR and capital inflow and outflow, Minero Peru will pay a great deal of attention to the zinc sales price offered by the OMRD affiliate. Consequently, OMRD should gauge the trend of the OMRD affiliate's opinion about the acceptable range of zinc price before negotiating with Minero Peru. This price range should cause DCFROR to change from minimum DCFROR for

mining firms to 20 percent under the conditions of a given smelting and refining cost and debt-equity ratio.

In negotiations, the easiest issue will be the smelting and refining cost, because both Peruvian and Japanese interests will coincide from the viewpoint of the benefits to be derived from each side. The lower the smelting and refining cost, the greater the Peruvian government revenue and the smaller the Japanese capital outflow.

High debt-equity ratio will be a relatively indifferent consideration for the Peruvian side because the impact of high debt-equity ratio on government revenue will be relatively small. Furthermore, a high debt-equity ratio will lighten the burden of capital equity for the Peruvian side. Hence, the debt-equity ratio will be determined by the budget constraints of the Peruvian side.

Once the smelting and refining cost and debt-equity ratio is fixed, the zinc sales price should be negotiated and narrowed from the range of minimum DCFROR and 20 percent DCFROR.

A negotiation based on this kind of numerical approach is much more comprehensive. It simplifies the negotiation process by forcusing on the benefits that will accrue to each party.

SELECTED BIBLIOGRAPHY

American Metal Market, 1982, Metal Statistics 1982, New York, pp.233-247

Banco Minero del Peru, 1972, Peruvian General Mining Law, Lima, Banco Minero del Peru, 97 p.

Belaunde F.T., and Kuczinski P.P.G., 1981, Nueva Ley General de Mineria Decreto Legislativo No.109, Lima, INKARI, 79 p.

Bosson R. and Varon B., 1977, "The Mining Industry and the Developing Countries", New York, Oxford University Press, pp. 151-177

Brodsky D.A. and Sampson G.P., 1980, "Retained Value and the Export Performance of Developing Countries", Journal of Development Studies, pp. 32-47

Bureau of Mines, 1980, Mineral Facts and Problems, Washington D.C., Bureau of Mines, pp. 1025-1043

Dayton L.M., 1978, An Analysis of Inflation's Impact on

Investment in the Mineral Industries, Colorado School of Mines, Thesis 2066

Faber M., 1982, "Some Old and New Devices in Mineral Royalties and Taxation", in Legal and Institutional Arrangements in Mineral Development, London, Mining Journal Books, pp. 104-122

Florez G., 1981, Mining Investment Opportunities in Peru, Lima, CENTROMIN

Geiger R., 1982, "International Codes of Conduct and Minerals Development", in Legal and Institutional Arrangements in Minerals Development, London, Mining Journal Books, pp. 21-28

Gillis M., 1982, "Evolution of Natural Resource Taxation in Developing Countries", Natural Resource Journal, vol. 22, pp. 619-648

Gillis M. and Wells L.T., 1980, "Negotiating and Implementing Minerals Agreements with Multinationals: Some Critical Tax and Development Issues" pp. 137-164 in Gillis and Beals eds., Tax and Investment Policies for Hard

Minerals: Public and Multinational Enterprises in Indonesia, Cambridge, Mass, Ballinger Publ. Co.

Inga, M., 1981, A Model for Economic Evaluation of Alternative Mineral Development Strategies in Peru, Colorado School of Mines, Thesis 2618

Kojima K., 1978, "Direct Foreign Investment", London, Croom Helm

Leon A.T.V., 1973, An Economic Evaluation of the Peruvian Mining Community, Colorado School of Mines, Thesis 1536

Metal Bulletin Handbook, 1982, Statistics and Memoranda, England, Metal Bulletin Books Ltd, p. 579

Metal Mining Agency of Japan and Japan International Cooperation Agency, 1982, Report on Geological Survey of the Oyon Area, Tokyo, p.33

Metal Mining Agency of Japan, 1982, Current Mining Projects in Peru, Tokyo, MMAJ, vol.11, No.10, pp. 46-88

----------, 1982, Foreign Direct

Investment in Peru, Tokyo, MMAJ, vol.11, no.11, pp. 37-44

----------, 1982, Current Worker's Problem in Peru, Tokyo, MMAJ, vol.12, no.4, pp.25-30

----------, 1982, Statement of Minister of Energie and Mines, Tokyo, MMAJ, vol.13, no.2, pp.32-38

Mikesell R.F., 1975, Foreign Investment in Copper Mining: Case studies of Mines in Peru and Papua New Guinea, John Hopkins Univ., pp. 3-35

----------, 1979, The World Copper Industry: Structure and Economic Performance, Johns Hopkins Univ., pp. 245-255

Ministerio de Energia y Minas, 1981, Informe de Situacion de los Projects del Sector Energia Y Minas, Lima

Ozawa T., 1977, "Japan's Resource Dependency and Overseas Investment", Journal of World Trade Law, vol.11, pp. 52-53

Petrick, A., 1980, The Economics of Minerals and Energy Projects, Petrick Associates, vol.1

Radetzki M., 1978, "Market Structure and Bargaining Power: A Study of Three International Mineral Markets", Resource Policy, pp. 115-125

----------, 1980, "LDC Policies Towards Foreign Mineral Investors", pp. 283-295 in Sideri and Johns eds., Mining for Development in the Third World, Pergamon Press

Seidman A., 1980, "Planning for Development in a Mineral-based LDC", pp. 283-295 in Sideri and Johns eds., Mining for Development in the Third World, Pergamon Press

Smith D.N. and Wells L.T., 1975, Negotiating Third-world Mineral Agreements: Promises as Prologue, Cambridge, Mass, Ballinger Publishing Co.

Stermole F.J., 1980, Economic Evaluation and Investment Decision Method, Golden, Investment Evaluation Co., 446 p.

Suratgar D., 1982, "International Project Finance and Security for Lenders", in Legal and Institutional Arrangements in Mineral Development, London, Mining Journal Books, pp. 144-157

Walde T.W., 1978, "Control of Transnational Corporations by Host Developing Countries", UNCTC/RTN/5, 21 p.

Zorn S., 1980, "Recent Trend in LDC Mining Agreements" in Sideri and Johns eds., Mining for Development in the Third World, Pergamon Press pp. 210-228