Growth of Copper Production: Determinants and Empirical Evidence

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Abstract

From the 1950s to 1980, the copper mining industry exhibited a phenomenal growth rate. However, beginning in the early 1980s through 1997, growth rate turned negative without any sign of reversal. In order to restore the important role the industry used to play in the economy, policy makers, and decision makers must understand the factors responsible for the rapid growth from the 1950s until 1980 and the equally rapid decline during the 1980s and the 1990s.

Growth of the copper mining industry is examined within the framework of a production function to identify the determinants of growth and their roles. The explanatory variables of growth are: copper resources, risk capital or investments, development in the world's copper market, technology, human capital in mining, and domestic social, legal, and political environment. Except for copper resources, which has been supportive of positive growth, all the variables have components that supported the growth of the copper mining industry during the 1950s-1980s period and contributed to its decline thereafter.

Availability of foreign capital, introduction of bulk mining technology, favorable copper prices and demand, and a conducive domestic social, political, and legal environment were responsible for the impressive growth experienced during the period from the 1950s to 1980. On the other hand, lack of foreign investment, declining market demand and prices, inadequate experience of local executives in the functions of top technical and managerial positions after 1974, arbitrary fiscal policies, lack of mining laws from 1986 to 1995, contradictory laws thereafter, and an uncertain domestic political, social, and legal environment caused the negative growth rates in the 1980s and 1990s.

The 1995 Mining Code, which allows 100 percent foreign investments in mining under the financial and technical assistance mode of mineral disposition, could have revived the industry after 1995 were it allowed to operate unhampered. However, the challenge to its constitutionality at the

Philippine Supreme Court stopped most efforts at mineral exploration. The situation was moreover aggravated by the passage of the Indigenous Peoples' Rights Act of 1997 (IPRA) which granted tribal peoples the right over mineral resources. This served as an even greater deterrent to mineral resources exploration and development. An anti large-scale mining environmentalism, espoused by highly organized groups and fueled by the IPRA, and the alleged adverse impacts of mining on the ecology has made the situation more complex and confused. Finally, it is concluded that prospects for future positive growth of the copper mining industry depends, to a large extent, on the Mining Act of 1995 being ruled constitutional.

Keywords: copper production, copper mining, mineral policy

Introduction

Objectives

This paper aims to identify some of the factors responsible for the rapid growth of the copper industry from around 1950 to the 1970s as well as those factors responsible for its continual decline thereafter. Knowing the factors that influence growth, it is then necessary to assess the role of each. The resulting knowledge, hopefully, could be put to good use by those who care about the industry. The second objective is to identify some lessons learned and make suggestions on how to improve the copper mining industry. Finally, the paper also aims to present some of the important data about the industry, which are difficult to get and assemble, for the benefit of future researchers.

Significance and problems of the copper mining industry

The copper mining industry used to be considered an important engine of economic growth. There was a time when it dominated the country's metallic mineral production (Appendix A: Table 6), and its contribution to export earnings was close to more than 16 percent. In addition, it contributed to government tax revenues, employment, and Gross Domestic Product (GDP). However, during the 1980s and the 1990s, the impressive contribution of the industry to export earnings and tax revenues, among others, gradually decreased to less than respectable levels. In part, this was due to the emergence of new export earners, such as the electronics industry and the overseas contract workers, and in part due to

actual production decline in the industry. Such decline was exacerbated by the rise of environmentalism in the 1990s that was directed specifically against the large-scale mining industry. Whether such decline can be arrested in the future and how are problems that are of great interest to people who care about the mining industry.

While the rise of new industries that contribute to national development is welcome, it is a good policy to insure that current contributors continue to do so. Such a policy is conducive to the sustainability of economic growth. It would, therefore, be a great challenge to policy makers and decision makers to see to it that the copper mining industry reasserts itself as an important contributor to the economic growth of the country.

One of the relevant literature referred to in this paper is regarded as the "Master Plan for the Philippine Mining Industry" (Clark, 1994). It observed among others, that the mineral industry used to play an important role in the Philippine economy, contributing up to 20 percent of export earnings in 1980. From then on, the industry's production continually declined while the mineral industries of other countries in the region and elsewhere expanded and prospered. The main causes of the decline were identified as the unattractive investment climate and unfavorable government policies during the period, notwithstanding the excellent mineral resources potential.

Santos (1988) identified the Vietnam War and the rapid growth of the Japanese economy, which expanded copper demand and raised copper prices, as the main stimuli in the development of the copper industry during the 1960s and the 1970s. Copper resources were then estimated at about 30,000 million metric tons (mt) while reserves were put at more than three billion mt.

Santos (1982) defined reserves as mineral stocks which are economically exploitable under existing technological, social and political conditions, whereas the more abundant mineral stocks categorized as submarginal and latent resources may become economic if there are sufficient improvement in social, political, economic, or technological conditions. It was hypothesized that mineral development (which may be proxied by reserves or production) is a function of the country's mineral resources endowment; domestic, social, political, and economic conditions; and global economic environment, investments, and technology. Finally,

Santos and Salita (1980) concluded that changes in the legal framework affect mineral development favorably if it is reasonable, stable, and would provide adequate profits to investors, and destructively, if it creates an environment in which reasonable return of investments is not forthcoming. Despite the importance of the legal structure, other factors, such as mineral endowment, technological innovations, world economic situations, and availability of investments likewise condition the development of the mineral industry.

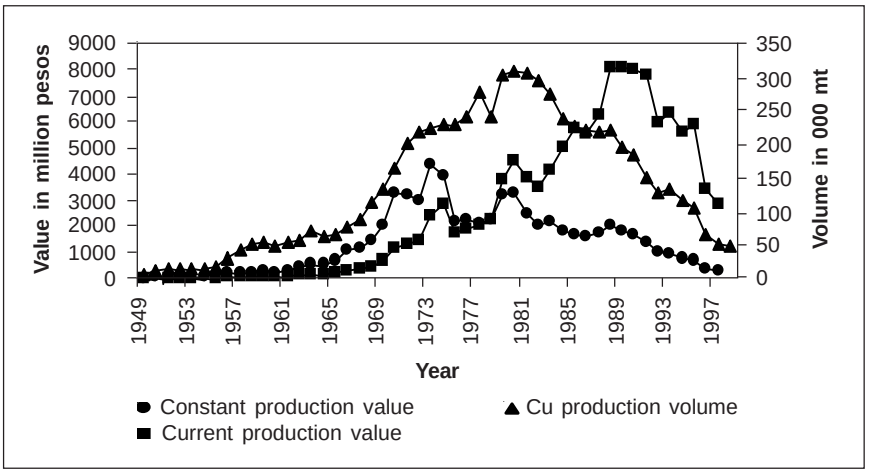
Mining revisited: Can an understanding of perspectives help? (Environmental Science for Social Change Institute, 1999) is a book of the Bishops-Businessmen Conference. It presents, among others, views on mining of the non-government organizations, the Church, the mining industry, and the government. It also presents relatively new data about the mining industry.

Growth of copper production

Growth trends in copper production

Figure 1 and Table 1 (Appendix B) document the impressive growth of copper production during the three decades beginning in 1949 and the remarkable decline it experienced since 1980. As noted above, copper production grew from 6,000 mt in 1949 to the peak level of 304,500 mt in 1980, corresponding to a phenomenal 13.06 percent annual growth rate.

Figure 1. Copper production and value of production at current and constant 1978 prices.



From its peak in 1980, production declined unabated to 48,640 mt in 1997 at -9.69 percent annually. Except for some minor kinks, the growth curve of physical copper production was smooth.

Growth curves of the value of production were more irregular in shape though they broadly followed the shape of the physical copper production curve. The growth of value at constant 1978 prices peaked in 1973, seven years earlier than physical production, then plunged down a steep rugged path. Curve of values of production at current market prices peaked in 1988, eight years later than physical production, after which it followed a downward trajectory. All curves have had a downward trend since 1988. The following section discusses the causes of the kinks and short term trends of the copper production curve during the study period.

Timing of identified growth trends

Some of the kinks or inflections in the growth curve of copper production during the 1949-1997 period can be ascribed to the events that occurred during certain periods, both local and global, as can be discerned from Table A. For instance, the highest annual growth rate of 17.78 percent that occurred in 1954-1960 was obviously induced by the expansion of copper demand during the Korean War. This was followed by a 12.22 percent annual growth in 1960-1973, coinciding with the height of the Vietnam War (and period of rapid growth in the Japanese economy). On the other hand, sluggish or negative growth rates occurred after 1973, during the Oil Crisis, Martial Law, EDSA Revolutionary Period, and EDSA Recovery Period. In fact, the negative growth rates of -7.43 percent and -21.68 percent annually coincided with the EDSA Revolutionary Period and EDSA Recovery Period, respectively. Reference to growth in real value of production indicates that the negative growth in production started in 1973 during the Oil Crisis Period and climaxed during the EDSA Recovery Period.

Explanation of the association of growth trends with these events is given under the section on determinants of growth of the copper industry. However, additional insights can be gained by briefly looking into the structure of the industry.

Structure of the copper industry

Major mining firms of the industry

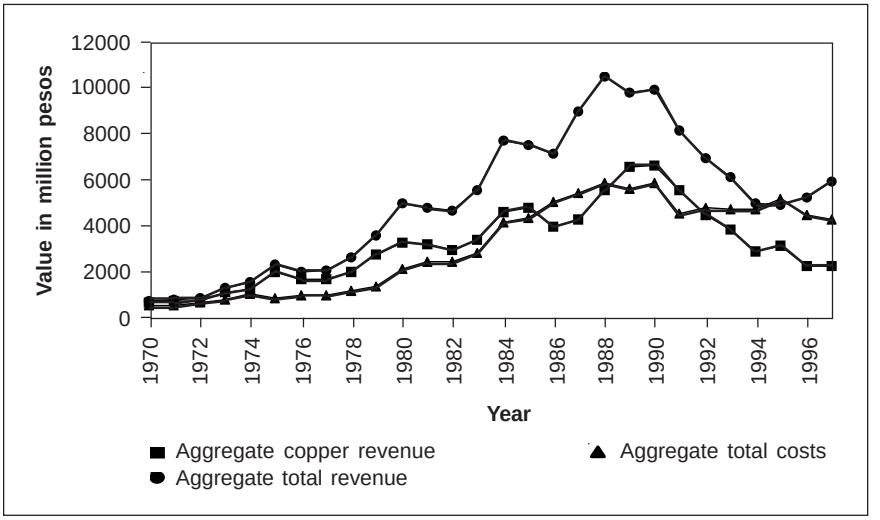
Many firms comprise the copper mining industry. The number increases rapidly in times of high copper demand and prices and decreases drastically when copper demand and prices slump. Small firms that produce high grade copper ore in small volume become economic to operate in times of high prices, but become uneconomic when prices slide down. Small capital investment needed to open and operate them allow mine operators to respond quickly to changing market conditions. In contrast, large firms maintain their level of output regardless of prices due to, among others, long term sales contracts and large fixed costs. Renegotiation of sales contracts, however, occur during times of prolonged depressed prices (e.g., in 1980s) with profound effects on the level of production.

Major corporate producers for 1970-1997 are shown in Table 2 (Appendix A). This table documents the entry and exit of major producers in the industry, such as Atlas Consolidated, MMIC (Bagacay), MMIC (Sipalay), Philex, Marcopper, and Dizon, among others. Finally, the table likewise shows the years when there are the greatest number of producing firms, defining in the process boom periods.

Table 3 (Appendix A) shows the number of copper establishments from 1970 to 1997. It moreover indicates that the most number of firms operated during the 1970-1980 boom period, after which the number of copper establishments progressively declined. The table further shows that there is a close correlation between the number of firms and growth of production in the copper industry.

Finally, apart from concentrates that contain copper, gold, and silver, among others, the country also produces blister and anode copper from the operation of PASAR (Philippine Associated Smelter and Refinery), located at Isabel, Leyte. PASAR is a copper smelter company partly owned by the government, by major copper producing companies, and by some foreign copper buying firms. It was one of the major industries intended to speed up the country's industrialization. Production of smelted copper (cathodes) are set down in Table 4 (Appendix A).

Figure 2. Structure of mineral output of leading copper companies.



Structure of revenues and costs of selected mining companies

The copper industry involves joint production of copper, gold, and silver. Pyrite, magnetite, and molybdenite are produced by some mining firms as byproducts. In fact, the copper industry can not be economic on the basis of the copper revenues alone. Examination of the outputs and costs of a number of copper mining firms as shown in Figure 2 and Table 5 (Appendix A) reveals that.

For instance, when the copper revenue, total revenues, and costs of the four leading copper firms are plotted in the same coordinate axes in Figure 2, it becomes clear that they would have suffered large losses in 1986, 1987, 1989, 1990, 1991, 1993, 1994, 1995, 1996, and 1997 if they depended only on copper as a source of revenue. It is, however, remarkable that before 1985, the major firms made profits even if they depended on copper revenue only. But if revenues from the main product, co-product, and byproducts are aggregated, then the major firms made profits in all the years, except in 1995. Table 5 (Appendix A) provides the basic data for Figure 2. This observation highlights the tremendous impact of increased taxes and other government charges on the profitability of the industry since the early 1980s.

The changing role of the copper industry in the economy may be reflected in the changes in the policies that affect it. The government would tend to favor it if its contribution to the economy is high or increasing, but may not be too considerate if the contributions are insignificant and declining.

Role of copper in the economy

Copper plays an important role in the national economy. It is a major component of domestic mineral production and mineral exports. It also provides tax revenues for the government.

On the average, copper accounted for 44.63 percent of metallic and 31.87 percent of total mineral production in 1949-1997. Shares of copper in total mineral and metallic mineral production were maximum during the 1968-1974 period. Beginning 1975, however, its share progressively regressed.

The decline in percent share of copper in the value of total mineral production is accompanied by a similar decrease in the value of total mineral and metallic mineral production. Table 6 (Appendix A) presents the share of copper production in total mineral and metallic production.

Figure 3. Share of value of copper in total exports and mineral exports.

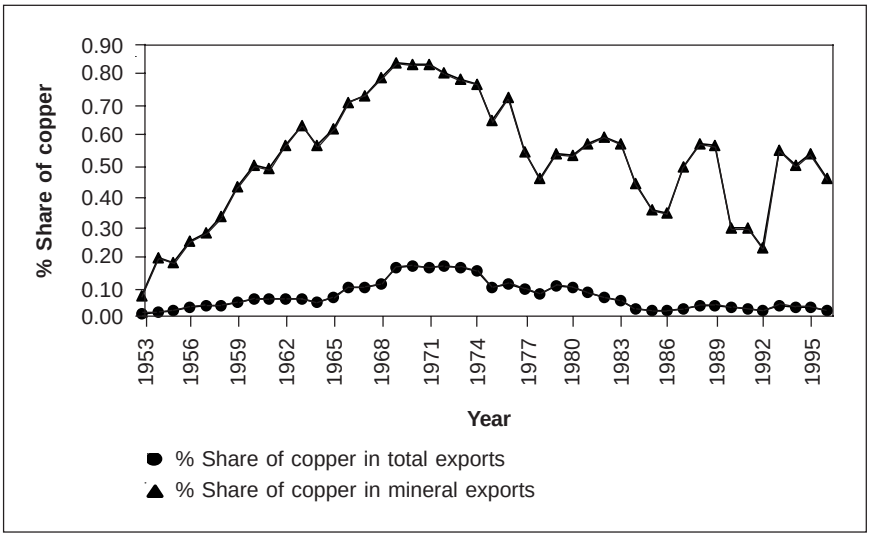
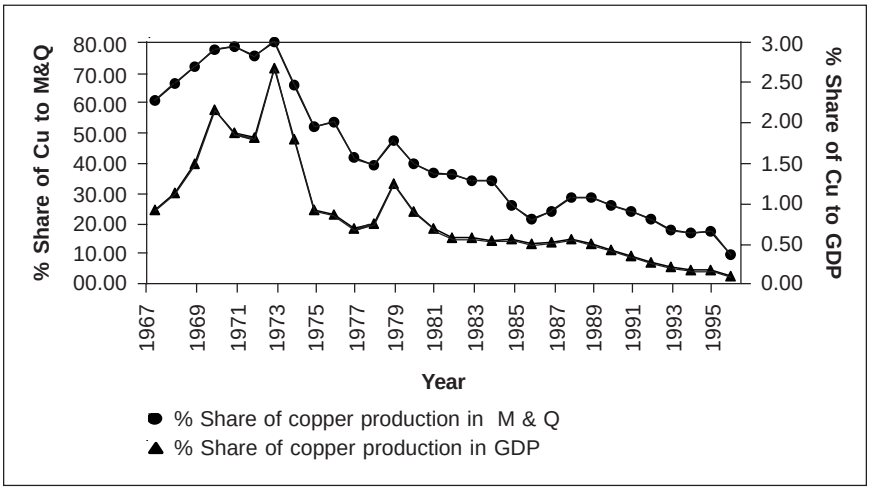


Figure 4. Share of copper production in mining and quarrying and gross domestic product.



The role of copper in total exports and mineral exports is even more impressive. Copper share in mineral export is 51.27 percent per annum, on the average, and reached as much as 83.13 percent in 1969. In total export, copper contributes, on the average, 6.15 percent per annum, reaching as high as 16.35 percent in 1972. Shares of copper in total and mineral exports were at their highest in 1968-1974 period, beyond which they continuously declined as shown in Figure 3. Decline of share in total export is more pronounced than share in mineral export. Average total exports and mineral exports are $4,585.76 and $349.8 million per annum, respectively, as shown in Table 7 (Appendix A).

The contribution of copper to national production is reflected in its share in gross domestic product (GDP). Table 8 (Appendix A) and Figure 4 show the share of copper in mining and quarrying (representing mining industry) and in GDP. In 1967-1997, average share of copper in GDP was 0.84 percent per annum. Highest share in GDP was 2.66 percent per year in 1973. The share of copper in GDP was highest in 1967-1980, after which it continuously declined. Its share in mining and quarrying was much higher at 41.23 percent per annum on the average. Percent share in mining and quarrying was highest in 1967-1980, beyond which it continuously declined. This decline is very clearly shown in Figure 4.

The decline of the Philippine copper mining industry must be viewed vis-a-vis the world copper production which grew continuously during the study period as shown in Figure 6. Why did the Philippine

copper mine production decline while world production continually experienced positive growth? This points to some important domestic problems that tend to undermine the industry.

Determinants of growth of copper mining production

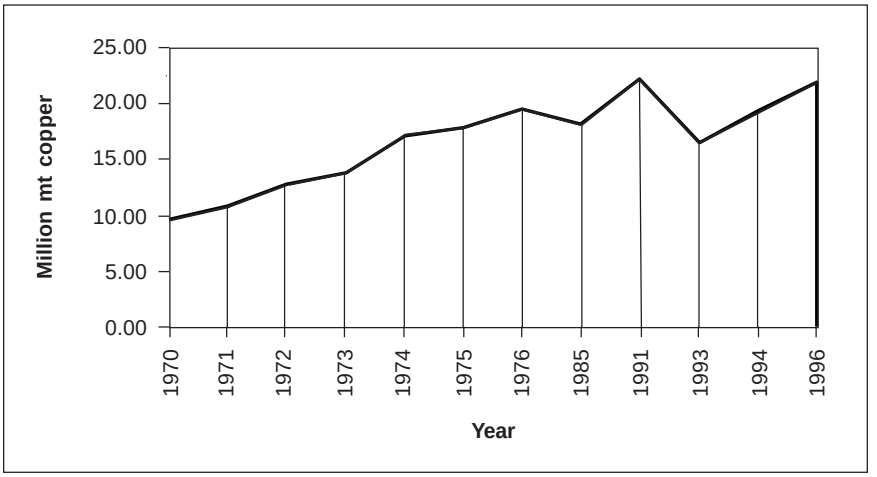
The major growth determinants of the copper mining industry are the following: (a) resources, (b) technology, (c) human capital, (d) investments, (e) domestic environment, and (f) global market development. Usually, the last two parameters are assumed constant. However, in this paper they are important variables. Domestic environment includes the social, political, legal, and economic environment, among others. Global market development refers to changes in the world market that affect the level of supply, demand, and prices of copper. Human capital refers to properly educated, trained, and experienced manpower (Mankiw, 1997). However, some writers (e.g., Samuelson & Nordhaus, 1998) include it in labor. The rest are standard variables found in most production function relation.

Copper resources and reserves

The most important factor for the existence of any mining industry is the availability of mineral reserves that are derived from resources through the application of exploration and other suitable technologies. Reserves are the resource input in mining production; they are the forms of mineral deposits from which a material like copper can be recovered at a profit.

Mineral resources, on the other hand, represent a portion of the country's "mineral endowment" upon which some exploration works have been done to determine the concentration of a mineral and its suitability for economic recovery. The more thoroughly the resources are studied, the greater is the certainty of knowledge about the occurrence of a mineralized rock of a given mineral concentration and economic potential. Resources in which the mineral content are determined with a probability of about 25 percent (plus or minus) and which can be extracted at a profit under prevailing conditions are called reserves. A country's mineral endowment refers to the average concentration of a mineral in the rocks of a particular area such as 134 mt per cu km or 14 kg gold per cu km, say for the Philippines. On the basis of copper endowment, the Philippines ranks

Figure 5. Philippine copper reserves, 1970 - 1996.



fourth in the world (Environmental Science for Social Change Institute, 1999). By means of exploration, the loci of high concentration of a given mineral in the rocks are mapped then further studied and transformed into different types of resources. A more comprehensive discussion on the concepts of mineral endowment, resources, and reserves is given by Brooks (1976).

As a result of investments in exploration and the application of bulk mining technology, copper reserves experienced considerable growth during the study period. It grew at an average annual rate of 5.35 percent from 9.47 million mt in 1970 to 21.79 million mt in 1996. During the same period, however, the average copper grade deteriorated from 0.69 percent to 0.46 percent, mainly as a result of the inclusion of low grade, high tonnage porphyry coppers in the stock of copper resources and reserves. It is significant that the growth of copper resources did not follow the negative trend exhibited by copper production during the 1980-1997 period. Figure 5 and Table 9 (Appendix A) reflect the generally upward movement of copper reserves.

Porphyry copper is the dominant deposit type during the 1970-1997 period. Massive copper sulfides, kuruko, and vein type deposits are insignificant in volume though they exhibit high grade (2.3-3.9 percent) copper.

Despite the inhospitable environment for mineral investment during the 1990s, a large deposit of porphyry copper was discovered in the late 1990s by a multinational corporation, one out of two whose FTAA applications were approved. Deposit is said to contain 26 billion pounds copper and 16 million ounces of gold. At 0.20 percent copper cut-off grade, the ore is estimated at 2.5 billion mt at 0.48 percent average copper (Madera & Rohrlach, 1998). This only confirms the rich mineral endowment of the country that is waiting to be tapped. However, no actual mining production has taken place yet due to numerous legal and environmental issues being raised by opponents.

Risk capital

The mining industry is generally characterized as highly risky and capital intensive. It is common for a major mining company to invest a few million US dollars, or even tens of million dollars in exploring a prospect only to realize that it is not economically viable. Usually large multinational corporations that specialize in various aspects of mining undertake mineral exploration. Their many projects scattered all over the world and their superior knowledge about various aspects of mining allow them to realize economies of specialization and thereby reduce their risks and costs. Such corporations invest only in mining, more specifically in certain types of mining, in order to preserve their competitive advantage.

After the exploration has blocked minimum economic-size reserves, the risks involved are just normal industrial risks. However, the investments for putting up the mining and beneficiating facilities are orders of magnitude higher than required in exploration. The blocked ores, mills, and plants, however, can be used as collaterals.

Foreign companies were major sources of capital in the mining industry from 1900, through the Commonwealth Period, up to 1974, when the Laurel-Langley Agreement expired. This agreement conferred American citizens and corporations the right to explore and extract minerals. Later, the 1935 Constitution reserved mining for Filipino citizens and corporations 60 percent of whose capital is owned by Filipinos.

In order to preserve the important role that the mineral industry used to play in the economy after divestment by foreigners in 1974, the Philippine government tried to fill the resulting void by offering liberal

loans or loan guarantees to "selected" local mining investors. A number of copper and gold mines came into stream as a result. These selected mining projects defaulted in paying their obligations when economic conditions became tough. High exposure of government financial institutions to the loans of these companies brought government to the brink of bankruptcy.

Prime Minister Virata, also the then current Finance Minister, pointed to the inherent flaw and disadvantages of the government's investing in the mining industry:

> In a speech of Prime Minister Cesar Virata, who is also the Finance Minister, he admitted that part of the blame for government take over of distressed industries can be traced to the government's "liberal grant" of guarantees for foreign borrowings in the last several years. He said, project evaluation was done haphazardly since lenders could rely on government guarantees if firms defaulted. The inherent weakness of these projects surfaced with the prolonged worldwide recession that has affected the Philippines since 1979.
>
> One of the government institutions most active in taking over distressed corporations is the Development Bank of the Philippines (DBP). It's total exposure in distressed corporations amount to P7 billion. Among the mining companies in which the DBP has substantial investment are Construction Development Corporation (P23.11 million), Marinduque Mining and Industrial Corporation (P1.35 billion) and Western Minolco (P262.08 million).
>
> Other mining firms where the government has considerable exposures are: Batong Buhay Gold Mine, Inc., Sabena Mining Corp., Acoje Mining Co., Inc., Atlas Consolidated Mining and Development Corp., Lepanto Consolidated Mining Co., Marcopper Mining, Hinobaan Mining Co., Inc., Negros Occidental Copperfield Mine, Inc., Semirara Coal Corp. and Vulcan Industrial and Mining Corp.

> Apart from the DBP, other government corporations that loaned money to the mining industries are the Philippine National Bank, National Development Corporation, Government Service Insurance System, and National Investment Development Corporation. (Securities and Exchange Commission-Business Day, 1982, pp. 294-298)

It is important to note that the efforts of local firms and the national government to fill the void left by foreign investors were quite unsuccessful in maintaining the growth of the mining industry. Such failure may be due to inadequacies in the following areas: experience as top managers of large-scale mining operations, mastery of mining technology, knowledge of mineral markets, and access to low cost funds that are needed to execute successful mineral projects.

It is commonly believed by many mineral economists that scarce domestic funds in developing countries are better invested in less risky ventures with high social returns than in mining. Developing countries need to use all available funds in doing projects needed for national growth but which foreigners are unwilling to undertake.

Since there are well established firms in the world dedicated only to mining, they could very well be used as agents to develop the local mining industry. All they need are a good mineral endowment (which the country has), a set of mineral policies that are fair, and a consistent as well as a stable political and social environment.

It is argued that even if foreign investors are willing to take just 40 percent of the share in capital, it is difficult to find local partners who are willing and able to assume the 60 percent share in investment. Scarcity of local capital can be inferred from the fact that for large mining and exploration projects scheduled for 1999 to 2008, $3,575 million out of $3,585 million are accounted for by foreign multinationals. This translates to 9 out of ten projects being invested in by foreign mining firms. (Environmental Science for Social Change Institute, 1999; see Appendix A: Table 11 for additional details.) The Clark study (1994) provides a good appreciation of the significance of the 60:40 rule to mining investments in the country:

> Perhaps no greater disincentive to foreign investment exists in the Philippines than that of the 60:40 Filipino-Foreign

> ownership rule that is applicable to Philippine mineral resources. The 60:40 rule does not recognize either modern contractual arrangements or provide for an equitable return on investment and thus it strongly inhibits investments. It further constrains development because the lack of domestic capital precludes the local (investors) industry from assuming the 60 percent equity required for joint venture. (pp. II – 47-48)

Developments affecting the world copper market

At least three major developments in the world affected the world copper market and ultimately the local copper industry. These are the three wars—World War II, Korean War, and Vietnam War; the Oil Crisis and consequent Global Recession; and the substitution of copper by fiber optics and aluminum.

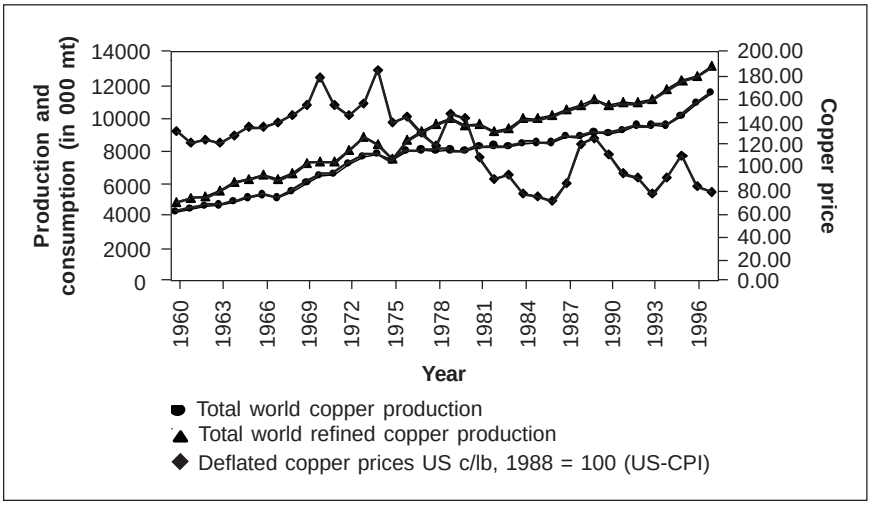
The wars

World War II led to the occupation of the Philippines by Japan in 1941-1945, which led to the deliberate decommissioning of mining facilities lest the Japanese benefit from them. Only negligible amount of copper production occurred during the period. This war also brought about the destruction of much of Japanese industries. Postwar reconstruction of the Japanese economy expanded the demand for copper in the region. Both the Korean and the Vietnam wars led to the expansion of the demand for copper and other war materials that gave rise to favorable copper prices. These events serve to explain the negligible copper output during the Japanese era and the upsurge during the 1950s, 1960s, and 1970s.

The oil crisis

The oil crisis of the 1970s and 1980s resulted from the dramatic hiking of oil prices dictated by the Organization of Petroleum Exporting Countries or OPEC. At the height of the crisis, oil prices went up from less than US$ 2.00 a barrel to US$ 32.00 in 1980. As a result, global recession occurred leading to a large cut-back in industrial production. Hence, the demand for copper declined, accompanied by a decrease in price. The inflation that accompanied the oil crisis forced governments to hike interest rates to contain it.

Figure 6. World copper production, consumption, and deflated prices.



The oil crisis affected the Philippine copper industry in the following ways:

a. Demand for copper decreased. Even Japanese buyers of copper concentrates in the country had to decrease their purchase by at least 15 percent (Clark, 1994).

b. Prices of copper severely declined.

c. Production costs of copper rose steeply due to high costs of materials and equipment brought about, among others, by high interest rates and depreciated or devalued peso.

These events curtailed the growth of production and demand for copper from the mid-1970s to 1997, as Table C (Appendix B) and Figure 6 show.

Substitution by aluminum and fiber optics

The intrusion of fiber optics and aluminum into the copper market has been shifting leftward the demand for copper over time. This further erodes the demand for Philippine copper and results in the curtailment of copper production. The substitution of copper by aluminum and fiber optics in electrical transmission and telecommunication, respectively—

the biggest markets for copper—indicates that the demand for and price of copper could only rise moderately since the 1980s. This will be discussed in greater detail in the next section.

Technology

Technological changes are an important driver of growth. Two groups of technologies significantly affected the growth of the copper industry, one positively, the other negatively. One shifted production to the right; the other shifted demand to the left.

Bulk mining technology

Tonnage of ore, in general, increases exponentially as the grade decreases (Brooks, 1976). Whereas before the 1950s all copper mines in the country were small vein type or massive sulfide deposits with grades way above 1.0 percent copper, after 1955 most of the copper mines were based on low grade (about 0.5 percent copper), high (30-250 million metric tons) tonnage reserves called porphyry copper deposits. These porphyry deposits became the dominant copper reserves due to the introduction of bulk mining technology that made economic deposits with as low as 0.4 percent average copper content. Atlas Mining, Philex Mining, Marcopper Mining, and Sipalay Mining are the best examples. Porphyry copper deposits rapidly expanded copper production from 1955 to the mid-1970s.

The Philippine porphyry copper deposits contain gold. The gold enhances the profitability of the copper in the ore. The value of the gold, in some cases, exceed the value of copper (e.g., Philex Mines). In fact, without the gold, most porphyry copper deposits can not be economic (see Figure 2).

There are two disadvantages of porphyry copper. Its low grade character requires plenty of energy to recover copper since large volumes of rocks have to be ground to recover the copper minerals. Moreover, the process of liberating the copper mineral causes the production discharge of large volumes of tailings with profound implications on the environment.

Introduction of bulk mining in the 1950s could be one of the major causes of the rapid growth experienced by copper production from the early 1950s to the mid-1970s. Its effects could continue into the future.

Substitution of copper by aluminum and fiber optics

Over the years, copper wires and cables have been used in electrical transmission and telecommunication systems. Long distance electrical transmission used to be a major copper application. However, during the study period, aluminum has thoroughly displaced copper in this market. This can be attributed to the lighter weight of aluminum which serves as an advantage over copper in overhead transmission lines. The largest tonnage of overhead cable are now aluminum-conductor steel re-enforced cable. Overall, copper has a small fraction of the power utility business in the U.S. (and the world). There is very little opportunity for copper to penetrate the utility market (Black, 2000).

Table D (Appendix B) shows the changing intensity of copper use from 1960 to 1985. The declining intensity of copper use over the years reflects the increasing penetration of the copper market by aluminum, hence, shrinkage of copper demand.

The use of copper in long distance telecommunications has been challenged by fiber optics. In 1983, for instance, copper consumption in telephone communications in Japan, U.S., western and southern Europe amounted to about 650,000 metric tons. However, optical fiber is claimed to be superior to copper in the application. For instance, optical fiber provides a means of communication that is more powerful, more efficient, more accurate, and, in many applications, more economical than communication over copper wires (Black, 2000).

Displacement of copper in electrical transmission commenced in the 1960s. However, the penetration of telephone communication systems by fiber optics started only in the early 1980s. Table E (Appendix B) documents the rate of displacement of copper by fiber optics from 1984 to 1995. Before 1984, there was but minimal optical fiber used in telephone communications. By 1995, about 70 percent of new installations used optical fibers, in the process displacing more than 300,000 metric tons of copper.

Substitution of copper by aluminum in the uses mentioned above is based on the lower price of aluminum over the years. Note that Table F (Appendix B) shows that the price of aluminum has always been lower than the price of copper during the study period.

Research and development

One way by which large multinational mining corporations keep their competitive edge is through research and development. By conducting exploration in different parts of the world, they discover the lowest cost copper deposits under existing conditions which they keep in their portfolio of resources. They continually advance their exploration technologies to sharpen their abilities in scanning ever larger areas and increasing the probability of successful discovery. Researches in mining and metallurgy seek to increase the efficiency of recovering metal values and reduce the cost of recovery. Multinational mining firms also analyze the legal, political, fiscal, and social conditions in different countries to determine the most advantageous venues for their investments. They likewise study the markets for their products to get the best prices.

Local mining firms, due to their relatively small size, are contented with adopting technologies that are available in the market and embedded in equipment. Many local mining firms do not seem to have effective research and development programs to protect or enhance their competitiveness. For instance, some well established local mining firms have failed to develop replacements to their reserves which they have been depleting for over 20 or more years. Even new mining firms just make do with marginal reserves. Hence, the country has been saddled with many mining firms that are continually losing (e.g., see Clark, 1994). There is no evidence that local mining firms will improve their research and development in the near future.

Human capital in mining

Men with appropriate education, training, knowledge, and experience in various aspects of mining comprise an important driver of growth. The long history of mining in the country that is said to cover more than a thousand years (Clark, 1994) and the gold mining boom of the 1930s gave rise to a large pool of experienced prospectors, placers, underground mining technicians and laborers, mining engineers, and metallurgists. These valuable human resources, in tandem with high level managerial expertise of expatriate employees that accompanied foreign investments, facilitated the growth of the country's mining industry during the study period. Many mining engineers even worked as exploration

geologists in search for new deposits. In the early 1960s, the United Nations put up the Institute of Applied Geology in cooperation with the University of the Philippines, Bureau of Mines, and the private mining companies in order to train mining engineers in exploration geology as well as to produce additional exploration geologists from the ranks of geologists and geology students. Graduates of the Institute provided the leadership in discovering new ore deposits, particularly porphyry copper deposits, that made possible the creation of new mining projects and the expansion of existing ones during the 1960s, 1970s, and 1980s (University of the Philippines, 1967).

While local mining technicians, mining engineers, metallurgists, and geologists provided technical services to the mining companies, foreigners rendered services at the senior technical and management level. Foreigners were responsible for evaluating ore reserves, for securing financing, for marketing, and for managing the company. Foreigners occupied the position of mine or mill superintendents, vice-presidents, president, and chairman of the board.

At the time when foreigners divested their shares and relinquished their managerial posts, at the expiration of "parity" in 1974, very few Filipinos had the experience of exercising senior managerial function in mining companies. But due to the operation of the law, Filipinos had to assume the positions of responsibility vacated by expatriates, notwithstanding their niggardly experience in such jobs. If indeed this were the case, then the mining companies they managed may have suffered as they lacked the necessary experience to master the intricacies of their new jobs. A few cases may be pertinent to test the preceding hypothesis.

Three of the top mining companies that were very lucrative decades before 1974 gradually became less profitable as the grade of their reserves declined (Santos, 1999). Although it is standard practice in mining to look for new reserves as the existing ones are depleting, these companies failed to locate new reserves until they came to a point when their operations could only yield perennial losses. After a long while however, at least one of them discovered new deposits[1] in the vicinity of the existing mine, indicating perhaps that the management lacked the experience to respond to the challenges of their new positions.

Two of the biggest mining organizations in the country faced different types of problems. One of them, the biggest and most profitable copper

mine in the country in the 1970s, encountered decreased profitability due to uncertain supply and high prices of oil during the energy crisis. Hence, it decided to contract a loan to build a coal-fired power plant for the use of the mine. However, the high interest rates that reached as much as 60 percent in the early 1980s, among others, caused the company to default in the payment of principal and interest. Hence, it was forced to stop operation. It is also significant that the president of the company, when it got into trouble, was a chemical engineer who was plucked from outside the mining industry. Moreover, a gold mine it used to operate but later abandoned has been found to be a world class gold-copper deposit when it was taken over and evaluated by a Canadian multinational mining corporation.

The second is a company that mined nickel ores and smelt them into nickel metal. It also had a large copper mine in its portfolio. Problems arose when the smelting process it adopted, one that was not yet proven commercially, never allowed the company full utilization of production capacity nor made any reasonable profit. As a result, the operation never made profit and the company defaulted in paying its loans. The nickel mine, the smelter facilities, and the copper mine had to be foreclosed by creditors (Santos, Delos Angeles, & Abayan, 1982).

An even clearer indication of the incapacity to manage mining operations is provided by the case of a number of failed or distressed mining companies. As a result of the energy crisis and the attendant financial crisis, they failed to comply with their financial obligations causing them to stop operations and their creditors foreclose their properties. According to some authorities, these mines should have never been in operation because they could only be viable at high copper and gold prices. In fact, only those properties that could survive even at predictably low prices should have been considered for mine development (Clark, 1994). Moreover, it can be argued that the failure of the financial institutions that evaluated the loan applications of the failed mining companies (mentioned by Minister Virata in his speech) to detect the lack of viability of the mining projects reflects inadequate expertise in dealing with mining projects.

This hypothesis that the decline of the copper industry since the 1970s is partly due to the lack of good top mining executives must be further investigated with greater care and detail. It is perhaps a very promising explanation of the decline and even virtual demise of the Philippine copper mining industry from the early 1974 to the present.

Domestic environment

Stability of mineral policy

Stable mineral policies are absolutely essential for the success of mining projects. Being highly capital intensive and risky, investors require stable policies in order to predict when they could recover their capital and earn reasonable profits. Taxes, royalties, and similar government charges comprise a major portion of the cost of mining and are instrumental in determining when a mining project will break even or if it will make profit at all.

Two major changes in mineral policies occurred during the study period. One involves changes in taxes and similar charges, the other concerns laws governing the mining industry.

As a result of the recession arising from high oil prices and global economic contraction during the early 1970s to 1980s the government decided to raise revenues from the mineral industries:

1. In 1981, Batas Pambansa 84 increased ad valorem taxes by 100 percent from 2.5 percent to 5.0 percent for metallic, and from 1.5 percent to 3.0 percent for nonmetallic minerals. This tax is among the highest in the world (Clark, 1994, I-16, II-18).

2. The above tax was changed under Republic Act 7729 of 1994 as follows: 2.0 percent for gold and chromite effective June 1994; 1.0 percent for copper and other metals in 1994-1997, 1.5 percent in 1998-1999, and 2.0 percent thereafter.

3. Value added tax. All registered businesses were required to pay 10 percent value added tax on the importation of or domestic sale of goods and services. However, mineral exporters were supposed to be exempted; they were entitled to a refund of VAT paid to the Bureau of Internal Revenue or BIR. Gold-producing companies were forced by law to sell their primary gold produce to the Central Bank (CB). Even though the BIR ruled in 1988 that sales of gold to the CB were to be classified as "export sale," the BIR made no refund to gold producers. The BIR reversed its ruling in 1992 and declared that sales of gold to CB and sales of

copper to PASAR (state-owned smelter) should not be considered as export sales, hence, subject to VAT despite the ruling of the Department of Justice that sales of gold to CB must be VAT-exempt.

4. As a result of the EDSA Revolution, no mining law was operative from 1986 to 1995 when the Mining Act of 1995 was passed. Despite the operation of the 1995 Mining Act, uncertainty still hangs in the air as its constitutionality is still being challenged, particularly the provisions on Financial and Technical Assistance which allows 100 percent foreign-owned firms to conduct mining.

5. The Indigenous People's Rights Act or IPRA (of 1997) which gave indigenous tribes control over the resources underneath tribal lands made most mineral lands inaccessible to mining. It is difficult enough to deal with government bureaucracies, but it is even more difficult to secure permits from numerous tribal members who are not knowledgeable about mining or of the limits of their power and authority. Though the constitutionality of this law has been challenged, the Supreme Court has failed to resolve it for good.

Instabilities in government fiscal policy since 1981 would not allow mining firms to make reasonable plans. In fact, since 1981 such changing tax rates and charges were enough to make a moderately profitable mining operation uneconomic. They could have caused *high grading*, the selective mining of high-grade ores to pay for increased costs, in the process destroying a large part of the mines' ore reserves. Such policies, therefore, caused production to contract and prevent industry expansion by new investments.

The uncertainty in the constitutionality of the Mining Act of 1995 and the simultaneous operation of IPRA (whose constitutionality is also in question) will tend to prevent new foreign investments, particularly in FTAA from 1995 onwards.

Anti-mining environmentalism in the Philippines

Environmental awareness in the Philippines is among the highest in the world. Surveys of the developing countries by Gallup Polls indicate that 94 percent of Filipinos polled are personally aware about environmental

problems. Countries surveyed, in addition to the Philippines, include (in the order of decreasing awareness) Nigeria, Mexico, Uruguay, Brazil, South Korea, Hungary, Russia, India, Chile, Turkey, and Poland. Environmental awareness in the Philippines even exceed many developed countries, such as Portugal, Canada, USA, Great Britain, Norway, Ireland, Netherlands, Japan, Germany, Finland, Denmark, and Switzerland (Dorgan, 1995).

Objections against mining in the country are summarized by the Archbishop of Ozamis City, Mindanao, which perhaps reflect the concerns of some of his constituency (Dosdado, 1998) rather than that of the Catholic Church:

1. Much of the land proposed for mining is within the ancestral land of the 8.5 million indigenous and tribal Bangsa Moro peoples. Tribal lands are targeted not only because they are often mineral rich but also because successive governments have failed to recognize the land rights of indigenous communities.

2. The Code (Mining Code of 1995) allows 100 percent foreign ownership in mining (previously maximum was 40 percent).

3. The Code grants large concessions which can then be mined using open pit and other bulk techniques. In a country as densely populated as the Philippines, such large-scale operations (using cyanide and other dangerous chemicals) pose a serious threat to livelihood and welfare of millions of affected people.

4. Mining could strip key forested watersheds and pollute the area downstream, including coastal waters. It will deprive many of the poorest people in the country of their existing lands and livelihood.

5. Compensation for damages from mining concerns have been minimal. The full social and environmental costs are left to the local population to absorb as best they can.

6. The main victims of the mining development will be small-scale miners, farmers and fisherfolk among the indigenous

peoples and other rural poor populations that might be expected to be the natural target beneficiaries of government programs, rather than their sacrficial lambs.

7. Small Mining can presently provide a good livelihood. It brings equitable development to whole communities and it benefits many more people than big mines. By contrast, the provisions of the Code allow 100 percent repatriation of profits for big firms. Local benefits accrues to central government rather than to peripheral communities.

Other groups or writers raise essentially the same issues. They also hold that the local minerals should not be exported, instead they should be used for the industrialization of the country (Almeda, Beroya, & Pajarillaga, 1998).

Undoubtedly, the Marcopper Tailings Spill incident on March 24, 1996, during which approximately 1.6 million cubic meters of mine tailings were allowed to escape from a tailings storage, adversely affecting the lives of 20,703 people and inundating the Boac and Makalupnit rivers, provided some visible support and credibility to the environmental issues raised against mining (Ramos, 1999).

The issues raised above are certainly debatable. However, those issues, among others, have helped create an environment that is considered unfavorable to mining. They have been raised by demonstrators against mining projects numerous times.

The domestic environment in the 1990s and beyond consists of opposing forces. The Mining Act of 1995 gives optimism to miners as can be seen in the large number of applications for MPSA, FTAA, and EP in Table E (Appendix B). However, the challenge to the constitutionality of FTAA, the operation of the IPRA, and anti-mining environmentalism serve to stifle copper industry growth. Government officials have become reluctant or overcautious in approving applications. Mining investors are appalled at the seemingly unwelcome treatment they are getting. Table E (Appendix B) reflects this confused domestic mining environment.

Further illustration of the confusion is provided by the case of the provincial government of Oriental Mindoro. The provincial lawmaking body passed an ordinance that bans large-scale mining for 25 years in the

province, in the process depriving mining firms that have exploration operations and mining applications in this province (Evora, 2002).

Conclusion

The determinants of the growth of copper production and their roles

The preceding analysis indicates that each of the explanatory variables of the production function posited in the section on Determinants of Growth of Copper Mining Production contributes towards explaining the growth of copper mining production by either increasing or decreasing growth during the 1950-1997 period. The determinants of copper mining growth or its decline are identified below. Brief statements on the nature or sense of their contributions are also provided.

Copper resources and reserves

Adequate copper resources made possible the rapid growth of copper production from the 1950s to the 1970s. Introduction of bulk mining technology made economic low grade-high tonnage porphyry coppers that are abundant in the country. As of now this type of deposit dominates the copper resources in the country. Associated gold provides additional value to the porphyry copper resources. In some cases, the value of the gold equals or exceeds that of copper.

The country still possesses relatively abundant resources that could support future growth at levels greater than that attained during the study period even on the basis of known resources alone. Explorations that have been conducted since the time the Mining Act of 1995 became effective indicate that there are bigger and higher quality copper resources that can be converted into reserves if investments in exploration will be encouraged by the government and allowed by the host communities.

Risk capital

Availability of risk capital, in tandem with expanding copper demand and favorable copper prices, was another important stimulus to the growth of the copper mining industry from the 1950s up to the 1970s and 1980s. Scarce domestic capital was augmented by infusion from foreign sources both in direct and portfolio investments.

Investments in mining, particularly copper mining, was greatly reduced after 1974 for a number of reasons, some of which are:

a. Reduced copper demand, depressed copper prices, and high production costs brought about by, among others, the energy crises of 1970s and 1980s;

b. Uncertain energy supply and prices;

c. Dramatic increase in taxes, particularly since 1980;

d. Divestment of foreign investors due to the termination of the parity law.

Attempts of government to arrest the downswing of copper production by providing liberal loans and loan guarantees to selected mining companies, instead increased the number of mining firms that failed.

The operation of the Mining Act of 1995 brought ashore a number of large multinational corporations that invested in exploration. Some made original discoveries while others are doing due diligence work on deposits that are already known. The enthusiasm of mining investors, however, was dampened by the challenge to the constitutionality of the Mining Act of 1995 and the operation of the IPRA which gave tribal communities rights over the mineral resources beneath their ancestral lands. This law restricts access to many mineral lands.

Human capital

Available, educated, trained, and experienced mining technicians, mining engineers, metallurgists, and geologists in combination with expatriate, high-level technical and managerial personnel contributed a lot to the rise of the copper mining industry from the early 1950s to the 1970s. However, the inadequate experience of Filipinos in high level technical and managerial mining jobs must have given the industry competitive disadvantage when the expatriate mine officials left after the expiration of the parity law. Considering the crucial role of the top management in making their mining company compete with multinational companies run by highly trained and experienced executives, it is likely that the local copper mining companies suffered a setback from 1974 onwards, when less experienced local officials assumed top technical and

managerial positions. There is some evidence that a few local mining executives are now responding to the challenges of their office by finding replacement to the ores that they have depleted.

Technology

As mentioned elsewhere, the introduction of bulk mining technology provided the copper that fed the growth of the copper mining industry since the 1950s. The future growth of copper mining could still be fed from porphyry copper deposits due to bulk mining technology.

Substitution of copper by aluminum in electrical transmission and by fiber optics in telecommunications since the early 1980s must have caused the demand for copper to shrink as prices either declined or stagnated. This phenomenon must have prevented any sudden upsurge of copper prices since the early 1980s. The trend is likely to continue in the future.

Lack of meaningful research and development efforts must have put local mining firms at a competitive disadvantage in the face of multinational mining corporations with strong research and development programs.

Developments in the world copper market

Some of the events that shaped the world copper market during the study period are presented below:

a. Korean War, Vietnam War, and the Recovery of the Japanese Economy. These events expanded the demand for copper with corresponding copper price increases. These served as a strong upward push for the country's copper mine production in the 1950s, 1960s, 1970s, and the early 1980s.

b. The oil crisis of the 1970s and 1980s gave way to global recession that led to the decrease in copper demand and prices as well as to high inflation and interest rates that caused prices of equipment and materials to soar.

c. Substitution of copper by aluminum and fiber optics, particularly since the 1980s, gradually helped erode copper demand and prices.

These developments in the world market help explain the rapid growth of copper production from the 1950s to the 1970s and the steep decline beginning in the mid-1970s and early 1980s. Substitution of copper by aluminum and fiber optics implies that dramatic increase in copper demand and prices in the near and medium term is highly unlikely.

Domestic social, legal, and political changes

Some of the important changes in the domestic scene that affected the growth of copper mining production during the study period are the following:

a. The termination of the parity law in 1974 prohibited foreign investors from owning more than 40 percent of equity capital in a mining firm. This dried up the flow of foreign capital for the industry.

b. Mine taxes and charges dramatically increased in 1981, for instance, the ad valorem taxes on copper and gold doubled in 1981. This sudden increase in taxes made mine operation very expensive and revealed a regime of unstable government policies which is not conducive to any reasonable mining.

c. The suspension of all mining laws as a result of the 1986 EDSA Revolution did not allow any new mining activities until the passage of the Mining Act of 1995.

d. A series of attempted coups d'etat after 1986 and, later, EDSA II and EDSA III in 2001—the former even caused the change of government—gave the impression of political instability which is unfavorable to all kinds of investments, particularly mining investment.

e. Passage of the Mining Act of 1995 provided the basic law for mining. It opened a brief spurt in exploration. However, challenges to the constitutionality of this law dampened the optimism of many investors in the mining industry.

f. Passage of the IPRA in 1997 made access to mineral land difficult.

g. Emergence of militant anti-mining environmentalism added to the unsettled peace and order in many places, and created a very unfavorable, some say hostile, environment for mining.

The domestic environment, therefore, contributed to the steep decline of the growth of the copper mining industry since the mid-1970s. It will also, at the least, temper any future surge in copper mining activities.

Some lessons learned to improve the prospects of the industry

Reflections on the problem confronted by the copper mining industry during the study period suggests that mining is a very complex industry that cannot be left to traditional mining people only. There is a felt need for top mining executives who are trained and experienced in matters like mine property evaluation, mining finance, and mineral marketing, among others, in order to compete with multinational corporations. Moreover, mining companies must also have professionals adept at agriculture, forestry, environmental science, management, sociology, economics, and anthropology to address the non-mining problems, such as environmental problems, employment generation, communication, and indigenous peoples.

Some of the lessons learned in writing this paper that are relevant to the future of the industry are set down below:

Copper and other mineral resources in the country remain abundant and excellent in quality. Geologic evidence and the discoveries made during the short span of the operation of the Mining Act of 1995 attest to this. We must learn how to use these God-given wealth to alleviate the poverty of our people, especially in places where these minerals occur. Mineral lands, in general, are not suitable for agriculture.

All real environmental problems attributed to mining can be solved by the application of the principles of modern management and science. Such problems can be properly solved at the design stage of the mining project. Designing for X, where X is any set of problems, such as environmental and employment problems, is a paradigm of modern management being employed by progressive global corporations (Willig, 1994).

Risk capital in one form or another can be expected to come provided our mineral laws and policies are reasonable, fair and stable. Foreign investments can bring in the best technologies that solve most of the problems connected to mining. New technologies and practices can be evolved in solving problems within the local context.

Research and development is a very neglected activity in the country's mining industry although it is essential in making the industry competitive and in solving its many problems. In addition to the traditional technical problems, the mining industry must be able to address problems such as the following:

1. How to produce an investment climate that is hospitable to mining.

2. How to generate maximum job opportunities in capital intensive mining. Perhaps the industry must consider other activities in tandem with mining to generate job opportunities, such as industrial tree plantation, furniture making and exporting.

3. Utilization of the large volume of mine tailings generated in bulk mining to avoid the problem of disposal. In this connection, note that the pyroclastic materials in the lahar deposits of Pampanga and vicinity were thought to be not useable a few years back although they are very much in demand now in the construction industry. Some valuable construction materials must be manufactured out of the tailings. In modern environmental management, elimination of wastes add to profit.

One of the best ways to make large-scale mining acceptable to host communities is to generate a large number of employment opportunities that would rival those in small-scale mining. This implies that mining companies must get involved simultaneously in other types of business, such as industrial tree plantation, agriculture, or other businesses that generate employment for the people in the host and neighboring communities and provide additional profits for the company. This approach will address two major concerns of host communities, namely, the conservation of the environment and poverty.

Finally, the government must learn to make laws and policies that are reasonable, fair and stable and implement them firmly and equitably.

Notes

[1]Lepanto Mining has discovered and developed its Far Southeast Deposit, a world class copper-gold deposit. There are also smaller gold-copper deposits discovered more recently.

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Appendix A

Table A. Growth of copper production during selected periods

Period	Physical production (%)	Real value (%)	Regime
1907-1934	n.d.	n.d.	American Regine
1937-1941	n.d.	n.d.	Commonwealth
1949-1954	15.16	32.99	Post WW II Reconstruction
1954-1960	17.78	18.16	Korean War
1960-1973	12.22	24.44	Vietnam War
1973-1980	4.07	-4.87	Oil Crisis
1972-1986	0.10	-4.55	Martial Law
1986-1992	-7.43	-6.82	EDSA Revolutionary Period
1993-1997	-21.68	-24.08	EDSA Recovery Period
1937-1997	n.d.	n.d.	Commonwealth-Present
1949-1997	4.46	5.54	Republic

Note. "n.d." - no available data.

Table B. Taxes paid by the mining industry, 1981-1993

Year	Tax (US $)	Year	Tax (US $)
1981	5,390	1988	22,266
1982	23,723	1989	67,721
1983	19,237	1990	40,272
1984	17,706	1991	32,889
1985	26,831	1992	21,040
1986	37,923	1993	35,710
1987	39,738		

Note. From East-West Center, 1994.
Average value of annual production in US $ for gold, 331,503,000; for copper, 326,993,000.

Table C. Growth of virgin copper supply, consumption, and prices

Item	Period 1 (1970-1997)	Period 2 (1960-1997)
Mine production	2.15 %	2.70 %
Consumption	2.17 %	2.75 %
Price	-3.01 %	-1.40 %

Note. From Table 10.

Table D. Changing intensity of use of copper (in metric tons per million US $ GDP)

Year	Japan	US	Sweden
1960	1.27	0.93	1.41
1965	1.11	0.98	1.14
1970	1.25	0.96	0.85
1975	1.00	0.63	0.81
1980	1.09	0.72	0.85
1985	0.94	0.64	0.82

Note. From UNIDO, 1991, Industry and Development Global Report, Washington D.C.

Table E. Displacement of copper by fiber optics

Year	Rate of fiber optics adoption (in %)	Displaced copper consumption (in metric tons)
1984	6.2	14.4
1985	10.0	35.1
1986	15.0	66.4
1987	20.1	106.8
1988	25.2	149.1
1989	32.0	189.6
1990	40.0	228.1
1991	46.0	259.4
1992	51.0	280.5
1993	58.0	296.1
1994	64.0	315.3
1995	70.0	321.9

Note. From UNIDO, 1991, Industry and Global Development Report, Washington D.C. for amount of copper displaced by fiber optics; Takeuchi et al., 1986, The World Copper Industry, Its Changing Structure and Future Prospects for adoption rates. Displaced copper refers to Japan, US, Western, and Southern Europe.

Table F. Current prices of copper and aluminum, 1955-1998 (in US cents per pound)

Year	Copper	Aluminum
1955	37.51	23.70
1960	32.34	26.00
1965	35.36	24.50
1970	58.07	28.70
1975	64.16	34.80
1980	101.31	0.761
1985	66.97	48.80
1990	123.16	74.00
1995	138.33	85.90
1998	78.64	65.50

Note. From Plunkert, Patricia A., 1998, Aluminum, in USGS Mineral Information (http:/minerals.usgs.gov/minerals/pubs/commodity/aluminum/050798.pdf).; Edelstein, Daniel, 1998, Copper, in USGS Mineral Information.

Table G. Summary of status of mining tenements as of February 2000

Status	Mineral rights applied for			Total
	MPSA	FTAA	EP	
1. Under process	1869	60	459	2388
2. Approved	123	2	16	141
3. Abandoned/withdrawn/ relinquished	109	58	71	238
4. Denied/cancelled	578	17	94	689
5. Expired	0	6	2	8

Source of Data:
From Mine Tenement Section, Mines and Geosciences Bureau, April 2000.

Appendix B

Table 1. Copper production and value

Year	Copper production 000 mt	Copper production % change	Current value mil P	Current value % change	Constant 1978 value mil P	Constant 1978 value % change
1949	6.00		4.56		21.92	
1950	10.00	50.00	8.25	57.61	38.37	54.57
1951	13.00	26.09	14.99	58.00	63.79	49.77
1952	13.00	0.00	19.38	25.55	88.09	32.00
1953	13.00	0.00	14.90	-26.14	70.28	-22.49
1954	14.00	7.41	18.97	24.03	91.20	25.91
1955	17.00	19.35	29.79	44.38	144.61	45.30
1956	27.00	45.45	47.07	44.96	213.95	38.68
1957	40.00	38.81	46.87	-0.43	210.18	-1.78
1958	47.00	16.09	49.92	6.30	217.04	3.21
1959	50.00	6.19	61.16	20.24	268.25	21.1
1960	44.00	-12.77	59.07	-3.48	248.19	-7.77
1961	52.00	16.67	78.28	27.97	323.47	26.34
1962	55.00	5.61	116.69	39.40	459.41	34.73
1963	69.00	22.58	140.13	18.25	522.87	12.92
1964	60.00	-13.95	145.55	3.79	503.63	-3.75
1965	63.00	4.88	184.88	23.81	624.59	21.44
1966	74.00	16.06	316.99	52.65	1,039.31	49.85
1967	86.00	15.00	350.77	10.12	1,082.62	4.08
1968	110.00	24.49	469.64	28.98	1,410.33	26.29
1969	131.00	17.43	657.50	33.33	1,945.27	31.88
1970	160.30	20.12	1,113.12	51.46	3,217.12	49.27
1971	197.40	20.74	1,233.49	10.26	3,099.23	-3.73
1972	213.70	7.93	1,360.43	9.79	2,931.96	-5.55
1973	221.19	3.44	2,296.19	51.18	4,260.09	36.93
1974	225.48	1.92	2,793.98	19.56	3,853.77	-10.02
1975	225.80	0.14	1,640.03	-52.05	2,116.17	-58.21
1976	237.60	5.09	1,841.54	11.58	2,166.52	2.35
1977	272.80	13.79	1,927.15	4.54	2,063.33	-4.88
1978	236.60	-14.21	2,163.56	11.56	2,163.56	4.74
1979	298.30	23.07	3,689.62	52.14	3,140.10	36.83
1980	304.50	2.06	4,409.28	17.77	3,174.43	1.09
1981	302.33	-0.72	3,781.86	-15.32	2,407.30	-27.49
1982	292.09	-3.45	3,446.32	-9.28	1,989.79	-18.99
1983	271.40	-7.34	4,046.61	16.02	2,124.20	6.53
1984	233.36	-15.07	4,970.07	20.48	1,735.36	-20.15
1985	222.19	-4.90	5,629.95	12.45	1,596.70	-8.32
1986	217.19	-2.28	5,460.59	-3.05	1,536.90	-3.82
1987	214.10	-1.43	6,141.26	11.73	1,665.65	8.04
1988	216.46	1.10	7,952.92	25.71	1,983.27	17.41
1989	191.93	-12.01	7,948.11	-0.06	1,766.64	-11.55
1990	180.46	-6.16	7,880.17	-0.86	1,576.98	-11.34
1991	148.00	-19.76	7,676.53	-2.62	1,293.65	-19.74
1992	123.50	-18.05	5,908.87	-26.02	913.98	-34.40
1993	129.30	4.59	6,261.90	5.80	876.28	-4.21
1994	112.10	-14.25	5,521.40	-12.57	708.65	-21.15
1995	102.64	-8.81	5,786.38	4.69	687.14	-3.08
1996	62.30	-48.91	3,364.29	-52.94	368.46	-60.38
1997	49.02	-23.86	2,792.00	-18.59	291.00	-23.49
1998	46.54	-5.19				

Sources of Data:

1949-1977: Santos and Salita, 1980 (Production and Current value).
1978-1996: National Statistics Office, Philippine Statistical Yearbook, various years.
1997-1998: Chamber of Mines of the Philippines, Newsletter.

Note: Constant value computed based on Philippine Consumer Price Index (CPI), 1978 = 100.

Table 2. Copper metal producers (production in 000 mt)

Companies	1970	1975	1980	1983	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999*
Manila Mining														4.7	1.1
Marcopper	34	34.5	34.4	34.8	33.1	18	5.9	20.9	38.6	35.6	25.9	7.2		0	0
Lepanto	26	12.9	15.2	15.7	12.7	12.3	11.6	10.2	11.3	13.3	9.7	8.4	0.5	0	0
Philex	17	27.1	21.2	20.6	23.6	15.1	13.9	17.4	14.8	17.7	17.7	15.5	24.4	22.8	9.6
Atlas	43	102	126	122	91.5	73.9	63	41.9	29.1						
Sipalay	20	24.3	17.3	28.3											
Bagacay	10	6.4													
Black Mt.	2	3.0													
Baguio Gold		3.5													
Dizon			25.2	25.8	23.9	16.4	14.1	12.1	15.9	14.2	13.1	13.2	5.6	0	0
Maricalum					10	33.8	31.8	22.8	26.6	31.2	36.2	17.9	17.6	19.0	12.2
N. Davao				18.3	20.4	10.9	7.6	0.9							
W. Minolco		8.5	13.9												
Cons. Mines	5		6.8												
BCI-Wildcat		1.70													
Acoje Mng.															
CDCP			20.4												
Bx Cu Shield					1.1										
Batong Buhay				5.4	5.7										
Samar Mining	2														
Sabena Mng.			9.6												
Basay Mng.				5.4											
Surigao C.	1														
TOTAL	160	224	290	276	222	180	148	126	136	112	103	64	49	44	23

Sources of Data:

1970-1995 Data: Mineral News Services, various years.
1996-1999 Data: Chamber of Mines (Philippines), Newsletter, various years.

Note: *1999 data is for January to June only.

Table 3. Number of copper establishments

Year	Copper production 000 mt	No. of copper establishments	Year	Copper production 000 mt	No. of copper establishments
1970	160.3	14	1985	222.2	9
1971	197.4	15	1986	217.2	9
1972	213.7	14	1987	214.1	8
1973	221.2	14	1988	216.5	8
1974	225.5	18	1989	191.9	8
1975	225.8	17	1990	180.5	7
1976	237.6	16	1991	148.0	7
1977	272.8	15	1992	123.5	7
1978	263.6	14	1993	129.3	6
1979	298.3	17	1994	112.1	5
1980	304.5	19	1995	102.6	5
1981	302.3	17	1996	62.3	5
1982	292.1	12	1997	48.6	4
1983	271.4	10	1998	43.5	3
1984	233.4	8			

Sources of Data:

1970-1995 Data: Mines and Geosciences Bureau, Mineral Statistics Section (data files).
1996-1998 Data: Chamber of Mines (Philippines), Newsletter, various years.

Table 4. Production of smelted copper by PASAR
(000 metric tons)

Year	PASAR	World total	% of total
1980	-	7,975	-
1981	-	8,422	-
1982	-	8,317	-
1983	38.80	8,335	0.47
1984	109.20	8,684	1.26
1985	133.80	8,931	1.50
1986	143.70	9,069	1.58
1987	164.50	9,240	1.78
1988	159.20	9,421	1.69
1989	156.30	9,720	1.61
1990	153.50	9,132	1.68
1991	167.50	9,066	1.85
1992	168.80	9,693	1.74
1993	212.40	9,671	2.20
1994	200.30	9,730	2.06
1995	242.20	9,729	2.49
1996	201.70	10,396	1.94
1997	206.20	10,860	1.90
Ave.	163.87	9,243.94	1.72
S.D.	48.70	747.93	0.46

Sources of Data: World Metal Statistics, various years.

Table 5. Structure of aggregate mineral output of leading copper companies (value in current million pesos)

Year	Aggregate copper revenue	Aggregate total revenue from copper, gold, silver	Percent share of copper revenue from total revenue	Aggregate total costs
1970	526	576	91.4	393
1971	564	638	88.4	397
1972	606	722	83.9	511
1973	948	1,156	82.1	658
1974	1,093	1,402	78.0	899
1975	1,843	2,208	83.5	705
1976	1,519	1,839	82.6	864
1977	1,534	1,957	78.4	864
1978	1,881	2,504	75.1	1,045
1979	2,632	3,446	76.4	1,199
1980	3,160	4,888	64.6	2,006
1981	3,069	4,711	65.1	2,323
1982	2,852	4,554	62.6	2,299
1983	3,242	5,476	59.2	2,716
1984	4,508	7,654	58.9	4,045
1985	4,672	7,450	62.7	4,233
1986	3,853	7,087	54.4	4,936
1987	4,183	8,938	46.8	5,315
1988	5,444	10,452	52.1	5,784
1989	6,498	9,732	66.8	5,498
1990	6,534	9,878	66.1	5,773
1991	5,462	8,098	67.5	4,447
1992	4,379	6,837	64.1	4,715
1993	3,713	6,061	61.3	4,607
1994	2,768	4,860	57.0	4,624
1995	3,002	4,828	62.2	5,055
1996	2,137	5,122	41.7	4,361
1997	2,102	5,848	35.9	4,187
Average	3,025.96	4,961.54	66.74	3,016.34
S.D.	1,729.54	3,009.25	13.90	1,965.25

Sources of Data: Leading copper companies included:

1975-1993: Atlas - no cost data available;
1970-1997: Philex;
1970-1996: Lepanto;
1970-1990 Marcopper;
1980-1997: Dizon.

Note: Raw data from Mines and Geosciences Bureau data files.

Table 6. Copper production as percent of total mineral production and metallic production (value in constant 1988 million pesos)

Year	Total mineral production	Copper production (% of total mineral production)	Metallic mineral production	Copper production (% of metallic production)
1949	1,143	7.69	817.62	10.75
1950	1,518	10.14	1,061.17	14.50
1951	1,991	12.85	1,443.17	17.73
1952	2,630	13.43	1,656.03	21.33
1953	2,758	10.22	2,113.30	13.34
1954	2,836	12.90	2,054.37	17.80
1955	3,268	17.75	2,342.03	24.76
1956	3,585	23.93	2,683.56	31.97
1957	4,091	20.60	2,793.56	30.17
1958	3,797	22.92	2,509.59	34.68
1959	4,658	23.09	3,049.07	35.28
1960	4,621	21.54	3,020.22	32.95
1961	5,413	23.96	3,480.70	37.27
1962	6,344	29.04	4,412.38	41.75
1963	6,483	32.34	4,439.32	47.23
1964	6,641	30.41	4,294.30	47.03
1965	7,860	31.86	5,099.43	49.11
1966	9,548	43.65	6,868.00	60.68
1967	10,255	42.33	6,987.62	62.13
1968	12,070	46.86	8,251.81	68.54
1969	14,558	53.58	10,538.50	74.02
1970	19,947	64.68	16,525.27	78.07
1971	20,237	61.41	15.865.99	78.33
1972	19,403	60.59	15,367.33	76.51
1973	26,290	64.98	21,538.58	79.32
1974	24,896	62.07	19,907.08	77.63
1975	20,441	41.51	14,381.44	59.00
1976	20,866	41.64	14,472.80	60.03
1977	22,595	36.62	16,270.39	50.85
1978	21,657	37.28	14,707.46	54.89
1979	27,175	43.52	20,177.24	58.61
1980	35,029	34.39	25,215.30	47.78
1981	27,562	31.84	18,560.09	47.28
1982	24,149	30.49	15,044.87	48.95
1983	21,555	38.08	17,925.56	45.79
1984	19,153	35.79	14,905.24	45.99
1985	19,950	31.53	16,080.45	39.12
1986	20,508	29.88	16,528.62	37.08
1987	21,249	31.48	17,595.97	38.02
1988	22,380	35.54	17,636.60	45.09
1989	20,703	34.22	15,455.89	45.83

Sources of Data:

1949-1969: Santos and Salita, NRCP, 1980.
1979-1997: MGB, Mineral News Service, various years.

Note: Metallic Production - Total of Precious Metals and Base Metals Constant Value computed based on Philippine-CPI.

Table 6. Copper production as percent of total mineral production and metallic production (value in constant 1988 million pesos)

Year	Total mineral production (Constant 1988 Prices) (P mil.)	Copper production (% of total mineral production)	Metallic mineral production (Constant 1988 Prices) (P mil.)	Copper production (% of metallic production)	Year	Total mineral production (Constant 1988 Prices) (P mil.)	Copper production (% of total mineral production)	Metallic mineral production (Constant 1988 Prices) (P mil.)	Copper production (% of metallic production)
1949	1,143	7.69	817.62	10.75	1973	26,290	64.98	21,538.58	79.32
1950	1,518	10.14	1,061.17	14.50	1974	24,896	62.07	19,907.08	77.63
1951	1,991	12.85	1,443.17	17.73	1975	20,441	41.51	14,381.44	59.00
1952	2,630	13.43	1,656.03	21.33	1976	20,866	41.64	14,472.80	60.03
1953	2,758	10.22	2,113.30	13.34	1977	22,595	36.62	16,270.39	50.85
1954	2,836	12.90	2,054.37	17.80	1978	21,657	37.28	14,707.46	54.89
1955	3,268	17.75	2,342.03	24.76	1979	27,175	43.52	20,177.24	58.61
1956	3,585	23.93	2,683.56	31.97	1980	35,029	34.39	25,215.30	47.78
1957	4,091	20.60	2,793.56	30.17	1981	27,562	31.84	18,560.09	47.28
1958	3,797	22.92	2,509.59	34.68	1982	24,149	30.49	15,044.87	48.95
1959	4,658	23.09	3,049.07	35.28	1983	21,555	38.08	17,925.56	45.79
1960	4,621	21.54	3,020.22	32.95	1984	19,153	35.79	14,905.24	45.99
1961	5,413	23.96	3,480.70	37.27	1985	19,950	31.53	16,080.45	39.12
1962	6,344	29.04	4,412.38	41.75	1986	20,508	29.88	16,528.62	37.08
1963	6,483	32.34	4,439.32	47.23	1987	21,249	31.48	17,595.97	38.02
1964	6,641	30.41	4,294.30	47.03	1988	22,380	35.54	19,636.60	45.09
1965	7,860	31.86	5,099.43	49.11	1989	20,703	34.22	15,455.89	45.83
1966	9,548	43.65	6,869.00	60.68	1990	17,462	35.23	12,796.00	48.07
1967	10,255	42.33	6,987.62	62.13	1991	15,823	31.92	11,226.38	44.99
1968	12,070	46.86	8,251.81	68.54	1992	14,894	26.93	8,859.90	45.27
1969	14,558	53.58	10,538.50	74.02	1993	13,153	26.72	8,280.98	42.43
1970	19,947	64.68	16,525.27	78.07	1994	12,654	22.46	7,785.28	36.50
1971	20,237	61.41	15,865.99	78.33	1995	13,334	20.66	7,250.43	38.00
1972	19,403	60.59	15,367.73	76.51	1996	13,649	10.83	6,183.57	23.89
					1997	13,829	8.44	5,683.07	20.54
					Ave.	14,012.47	31.87	10,043.75	44.63
					S.D.	8,673.22	14.98	6,733.10	18.18

Sources of Data: 1949-1969: Santos and Salita, NRCP, 1980; 1979-1997: MGB, Mineral News Service, various years.
Note: Metallic Production - Total Precious Metals and Base Metals Constant Value computed on Philippines-CPI.

Table 7. Value of mineral and copper exports (F.O.B. in million U.S. dollars)

Year	Total exports	Total exports (%change)	MIneral exports	Mineral exports (%change)	Copper conc. & metal exports	Copper conc. & metal exports (%change)	% share of Cu in total export	% share of Cu in mineral exports
1953	398	-	46	-	3	-	0.75	6.52
1954	400	0.50	26	-55.56	5	50.00	1.25	19.23
1955	401	0.25	40	42.42	7	33.33	1.75	17.50
1956	453	12.18	53	27.96	13	60.00	2.87	24.53
1957	431	-4.98	55	3.70	15	14.29	3.48	27.27
1958	493	13.42	52	-5.61	17	12.50	3.45	32.69
1959	529	7.05	52	0.00	22	25.64	4.16	42.31
1960	560	5.69	61	15.93	30	30.77	5.36	49.18
1961	500	-11.32	56	-8.55	27	-10.53	5.40	48.21
1962	556	10.61	52	-7.41	29	7.14	5.22	55.77
1963	723	26.11	66	23.73	41	34.29	5.67	62.12
1964	742	2.59	61	-7.87	34	-18.67	4.58	55.74
1965	768	3.44	77	23.19	47	32.10	6.12	61.04
1966	828	7.52	107	32.61	75	45.90	9.06	70.09
1967	821	-0.85	104	-2.84	75	0.00	9.14	72.12
1968	858	4.41	114	9.17	89	17.07	10.37	78.07
1969	855	-0.35	160	33.58	133	39.64	15.56	83.13
1970	1,142	28.74	224	33.33	185	32.70	16.20	82.59
1971	1,189	4.03	224	0.00	185	0.00	15.56	82.59
1972	1,168	-1.78	239	6.48	191	3.19	16.35	79.92
1973	1,837	44.53	374	44.05	290	41.16	15.79	77.54
1974	2,725	38.93	518	32.29	393	30.16	14.42	75.87
1975	2,294	-17.17	332	-43.76	212	-59.83	9.24	63.86
1976	2,574	11.50	371	11.10	266	22.59	10.33	71.70
1977	3,151	20.16	501	29.82	268	0.75	8.51	53.49
1978	3,425	8.33	554	10.05	250	-6.95	7.30	45.13
1979	4,601	29.30	831	40.00	440	55.07	9.56	52.95
1980	5,788	22.85	1031	21.48	545	21.32	9.42	52.86
1981	5,720	-1.18	758	-30.52	429	-23.82	7.50	56.60
1982	5,021	-13.02	532	-35.04	312	-31.58	6.21	58.65
1983	5,005	-0.32	440	-18.93	249	-22.46	4.98	56.59
1984	5,391	7.43	266	-49.29	115	-73.63	2.13	43.23
1985	4,629	-15.21	243	-9.04	84	-31.16	1.81	34.57
1986	4,842	4.50	267	9.41	90	6.90	1.86	33.71
1987	5,720	16.63	224	-17.52	109	19.10	1.91	48.66
1988	7,074	21.17	383	52.39	216	65.85	3.05	56.40
1989	7,821	10.03	424	10.16	237	9.27	3.03	55.90
1990	8,186	4.56	723	52.14	207	-13.51	2.53	28.63
1991	8,840	7.68	610	-16.95	174	-17.32	1.97	28.52
1992	9,824	10.54	633	3.70	140	-21.66	1.43	22.12
1993	11,375	14.63	686	8.04	373	90.84	3.28	54.37
1994	13,483	16.96	780	12.82	383	2.65	2.84	49.10
1995	17,447	25.63	893	13.51	475	21.45	2.72	53.19
1996	20,543	16.30	772	-14.53	349	-30.58	1.70	45.21
1997	25,228	20.47	726	-6.14	275	-23.72	1.09	37.88
Ave.	4,585.76	9.38	349.8	6.22	180.09	10.01	6.15	51.27
S.D.	5,600.53	13.25	287.73	25.98	147.59	33.14	4.68	19.25

Sources of Data:

1953-1969: Santos and Salita, NRCP, 1980;
1970-1989: NSO, Philippine Statistical Yearbook, various years;
1990-1996: Bangko Sentral ng Pilipinas, Selected Philippine Indicators, Sept. 1997.

Table 8. Share of copper in gross domestic production and in mining and quarrying (in million pesos, current prices)

Year	Copper	M & Q	GDP	% share of Cu in M & Q	% share of Cu in GDP
1967	262	436	29,024	60.09	0.90
1968	355	539	32,129	65.86	1.10
1969	520	729	35,296	71.33	1.47
1970	911	1,181	42,448	77.14	2.15
1971	928	1,187	50,120	78.18	1.85
1972	1,011	1,346	56,075	75.11	1.80
1973	1,913	2,407	71,786	79.48	2.66
1974	1,470	3,097	99,638	65.39	1.78
1975	1,026	2,000	114,603	51.30	0.90
1976	1,129	2,128	133,928	53.05	0.84
1977	1,032	2,488	155,631	41.48	0.66
1978	1,283	3,333	178,603	38.49	0.72
1979	2,713	5,810	220,477	46.70	1.23
1980	2,153	5,460	243,749	39.43	0.88
1981	1,875	5,173	281,596	36.25	0.67
1982	1,735	4,882	317,177	35.54	0.55
1983	2,067	6,182	369,077	33.44	0.56
1984	2,726	8,142	524,481	33.48	0.52
1985	3,031	11,893	571,883	25.49	0.53
1986	2,940	14,144	608,887	20.79	0.48
1987	3,332	14,354	682,764	23.21	0.49
1988	4,315	15,275	799,182	28.25	0.54
1989	4,340	15,446	925,444	28.10	0.47
1990	4,276	16,659	1,073,098	25.67	0.40
1991	4,076	17,504	1,244,741	23.29	0.33
1992	3,396	16,263	1,338,421	20.88	0.25
1993	2,846	16,621	1,474,457	17.12	0.19
1994	2,653	16,509	1,692,932	16.07	0.16
1995	2,924	17,178	1,906,328	17.02	0.15
1996	1,625	17,316	2,196,595	9.38	0.07
Ave.	2,162.10	8,189.40	582,352.33	41.23	0.84
S.D.	1,220.08	6,604.83	623,908.42	21.42	0.65

Sources of Data:

1967-1992: NSO, Philippine Statistical Yearbook, various years;
1993-1996: Bangko Sentral ng Pilipinas, Selected Philippine Economic Indicators, 3rd Quarter, 1997. (for 1993-1996 data).

Notes:

1. From 1976, iron ore is included in other metal mining.
2. In 1970 and 1972, nickel is included in other metal mining.
3. Other metal mining includes: manganese ore, quicksilver, lead, zinc, pyrite cinders, silver and molybdenum mining.
4. Other non-metallic mining includes: coal, salt, pyrite, guano, gypsum, asbestos, taic, tuff, sulphur mining and quarrying.
5. Stone quarrying includes: gravel and sand, adobe, marble, feldspar, dolomite, silica, limestone and clay pits.
6. Data for 1974 are average of (1973 & 1975).

Table 9. Philippine copper reserves, 1970-1996

Year	Total ore reserves (million MT)	Average grade (% Cu)	Metal content (million MT Cu)
1970	1,375.32	0.69	9.49
1971	1,685.00	0.64	10.78
1972	2,034.65	0.62	12.61
1973	2,294.14	0.60	13.76
1974	2,775.91	0.61	16.93
1975	3,206.23	0.55	17.63
1976	3,518.32	0.55	19.35
1985	4,092.44	0.44	18.01
1991	4,776.99	0.46	21.97
1993	3,716.99	0.44	16.35
1994	4,279.81	0.45	19.26
1996	4,789.52	0.46	21.79

Sources of Data:

Santos and Salita, NRCP, 1980 (from 1970-1975 data);
Mine Technology Division (Mineral Reserves Inventory system), Mines and Geosciences Bureau, Summary of Philippine Mineral Reserves: Vol. 1: Updated Section and Vol. 2: Unupdated Section (unpublished).

Note.

The Mineral Reserves Inventory System was discontinued after 1996 due to budgetary constraints.

Table 10. World copper mine production, refined copper consumption and deflated copper prices

Year	Total world Cu production (000 mt)	Total world Cu production (000 mt)	Deflated Cu prices 1988=100 (US-CPI) US c/lb
1960	4,239	4,769	129.80
1961	4,392	5,082	120.48
1962	4,551	5,168	122.08
1963	4,622	5,529	120.12
1964	4,846	6,000	125.92
1965	5,060	6,192	134.14
1966	5,214	6,463	134.07
1967	5,059	6,217	137.22
1968	5,459	6,548	143.25
1969	5,942	7,136	153.08
1970	6,393	7,294	176.20
1971	6,472	7,295	152.45
1972	7,058	7,941	143.51
1973	7,515	8,739	153.50
1974	7,670	8,305	182.88
1975	7,318	7,442	137.32
1976	7,845	8,537	142.82
1977	7,971	9,061	128.46
1978	7,879	9,517	117.14
1979	7,934	9,853	144.87
1980	7,864	9,417	141.45
1981	8,158	9,523	107.95
1982	8,217	9,085	89.26
1983	8,120	9,315	92.22
1984	8,301	9,855	76.50
1985	8,391	9,858	73.82
1986	8,401	10,080	70.50
1987	8,790	10,429	84.68
1988	8,788	10,659	119.11
1989	9,025	10,982	123.78
1990	8,956	10,695	109.66
1991	9,099	10,813	94.31
1992	9,418	10,813	90.03
1993	9,426	10,995	75.67
1994	9,418	11,664	89.39
1995	10,018	12,147	108.59
1996	10,725	12,411	82.97
1997	11,348	13,016	77.16
1998		13,315	

Sources of Data:

1960-1980: Production and Consumption;
1984-1989: UNCTAD Commodity Statistics;
1981-1997: World Bureau of Metal Statistics;
1960-1971: Santos and Salita, NRCP, 1980;
1972-1997: World Metal Statistics.

Table 11. Investment in mining and exploration in the next debate (U.S. million $)

Project	Province	Decision	1999	2000	2001	2002	2003
Masbate Gold Proj.* base metals mineral resources	Masbate*	1999	**30**	**10**	0	0	0
Didipio Copper Proj. Climax-Arimco	Nueva Vizcaya**	1999	**50**	**80**	**20**	0	0
Canatuan Gold-Copper Proj. TVI, Pacific	Zamboanga del Norte**	1999	**20**	**10**	0	0	0
King King/Echobay /TVI	Davao del Norte**	1999	0	**100**	**300**	**200**	0
Banahaw Banahaw mining	Agusan del Sur	1999	0	10	0	0	0
Far Southeast Lepanto Consolidated/ CRA	Benguet*	1999	0	**50**	**150**	**150**	0
Toledo Copper Atlas	Cebu	2000	0	**70**	**100**	0	0
Tampakan Copper WMC	South Cotabato	2002	0	0	0	**200**	**400**
Hinobaan Intl. Pursuit Phil.	Negros Occidental	2003	0	0	0	**50**	**150**
Taysan Chase Resources	Batangas	2004	0	0	0	0	**50**
Sub Total			100	330	570	600	600
Existing Projects			20	20	0	0	0
Exploration	Totals		20	40	60	60	60
			140	385	690	660	660

Note. *Philippine Mining Conference 1997*, Environmental Science for Social Change (1999), Mining Revisited: Can an Understanding of Perspectives Help? Bishops-Businessmen's Conference for Human Development.
* Priority Depressed Areas
** Less Developed Areas

Table 11. Investment in mining and exploration in the next debate (U.S. million $), cont.

Project	Province	Decision	2004	2005	2006	2007	2008	Total
Masbate Gold Proj.* base metals mineral resources	Masbate*	1999	0	0	0	0	0	**40**
Didipio Copper Proj. Climax-Arimco	Nueva Vizcaya**	1999	0	0	0	0	0	**150**
Canatuan Gold-Copper Proj. TVI, Pacific	Zamboanga del Norte**	1999	0	0	0	0	0	30
King King/Echobay /TVI	Davao del Norte**	1999	0	0	0	0	0	600
Banahaw Banahaw mining	Agusan del Sur	1999	0	0	0	0	0	10
Far Southeast Lepanto Consolidated/ CRA	Benguet*	1999	0	0	0	0	0	350
Toledo Copper Atlas	Cebu	2000	0	0	0	0	0	170
Tampakan Copper WMC	South Cotabato	2002	**300**	**100**	0	0	0	1000
Hinobaan Intl. Pursuit Phil.	Negros Occidental	2003	**100**	0	0	0	0	300
Taysan Chase Resources	Batangas	2004	**150**	**100**	0	0	0	300
			550	200	0	0	0	2,950
Sub Total			0	0	0	0	0	40
Existing Projects			60	60	60	60	60	540
Exploration	Totals		610	260	60	60	60	3,585

Note. *Philippine Mining Conference 1997*, Environmental Science for Social Change (1999), Mining Revisited: Can an Understanding of Perspectives Help? Bishops-Businessmen's Conference for Human Development.

* Priority Depressed Areas

** Less Developed Areas