



CODELCO-Chile: A corporate profile of the world's leading copper producer

By Ciaran O'Faircheallaigh

When it was established in 1976, CODELCO-Chile was already the world's largest single producer of copper, and over the next decade it increased its output from 850 kt to over 1 Mt and its share of Western World mine production from 14 to 17 per cent. This article provides an economic and financial profile of CODELCO-Chile, analyzing its production and cost structure, its corporate strategy, its financial relations with the Chilean government, and the issue of whether its market behaviour has been influenced by the fact that it is a state-owned corporation.

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The Chilean state copper mining company, *Corporacion Nacional del Cobre de Chile* (COCELCO-Chile), was established on 1 April 1976, and its creation marked the culmination of a series of initiatives taken by Chilean governments over the period since 1967 to increase state ownership of the country's *Large Copper Mines* (LCMs). The events and policies leading to its establishment have been analyzed in detail elsewhere,¹ as have the history and the physical details of CODELCO-Chile's individual mining and processing operations.² This article provides an economic and financial profile of the corporation, analyzing CODELCO's role in international copper markets, its corporate strategies in areas such as investment, production, and pricing, and its financial relationship with the Chilean government. Particular attention is paid to the manner in which CODELCO has responded to depressed copper prices which have prevailed for much of the period since 1976, and to the question of whether its strategies have been influenced in fundamental ways by the fact that it is state owned.

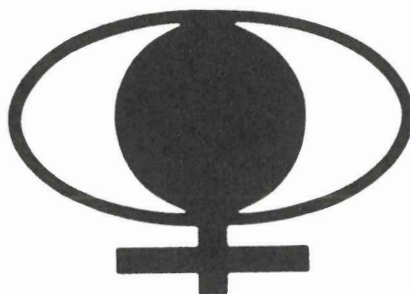
Background

Chile has long been a key supplier to international copper markets, reflecting the size and richness of its copper resources (see below). For much of the 19th century it was the world's largest producer, but lost that position in the mid 1880s as the United States used newly-discovered mining and processing technologies to develop its huge, low-grade copper deposits; by 1910 Chile accounted for only some 5 per cent of world production. However, during the early decades of the 20th century a number of major US mining companies realized that Chile possessed copper deposits of similar size but superior richness which could be exploited with the new technology, and they soon controlled much of Chile's copper mining sector, which had been largely in domestic hands during the

previous century. By the end of World War II Chile produced a fifth of the Western World's copper.

During the decade after the War the Chilean government substantially increased its share of the profits generated by copper mining; the companies responded by minimizing their investment in Chile, with the result that production declined significantly both in absolute terms and as a proportion of Western World output (see Table 1). Introduction of tax concessions in 1955 had only a marginal effect on investment and output, and Chile's share of world production continued to fall. In 1967 the Chilean government took a 51 per cent interest in the subsidiaries of the major foreign companies (Kennecott and Anaconda), and major new investment programmes were planned and implemented. Before these could reach fruition, the government nationalized all the major foreign-owned mines (in 1971); these initially existed as individual enterprises owned by a state holding company, CODELCO, and in 1976 became the operating divisions of CODELCO-Chile. Between 1971 and 1976 CODELCO retained the regulatory powers which it had exercised over the foreign companies in the period before nationalization, but with the creation of CODELCO-Chile these were transferred to the newly created Chilean Copper Commission, which also acts as adviser to the Chilean government on copper policy.

CODELCO's operations have accounted for between 80 and 85 per cent of Chile's copper output during recent years, and they represent what was traditionally referred to in Chile as the Large Copper Mines. The remaining production comes from another state-owned company, ENAMI (about 9 per cent of output), and two medium-sized mines which are privately owned (about 8 per cent). Much of the raw material which feeds ENAMI's smelting and refining facilities is produced by a large number of small copper mines, most of which are privately owned, utilize less



The logotype of Codelco-Chile

sophisticated mining methods, and are relatively labour intensive.³

Copper mining has played a key role in Chile's economy throughout the last 50 years. While its contribution to GNP and especially to employment have been relatively modest (about 10 and 2 per cent respectively during 1950—1975), it has been crucial in generating export income and government revenues. Between 1952 and 1971 copper accounted for an average of 70 per cent of exports by value, and for about a quarter of total tax revenue.⁴ During recent years the sector's relative contribution has declined, but it is still of enormous economic

significance, and its key role in generating foreign currency has been given additional importance by Chile's debt crisis. In 1984, copper accounted for 43 per cent of Chile's exports by value, while CODELCO's payments to the Treasury amounted to 10 per cent of all revenue and grants received by the Chilean government.⁵

CODELCO-Chile

CODELCO-Chile's corporate headquarters are located in Santiago, and perform centralized functions such as corporate development, sales, finance,

accounting, and procurement of strategic suppliers. It has four operating divisions. Chuquicamata, situated in the Atacama desert of northern Chile, is an open-cut operation which started producing in 1915 and currently ranks as the world's largest copper mine; it accounts for some 50 per cent of CODELCO's output (see Table 2), and now includes the Exotica mine, initially developed as a separate operation some six km away. El Teniente, located 80 km southeast of Santiago, is the world's largest underground copper mine, contributing nearly a third of CODELCO's output. Production from the remaining

Table 1

Mine production of copper, CODELCO, Chile, and Western World, selected yrs 1945—70, and 1971—85 (kt)

Year	CODELCO	Chile	Western World	as % of Western World CODELCO	World Chile
1945		446	2 024		22
1950		363	2 286		16
1955		434	2 731		16
1960		532	3 613		15
1965		585	4 147		14
1970		686	5 141		13
1971	571	708	5 113	11	14
1972	593	717	5 638	11	13
1973	615	735	6 038	10	12
1974	763	902	6 141	12	15
1975	682	828	5 731	12	14
1976	854	1 005	6 166	14	16
1977	893	1 056	6 274	14	17
1978	876	1 034	6 101	14	17
1979	910	1 063	6 135	15	17
1980	905	1 068	6 042	15	18
1981	894	1 081	6 482	14	17
1982	1 033	1 242	6 233	17	20
1983	1 012	1 258	6 275	16	20
1984	1 050	1 291	6 362	17	20
1985	1 077	1 356	6 462	17	21

Source:

Chile and Western World: World Bureau of Metal Statistics, *World Copper Statistics Since 1950*, *World Copper Statistics Since 1950: 1983 Supplement*, and *World Metal Statistics*, various issues; CODELCO: CODELCO, *Annual Report*, 1975, CODELCO-Chile, *Annual Report*, various years.



	CODELCO-Chile Mining Divisions
	Shipping Ports

divisions, El Salvador and Andina, is on a considerably smaller scale (see Table 2). With the exception of Andina, each division has both smelting and refining capacity. The company employs a total of nearly 25 000 people, 97 per cent of whom work in the operating divisions; its workforce declined from 31 000 in 1976, though this partly reflected the results of putting some employees on a self-employed contractor basis.

CODELCO recovers only minor amounts of precious metals from its copper ores, but does obtain significant quantities of by-product molybdenum, and is one of the world's leading producers of this mineral (20 per cent of total output in 1986). In 1985, molybdenum accounted for 8 per cent of CODELCO's sales revenue and other by-products for 3 per cent, a lower percentage than during the late 1970s and early 1980s when by-product prices were higher (see Table 7). Most of CODELCO's output of both copper and molybdenum is exported; in 1983 copper sales were accounted for largely by Western Europe (48 per cent), the US and Canada (26 per cent), Latin America (9 per cent) and Japan (8 per cent).

CODELCO produces and sells its copper in a variety of forms; Table 3 provides a break-down of production by type over the period 1971—85. It is part of the company's strategy to have as large a proportion as possible of its sales in the form of more highly processed products (i.e. electrolytic and fire-refined copper) as against smelter output (blister copper) or mine output (copper concentrate). Table 3 indicates that production of electrolytic and especially of fire refined copper grew rapidly over the period 1971—85, by 76 and 200 per cent respectively, while output of blister stagnated (up by 4 per cent). However, concentrate production increased most rapidly of all (by 300 per cent), with the net result that in 1985 the share of more highly refined products in total output was the same as in the early 1970s (62 per

Table 2
CODELCO-Chile's copper output by type
(kt and per cent, 1971—1985)

Year	Electrolytic		Fire-refined		Blister		Concentrates		Other	
	amount	%	amount	%	amount	%	amount	%	amount	%
1971	293	51	48	8	170	30	60	11	—	—
1972	327	55	72	12	132	22	57	10	4	1
1973	304	49	53	9	136	22	105	17	17	3
1974	378	50	85	11	147	19	120	16	32	4
1975	356	55	101	15	143	21	78	11	5	1
1976	437	51	117	14	179	21	115	13	7	1
1977	464	52	121	14	170	19	137	15	—	—
1978	461	53	117	13	134	15	164	19	—	—
1979	428	53	132	15	139	15	161	18	—	—
1980	506	56	121	13	115	13	162	18	—	—
1981	465	52	112	13	154	17	163	18	—	—
1982	495	48	150	15	171	17	216	21	—	—
1983	481	48	133	13	201	20	197	19	—	—
1984	511	49	153	15	183	17	203	19	—	—
1985	517	48	145	13	176	16	239	22	—	—

Table 3
Copper production from individual CODELCO mines, 1971—86
(kt and per cent of total)

Year	Chuquicamata		El Teniente		Salvador		Andina		Exotica	
	amount	%	amount	%	amount	%	amount	%	amount	%
1971	250	44	147	26	85	15	54	9	35	6
1972	234	39	190	32	83	14	54	9	31	5
1973	265	43	178	29	84	14	56	9	32	5
1974	357	47	226	30	80	10	68	9	32	4
1975	305	45	234	34	81	12	62	9	—	—
1976	446	52	269	31	83	10	57	7	—	—
1977	478	53	276	31	81	9	59	7	—	—
1978	501	57	251	29	77	9	47	5	—	—
1979	507	56	278	31	78	9	48	5	1	—
1980	511	56	266	29	75	8	53	6	—	—
1981	472	53	292	33	77	9	53	6	—	—
1982	553	54	336	33	90	9	54	5	—	—
1983	559	55	305	30	87	9	61	6	—	—
1984	567	54	283	27	94	9	105	10	—	—
1985	549	51	323	30	97	9	108	10	—	—

Note:

¹ Included in Chuquicamata after 1979.

Source:

1971—77, 1983—85, *Annual Reports* of CODELCO and CODELCO-Chile; 1978—82, *Copper Studies*, October 1983, 5.

cent). This reflects the fact that the capacity of CODELCO's processing plants has not kept pace with growth in its mine output, though major expansions currently under way at Chuquicamata and El Teniente will help to restore the balance. In addition, despite oversupply in world markets for refined copper, concentrate markets have been tight due to excess refining capacity, and it may have been to CODELCO's advantage to market a substantial proportion of its output in this form. CODELCO formerly sold its molybdenum as concentrates but now markets most of it as molybdenum oxide, produced either at its own plant at Chuquicamata (opened in 1982) or at toll plants in Chile and overseas.

As part of its strategy of producing higher-value products CODELCO helped establish a continuous cast copper rod mill in West Germany in 1975, taking a 40 per cent interest in a joint venture (Deutsche Giessdraht) with

Norddeutsche Affinerie and Hüttenwerke Kayser; the plant has an annual capacity of 157 500 tonnes. In 1983 it acquired a 26 per cent interest in Soc. Lensoise du Cuivre, a rod mill in northern France. CODELCO also maintains a substantial marketing organization overseas, with subsidiary companies in New York, London, Düsseldorf and Paris and 18 agents located in Europe, North and South America, and Asia.

CODELCO is one of the lowest cost copper producers in the world. It is difficult to document this in detail because directly comparable cost data for individual corporations is difficult to obtain, and because production costs are usually calculated net of by-product revenue and so can fluctuate substantially over short time periods in line with by-product prices. However, Table 4 provides some general information on costs in the major copper producing countries in 1984, compiled by the World Bank. The lowest cost producers

are Papua New Guinea and Mexico, which obtain very substantial revenues from gold/silver and silver respectively, but together these countries account for only 8 per cent of total Western World copper production. South Africa/Namibia and Zaire have costs comparable to Chile's, while those of the remaining producers, which account for over 50 per cent of Western World output, are substantially higher.

Two points should be made regarding these cost figures. First, other sources place CODELCO's costs considerably lower than the World Bank figure for Chile.⁶ Second, it could be argued that allocation of costs on a pro rata basis to the various metals produced offers a more reliable indication of the fundamental cost competitiveness of copper producers. On this basis, Chile is certainly the lowest cost producer in the world.

Table 5 provides more detailed information on CODELCO's costs over the years 1973—85. Costs were at a very high level in 1973 and 1974, due in large measure to serious industrial relations problems experienced by CODELCO after nationalization, and to the loss of some experienced technical personnel. Net costs fell substantially between 1973 and 1979, as by-product revenue grew strongly (2.8c/lb to 19.0c/lb), administrative costs were cut dramatically (12.9c/lb to 1.4c/lb), and gross operating costs per pound declined by 43 per cent. In particular, operating costs were favourably affected by the restoration of labour discipline and efficient work practices, a decline in mineworkers' real wages, and by the impact on input costs (as expressed in US dollars) of the drastic devaluation of the Chilean peso during 1973—75. The substantial growth in copper production over this period (from 615 kt to 910 kt), made possible by the earlier investment programmes, also contributed significantly to the fall in unit costs.

Net costs increased between 1979 and 1981, due mainly to a substantial in-

Table 4

Production costs for major copper producing countries, c/lb, net of by-product revenue, 1984

Country	Production cost/lb	% of Western World output
Papua New Guinea	32.4	2.6
Mexico	37.9	3.3
Zaire	45.2	7.9
South Africa/Namibia	45.6	4.1
Chile	48.7	20.2
Philippines	55.5	3.7
Canada	56.0	11.3
Peru	56.8	5.7
Australia	66.3	3.7
Zambia	67.0	9.1
USA	78.1	17.2

Source:

World Bank, *The World Copper Industry: Its Changing Structure and Future Prospects*, Washington, DC, 1987; World Bureau of Metal Statistics, *World Metal Statistics*, various issues.

crease in real wages; contributory factors were the decline in molybdenum prices (only partly offset by an increase in the volume of output), the rise in international oil prices, and the impact of a peso appreciation on US dollar costs. They declined again after 1981, due mainly to the implementation of investment programmes designed to cut costs, for example through modernization of plant and equipment, use of more energy-efficient processing techniques, and modification of power plants to use cheaper forms of energy. In addition to reducing the cost of material inputs, these initiatives allowed a reduction in the company's workforce; since real wages increased only marginally and copper output grew by 20 per cent between 1981 and 1985, the net result was a substantial decline in labour costs per pound of copper. A further depreciation of the peso also helped to reduce US dollar costs.

Significant cost variations occur between CODELCO's individual operat-

ing divisions. It has been estimated, for example, that in 1982 net costs per lb of copper were 28.6c at Chuquicamata, 32.4c at El Teniente, 40.5c at Andina (excluding smelting and refining charges), and 50.5c at El Salvador.⁷ As part of its general drive to reduce production costs, CODELCO concentrated investment in its lower cost mines, and the share of output accounted for by Chuquicamata and El Teniente increased from 70 per cent in 1971 to 85 per cent in 1983. Discovery of additional high-grade ore at Andina itself and at the nearby Sur Sur deposit have lead CODELCO to upgrade operations at this division, and its share of output has increased during recent years.

CODELCO's favourable cost position reflects a variety of factors, the most important of which involves the quality of its mineral resources. The company accounted for nearly 25 per cent of the Western World's identified copper reserves in 1983; more importantly, its copper deposits are well above

the world average in terms of ore grade (0.93 per cent copper versus 0.77 for the rest of the Western World in 1983), are individually so large that they can support massive mining and refining operations which benefit from considerable economies of scale, and have other geological characteristics which facilitate their economic exploitation (e.g. lack of impurities, softness of ore). These natural advantages are more than sufficient to offset the geographical remoteness and harsh climate which raises costs for some of its mines, and the fact that its by-product revenues are not as substantial as those of certain producers. (A number of CODELCO's major competitors, for example Zambia and Zaire, do of course also suffer serious locational disadvantages while others, for instance Peru and Zambia, are in a similar or poorer position than CODELCO as regards by-product revenue.) In terms of inputs, CODELCO labor costs are well below those of some competitors, for example the US, Cana-

Table 5
CODELCO's production costs, 1973—1985
(USc/lb)

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Copper production (kt)	615.3	762.9	682.4	854.1	892.7	876.5	910.2	904.5	893.6	1 032.9	1 012.1	1 049.8	1 076.7
Costs (USc/lb)													
Gross operating	74.8	73.9	42.1	37.9	37.3	36.8	42.3	57.3	62.1	43.5	41.5	36.3	34.2
Administration and sales	12.9	12.6	13.0	4.0	3.5	1.2	1.4	2.0	2.4	1.8	1.5	1.5	1.2
Depreciation, financial	11.8	9.5	1.8	7.7	7.3	7.8	6.9	6.6	8.9	8.2	12.8	9.5	11.3
Less Income from by-products	2.8	4.3	6.5	5.1	6.4	8.8	19.0	20.6	13.5	9.5	9.5	8.6	7.0
Total net cost	96.7	91.7	50.4	44.5	41.7	37.0	31.6	45.3	59.9	44.0	46.3	38.8	39.7

Source:

C Fortin, 'Copper Investment Policy in Chile', Table II, 319; 'Chilean Copper Policy: International and Internal Aspects', Table 3, 60, based on CODELCO—Chile's *Annual Reports*.

da, and Australia; a recent report by the US Congressional Research Service estimated that the average annual wage of CODELCO workers was 5 724 USD in 1983, compared to an average of 29 036 USD for employees of US copper companies.⁸ This offsets any disadvantage it incurs through dependence (now diminishing) on imported petroleum as an energy source.

CODELCO's corporate strategy

The Chilean government officials and company directors and managers who have expounded CODELCO's corporate strategy are all agreed that its underlying principle is profit maximization. In the words of one senior executive:

"The fundamental aim of the Corporation is to manage its mineral and human resources . . . in order to maximize profits."⁹

Some Chilean commentators have argued that this principle should be subject to broader goals of national development; in the words of Ernesto Tironi, for example:

". . . the primary goal should be profit maximization but if and only if this goal is pursued within the frame of economic policies that reflect the general national interests as these are expressed in the development plans for the nation as a whole."¹⁰

However, most official policy statements stress the primacy of profit maximization.¹¹ Two issues arise. First, what investment, production, and pricing strategies are regarded as most likely to maximize CODELCO's profits? Second, have CODELCO's investment and production decisions actually corresponded to publicly-stated policy?

Three factors have been crucial in determining CODELCO's corporate strategy. The first is its international cost competitiveness. The second involves the recent price history for CO-

DELCO's major product, copper. In real terms, prices have been at their lowest since the Great Depression, and the 'trough' in prices has lasted for considerably longer than what is considered 'normal' for the cyclical copper industry. The third factor is the firm belief among CODELCO managers and government officials that any action by CODELCO aimed at curtailing production in order to raise prices would be futile. In support of this belief they quote econometric and other studies which indicate that even if Chile cut its copper output substantially and other producers belonging to the *International Council of Copper Exporting Countries* (CIPEC) did likewise, the impact on prices would be slight and Chile would incur a major loss of export revenue. It is also argued that since a substantial proportion of CODELCO's costs are fixed, such revenue loss would result in a significant decline in the corporation's profits.¹²

In these circumstances, the correct strategy is seen to be one of maintaining production at current levels and indeed to increase it in order to take advantage of any incremental growth in world copper demand or of mine closures. Such closures could result from exhaustion of ore reserves or from the financial insolvency of higher-cost producers in a highly competitive market.

"It is CODELCO's current production policy to maintain its present level of production . . . and to increase this level of production only as the total market expands in order to maintain its current share of that total market. If, however, other competing mines are depleted or cease production, CODELCO is prepared to increase its production levels."¹³

It should be noted that CODELCO's officials do not envisage the possibility of *reducing* output in line with any *fall* in copper consumption, a separate issue to that of cutting output to try and raise

prices at any given level of consumption. In the words of one official, '. . . if world demand decreases, we do not plan production level changes up or down from our present basic . . . level'.¹⁴

In practice, it is extremely difficult, if not impossible, for output from large-scale mining operations to be tailored to marginal shifts in demand or supply. Investments in mine development, processing facilities, and plant and equipment must be planned well in advance, and by the time they come on stream market conditions may already have changed. It was some seven years before the full impact of investments undertaken in Chile's large copper mines during the late 1960s was felt; unforeseen technical difficulties and the political upheavals of the early 1970s were partly responsible for this delay, but the gestation period for major investments is nevertheless considerable. On the other hand, what appear to be fundamental shifts in supply or demand conditions may turn out to be short lived. So, for example, the closure of several large copper mines in the US during the early 1980s was seen by many commentators as heralding a permanent shift in the locus of world copper production towards lower-cost producers elsewhere, including Chile; yet quite a few of those mines are now again producing or about to resume production, having drastically trimmed their input costs (especially power and labour) and modernized their plant and facilities.¹⁵ Thus in practice CODELCO must, like other major copper producers, take a longer-term and general view of likely market developments and plan accordingly within the constraints of available resources which, as we shall see, can be quite severe in CODELCO's case.

There is another respect in which CODELCO's role in international copper markets is less clearly defined than public statements by Chilean officials would suggest. Their references to mine closures imply that CODELCO's role in this regard is passive, i.e. it responds to

opportunities which come its way as a result of other producers falling on hard times. However, an aggressive investment and production strategy by CODELCO might, by adding to supply in a weak market, further depress prices and drive competitors out of business, allowing CODELCO to capture their share of the market. Indeed while some commentators have taken the company's public policy statements at their face value others, and particularly CODELCO's competitors, see its role in world markets as considerably more aggressive than its officials suggest. So, for example, senior executives of US copper companies regard CODELCO's production increases in the early 1980s, a time of severely depressed prices, as a deliberate attempt to force higher cost competitors to close down.¹⁶ In June 1984 the US International Trade Commission recommended to President Reagan the introduction of trade sanctions designed to "protect" US copper producers from "unfair" competition from Chilean imports.

What investment and production strategies has CODELCO followed *in practice*? To deal with this point, it is necessary to examine its production and investment history in more detail, and Table 6 provides some relevant data. It shows percentage changes in CODELCO's output, in output from other Western World mines, and in world consumption of refined copper over the period 1971—1985. Figures are also provided on gross investment by CODELCO and on its share of world mine production. CODELCO's output rose much more quickly than that of other Western World mines and than copper consumption over the years 1971—85, by 89 versus 19 and 27 per cent respectively. It could be argued that during 1971—76 Chile was to at least some extent recovering ground lost earlier, but even since 1976 CODELCO's output has grown relatively quickly, by 26 per cent versus 1.6 per cent for other Western World mines and 13.6 per

cent for copper consumption. Thus by 1985 CODELCO was contributing almost all of the additional mine production of copper which was helping to meet growth in consumption over the previous decade. In reality, of course, it was not a case of CODELCO supplying incremental demand and other copper producers remaining in a 'status quo' position; the distribution of mine production between individual producers changed very substantially, with high-cost mines closing down or cutting output (especially in the US) and other producers in addition to CODELCO expanding output.

The data in Table 6 also emphasise the point made earlier regarding the absence of any neat correlation between changes in CODELCO's output and short-term fluctuation in copper demand and supply; rather major increases in output have come about as large discrete expansions which result from major investment programmes implemented over a number of years. Thus output grew very substantially in 1974—76, as a result of projects initiated in the late 1960s, and in 1982 because of substantial investments made during 1979—1981 (see Table 6, lines 4 and 5); this latter expansion coincided with a substantial *fall* in world copper consumption. The fall in production in 1975 was part of joint action by CIPEC countries aimed at reversing the drastic price decline which commenced in mid 1974; it failed in this aim, and though it may have prevented an even more precipitous fall in prices its failure convinced the Chileans, reluctant participants in any case, of the futility of joint production cuts. As Table 6 indicates, any cuts in CODELCO's output since 1975 have been insignificant, even during 1980—82 when copper consumption fell substantially; this is in line with official statements that CODELCO's production will not be reduced downwards in line with consumption.

Thus over the decade 1976—85 CO-

DELCO's approach seems to have been to maintain output at all times, assuming that the brunt of any short-term drops in consumption will be borne by other less competitive producers, and to gradually increase output through a series of investment programmes which will allow it to capture a substantial proportion of any long-term growth in copper demand. If that additional demand does not in fact materialize, CODELCO's officials are presumably confident that they are in a sufficiently strong competitive position to capture a greater share of existing markets by driving higher-cost producers out of business. As the final line of Table 6 indicates, the long-term outcome of this strategy may well be that CODELCO increases, rather than simply maintains, its share of the total world market.

The extent to which CODELCO expands its output depends, of course, not simply on its competitiveness and on growth in copper demand, but also on the resources it has available to finance capital investment. An examination of this issue requires a more detailed analysis of the relationship between CODELCO and the Chilean government.

CODELCO and the Chilean government

Formally, the Chilean government has no statutory powers to direct or manage CODELCO's operations; these powers are held by the Board of Directors and the company's President and Chief Executive Officer. However, in practice the government exercises effective control over its investment and production strategies. It appoints senior corporate officials (often from the ranks of the military) and, even more importantly, determines what resources will be available to CODELCO to fund capital expenditure.

In addition to income and other taxes, CODELCO must pay to the Chilean Treasury each year and advance equal to the expected excess of total

Table 6

Trends in CODELCO's copper production and investment, 1971—1985

Year	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1971-85	1976-85
% Change in CODELCO output (1)	3.9	3.6	24.1	-10.6	25.2	4.6	-1.9	3.9	-0.5	-1.2	15.5	-2.0	3.8	2.6	88.6	26.1
% Change in output, rest of Western World (2)	11.1	7.5	-0.8	-6.1	5.2	1.3	-3.0	0.0	-1.7	8.8	-6.9	1.2	0.9	1.4	18.6	1.6
% Change in Western World copper consumption (3)	9.3	10.9	-6.4	-16.3	18.2	7.0	5.9	3.3	-5.4	1.7	-6.5	0.6	11.0	-3.3	27.4	13.6
CODELCO's gross investment —																
Current USD (4)				116	111	100	161	178	267	307	234	201	276	370		
Constant 1978 USD (5)				151	146	117	161	159	221	267	202	169	na	na		
CODELCO's share of Western World output (6)	11	10	12	12	14	14	14	15	15	14	17	16	17	17		

Note:

na = Comparable price index unavailable.

Source:

Lines 1, 2 and 6: derived from Table 1; Line 3: World Bureau of Metal Statistics, *World Copper Statistics Since 1950, World Metal Statistics*; Lines 4 and 5: 1976—1983, C Fortin, *Copper Investment Policy in Chile*, Table III, 319.

revenues over total planned expenditures. In effect, the entire financial surplus generated by CODELCO is transferred to the Chilean Treasury; indeed over the period 1975—85 payments to government slightly exceeded CODELCO's gross operating profits (6 billion US dollars (G USD) versus 5.8 G USD).¹⁷ Even part of its depreciation and amortization allowances were extracted by the Treasury in connection with a revaluation of the company's assets in 1982 and 1983. Thus CODELCO has little control over how the funds it generates are used. It submits an annual budget which sets out its proposals for capital expenditure in the following year; these must be approved by the ministers of Mining and Finance, after which the requisite funds are made available or, alternatively, approval is given for CODELCO to seek capital from outside sources. In this way the Chilean government closely controls CODELCO's investment programme, which consequently reflects its priorities rather than those of CODELCO's management. The government's ap-

proach has in turn been influenced by its general policies towards development of the copper sector, and particularly by the desire of the Pinochet regime to see private mining companies assume an active role in large scale copper mining once again.

The issue of Chile's copper investment policy has been discussed in detail in recent articles by Carlos Fortin.¹⁸ To summarize, the government attempted to encourage renewed private investment in the years after 1974 through a series of generous incentive measures. In the expectation of this strategy's success, CODELCO was provided with minimal investment funding (see Table 6), and had this situation continued its output would certainly have begun to decline since average ore grades were falling and substantial investment was consequently required simply to maintain output. In 1977—1978 CODELCO formulated a number of alternative investment proposals which highlighted this fact, and attempted to quantify the investment required to maintain output and that needed to increase it by 25—30

per cent. By this time it was becoming apparent that Chile's investment incentives were not going to lead to a rapid growth in foreign investment (at least in the short term), and additional resources were made available to CODELCO, partly from its own corporate funds but mainly through approval for borrowings (see below). This permitted throughput of ore to be increased sufficiently not only to counteract the effect of declining grades, which fell from an average of 1.73 per cent in 1976 to 1.55 per cent in 1983, but to allow a significant increase in copper output (see Table 1).

Table 7 provides more detailed financial data regarding CODELCO-Chile's operations. It shows that the company has consistently generated substantial profits, even when copper prices were very low. Its return on capital has been impressive by international standards; over the period 1976—83 its pre-tax return on capital averaged 29 per cent compared, for example, to an average of 13 per cent for the Canadian metal mining sector.¹⁹ However, since CODELCO

Table 7

Financial data, CODELCO, 1976—85 (M USD)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Operating Results:										
Sale of copper			1 094.1	1 690.1	1 869.8	1 474.5	1 442.6	1 562.6	1 336.1	1 432.7
Sales of by-products			170.2	381.3	411.0	266.6	217.1	211.5	198.5	165.3
Total	1 268.0	1 231.2	1 264.3	2 071.4	2 280.8	1 741.2	1 659.6	1 774.1	1 534.6	1 598.0
Less: Cost of Sales	665.5	732.8	713.0	848.9	1 413.3	1 224.1	990.4	925.2	839.7	812.8
Gross Profit	602.4	498.4	551.2	1 222.5	1 137.5	517.0	669.3	848.8	694.9	785.2
Less: Depreciation and amortization	126.1	121.5	126.3	122.4	124.6	114.8	132.9	184.3	225.8	267.6
Administrative, selling and other expenses	70.4	69.5	18.9	22.0	50.8	76.1	52.0	44.2	28.2	35.1
Operating Profit	405.9	307.4	406.0	1 078.1	962.1	326.1	484.3	620.4	440.9	482.5
Less: Non-operating expenses (net)	37.4	22.3	28.6	20.6	(2.7)	31.4	43.8	92.2	108.2	47.9
Income before taxes	368.5	285.0	377.5	1 057.5	964.8	294.7	440.5	528.3	332.7	437.6
Income and special taxes	189.9	126.0	144.7	590.2	563.5	197.4	280.0	307.6	189.0	287.2
Net income	178.6	159.0	232.8	467.3	401.3	97.3	160.6	220.7	143.7	150.4

Source:

CODELCO—Chile, *Annual Reports*.

is unable to retain its financial surpluses, working capital has declined substantially, from 559 M USD in 1979 to 78.4 M USD in 1985, and CODELCO has been forced to borrow, often over short terms, both to finance its ongoing operations and its investment programme. Outstanding loans grew from less than 100 M USD in 1980 to 800 M USD in 1983, 987 M USD in 1984, and 1 075 M USD in 1985. Its interest charges increased from 22 M USD in 1977 to 113 M USD in 1985. This is clearly a disturbing development from CODELCO's point of view at a time when many of its competitors are substantially reducing their debt and interest burden; in 1985 the company's interest charges represented a cost of nearly 5c for every pound of copper produced.

CODELCO's lack of control over the financial resources it generates, combined with uncertainty regarding trends in copper demand, means that considerable uncertainty surrounds its future investment and production plans. In 1982 the company's long-range plan indicated that annual output would reach 1.53 Mt by 1992.²⁰ By 1984 it was ap-

parent that the resources available to CODELCO would not permit expansion on such a scale and that copper demand was unlikely to absorb the additional output; CODELCO stated its intention of increasing production to 1.35 Mt by 1995, but only if growth in copper demand warranted this.²¹ However, as mentioned above, what this actually means is that output will be increased if CODELCO *believes* that growth in demand will warrant it. It seems certain that CODELCO will expand output to some extent over the next five years, and in this regard it is important to note that the issues of maintaining production, expanding production, and cutting costs cannot be separated neatly. So, for example, the prime objective of investment plans announced for Chuquicamata and El Teniente in the early 1980s was to compensate for falling grades, but in both cases they involved initiatives resulting in higher production levels,²² which would in turn have a favourable effect on *unit* production costs. It is estimated that output will reach 1.1 Mt in 1987, and if recent investment levels are maintained it seems en-

tirely possible that it will reach 1.35 Mt by 1995.

CODELCO's market behaviour

Is CODELCO's market behaviour affected by the fact that it is a state-owned enterprise? The most obvious way in which this might happen is if state ownership brought with it benefits which freed CODELCO of economic constraints faced by privately-owned copper producers, in other words if CODELCO received subsidies as a result of being state owned. It is very clear that CODELCO does not receive any direct subsidization from the Chilean Treasury; indeed as indicated above the opposite is the case, with the government extracting such large surpluses from the corporation that its internal financial resources have been reduced to a level which most private corporations would regard as inadequate. Subsidization of CODELCO's operations could of course occur indirectly, in two principal ways — either through provision of 'cheap' capital, or where exchange rates were deliberately manipulated so as to give CODELCO a

comparative edge over its competitors.

Considerable attention has been focused during recent years on the possibility that international financial institutions (IFIs) such as the World Bank, regional development banks, and the IMF may be slowing down adjustment processes in world metal markets by providing LDC mineral producers with subsidized finance, allowing them to maintain production at unjustified levels and to undertake investments which would not be warranted on strictly commercial criteria.²³ Until 1983 CODELCO made very little use of credit from such sources; in that year, outstanding debt was accounted for by private commercial banks (91 per cent), suppliers (5 per cent), and other creditors (3 per cent), with IFIs accounting for only 1 per cent. This situation changed somewhat when the InterAmerican Development Bank agreed to provide a 268 M USD loan to the Chilean government to help finance CODELCO's investment programme (drawn down in 1983 and 1984 and disbursed to the company from September 1984). The loan had a five year grace period and a fifteen year repayment period, terms certainly more generous than would apply to a similar commercial loans. However, in the absence of information on interest rates and other loan conditions, it is not possible to calculate exactly what element of subsidy is involved. Neither is it clear from CODELCO-Chile's annual reports whether the subsidy has been passed on the company; it is common practice in many LDCs for national treasuries to charge state mining companies 'commercial' terms for IFI loans and themselves retain the subsidy component. The impact of any subsidy on CODELCO's production costs would in any case be minor. For example, assuming that its net effect was to reduce the rate of interest by 5 percentage points, the saving in annual interest charges for CODELCO would amount only to some 0.6c per pound of copper produced, an insignificant

amount in terms of existing relative cost differences (see Table 4) and certainly far outweighed by the interest burden imposed on CODELCO as a result of its financial arrangements with the Chilean Treasury. In addition, CODELCO's investment and production policies were firmly set long before the loan was negotiated.

The issue of currency depreciation is considerably more complex. It has been suggested that LDC copper producers have deliberately depreciated their currencies during recent years in order to gain or retain an international competitive advantage; as a result of depreciation, domestic costs decline in foreign currency terms, making the producer concerned more competitive on world markets. There is a considerable body of economic literature which suggests that in the long run exchange rates are determined by relative inflation rates, implying that domestic costs would eventually increase so as to re-establish the original real (i.e. inflation-adjusted) exchange rate, and to negate the competitive advantage gained through depreciation. LDC governments may of course be more concerned with short to medium term effects. In addition, most LDC mining companies import a significant proportion of their inputs, reducing the cost advantage they derive from devaluation of the domestic currency, but in this regard it should be noted that CODELCO purchases a considerably higher proportion of its inputs locally than do some of its competitors, notably Zambia, Zaire and Papua New Guinea.

However, exchange rate changes have very wide-ranging effects, some of them negative, on 'open' economies such as those of the major LDC mineral exporters. So, for example, the substantial depreciation of the Zambian Kwacha between late 1985 and mid 1986 certainly improved the competitive position of ZCCM, the state mining company, at least in the short term. But it created major problems for Zambia's economy,

for example through its impact on prices of essential imports and on Zambia's debt service payments.²⁴ It would be an extremely complex matter to manipulate exchange rates so to assist a state mining company, while at the same time ensuring that the wider economy was not adversely affected. It should also be noted that economic conditions which warranted devaluation (e.g. rapid domestic inflation) might have negatively affected a company's competitive position in any case, so that devaluation would simply help it regain lost ground.

The speed with which the impact of devaluation 'feeds through' into a mining company's domestic costs is clearly of crucial importance, and the wage response is very significant in this regard. It is often assumed that devaluation leads to a decline in real wage costs for LDC mineral producers, but this is only so if workers are not in a position to obtain money wage increases which at least match the rate of inflation. As mentioned above, CODELCO's workers have been able to do so since the late 1970s; their role in the strategic and highly efficient copper sector may confer on them bargaining power which ensures that their wages respond to price increases more quickly than for the economy as a whole. This would of course reduce the benefits derived by CODELCO from a peso devaluation.

In sum, it is important to examine the extent to which devaluation is real for an individual state-owned company, i.e. the extent to which its impact is negated by changes in its costs relative to changes in its competitors' costs. This is extremely difficult to do, because it requires detailed information on the break-down between imported and domestic purchases and on price indices for various inputs, information which is rarely available. The standard approach is simply to compile a composite index derived from changes in exchange rates and in consumer prices, i.e. one which indicates price changes in a number of countries in terms of a single currency, usually the

US dollar. It is assumed that consumer prices provide a reasonable proxy for mining company input prices.²⁵ Some relevant data is contained in Table 8, which presents USD price indices for seven leading copper producers over the period 1976—85. What these indices show is the relationship between domestic inflation and the domestic currency/USD exchange rate; a falling index indicates that prices are rising less rapidly than the rate of depreciation (improving competitiveness), a rising index that the opposite is occurring.

The data indicate that over the period 1976—81 Chile's inflation rate was generally higher than the rate of currency depreciation; this was also the case for the other producers, though not to as great an extent, as indicated by the fact that the percentage increase in Chile's index during 1976—81 was larger than that for any other producer. In other words, over this period Chile's competitive position *worsened* vis-a-vis every other major copper producer as a result of exchange rate and domestic price trends. After 1981 the position changed, with Chile's index falling by 46 per cent during 1981—85. However, it should be noted that Zaire's index fell even more sharply (by 51 per cent), and that those of Zambia and Peru also fell substantially (29 and 26 per cent respectively). Thus to the extent that data of this type allows conclusions regarding the competitiveness of individual producers, it appears that over the decade as a whole CODELCO derived little net advantage from changes in the peso exchange rate.

It seems clear that CODELCO does not receive any subsidies, direct or indirect, which might allow it to pursue strategies not available to privately-owned producers; indeed it could be argued that the need to make excessive use of loan finance imposed on it by Chile's government raises its cost of capital above that of its major competitors. There remains the more general question of whether CODELCO's cor-

porate strategy differs in important ways from those of privately-owned mining companies.

This issue can be approached in two ways. First, there is the empirical question of whether private producers enjoying a comparable cost advantage have behaved in a similar way. Many apparently have. For example, the major *privately-owned* producers in Chile have also increased their output during recent years, or are currently in the process of doing so. In 1985, for instance, Exxon commenced an 80 M USD investment at its El Soldado-mine aimed at increasing output from 30 kt of copper in concentrate to 60 kt by 1987.²⁶ More generally, it seems apparent that low-cost producers have tended to maintain output during periods of depressed consumption and prices, and in at least some cases to gradually expand it so as to increase their market share. The Canadian Kidd Creek Mines (now part of Falconbridge Limited), for instance,

is a low-cost producer because of high grades, substantial co-product credits, and highly efficient processing plants; it did not cut copper output significantly in any year between 1978 and 1984, and increased production overall by 98 per cent during this period.²⁷

Second, there is the question of whether CODELCO's strategy represents an economically logical approach for a profit-maximizing firm. A judgement on this issue depends critically on two inter-connected factors, first the likely impact of its actions on prices, and second their impact on competing firms. CODELCO believes that a strategy of increasing production in line with growth in demand will not adversely affect prices, while cutting output will not improve them. The validity of the first point depends, of course, on whether expected increases in demand actually materialize; if they do not prices will presumably fall as a result of CODELCO's additional production, a

Table 8

Consumer price indices for major copper producing countries, in USD terms, 1976.—1985 (1980 = 100)

Year	Chile	Peru	Zambia	Zaire	Australia	Canada	USA
1976	61	84	65	47	74	84	69
1977	72	87	70	74	75	84	74
1978	69	68	81	113	84	85	79
1979	78	83	90	114	90	91	88
1980	100	100	100	100	100	100	100
1981	120	121	104	86	111	110	110
1982	101	119	109	89	109	118	117
1983	83	108	97	71	106	125	122
1984	79	107	116	38	108	124	126
1985	64	89	74	na	92	122	131

Source:

International Monetary Fund, *International Financial Statistics Yearbook 1986*, relevant country tables.

possibility noted by some Chilean commentators who oppose any further expansion of output.²⁸ A price decline might be short-lived if it resulted in higher-cost producers closing down, which raises the issue of CODELCO's impact on its competitors. As mentioned above, the company apparently believes that it can force higher cost mines out of business, but this is by no means certain. Many high cost mines have continued to produce while incurring substantial losses; most closures have occurred in the US, and as mentioned already some of the major mines involved are now in the process of re-opening. If CODELCO overestimates growth in demand and underestimates the staying power of its competitors, its strategy could lead to a substantial price decline which would affect all of its sales and could reduce its total revenues substantially.

As regards the alternative strategy of restricting output (or at least growth in output), it could be argued that while Chile or the CIPEC countries alone are unlikely to have a major effect on prices, exercise of restraint by the majority of producers could have an impact. Some evidence for this view is supplied by the recent history of zinc prices, where production restraint by major producers has apparently helped to modify the downward price trends experienced in most mineral markets.

There is no agreement on the issues discussed above even among Chileans involved in the copper industry, let alone among mineral policy analysts generally. This lack of agreement reflects fundamental uncertainties regarding future trends in copper demand and supply, and imperfect understanding of relationships between copper demand, supply and prices. In the face of these uncertainties, CODELCO faces risks whatever strategy it adopts. The available evidence suggests that its choice of strategy reflects fundamental economic factors, rather than the fact that it is a state-owned corporation.

Notes:

¹ N Girvan, *Corporate Imperialism: Conflict and Expropriation*, Monthly Review Press, New York, 1976, Chapter 2; T H Moran, *Multinational Corporations and the Politics of Dependence: Copper in Chile*, Princeton University Press, 1974; E Tironi, 'Issues in the Development of Resource-Rich LDCs: Copper in Chile', in L B Krause and H Patrick (eds), *Mineral Resources in the Pacific Area*, Federal Reserve Bank of San Francisco, 1978, 366—413.

² See, for example, *Copper Studies*, October 1983, 4—16; *Skilling's Mining Review*, 1987-06-20, 4—12.

³ Most recent research published in English has concentrated on the Large Copper Mines. For an earlier discussion of the small and medium mining sector, see E Tironi, 'The Small- and Medium-Scale Copper-Mining Sector in Chile', in A Seidman (ed), *Natural Resources and National Welfare: The Case of Copper*, Praeger, New York, 1975, 156—88.

⁴ Tironi, 'Resource rich LDCs', 376.

⁵ Derived from CODELCO-Chile, *Annual Report 1985*, and International Monetary Fund (IMF), *International Financial Statistics Yearbook*, 1985 and 1986.

⁶ See Table 5, and L R Soto, 'CODELCO-Chile: Situation and Perspective', Paper Presented to the Canadian Institute of Mining Mineral Economics Symposium, Toronto, 1984-11-18/20, 10.

⁷ *Copper Studies*, October 1983, 7.

⁸ US House of Representatives Congressional Research Service, *The competitiveness of American Metal Mining and Processing*, Washington DC, July 1986, 27.

⁹ Soto, 'CODELCO-Chile', 1.

¹⁰ E Tironi, 'Economic Planning in the Nationalized Copper Sector', in Seidman, *Natural Resources and National Welfare*, 190.

¹¹ See, for example, C Fortin, 'Copper Investment Policy in Chile', *Natural Resources Forum*, 8(4), 1984, 316, 318, and 'Chilean Copper Policy: International and Internal Aspects', *IDS Bulletin*, 17(4), 1986, 59.

¹² Soto, 'CODELCO-Chile', 7—8. See also the comment by R F Mikesell, 'The Structure of the World Copper Industry', in Sideri and S Johns, *Mining for Development in the*

Third World, Pergamon, New York, 66.

¹³ Soto, 'CODELCO-Chile', 6; see also the statement by Ruben Schindler, Executive Vice President of the Chilean Copper Commission, quoted in J O'Brien, 'A case of heightened awareness: CESCO International Seminar on Challenges of Copper to the Year 2000', *Resources Policy*, 12(1), 1986, 77—9.

¹⁴ Soto, 'CODELCO-Chile', 14.

¹⁵ For a detailed discussion of one mine's experience in this regard, see G F Joklik, 'Reducing Big Ticket Costs—The Bingham Canyon Case Study', *Mining Review*, May 1987, 30—34.

¹⁶ See, for instance, C F Barber, 'Compensatory Financing Rules Can be Counterproductive', *American Banker*, 1983-09-27.

¹⁷ Derived from Fortin, 'Chilean Copper Policy', Table 3, 60.

¹⁸ Fortin, 'Copper Investment Policy in Chile', 'Chilean Copper Policy'.

¹⁹ CODELCO-Chile, *Annual Report*, various years; information supplied by Energy, Mines and Resources Canada.

²⁰ *Copper Studies*, October 1983, 16.

²¹ Soto, 'CODELCO-Chile', 9.

²² *Copper Studies*, October 1983, 9, 13; *Engineering and Mining Journal*, June 1985, 17—18.

²³ See, for example, Barber, 'Compensatory Financing Rules'; Exxon Minerals Company, *Impact of International Lending Institutions on Major LDC Mineral Producing Countries*, Houston, April 1985.

²⁴ *Africa*, January 1986, 74.

²⁵ See, for example, *Copper Studies*, October 1983, 2—4; D L Maxim, 'Exchange Rates and the International Trade in Metals: The Case of Copper', Paper Presented to the Conference on the New Future of World Metals, New York, May 1986.

²⁶ W J McCutcheon, 'Copper', in Energy, Mines and Resources Canada, *Mineral Industry Annual Review 1985*, Ottawa, 23.3.

²⁷ Kidd Creek Mines Ltd, *Annual Report*, various years.

²⁸ O'Brien, 'A case of heightened awareness', 79. ■