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Socioeconomic Foundation for and Implications of National Environmental Policy in Chile

by

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Preface

ILO work on environment and employment commenced with a contribution to the Rio Earth Summit entitled Environment, employment and development.[1] Subsequently, a set of conceptual and empirical case studies linking environment, employment and poverty alleviation is being synthesized in a volume.[2]

This study is the third in a series of conceptual and empirical case studies focusing in depth on specific issues of Agenda 21 adopted by Rio Earth Summit.[3]

The study by Sanford Malman of the Centro de Investigación y Planificación del Medio Ambiente, Santiago, deals with the linkages among growth, employment and environmental pollution/degradation by analysing the national press coverage of environmental issues taking into account the political and socioeconomic transformations that have occurred in Chile over the past 20 years. The study shows that the type of policy intervention will clearly vary from sector to sector depending on the nature of environmental or pollution problem and on the potential for further sectoral growth and employment expansion. A single unique economy-wide policy prescription for environmental protection would not be appropriate if sustainable growth and job creation are not to be jeopardized when the policy measure has to be tuned to tackle the particular sector-specific environmental problem.

Finally, the survey of the national media reporting reveals an active government role on environmental matters in virtually every sector of the economy except in mining and trade where the business community is seen to play a more dominant role. This initial survey clearly provides a solid empirical foundation for feeding both the employment and growth concerns into the ongoing national debate on national environment policies and legislation.

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[1] A.S. Bhalla (ed.), *Environment, employment and development*, Geneva, ILO, 1992.

[2] Iftikhar Ahmed and J.A. Doeleman (eds.), *Beyond Rio: The environmental crisis and sustainable livelihoods in the Third World*, London, Macmillan, forthcoming.

[3] Other studies completed concern the indigenous tribal people of India (Rural poverty, environmental degradation and agrarian structure: Evidence for tribal people from India, WP. 239); rural and urban Kenya (Environment, technology and poverty linkages in Kenya); operationalization of Agenda 21 concepts like sustainable livelihoods and environmentally sound technology (WP. 243).

Contents

1. Introduction

In recent years, Chile has been able to build a wide consensus that protection of the environment should be an integral part of the country's economic development efforts. Significant segments of the nation's business sector and government officials have shared this vision, which is a rare phenomenon among developing countries. Growing environmental consciousness has made environmental protection a principal political priority in Chilean society. The opening of the economy to world markets over the last decade, and the reestablishment of democracy in 1990 have been mutually reinforcing in the achievement of consensus.

After decades of ignoring the impacts and costs of environmental degradation, and failure to create frameworks, institutions, and programmes for environmental protection, significant progress has been made in less than 5 years. Chile's sustained economic growth and ample flows of investment funds, have contributed to creating the conditions necessary for organizing an effective system of environmental management.

The primary objective of this study is to trace the interrelationships between the structural transformations of the Chilean economy and the evolution of national environmental policy over the last 20 years. The next section draws upon the comprehensive and consistent inter-sectoral transactions data recently released by the Central Bank which permits an assessment of the strategic importance of the agricultural, forestry, fishing, and mining sectors. Such data is particularly important for analysing the environment impacts from a sector's total domestic production. As will be shown, a sector's share of a nation's (or a region's) total output can be quite different from its share of final demand or value added (the series that are typically drawn upon in assessing the environmental relevance of the sectoral composition of output). Time series data from various sources is also utilized to analyse sectoral and regional dynamics. This is followed by an analysis of the regional and sectoral specificity of Chile's environmental problems. Because of the paucity of systematic environmental statistics, this section is based on innovative use of a database of environmental press coverage.

The fourth section of the study traces the evolution of environmental policy in the context of the socioeconomic foundations for those policies presented in the earlier sections. The final section of the paper discusses the outlook for new directions in environmental policy in Chile.

2. Structural Characteristic of the Chilean Economy

Post-1945 Chilean Regimes of Accumulation

In periodizing postwar economic history, in countries throughout the world the early 1970s mark a break from one regime of accumulation to another. In Chile, 1973, the year of the military coup, is a much clearer and abrupt demarkation of the shift from one regime of accumulation to another than can typically be identified from an analysis of a country's economic history.

The 1945-73 period was based on a model of growth, somewhat modified in various sub-periods, of promoting development by means of protection of domestic industries from foreign competition, and by an intensive role for the State in the direction of industrial policy.

At the time of the military coup in September 1973, the annual rate of inflation was 605 per cent; more than 5000 firms and banks - accounting for an estimated 40 per cent

of GDP - were controlled by the State; sectoral and national labour unions had high memberships and were politically powerful; there was a multiple exchange rate system; domestic industry was protected by high tariffs; and copper accounted for over 80 per cent of total exports (Morande, 1993).

The principal policy objectives of the economists installed by the junta were the reestablishment of macroeconomic stability; reversal of massive State ownership and management; and replacement of an inward-oriented import substitution development programme with an export-driven, largely natural resource-based development strategy.

Some of the earliest steps were aimed at establishment of reliance on the price system, rather than bureaucratic interventionism as the principal mechanism of economic coordination. Almost all price controls were eliminated in the month after the coup. The multiple exchange rate system was replaced by a single exchange rate, fixed by a crawling peg system. The trade liberalization reform started with the elimination of all non-tariff barriers and a tariff reductions plan in which the median tariff was reduced from 40 per cent in 1975 by 10 percentage points every year, reaching an average level of 10 per cent by 1978 (Morande, 1993, p. 14).

The deregulation and privatization process was implemented in a gradual way. Smaller firms which had been taken over by the government were the first to be returned to their original owners. At the end of 1976, 79 per cent of the total assets of the 100 largest companies were still State-owned (Ritter, 1990, p. 175). In the agricultural sector, approximately one-fourth of the lands that had been taken over under the agrarian reform were returned to previous owners. The new government gave title to about 45,000 small farmers from lands that had been cooperatives.

In the aftermath of the coup, the government sought to crush the power of labour by dissolving unions and jailing or exiling their leadership. In 1979, new labour legislation was adopted aimed at increasing the flexibility of the labour market. The key aspects were: collective bargaining was limited to the firm level; union affiliation was made voluntary; employers were given the right to dismiss workers without expression of cause, and indemnization in cases of findings of unjust dismissals was limited; a 70-day limit was established for the duration of strikes; and lock-outs were permitted (Valásquez, 1993).

The overwhelming 'no' outcome of the October 1988 referendum on continuation of military rule, led to a presidential electoral campaign between the right, advocating the continuation of the Pinochet regime's economic policies, and an alliance of centre-left parties, whose candidate Patricio Aylwin, won the election and took office in 1990.

It is important to bear in mind, that the basic development policy of opening the economy to foreign competition and fostering an export-led growth strategy, initiated by the military government in 1974, has been maintained by the democratically elected government. With priority given to maintaining macroeconomic stability and promoting growth, the main shifts in policy were related to objectives of improving distributional equity, and labour reform.[1] The distributional objective implied increasing annual

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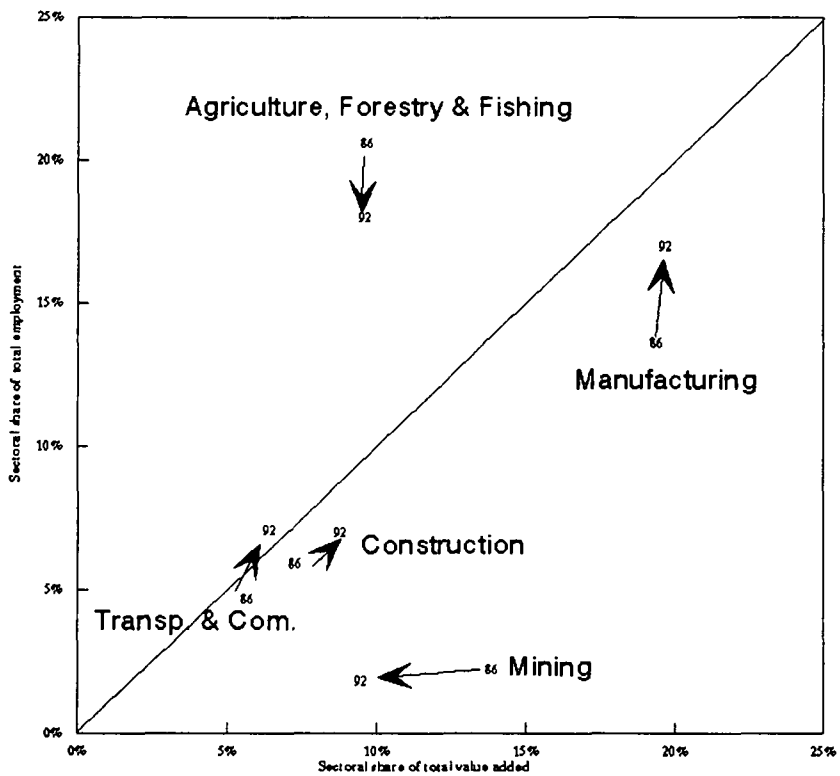
[1] See Cortázar (1993), the Minister of Labour under the Aylwin government, for a comprehensive review of the administration's accomplishments in: the establishment of tripartite social accords; reform of labour legislation; administration of compliance with labour legislation; training and education programmes; and social security. Epstein's (1993) assessment is more sceptical of the benefits to the average union member of the new non-conflictual model of labour relations being practised by the leadership of the national labour organization (Central Unitaria de

government spending on programmes targeted to the lowest income groups by around 600 million dollars, financed through reform of the tax system (Muñoz and Celedon, 1993). The negotiations leading to labour law reform and modification of the tax code led to important qualitative changes in the relationship between the new government and the business community. Three phases can be identified: (1) an initial period of distrust and caution; (2) a gradual acceptance of the new political conditions generated by the transition to democracy; and (3) a progressive rapprochement and consolidation of confidence in the economic management of the new government (*ibid.*, p. 109).

These changes in the character of the relationship, based on the successful experience in the tax and labour law arenas, as well as on the business community's recognition of the role of the government's policy in promoting robust growth and maintaining overall macroeconomic stability, had their counterpart in the creation of consensus regarding directions for environmental policy.

Graph 1: Shifts in sectoral value added and employment



Source: Banco Central de Chile (1993a p. 249, 1993b p.12)

Trabajadores).

Sectoral and Regional Development Under the Open Economy Model

In recent years, Chile has had one of the fastest growing economies in the world, increasing at a rate of 6 per cent in 1991 and an impressive 10 per cent in 1989. This is in sharp contrast to the social devastation provoked by the 1982 and 1975 recessions in which GDP fell by approximately 13 per cent in each case. Although export growth is a fundamental driving force behind this economic success, in the last 5 years, the fastest growing sector has been telecommunications and transport, two sectors whose infrastructures are deemed to be crucial for sustained export growth. In every year since 1988, the growth rate of the transport and communications category has far exceeded that of every other sector (except fishing in 1989).

Graph 1 displays the sectoral shifts between 1986 and 1992 in the share of value added along the horizontal axis and in employment along the vertical axis. As the graph indicates, the manufacturing sector share of employment grew substantially while remaining a fairly constant proportion of value added. The reverse situation has been experienced by agriculture, forestry and fishing. For mining, there was a large relative reduction in the share of value added and a rather modest decline in the share of employment. The absolute level of mining employment rose from 84.1 thousand in 1986 to 86.9 thousand in 1992 (but falling from a 1989 peak of 102.6 thousand), while value added fell in absolute terms (at constant prices).

The recently released input-output tables for 1986, which will be referred to as MIP86 (Matriz de Insumo-Producto para la Economía Chilena, 1986), provide a comprehensive and consistent basis on which to assess the importance of the natural resources sectors of the Chilean economy.[2] Graph 2 shows that the natural resource sectors have fairly high direct forward and backward linkages with the rest of the economy.

The underlying basis for the position of the various sectors in the graph will be discussed in detail below.

The primary sectors (agriculture, forestry, fishing, and mining) currently account for approximately one-fifth of GDP and employment. Because of the high labour productivity of the mining sector, its contribution to employment (2.3 per cent in 1990) is small in relation to its contribution to GDP (9.5 per cent in 1990). Value added per employee in the Chilean mining sector is over 4 times as high as the economy-wide average.

Historically, there were much more profound transformations in the structure of employment in the 1960s and 1970s than in the 1980s, with deep absolute and relative shifts out of agriculture, fishing, and forestry, and absolute and relative expansion of the service sector. An exception to this general rule, however, is the dramatic contraction of government employment in the 1980s (from 518,000 in 1983 (16.2 per cent of total employment) to 313,000 (7.6 per cent of total employment) in 1988 (Ritter, 1990, p. 167).

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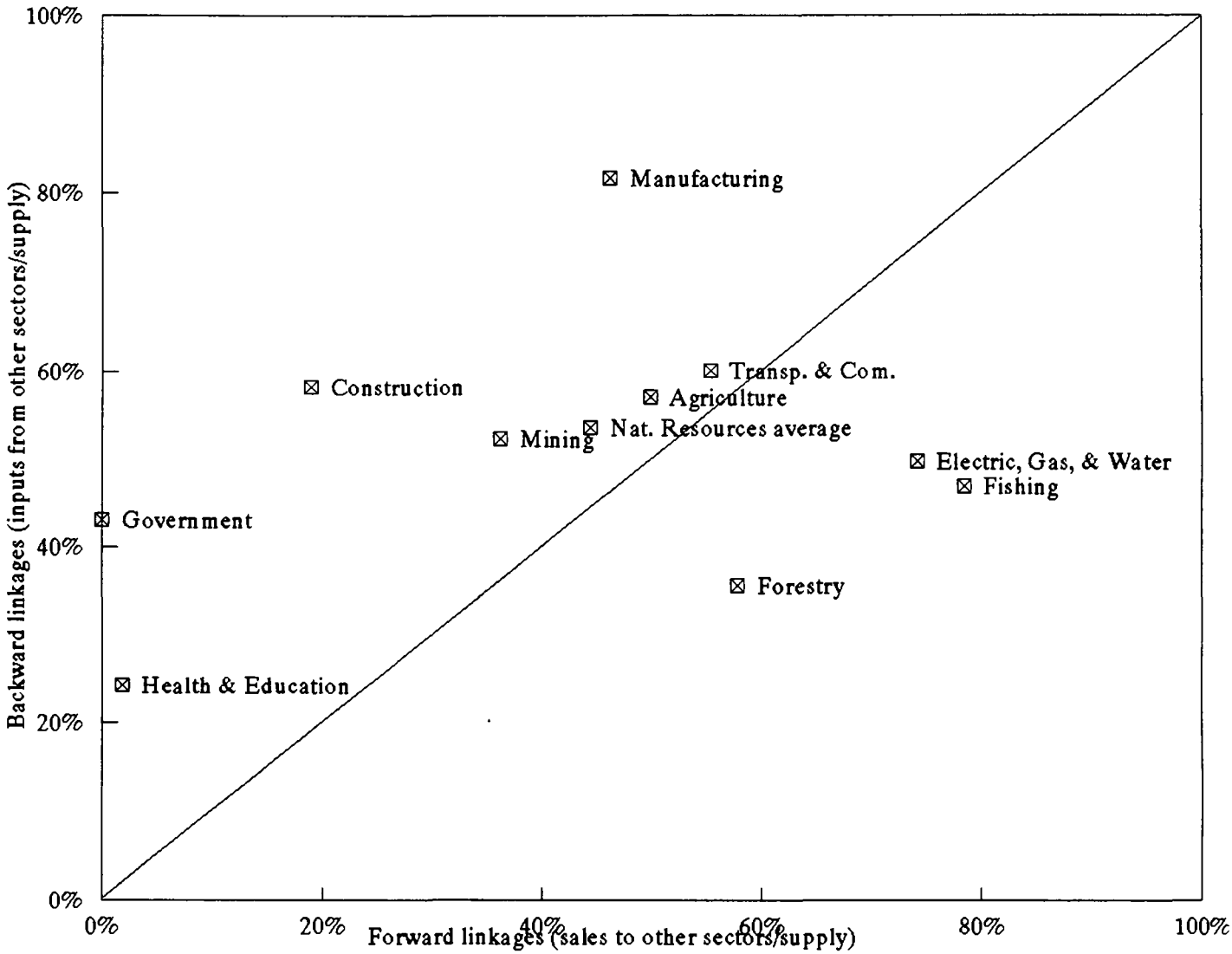
[2] Since the early 1970s, input-output economics has been used to evaluate environmental repercussions (for example, Leontief, 1972). More recently, Blades (1989) has pointed out that an extension of the conventional input-output tables by matrices of pollutants by various processes would have limited use since the kind of data that policy makers require concerning the output of pollutants needs to be site-specific in order to be useful. However, modifying the input-output approach to isolate pollution abatement costs, can provide an extremely useful basis for evaluating the economy-wide costs of legislation which imposes expenditure for pollution abatement.

Graph 2: Direct forward and backward sectoral linkages



Source: Banco Central de Chile, 1992b. Tables 1 and 4.

Exports

Chile's export-oriented development strategy has played a pivotal role in bringing environment issues to policy arenas in which this dimension had long been ignored. Among the explanations for this new linkage are: explicit requirements in many international markets for the assurance of the environmental quality of agricultural products; recognition of the marketing value of a 'green' image both at the company level as well as at the level of the overall perception of the country's environmental record; the voluntary adoption of international environmental standards, as a matter of corporate policy, by many of the international corporations investing heavily in natural resource-based production for the export market; compliance with environmental guidelines imposed by international lending agencies; and the understanding that trade agreements will be tied to environmental issues.

Over the last 20 years, export growth has generally far exceeded the overall rate of growth of the economy. In 1992, for instance, GDP grew at 10.3 per cent whereas export growth was 16.8 per cent. In order to accommodate the dynamism of the export market, major investments have been undertaken to strengthen the port facilities and related infrastructure.

Chile's exports are dominated by the mining, agricultural, forestry, and fishing sectors. Between 1970 and 1990, the share of the total accounted for by agricultural, forestry, and fishing exports has grown throughout the period. Natural resources have represented about 60 per cent of total exports, the largest proportion of which corresponds to the mining sector (46.7 per cent of total exports in 1992). Copper exports alone accounted for 38.8 per cent of the total.[3] The manufacturing industries that are based on the output of agriculture, forestry, and fishing represent a growing fraction of the export market. These tendencies will be analysed in more detail below.

Regional Development Tendencies[4]

There are a number of key aspects of the current stage of economic development in Chile that are highly favourable to regional development. To begin with, in recent years, increasing proportions of productive investments have been directed to the regions (i.e. to regions other than the Santiago Metropolitan Region). This is driven by important investments in exploitation of natural resources primarily for the export market. Examination of data on the distribution of planned investments over the period 1993-2000 by sector and across regions, shows that relative to an employment or GDP share benchmark, a disproportionate share of productive investment is directed to regions other than Santiago. It is only in the service sector that the Santiago share of total investment predominates.

Second, much of the new investment directed to the regions is for industrial processing of natural resources rather than mere exploitation of the primary resources.

A third, highly relevant tendency is the notable improvement in the capacity of the regions to develop their own human capital resources. Technological development, levels of educational attainment, training of workers, and the capacity within the regions to undertake scientific research oriented toward the development of their own region have made notable advances.

Fourth, the environmental standards which increasingly characterize world markets are forcing local enterprises that exploit natural resources to make their productive activities compatible with environmental conservation. Many modern enterprises that are processors of natural resources are adopting production methods and programmes oriented towards environmental protection driven by the demands of the markets in developed countries.

Fifth, in each region, the public is increasingly adopting an attitude of vigilance and caution regarding the environmental resources of their region. The belief that the quality

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[3] It should be noted that shifts in the international price of copper can have enormous impacts on share of the mining sector. The absolute tonnage has continued to grow throughout the period.

[4] See Geisse and Sabatini (1991) for a more complete elaboration of the ideas presented in this section.

of life could be improved through the domination and manipulation of nature is increasingly being rejected. The new environmental ethic that is on the ascent worldwide is increasingly strong in Chile as well. Seeking to establish an equilibrium between development and conservation, this new ethic is a strong force favouring the possibilities for the sustainable development of the regions.

Sixth, modern enterprises in Chile, like their counterparts in other parts of the world, are increasingly adopting communication and information systems that not only permit better internal integration of branch offices and factories across regions, but also facilitate their integration within each of the regions in which they reside. Furthermore, the tendency towards more 'flexible' productive systems, emphasizing the use of subcontracting, has stimulated the development of small and medium-sized enterprises in the regions.

Finally, regionalist and anti-centralist sentiments have never been stronger. The majority of political parties have emphasized decentralization in favour of the regions in their political programmes. The broad political consensus in this regard was reflected in recent legislation regarding the structure of regional and municipal government.

In the following sections the economic characteristics of the natural resources and natural resource-based manufacturing sectors will be examined in greater detail to set the stage for reviewing the environmental policies of these sectors in the fourth section of the paper.

The Agricultural Sector

The MIP86 data provides a breakdown of agricultural activities for the 1986 snapshot. This data indicates the extent to which fruit exports have dominated the export activities of the farm sector (83.5 per cent of the 1986 total). Since most agricultural production is for the domestic market, the fruit subsector not surprisingly accounts for only 28.4 per cent of the total supply of agriculture, fruits, livestock and agricultural services. When the farm sector data are combined with food and other farm sector-based manufacturing activities (ISIC division 31, excluding fish processing) the export market only represents 10 per cent of the total supply of agricultural and food products. The relative dependence of the individual manufacturing sectors based on farm production and their respective export orientations are displayed in Table 1.

About one-fourth of agricultural output allocated to intermediate demand is for non-food sector manufacturing, but these other sectors have low agricultural input/output coefficients (averaging .01). The sectors that absorb the lion's share of farm output are sugar, meat packing, milling and bread, and dairy production. The canned fruits and vegetable industry has the strongest export orientation of the agricultural processing group (27.4 per cent of its 1986 output, which was 1.1 per cent of total exports in that year).

The Fishing Sector

The Chilean fishing sector has evolved through a number of distinct historical phases. The first important stage began in the 1950s. During the 1960s with the help of state subsidies, there were major investments in the north of the country in fishmeal processing plants. The industry faced its first crisis from a significant shortfall in the availability of anchovies, due to a combination of overfishing and the impact of the hot currents associated with the 'El Niño' phenomenon.

Table 1. Manufacturing related to agricultural production

Sector	1986 pesos (millions)			Sectoral shares (%)			Shares of sectoral output	
	Agricultural inputs	Sectoral output	Sectoral exports	Agricultural inputs	Sectoral output	Sectoral exports	Agricultural inputs	Sectoral exports
Sugar (3118)	24 939	43 430	2 307	9.1	0.6	0.2	57.4	5.3
Meat slaughtering (3111)	76 343	184 557	2 972	27.8	2.4	0.3	41.4	1.6
Animal feed (3122)	5 693	16 098	161	2.1	0.2	0.0	35.4	1.0
Milling and treads (3116)	50 599	174 397	761	18.4	2.3	0.1	29.0	0.4
Wine and liquor	10 279	44 027	3 071	3.7	0.6	0.3	23.3	7.0
Dairy products (3112)	17 143	74 024	721	6.3	1.0	0.1	23.2	1.0
Canned fruits and vegetables (3113)	6 757	38 177	10 479	2.5	0.5	1.1	17.7	27.4
Oils and fats (3115)	6 980	46 286	491	2.5	0.6	0.0	15.1	1.1
Other food production (3119)	2 460	44 070	1 404	0.9	0.6	0.1	5.6	3.2
Beverages, except wine and liquor (3133)	1 702	44 070	1 105	0.6	0.6	0.1	3.9	2.5
Tobacco (3140)	1 351	57 127	773	0.5	0.7	0.1	2.4	1.4
Subtotal	204 246	766 263	24 245	74.5	10.0	2.4	26.7	3.2
Other sectors	70 028	6 864 571	970 389	25.5	90.0	97.6	1.0	14.1
Total	274 274	7 630 834	994 634	100.0	100.0	100.0	3.6	13.0

Source: Banco Central de Chile (1992, Tables 2 and 3).

The second phase is marked by the growth in the Spanish Sardine catch and rapid expansion of the export market.

In terms of primary fish production, the pelagic fish, principally anchovies, sardines and mackerel, have historically dominated the annual catch, accounting for over 90 per cent of the total.

The third phase of historical development of the fishing sector is marked by the rapid growth of fish farming at the end of the 1980s. Aquaculture has experienced particularly rapid growth in the last 2 years, making Chile the second largest producer of salmon in the world after Norway. Achieving this has required compliance with the quality standards demanded in the foreign world after Norway. Fish farming has been most extensively developed in Region X, where over 1,300 concessions have been authorized (Buschmann, *et. al.*, 1993, p. 71).

In analysing the fishing sector it is important to remember that the fish processing sectors (fishmeal, fishoil, canning, etc.) are, from an economic accounting standpoint, considered to be industrial activities. Therefore, employment and GDP statistics for the fishing sector include primary fishing activities only; the industrial component is in the industry category. In 1986, primary fishing activities represented 1 per cent of the value of all goods and services supplied to the Chilean economy. Most of the extractive fishing sector is to meet the intermediate demand of the fish processing sector. The intermediate demand of the fishing sector represented 78.5 per cent of its total output and 53.6 per cent of the total inputs required by the fish processing industry (ISIC 3114). Only 2.6 per cent of fish production is directly exported.

Of the over 6 million metric tons of fish caught or raised in 1991, 88.8 per cent was unloaded from large vessels, mainly in northern ports of the Tarapaca Region and in the southern ports of the Bío-Bío Region, with somewhat smaller, but still important activity in the Valparaíso and Antofagasta regions. Artisan fishing, which accounted for approximately 7 per cent of total production in 1991, is also concentrated in the Bío-Bío Region, but is the principal form of fishing activity in the far south (Magallanes Region). Seventy-five per cent of aquaculture production is located in the south in the Los Lagos Region.

Fishmeal and fish oil are the dominant subsectors, providing 74.8 per cent and 14.7 per cent, respectively, of total 1991 production (measured in metric tons). These activities are concentrated in the Bío-Bío Region in the South (principally in Talcahuano) and in the northern-most region of Chile (Tarapaca, principally in the cities of Arica and Iquique). The canning industry is also important in these areas, but also in Coquimbo, and in the Los Lagos Region in the south, where canning activity is for aquaculture output (principally salmon and trout). The canning subsector has strategic importance because of its close link with the national metallurgical industry (Mizala, 1992, p. 166). The metal products sector was the second largest provider of total inputs to the fish processing industries (Banco Central de Chile, 1992b, Table 2).

Table 2. Regional distribution of employment in the forestry sector

Region		Forestry and logging	Wood products	Pulp and paper	Services	Total
V	Valparaiso	742	1 412	17	225	2 396
VI	O'Higgins	1 114	1 797	102	422	3 435
VII	Maule	6 766	4 581	480	1 865	13 692
VIII	Bio-Bio	21 140	13 367	2 742	8 115	45 364
IX	La Araucania	4 855	5 509		939	11 303
X	Los Lagos	2 399	8 338	165	991	11 893
XI	Aysén	232	456		128	816
XII	Magallanes	55	471		145	671
R.M.	Santiago	211	3 367	3 543	841	7 962
	Other regions	329	484		101	914
	Total	37 843	39 782	7 049	13 772	98 446

Source: Instituto Forestal, 1991 Tables 8.1 and 8.2.

Subsector shares of regional forest sector employment (%)

Region		Forestry and logging	Wood products	Pulp and paper	Services	Total
V	Valparaiso	31.0	59.0	1.0	9.0	100.0
VI	O'Higgins	32.0	52.0	3.0	12.0	100.0
VII	Maule	49.0	33.0	4.0	14.0	100.0
VIII	Bio-Bio	47.0	29.0	6.0	18.0	100.0
IX	La Araucania	43.0	49.0	0.0	8.0	100.0
X	Los Lagos	20.0	70.0	1.0	8.0	100.0
XI	Aysén	28.0	56.0	0.0	16.0	100.0
XII	Magallanes	8.0	70.0	0.0	22.0	100.0
R.M.	Santiago	3.0	42.0	44.0	11.0	100.0
	Other regions	36.0	53.0	0.0	11.0	100.0
	Total	38.0	40.0	7.0	14.0	100.0

Regional distribution of employment in the forestry sector

Region		Forestry and logging	Wood products	Pulp and paper	Services	Total
V	Valparaiso	2.0	3.5	0.2	1.6	2.4
VI	O'Higgins	2.9	4.5	1.4	3.1	3.5
VII	Maule	17.9	11.5	6.8	13.5	13.9
VIII	Bio-Bio	55.9	33.6	38.9	58.9	46.1
IX	La Araucania	12.8	13.8	0.0	6.8	11.5
X	Los Lagos	6.3	21.0	2.3	7.2	12.1
XI	Aysén	0.6	1.1	0.0	0.9	0.8
XII	Magallanes	0.1	1.2	0.0	1.1	0.7
R.M.	Santiago	0.6	8.5	50.3	6.1	8.1
	Other regions	0.9	1.2	0.0	0.7	0.9
	Total	100.0	100.0	100.0	100.0	100.0

Fishing tends to have substantially higher wage and salary scales than the fish processing industries (Duhart and Weinstein, 1991, p. 50). For the industrial fleets, remuneration tends to be in the form of a fixed base salary and a variable amount based the tonnage of the catch (ibid., p. 56). There are wide salary dispersions dependent on occupational categories and the type of ship. Fisherman are not subject to the limitation on weekly hours of work of 48 hours generally applicable to the rest of the Chilean labour force. In addition to the long hours, the work effort required tends to be extraordinarily exhausting, both physically and mentally (ibid., p. 54). Due to the more severe climate (much more rain, fog, rough waters, and temperature extremes), the working conditions in the southern fishing regions tend to be much more hazardous than in the northern regions.

The Forestry Sector

The forest and forest products industries have been among the most dynamic sectors of the Chilean economy in recent years, accounting for 3.3 per cent of GDP in 1990, whereas in 1974 they represented 2.4 per cent. Unfortunately, a number of serious social and environmental problems have accompanied the great economic success of these industries.

Among the recent developments concerning the forestry sector, the following stand out: (1) a significant increase in exports, forest production and acreage planted with pine (*pino insigne*); (2) investment and modernization of a significant number of industrial plants; (3) advances in forestry legislation; (4) consolidation and management of several important national parks; and (5) progress in forestry research.

The State has played an important role in the growth of the forestry sector. Among some of the measures that can be highlighted are: subsidies for forestation and management; management of planting directed by the Instituto Forestal on private lands, or lands later privatized; sale of public lands at low prices to the largest firms in the

industry; establishment of tax benefits; liberalization and promotion of exports; and financing of research, training, technical assistance, etc.

Many of the significant environmental problems of the forestry sector are directly and significantly connected to economic aspects of the industry. For example, reforestation with only one species (*pinus radiata*), can be a cause of significant ecological disaster if measures are not taken to avoid it. Since 1988, there has been a policy of replacing pines (*pinus radiata*) by eucalyptus and other conifers. Another form for diminishing the risks of monoculture is to augment the genetic variability of the species. In the decade of the 1970s, a programme of improving genetic diversity was pursued as a means of evading some of the harmful effects of monocultivation.

Negative economic impacts of forestry production on other sectors is also significant. One example is the impact of the forestry industry on the condition of roads. The roads of the forest exploitation-intensive regions are subject to high level of deterioration due to the activity of the sector, due more specifically to the high tonnage and types of vehicles used. This leads to problems for other users (deterioration of their vehicles, higher road taxes, etc.) as well as for the communities that depend on these roads for access. Other sources of economic losses result from higher transportation costs and harmful impacts on tourism.

In Chile, one of the most compelling instances supporting the argument that there is a strong causal relationship, at the microeconomic level[5], of poverty causing environmental degradation is for the case of firewood (leña) extraction by poor, small producers. An estimated 60 per cent of the extraction of native forests in Chile is for the use of firewood by poor families in rural areas (Foxley, 1992, p. 42).

If the primary forestry sector is grouped with the forest product industries (lumber, furniture, pulp and paper) the combined sector currently represents approximately 3 per cent of GDP. Since 1974, the combined sector has grown substantially faster than the rest of the economy in every year except in 1977 and 1989, and in the recession years of 1975 and 1982 when the contraction was nearly twice as deep as for the economy as a whole.

Table 2 shows the regional distribution of employment for the forestry and forest product industries. The middle panel of the table shows the share of each of the subsectors for each of the regions. The bottom panel shows the relative extent of employment in the various regions for each subsector. All of the forestry and forest product industries are most heavily concentrated in the Bío-Bío Region, particularly, however, the forestry and logging component. In all of the other regions, except the Maule and the Metropolitan Regions, the wood product industries are the most important source of employment. Until the opening of major new plants in the Bío-Bío Region in 1992, more than half of employment in the pulp and paper industry had been concentrated in the Metropolitan Region.

The Mining Sector

The Chilean mining sector has an enormous impact on the economy. Although absorbing only a little over 2 per cent of total employment, it accounted for 45.5 per cent

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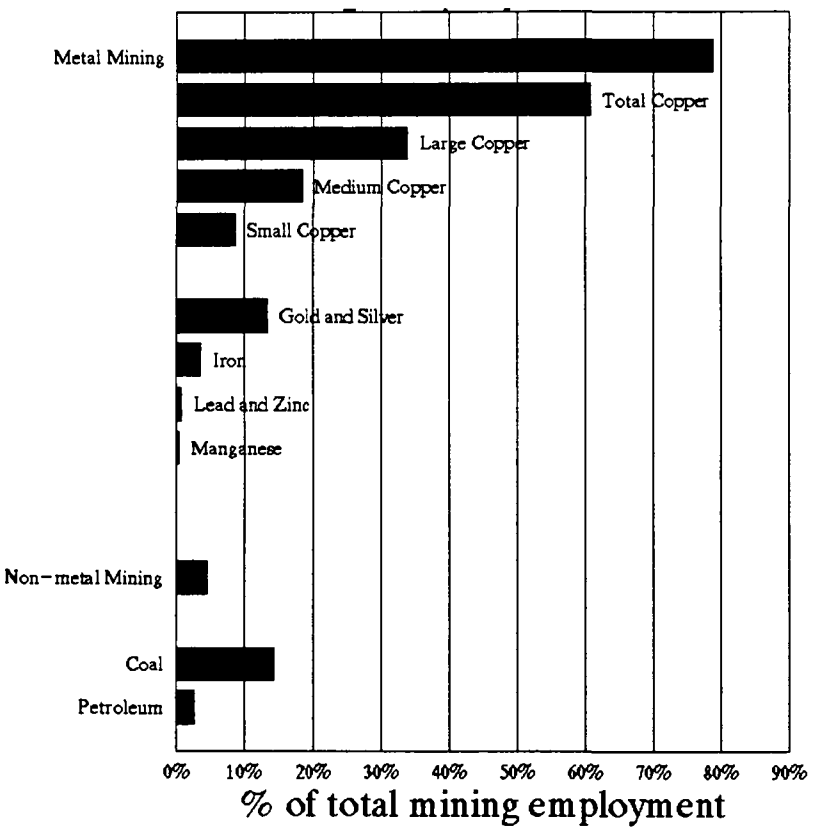
[5] I.e. the type of production practices of poor, small operators. This is very different from the macroeconomic argument that a poor country cannot afford to invest heavily in environmental protection.

of exports in 1986. In the MIP86 data, six out of the 75 sectors analysed are for mining activities. The six sectors (with their International Standard Industrial Codes) are Copper (2120), Iron (2202), Petroleum and Natural Gas (2110), Coal (2120), Sand and Stone (2400), and Other Minerals (2300). Table 3 shows the relative importance of each of these six subsectors in relation to domestic production and total supply, intermediate and final demand, and value added.

The distribution of employment among the various form of mining activities is provided in Graph 3. Metal mining accounted for nearly 80 per cent of total mining

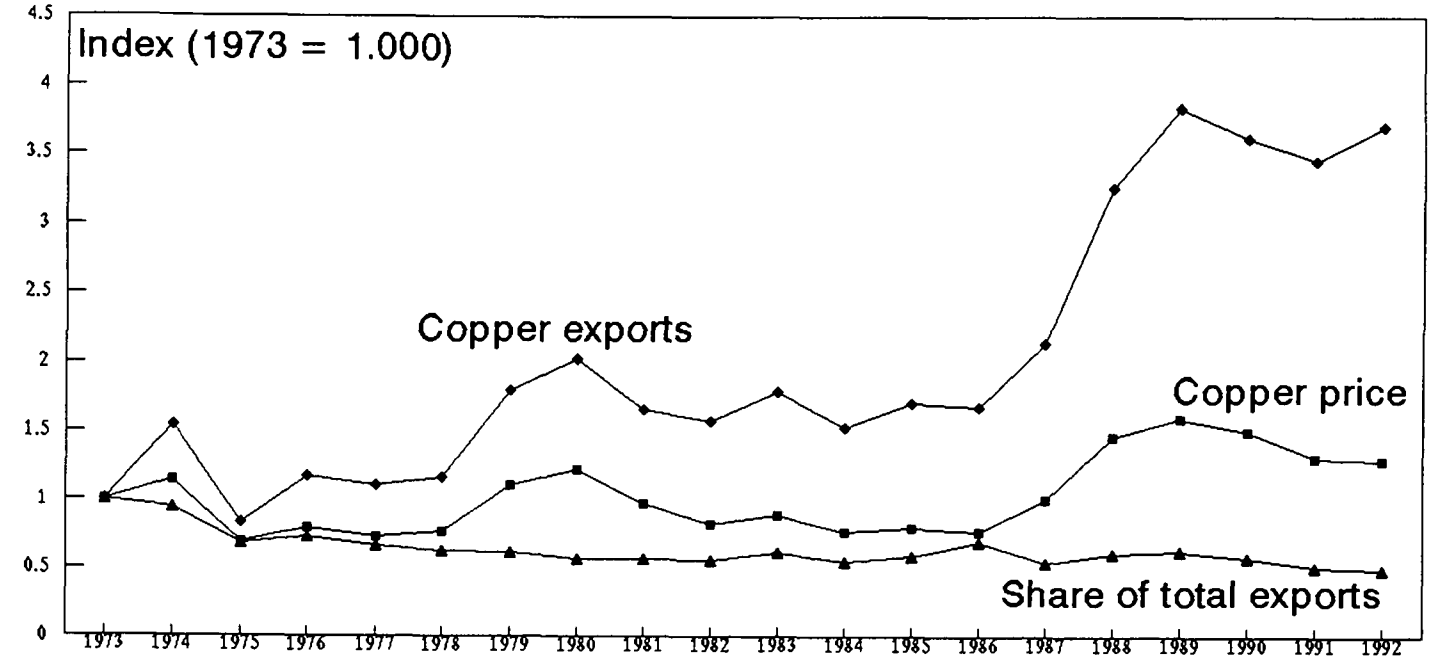
Graph 3: Sectoral distribution of mining employment



Source: Servicio Nacional de Geología y Minería, 1991, p. 109.

employment in 1991. Copper miner's share of total employment was 60 per cent, a little over half of which worked in the *Gran Minería*. The dominant role of copper mining is most pronounced in terms of its contribution to mining exports - about 75 per cent of the total. Due to the volatility of the international price of copper, the sector's contribution to the economy can vary widely, even in the absence of substantial shifts in the physical volume of production (see Graph 4). Because copper refining is included in the copper mining sector (i.e. is not classified as a manufacturing activity) the bulk of intermediate

Graph 4: Indices of copper prices, exports, and share of total exports



Source: Morande, 1993.

demand (82.3 per cent) is for intrasector transactions. The purchases of ENAMI[6] from the small and medium-sized mining operations for further processing represents a major proportion of the intermediate demand.

Another measure of the importance of the copper sector to the Chilean economy is the extent of its integration with other domestic production activities. Table 4 lists the sectors that provide inputs to copper mining and processing, showing the imported content for each sector and the respective input-output coefficients. On average, only 24.2 per cent of the inputs required by the sector are provided by imports. The Copper sector demands 15.2 per cent of electricity generated in Chile and 13.2 per cent of all railroad transportation. The period from 1975 to 1983 was one of relative stagnation for the mining sector under the combined impact of the two consecutive recessions and a rather sudden expansion of foreign competition (CEPAL, 1989, p. vii). In the subsequent period, partly as an attempt to stimulate domestic demand, the new economic team (following the 1982 recession) began a policy of encouraging the state-owned firms to substitute imports used in mining production by domestic producers (CEPAL, 1989, p. ix). An additional important factor contributing to the articulation of copper mining with domestic inputs is the growing use of national engineering firms in the design phase of investment projects.

[6] The Empresa Nacional de Minería (ENAMI) is a state-owned firm that was created in 1960 with the objective of helping to promote the development of small and medium-size mining operations. It is the main processor and exporter of the output of this segment of the mining sector.

Table 3. Composition of intermediate and final demand in the mining sector

1986 pesos (millions)

	Net	Total intermediate			Final demand	
	Supply	Imports	Supply	Demand	Exports	Other	Total
Copper (2120)	393 994	2 551	396 545	55 241	338 396	2 908	341 304
Iron (2202)	23 671	4	23 675	5 347	17 812	516	18 328
Petroleum and Natural Gas (2110)	73 049	55 955	129 004	124 384	0	4 620	4 620
Coal (2120)	16 066	5 043	21 109	24 974	0	(3 865)	(3 865)
Sand and Stone (2400)	9 934	65	9 999	9 999	0	0	0
Other minerals (2300)	133 886	5 297	139 183	40 981	96 188	2 014	98 202
Total mining	650 600	68 915	719 515	260 926	452 396	6 193	458 589

Composition of mining sector demand (%)

	Net	Total intermediate			Final demand	
	Supply	Imports	Supply	Demand	Exports	Other	Total
Copper (2120)	99.4	0.6	100.0	13.9	85.3	0.7	86.1
Iron (2202)	100.0	0.0	100.0	22.6	75.2	2.2	77.4
Petroleum and Natural Gas (2110)	56.6	43.4	100.0	96.4	0.0	3.6	3.6
Coal (2120)	76.1	23.9	100.0	118.3	0.0	-18.3	-18.3
Sand and Stone (2400)	99.3	0.7	100.0	100.0	0.0	0.0	0.0
Other minerals (2300)	96.2	3.8	100.0	29.4	69.1	1.4	70.6
Total mining	90.4	9.6	100.0	36.3	62.0	0.9	63.7

	Subsector shares of total mining (%)						
	Net		Total intermediate		Final demand		
	Supply	Imports	Supply	Demand	Exports	Other	Total
Copper (2120)	60.6	3.7	55.1	21.2	74.8	47.0	74.4
Iron (2202)	3.6	0.0	3.3	2.0	3.9	8.3	4.0
Petroleum and Natural Gas (2110)	11.2	81.2	17.9	47.7	0.0	74.6	1.0
Coal (2120)	2.5	7.3	2.9	9.6	0.0	-62.4	-0.8
Sand and Stone (2400)	1.5	0.1	1.4	3.8	0.0	0.0	0.0
Other minerals (2300)	20.6	7.7	19.3	15.7	21.3	32.5	21.4
Total mining	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Banco Central de Chile (1992b).

Table 4. Intermediate demand inputs to copper mining

Sector	Inputs to copper mining				Sectoral output	Input/ output co-efficient
	Total	National	Imported	% imported		
Copper mining	45 481	43 127	2 354	5.2	396 545	0.115
Generation of electricity	24 228	24 228	0	0.0	159 464	0.152
Extraction of other minerals	22 416	19 746	2 670	11.9	139 183	0.161
Non-electrical machinery	21 424	2 686	18 738	87.5	202 957	0.106
Petroleum refineries	16 545	12 609	3 936	23.8	342 663	0.048
Metal products	13 768	10 142	3 626	26.3	136 620	0.101
Business services	11 508	11 508	0	0.0	192 924	0.060
Other chemical products	8 494	6 078	2 416	28.4	201 017	0.042
Chemical substances	6 586	3 414	3 172	48.2	149 849	0.044
Basic metal industries	6 281	2 528	3 753	59.8	127 143	0.049
Non-metalic mineral products	5 961	5 027	934	15.7	56 415	0.106
Road transportation, freight	5 925	5 925	0	0.0	128 273	0.046
Trade	3 936	0	3 936	100.0	86 381	0.046
Rubber	3 886	643	3 243	83.5	21 698	0.179
Electrical machinery and accessories	3 656	1 526	2 130	58.3	141 775	0.026
Road transportation, passengers	3 452	3 452	0	0.0	125 730	0.027
Construction	3 220	3 220	0	0.0	390 862	0.008
Financial services	3 160	3 160	0	0.0	293 249	0.011
Plastic products	2 902	2 329	573	19.7	73 771	0.039
Railroad transportation	1 807	1 807	0	0.0	13 723	0.132
Transportation equipment	1 645	76	1 569	95.4	145 127	0.011
Other inputs	11 842	9 730	2 112	17.8	4 105 495	0.003
Total	228 123	172 961	55 162	24.2	7 630 834	0.030

Source: Banco Central de Chile, 1992b.

It is argued that Chilean engineers are likely to have more information concerning national capabilities and a greater proclivity to use domestically produced inputs in copper mining and refining operations (CEPAL, 1989, p. ix).

In analysing the Chilean copper sector it is fundamental to recognize the heterogeneity of production processes, working conditions, productivity levels and remuneration scales, all driven primarily by the scale of operations and geological characteristics of the various mining sites. In 1991, 61 per cent of the tonnage of fine copper was produced by the *Gran Minería*, 37 per cent by the medium-sized producers, and about 2 per cent by the small producers (SERNAGEOMIN, 1992, p. 17).

The *Gran Minería* consists of CODELCO's[7] four divisions: Chuquicamata in the Antofagasta Region (57 per cent of 1991 CODELCO production); El Salvador in the Atacama Region; Andina in the Valparaíso Region, which began to operate in 1976 (10.1 per cent of 1991 CODELCO output); and El Teniente in the O'Higgins Region, an underground mine near the city of Roncongua that produced 24.8 per cent of the company's 1991 output. El Teniente is the largest underground copper mine in the world, and Chuquicamata is the world's largest open-pit copper mine (Barrera, 1990, p. 33). Since 1960, the underground mines of the El Salvador division have produced about 100,000 metric tons throughout the period, whereas there has been a considerable expansion of production by Chuquicamata and El Teniente. Since the mid-1960s, electrolytic copper has been CODELCO's most important product, accounting for 76.7 per cent of 1991 production (SERNAGEOMIN, 1992, p. 20). The other types of output as of 1991 were 9.9 per cent in the form of copper concentrates, 13.3 per cent in the form of 'blister' of varying purities (copper in bars, which needs to refined for industrial use but can be directly used by the chemical industry).

Barrera (1990) has pointed out that there have been dramatic shifts in the composition of the CODELCO labour force. Between 1976 and 1986, nearly all of the over 6,000 reductions in employment were of manual labourers. Managerial staff actually grew slightly, and the number of technicians and skilled workers dropped by only approximately 100.

In 1991, 56 per cent of copper mining employment was in the *Gran Minería*, 30 per cent worked in medium-sized copper mining, and the remaining 14 per cent were employed in small-scale mining operations. The average salary per employee of the *Gran Minería* is double that of the medium-sized sector although productivity (in terms of tons per employee) is similar. The per capita remunerations gap between the large and small sectors is more consistent with their productivity differentials. That is, both income per employee and output per employee are approximately 7 times greater for the large-scale sector than for the small-scale sector (SERNAGEOMIN, 1992, pp. 108-109).

According to MIP86 data, the energy sector component of mining (petroleum, natural gas, and coal) is all for domestic use. Imports provided 43.4 per cent of Petroleum

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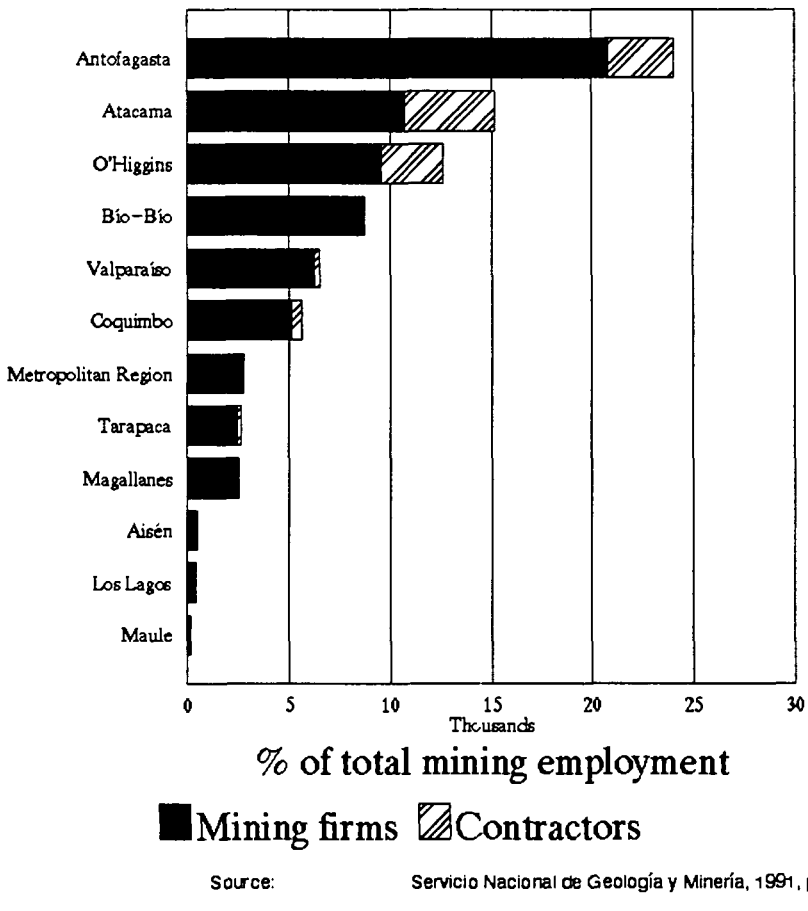
[7] The Corporación Nacional del Cobre (CODELCO) was established in 1976. In line with its ideology of reducing the role of the State, the military government's policy was to place strong budgetary restrictions on the company that only permitted a level of investment sufficient to compensate for falling purities of the available reserves. Following the economic crisis of 1981-1982, when it became clear that foreign investment was not reaching the anticipated levels, a more active role for CODELCO in the development of the mining sector was deemed to be an economic necessity (CEPAL, 1989, p. 9).

and Natural Gas utilized throughout the economy, and 23.9 per cent of the coal. Coal miners represented 14.2 per cent of those employed in the mining sector in 1991 (see Graph 3). The costs of production of Chilean coal are substantially higher than imported coal, and the government is seeking ways to phase out production in a manner that will minimize the social dislocation.

Because its growth rate has been somewhat lower than the most dynamic sectors of the economy, the mining sector share of GDP has been declining. Mining investments continue to be the largest of any sector. Private sector mining investment planned through the end of the decade represents 12.5 per cent of the total, and the announced projects of the state-owned CODELCO is nearly as large (Sociedad de Fomento Fabril, 1993). The bulk of the planned mining investments are concentrated in the three northern-most regions of the country. Major investments in pollution abatement expenditures will be undertaken by the Chuquicamata Division of Codelco and by ENAMI for the Ventanas and Paipote copper smelters.

Graph 5: Regional distribution of mining employment, 1991



Source: Servicio Nacional de Geología y Minería, 1991, p. 117.

Approximately 23 per cent of total mining employment is located in the Antofagasta Region in the north of Chile (see Graph 5). The other important locations of mining activity are in the regions of Atacama (14.1 per cent), Coquimbo (11.9 per cent), O'Higgins (11.4 per cent), and Bío-Bío (16.8 per cent, nearly all of which is in coal mining). The somewhat limited contribution of petroleum production (3.3 per cent of the

value of mining output, and 2.6 per cent of mining employment - see Graph 5) is concentrated in the southern-most part of Chile.

The Manufacturing Sector

The relationships described above between the primary sectors and the manufacturing sectors to which they are structurally linked are summarized in Table 5. The primary sectors and the related manufacturing processes contribute nearly equally to their combined contribution of 36.7 per cent of the value of total output. In the case of the forestry sector, the manufacturing activities of ISICs 33 and 34 are far more significant to the economy than the unprocessed products (4 per cent versus 0.4 per cent of the value of all goods and services). In the mining sector, the relationship is reversed, although somewhat due to the convention of not classifying the output of copper smelters as a manufacturing activity, but rather as part of copper mining.

The relative export-orientation of the unprocessed natural resources sectors and the natural resources intensive manufacturing processes is shown in Table 6. Overall, the former are more oriented to external markets than the latter. The clear exception to this rule is the fishing sector, in which only a small fraction of primary production is exported directly. In contrast, 76.8 per cent of the fish processing sector's output is for export - the highest share among the natural resources sectors.

Table 7 shows the domestic (i.e. excluding imported) natural resources inputs as a ratio of domestic manufacturing production (i.e. input/output coefficients) grouped according to types of inputs. The natural-resource intensity of these manufacturing processes is not the only environmentally-relevant aspect according to which they can be ranked. The last column of the table ranks these sectors by an index of toxic emissions based on U.S. data from the Toxic Release Inventory[8].

This same information is displayed graphically in Graph 6 and summarized by broad industrial groups and ranges of the toxicity index in Table 8. This table shows the distribution of the 1986 value of domestic manufacturing production by these dimensions. This information is only meant to be suggestive for further investigation. The essential question is whether the U.S. emissions data is relevant to Chile. For instance, in the pulp & paper industry, a large portion of the current Chilean production is from very recently built plants which incorporated state-of-the-art technologies for minimizing pollution.

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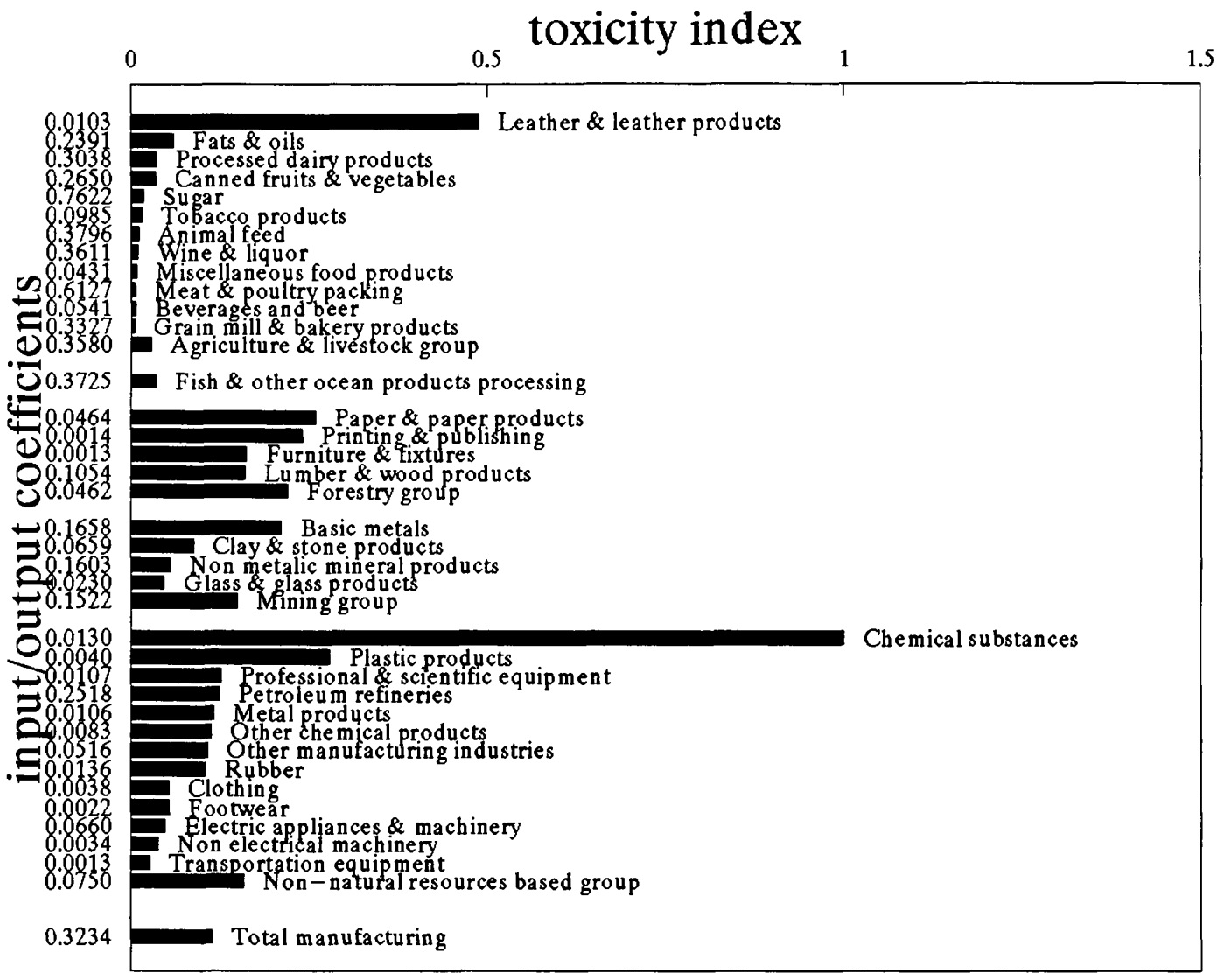
[8] The data for constructing the index was taken from Ten Kate (1993), who used the same methodology for an analysis of industrial development and the environment in Mexico which was presented at a well attended seminar in Santiago. The pollution data is from the Toxic Release Inventory (TRI) database maintained by the US Environmental Protection Agency. The TRI database contains information on emissions of 320 toxic substances. The system makes available a number of alternative indices based on different methods of weighting the various substances. The TRI-based indices are combined with U.S. Census of Manufactures data to generate series at the 4-digit ISIC level of kgs. of pollutants per million dollars. In this application, the 'AVHUM' kgs. per million dollars series were converted to index numbers by normalizing by the value for chemical substances (ISIC 3510). Gómez-Lobo (1992) used the same data, obtained from the World Bank's Industrial Pollution Forecasting System. Gómez-Lobo then applied these U.S.-based series to value added data for 28 industrial subsectors in Chile. The MIP86 data provides more desegregation than was available to Gómez-Lobo.

Graph 6: Input-output coefficients and indices of toxicity for manufacturing



Source: Input-output coefficients: Banco Central de Chile, 1993b
Toxicity index: Toxic Release Inventory data reproduced in Ten Kate, 1993.

Table 5. Value added in natural resource and related manufacturing sectors

	ISIC	Total supply (1)	Value added (2)	Remunera-tion (3)	(2)/(1) (4)	(3)/(2) (5)	Total supply (6)	Value added (7)	Remunera-tion (8)
Agriculture									
Primary	11	549 209	235 738	64 341	42.9%	27.3%	7.2%	7.2%	5.5%
Food manufacturing	31 except 3114	796 843	149 537	46 684	18.8%	31.2%	10.4%	4.6%	4.0%
Total		1 346 052	385 275	111 025	28.6%	28.8%	17.6%	11.8%	9.6%
Forestry									
Primary	12	27 455	17 650	2 969	64.3%	16.8%	0.4%	0.5%	0.3%
Related manufacturing	33 and 34	303 073	104 055	32 777	34.3%	31.5%	4.0%	3.2%	2.8%
Total		330 528	121 705	35 746	36.8%	29.4%	4.3%	3.7%	3.1%
Fishing									
Primary	13	74 760	39 625	13 670	53.0%	34.5%	1.0%	1.2%	1.2%
Fish processing	3114	128 620	33 855	10 400	26.3%	30.7%	1.7%	1.0%	0.9%
Total		203 380	73 480	24 070	36.1%	32.8%	2.7%	2.2%	2.1%
Mining									
Primary	21,22,23 and 24	719 515	342 852	99 343	47.7%	29.0%	9.4%	10.5%	8.5%
Related manufacturing	36 and 37	208 500	56 729	16 348	27.2%	28.8%	2.7%	1.7%	1.4%
Total		928 015	399 581	115 691	43.1%	29.0%	12.2%	12.2%	10.0%
Total Natural Resources-based									
Primary		1 370 939	635 865	180 323	46.4%	28.4%	18.0%	19.5%	15.5%
Related manufacturing		1 437 036	344 176	106 209	24.0%	30.9%	18.8%	10.5%	9.1%
Total		2 807 975	980 041	286 532	34.9%	29.2%	36.8%	30.0%	24.6%
Total		7 630 834	3 268 418	1 162 533	42.8%	35.6%	100.0%	100.0%	100.0%

Table 6. Exports of the natural resource and related manufacturing sectors

		Total			Share of total	
		Supply*	Exports*	(2)/(1)	Supply	Exports
	ISIC	(1)	(2)	(3)	(4)	(5)
Agriculture						
Primary	11	549 209	111 807	20.4%	7.2%	11.2%
Food manufacturing	31, except 3114	796 843	24 245	3.0%	10.4%	2.4%
Total		1 346 052	136 052	10.1%	17.6%	13.7%
Forestry						
Primary	12	27 455	7 831	28.5%	0.4%	0.8%
Related manufacturing	33 and 34	303 073	71 913	23.7%	4.0%	7.2%
Total		330 528	79 744	24.1%	4.3%	8.0%
Fishing						
Primary	13	74 760	1 937	2.6%	1.0%	0.2%
Fish processing	3114	128 620	97 736	76.8%	1.7%	9.9%
Total		203 380	100 673	49.5%	2.7%	10.1%
Mining						
Primary	21, 22, 23 and 24	719 515	452 396	62.9%	9.4%	45.5%
Related manufacturing	36 and 37	208 500	13 058	6.3%	2.7%	1.3%
Total		928 015	465 454	50.2%	12.2%	46.8%
Total Natural Resources-based Primary						
Primary		1 370 939	573 971	41.9%	18.0%	57.7%
Related manufacturing		1 437 036	207 952	14.5%	18.8%	20.9%
Total		2 807 975	781 923	27.8%	36.8%	78.6%
Total		7 630 834	994 634	13.0%	100.0%	100.0%

* millions of 1986 pesos

Source: Banco Central de Chile (1992b, Table 3).

Table 7. Input-output coefficients and indices of toxic emissions

ISIC		Domestic natural resources inputs (1)	Domestic production (2)	Share of domestic manuf. production (%) (3)	(1)/(2) (4)	Toxicity index (5)
3230	Leather and leather products	169	16 409	0.9	0.0103	0.4886
3115	Fats and oils	6 909	28 892	1.7	0.2391	0.0597
3112	Processed dairy products	15 665	51 570	3.0	0.3038	0.0362
3113	Canned fruits and vegetables	7 587	28 635	1.6	0.2650	0.0345
3118	Sugar	27 354	35 890	2.1	0.7622	0.0181
3140	Tobacco products	1 434	14 553	0.8	0.0985	0.0157
3122	Animal feed	5 488	14 459	0.8	0.3796	0.0112
3131	Wine and liquor	10 400	28 799	1.6	0.3611	0.0092
3119	Miscellaneous food products	2 120	49 140	2.8	0.0431	0.0076
3111	Meat and poultry packing	76 580	124 986	7.2	0.6127	0.0069
3133	Beverages and beer	1 659	30 686	1.8	0.0541	0.0060
3116	Grain mill and bakery products	46 781	140 602	8.1	0.3327	0.0045
	Agriculture and livestock group	202 146	564 621	32.3	0.3580	0.0283
3114	**Fish and other ocean products processing**	46 379	124 507	7.1	0.3725	0.0345
3410	Paper and paper products	4 818	103 739	5.9	0.0464	0.2589
3420	Printing and publishing	61	44 242	2.5	0.0014	0.2400
3320	Furniture and fixtures	40	30 257	1.7	0.0013	0.1617
3310	Lumber and wood products	5 897	55 924	3.2	0.1054	0.1586
	Forestry group	10 816	234 162	13.4	0.0462	0.2188
3700	Basic metals	13 327	80 359	4.6	0.1658	0.2103
3610	Clay and stone products	262	3 978	0.2	0.0659	0.0881
3690	Non-metalic mineral products	6 618	41 273	2.4	0.1603	0.0550
3620	Glass and glass products	193	8 405	0.5	0.0230	0.0465
	Mining group	20 400	134 015	7.7	0.1522	0.1485

ISIC		Domestic natural resources inputs (1)	Domestic production (2)	Share of domestic manuf. production (%) (3)	(1)/(2) (4)	Toxicity index (5)
3510	Chemical substances	502	38 729	2.2	0.0130	1.0000
3560	Plastic products	200	50 056	2.9	0.0040	0.2782
3850	Professional and scientific equipment	39	3 630	0.2	0.0107	0.1264
3530	Petroleum refineries	46 134	183 190	10.5	0.2518	0.1233
3810	Metal products	850	80 062	4.6	0.0106	0.1148
3520	Other chemical products	859	104 088	6.0	0.0083	0.1124
3900	Other manufacturing industries	273	5 287	0.3	0.0516	0.1077
3550	Rubber	332	24 384	1.4	0.0136	0.1041
3220	Clothing	265	69 929	4.0	0.0038	0.0537
3240	Footwear	67	29 994	1.7	0.0022	0.0534
3830	Electric appliances and machinery	1 984	30 042	1.7	0.0660	0.0470
3820	Non-electrical machinery	89	26 002	1.5	0.0034	0.0376
3840	Transportation equipment	58	43 536	2.5	0.0013	0.0266
	Non-natural resources based group	51 652	688 929	39.5	0.0750	0.1576
	Total manufacturing	564 755	1 746 234	100.0	0.3234	0.1145

Source: Value of domestic production and inputs: Banco Central de Chile (1992b, Table 1 and Table 6).
Toxicity index: Ten Kate (1993, p. 72, AVHUML index)

Table 8. Distribution of value added by level of toxicity of emissions

	Range of values of the toxicity index			
	Low	Medium	High	Total
Agriculture and livestock group	31.4		0.9	32.3
Fish and fish processing	7.1			7.1
Forestry group		4.9	8.5	13.4
Mining group	3.1		4.6	7.7
Natural resources-based sub-total	41.6	4.9	14.0	60.5
Non-natural resources based group	11.4	22.7	5.3	39.5
Total manufacturing	53.0	27.7	19.3	100.0
Toxicity index ranges	<.1	.1 - <.2	>.2	

Source: Value of domestic production: Banco Central de Chile (1992, Table 1)

3. The Environmental Problems of Chile

The coverage of environmental themes in the press is one of the key sources of information that forms public opinion regarding the relative importance of the environmental problems a country faces; their territorial specificity; the adequacy and effectiveness of laws, standards, programmes, plans and other diverse forms of administration and management; and forms of public participation and social mobilization around environmental preoccupations. It is also a primary channel through which the public comes to know who the key actors are in causing environmental degradation; who are the public officials, activists, or academics that identify and call attention to specific environmental problems; and who are seen to be effectively managing and proposing solutions to these problems.

This section describes an approach to quantifying environmental press coverage that has been applied in Chile. Such an approach can be particularly helpful in a context in which many quantifiable dimensions of environmental problems and policy are either not comprehensively measured, or only become available with considerable lags. This is the current situation in Chile as it is in most developing countries. The approach that will be described, would, however, seem to have merits even in countries that systematically collect data on the various physical and socioeconomic aspects of environmental problems.

A database has been designed for analysing the content of articles concerning environmental issues appearing in newspapers and mass circulation weekly news magazines published in Chile.[9] The articles analysed came from 16 regional newspapers,

[9] In analysing and codifying any article, the database received one observation for each unique intersection of the database variables. To clarify this, one could assume that the database design only had three fields (environmental problem, region and economic sector). If an article dealt with four regions, three environmental problems, and two economic sectors, the database would not

10 Santiago-based newspapers, and 11 news magazines (all of which are based in Santiago). The coverage was therefore close to being the complete universe of Chilean environmental reporting (i.e. not just a sample).[10]

If several years of data were available, this tool could provide an extremely powerful means of analysing structural change in environmental policy and progress in confronting environmental problems. The current version of the database is complete for 1992 and is being continued for 1993.[11] Since the database entries identify the date of the article it is possible to analyse variation over time and investigate seasonal patterns of coverage. Given the 1 year limitation, the most powerful current use is to aggregate over the temporal dimension.

Graph 7 shows the relative amount of coverage given to environmental problems that were the focus of considerable reporting in 1992. In general, these results are consistent with the Chilean scientific community's assessment of the relative importance of the various environmental problems confronting Chile.[12] Some exceptions are the number of articles on cholera for which the newsworthiness was far disproportional to the health risk, and the massive attention that was given to the proposed passage through Chilean waters of a Japanese ship carrying plutonium radioactive waste. Problems related to soil quality and erosion seem to be under-reported. Most of the reporting is on long-term environmental problems. Environmental emergencies (for example relating to Santiago air quality) do, naturally, also receive more attention than less dramatic, although very serious problems. What this suggests is that the cross-referencing of environmental problems with

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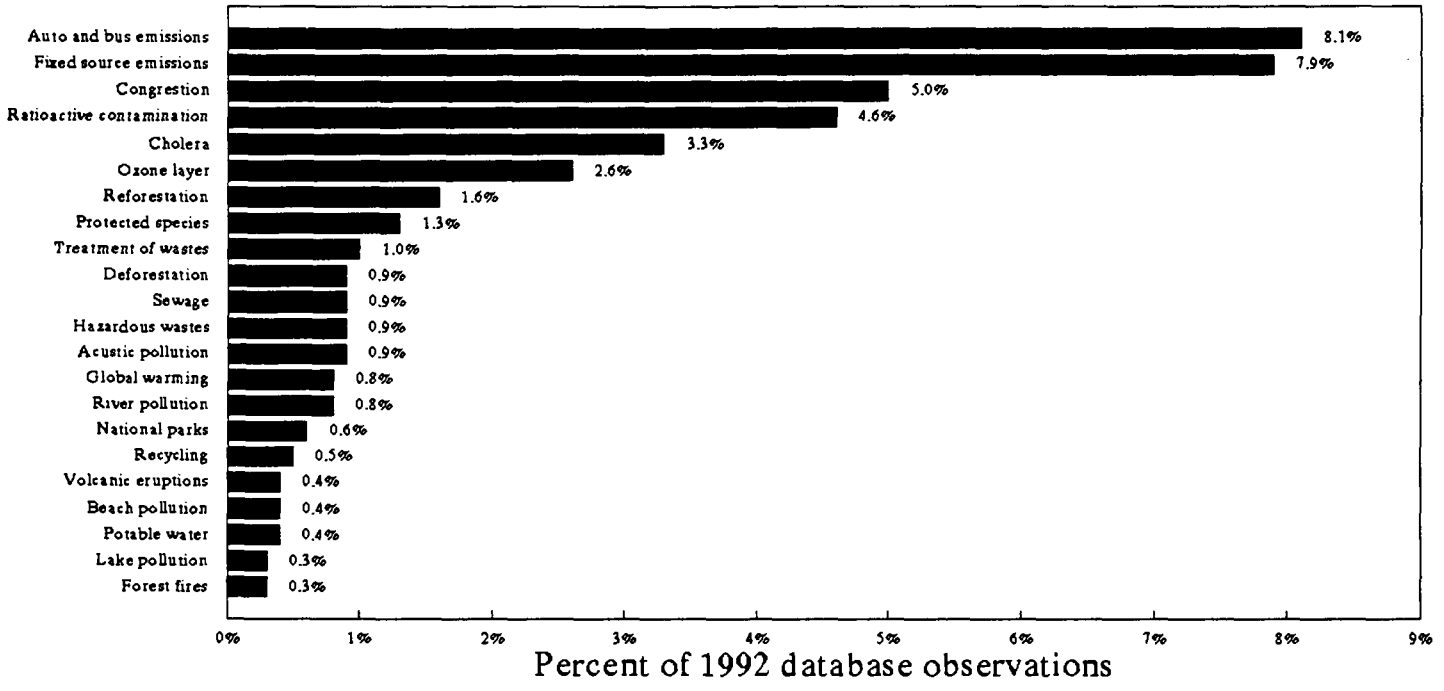
be assigned 24 observations (4 x 3 x 2), but only the number of relevant intersections of the variables as developed in the article. An intersection of variables for a section of an article would be, for instance, the environmental problem pertaining to an economic sector in a specified region. For 1992, the codification of 7,133 articles on Chilean environmental reporting required 23,071 database observations (or an average of 3.2 observations per article). The number of observations per article can be taken to be an indicator of the information content of an article. The quantitative measure for analytical purposes can therefore be either the number of articles or the number of observations. Given that it would typically be appropriate to take into consideration the information content of articles, i.e. not give the same weight to every article, the number of observations was considered to be a preferable measure.

[10] Chile has a fairly robust newspaper industry. Two newspapers are published in the city of Punta Arenas in the southern-most region; one in each of the three principal cities of the Los Lagos Region in the south (Puerto Montt, Osorno, and Valdivia); one in Concepción in the Bío-Bío Region; one in Temuco in the La Araucania Region: two in Valparaíso; one in La Serena in the Coquimbo Region; and four in the Antofagasta Region. The Regions of Aisén, Maule, O'Higgins, and Atacama do not have any locally-based newspapers.

[11] The 1993 version of the database has been extended to allow for the quantitative treatment of categories of opinions expressed concerning an environmental issue.

[12] In 1991, the National Environmental Commission (CONAMA) published a comprehensive compendium of environmental problems by region. The ranking of problems was based on a Delphi approach for a panel of experts in each region. Each participant rated the importance of the problem on a six-point scale (from 'irrelevant' to 'of maximum importance') and the possibility of controlling the problems rated on a four-point scale (from 'not controllable' to 'easy to control').

Graph 7: Relative press coverage of environmental issues in 1992



Source: CIPMA, 1992 PRENSA database

other dimensions of the database are far more illuminating than focusing on a simple ranking of environmental problems.

Table 9 cross-references 7 broad categories of environmental issues[13] and sector of economic activity by one-digit standard industrial codes.[14] The top panel displays the number of database observations for each intersection of economic sector and category of environmental problem. The economic sectors are listed in order of ascending total coverage. The middle panel shows the percentage distributions of the rows of the upper

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[13] The infrastructure category includes such issues as sewage, potable water, treatment of waste, road conditions and congestion, housing, etc. The conservation category includes reporting on national parks and reserves, protected species, reforestation, recycling, etc.

[14] There are two important exceptions to the classification rule according to ISIC codes: fish processing is classified under primary fishing rather than within the industrial category; and wood products are included in the forestry sector rather than the industrial category. The 1993 version of the database creates industrial subcategories to make it easier to relate results to economic statistics. The database desegregates those economic sectors that are particularly environmentally relevant. For example, the mining sector distinguishes among copper, other metals, coal, petroleum, and other non-metals and combustibles. The agricultural, forestry, and fishing sectors are also further disaggregated. The only industrial disaggregation is for food and beverages, cement, iron and steel, pulp and paper, chemicals, and petroleum refining.

panel. The bottom panel shows the percentage distributions of the columns of the upper panel. As mentioned in the footnote, the fishing sector data includes the fish-processing industry. The table shows that there is far more coverage of the pollution problems generated by the fish processing industries (in such cities as Talcahuano, Arica, and Iquique) than the coverage given to fishing bans and other problems relating to over fishing (that are classified in the conservation category).

The forestry sector coverage is dominated by the native forest issues currently pending in the Chilean Congress (48 per cent of the total forestry sector coverage). In the coverage of the mining sector, nearly 70 per cent of the coverage is regarding air pollution (which in turn is dominated by the coverage of the copper smelter facilities). For industrial activities, gaseous emissions receive far more attention than solid or liquid waste issues.

The coverage of the transport sector gives almost equal attention to air pollution problems generated by the sector as to congestion and other infrastructure issues. The nearly 22 per cent of coverage of transport related themes included in the 'other pollution' category is dominated by the case of the Japanese ship containing radioactive waste which was referred to above, but also includes a significant amount of coverage dealing with noise pollution.

Focusing on the bottom panel leads to the following conclusions: the native forest issue (and other forestry conservation themes such as reforestation) was the principal conservation issue in 1992, accounting for nearly 30 per cent of total conservation reporting; after the agricultural sector itself, the mining industry is viewed as having the largest impact on soil quality; the transport sector is a fairly evenly ranked contributor to air pollution problems.

Chilean environmental problems are highly sector specific, and because of the regional specialization in type of economic activity, the environmental problems are highly region-specific. Graph 8 adds the regional dimension to the picture (removing the breakdown of pollution problems). The horizontal axis of this set of graphs show the proportion of the total coverage of the sector that pertains to each region. The vertical axis of each graph shows the importance of the sector in the total environmental coverage of each region.

Qualitatively speaking, it is not surprising that the Santiago region dominates the environmental coverage of the transport, industry, services, construction, utilities and trade sectors. Yet the Santiago domination, in quantitative terms, is substantially higher than employment or GDP shares would suggest. This would seem to indicate that: (i) the sectorally-specific environmental problems of Santiago are far more serious than those of the other regions; (ii) that environmental reporting reflects a Santiago-centric bias; or (iii) some combination of the other two explanations.

Graph 8: Environmental press coverage by sector and region

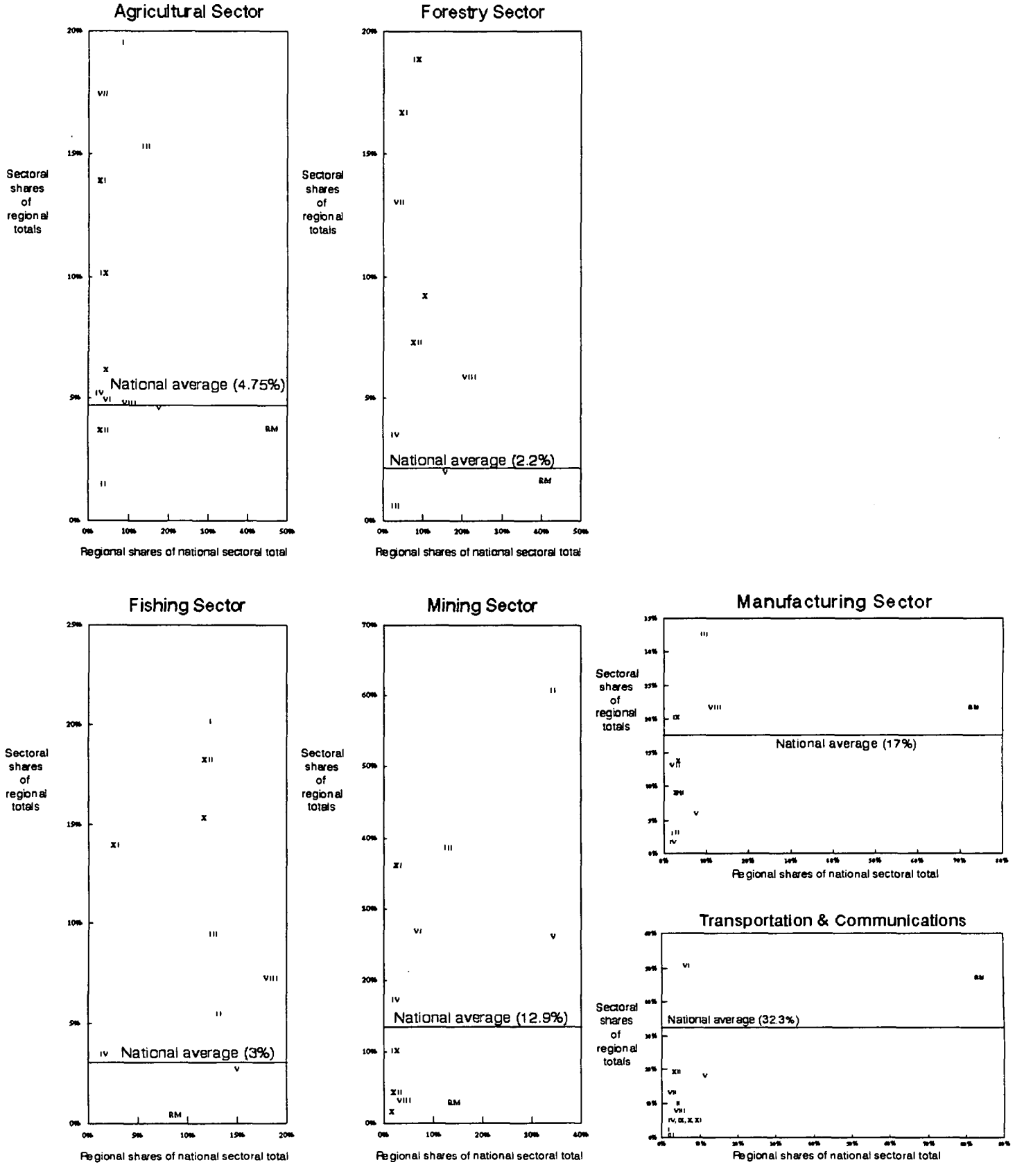


Table 9. Coverage of environmental problems by economic sector

Number of observations (in database of environmental press coverage)

Sector of economic activity	Type of pollution							
	Air	Water	Soil	Other*	Infrastructure	Conservation	Other**	Total
Trade	137	2	3	74	10	6	12	244
Fishing	79	139	2	78	13	20	59	390
Electricity, gas and water	206	9	0	239	5	164	36	659
Forestry	60	5	3	8	5	240	179	500
Agriculture	158	39	50	114	117	38	154	670
Construction	263	83	7	33	420	32	25	863
Mining	958	237	44	15	45	77	38	1 414
Other services	683	166	34	182	163	136	134	1 498
Industry	1 491	160	23	246	177	78	128	2 303
Transport and communications	1 671	143	6	948	1 466	39	60	4 333
Total	5 706	983	172	1 937	2 421	830	825	12 874

Distribution of coverage for each economic sector (%)

Sector of economic activity	Type of pollution							
	Air	Water	Soil	Other*	Infrastructure	Conservation	Other**	Total
Trade	56.1	0.8	1.2	30.3	4.1	2.5	4.9	100.0
Fishing	20.3	35.6	0.5	20.0	3.3	5.1	15.1	100.0
Electricity, gas and water	31.3	1.4	0.0	36.3	0.8	24.9	5.5	100.0
Forestry	12.0	1.0	0.6	1.6	1.0	48.0	35.8	100.0
Agriculture	23.6	5.8	7.5	17.0	17.5	5.7	23.0	100.0
Construction	30.5	9.6	0.8	3.8	48.7	3.7	2.9	100.0
Mining	67.8	16.8	3.1	1.1	3.2	5.4	2.7	100.0
Other services	45.6	11.1	2.3	12.1	10.9	9.1	8.9	100.0
Industry	64.7	6.9	1.0	10.7	7.7	3.4	5.6	100.0
Transport and communications	38.6	3.3	0.1	21.9	33.8	0.9	1.4	100.0
Total	44.3	7.6	1.3	15.0	18.8	6.4	6.4	100.0

Continuation of table 9

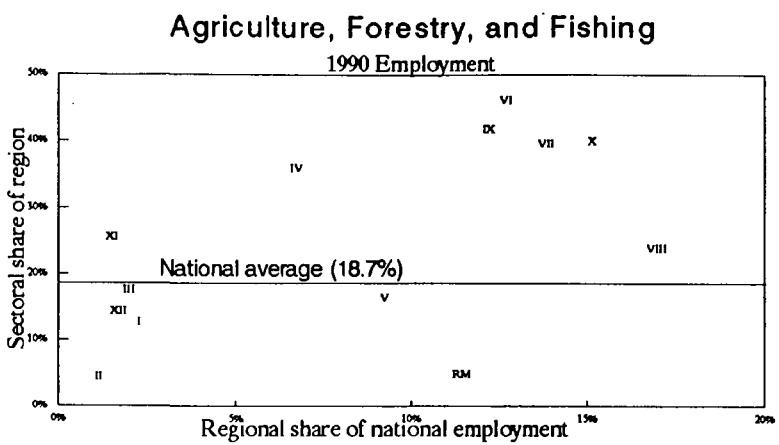
Sector of economic activity	Relative coverage by economic sector for each environmental issue (%)							
	Type of pollution							
	Air	Water	Soil	Other*	Infrastructure	Conservation	Other**	Total
Trade	2.4	0.2	1.7	3.8	0.4	0.7	1.5	1.9
Fishing	1.4	14.1	1.2	4.0	0.5	2.4	7.2	3.0
Electricity, gas and water	3.6	0.9	0.0	12.3	0.2	19.8	4.4	5.1
Forestry	1.1	0.5	1.7	0.4	0.2	28.9	21.7	3.9
Agriculture	2.8	4.0	29.1	5.9	4.8	4.6	18.7	5.2
Construction	4.6	8.4	4.1	1.7	17.3	3.9	3.0	6.7
Mining	16.8	24.1	25.6	0.8	1.9	9.3	4.6	11.0
Other services	12.0	16.9	19.8	9.4	6.7	16.4	16.2	11.6
Industry	26.1	16.3	13.4	12.7	7.3	9.4	15.5	17.9
Transport and communications	29.3	14.5	3.5	48.9	60.6	4.7	7.3	33.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

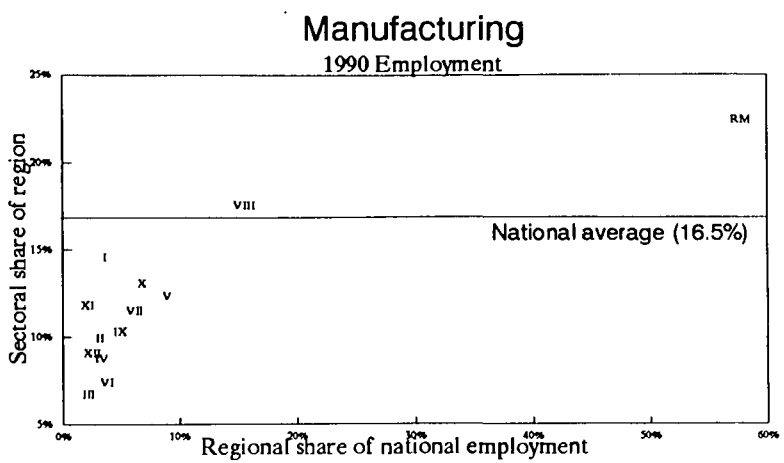
* Indoor, radioactive, acustic, visual, food contamination, odour, hazardous wastes.

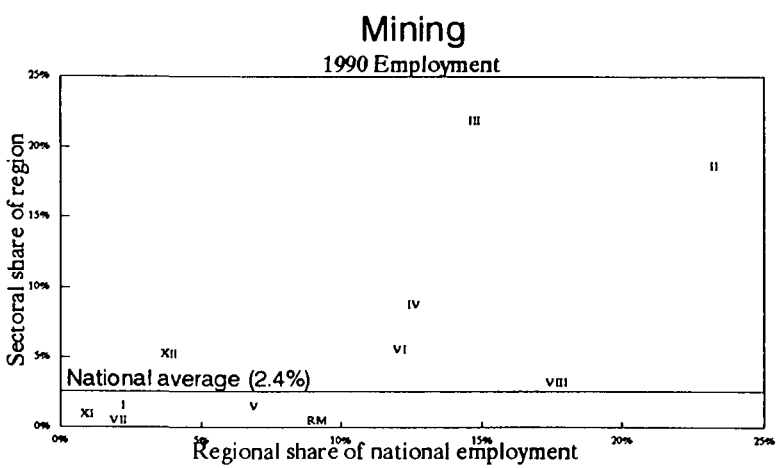
** Environmental degradation, natural disasters, ecosystems, global issues.

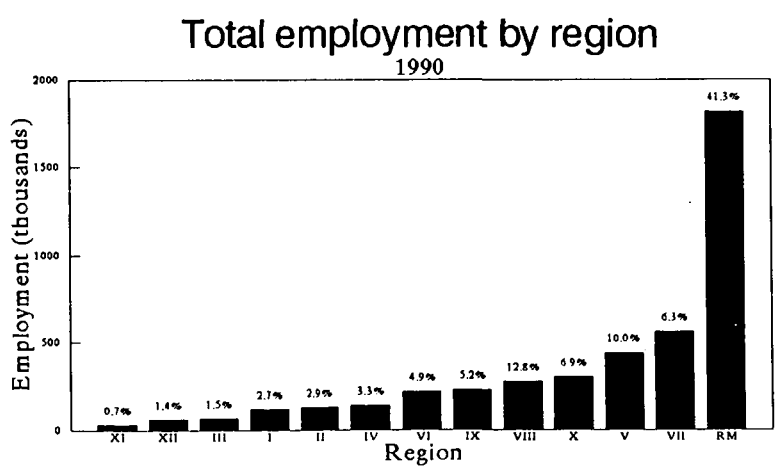
Source: CIPMA, 1992, PRENSA database.

Graph 9: Regional distribution of employment, 1990









The problem of any regional bias of reporting can be abstracted from by focusing instead on the relative sectoral coverage in each region (the vertical axis of each sectoral graph). These distributions can be usefully related to the employment-based distributions as a crude indicator of the employment implications of the environmental problem (see Graph 9). The public policy, employment-oriented thought process in this type of evaluation would seem to be: pay close attention to situations in which a sector accounts for a high proportion of the region's employment and the relative importance of the environmental problems is much greater than the employment share. For instance, worry more about mining environmental problems in Region III than about industrial problems (even though the coverage of the environmental problems of the industrial sector is nearly the same as that of the mining sector). The massive attention given to the planned Pangue hydroelectric project, situated in the scenic beauty of the upper Bío-Bío river, dominates the environmental coverage of the Bío-Bío Region but has a limited direct employment impact.

The database design allows for a less round-about approach to evaluating employment implications of environmental problems. Unfortunately, the theme is not a subject matter of environmental reporting as is clear from Table 10. The Transport sector is the only economic activity for which labour is viewed as a relevant actor. This does not appear to be the result of any bias in reporting. It seems to reflect the absence of labour from environmental debates in Chile. This is perhaps one of the legacies of the suppression of the labour movement during the Pinochet years.

In the environmental reporting database, governmental activities are identified by one of the governmental categories of the 'institution' variable rather than as a category of 'sector of economic activity'. Table 10 shows that governmental officials are currently the primary actors in environmental affairs in every sector of economic activity except in Mining and Trade where business representatives are the dominant subjects in environment reporting. This is in sharp contrast to the 1980s when NGOs and academics were nearly the only voices. NGOs have participated in environmental issues concerning almost every sector of the economy (see the middle the panel of Table 10), but have been relatively marginally covered by the press relative to university researchers, business, and government (see bottom panel of Table 10).

Press coverage is not simply a detached written record of events and social interactions. The attention that press coverage gives to some environmental problem, policy failure, or programmatic success, tends to promote change - by stimulating new actions, avoiding approaches that have proved, at least in the public perception, to be ineffective, and multiplying instances of successful programmes and policies. An analytical tool of the kind described above can be used to shed light on these processes.

Table 10. Environmental press coverage by sector and type of actor

Number of observations (in database of environmental press coverage)

Institution	Agriculture	Forestry	Fishing	Mining	Industry	Transport and Communi-cation	Other services	Construc-tion	Electricity gas and water	Trade	Total
Labour	5	0	4	4	5	115	7	2	0	0	142
Unclassified	51	33	22	13	29	297	65	17	23	10	560
NGO	62	48	36	77	78	90	100	20	53	8	572
Education	45	73	42	67	233	134	441	40	39	19	1 133
Foreign*	90	65	48	71	236	514	61	50	107	25	1 267
Business	161	115	98	683	747	981	199	290	135	119	3 465
Government	256	166	140	499	975	2 265	625	444	302	63	5 735
Total	685	503	397	1 462	2 356	4 361	1 511	869	684	245	12 874

Distribution of sectoral coverage for each institution (%)

Institution	Agriculture	Forestry	Fishing	Mining	Industry	Transport and Communi-cation	Other services	Construc-tion	Electricity gas and water	Trade	Total
Labour	3.5	0.0	2.8	2.8	3.5	81.0	4.9	1.4	0.0	0.0	100.0
Unclassified	9.1	5.9	3.9	2.3	5.2	53.0	11.6	3.0	4.1	1.8	100.0
NGO	10.8	6.4	6.3	13.5	13.6	15.7	17.5	3.5	9.3	1.4	100.0
Education	4.0	6.4	3.7	5.9	20.6	11.8	38.9	3.5	3.4	1.7	100.0
Foreign*	7.1	5.1	3.8	5.6	18.6	40.6	4.8	3.9	8.4	2.0	100.0
Business	4.6	3.3	2.8	19.7	21.6	28.5	5.7	8.4	3.9	3.4	100.0
Government	4.5	2.9	2.4	8.7	17.0	39.5	10.9	7.7	5.3	1.1	100.0
Total	5.3	3.9	3.1	11.4	18.3	33.9	11.7	6.8	5.3	1.9	100.0

Institution	Relative institutional coverage for each sector of economic activity (%)										
	Agriculture	Forestry	Fishing	Mining	Industry	Transport and Communi-cation	Other services	Construc-tion	Electricity gas and water	Trade	Total
Labour	0.7	0.0	1.0	0.3	0.2	2.6	0.5	0.2	0.0	0.0	1.1
Unclassified	7.4	6.6	5.5	0.9	1.2	6.8	4.3	2.0	3.4	4.1	4.3
NGO	9.1	9.5	9.1	5.3	3.3	2.1	6.6	2.3	7.7	3.3	4.4
Education	6.6	14.5	10.6	4.6	9.9	3.1	29.2	4.6	5.7	7.8	8.8
Foreign*	13.1	12.9	12.1	4.9	10.0	11.8	4.0	5.8	15.6	10.2	9.8
Business	23.5	22.9	24.7	46.7	31.7	21.1	13.2	33.4	19.7	48.6	26.9
Government	37.4	33.0	35.3	34.1	41.4	51.9	41.4	51.1	44.2	25.7	44.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

* Foreign institution. Foreign-owned companies with a presence in Chile are classified in the business category. The category includes foreign governments and their embassies in Chile, educational and research institutions in other countries.

Source: CIPMA, 1992 PRENSA database.

4. The Evolution of Chilean Environmental Policy

A Conceptual Framework for Analysing Environmental Legislation

Raúl Brañes (1991) has provided a useful conceptual framework for analysing the state of a country's national environmental policy, oriented towards providing a basis for international comparisons and evaluation of policy evolution. To begin with, it is important to have a precise definition of the concept of environmental legislation. For this purpose, the following three forms of environmental legislation should be distinguished:

- **Explicitly environmental legislation.** Legislation that embodies a modern[15] conception of environmental policy, providing a systemic framework for integrating or superseding existing, usually dispersed legislation. A key element of this form of legislation is the specification of the instruments for the application of environmental policy, which usually include provisions regarding: mandating preparation of national and regional environmental plans; technical standards; the formal frameworks for environmental impact assessment; the implementation and maintenance of national systems of protected areas; the prevention and control of environmental catastrophes; monitoring and enforcement systems; and the creation and accessibility of information systems.

- **Environmentally relevant sectoral legislation.** Laws or other legal norms regulating certain environmental aspects of an economic sector or other social activity. The three broad themes covered by this category are: (i) natural resource protection (water, soil, wildlife, coastal ecosystems, etc.); (ii) housing, transport and other urban ordinances; and (iii) human health protection, including occupational health and safety.

- **Indirectly environmentally relevant legislation.** Laws or other legal norms that were not enacted explicitly for environmental protection, but that nevertheless regulate conduct having significant environmental impacts.

Historically, these three forms of legislation have tended to be enacted in the reverse of the order listed. The 'indirect' type of legislation began to be introduced in Latin America in the previous century; 'sectoral' type legislation was introduced in the first half

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[15] Brañes lists the following as the cornerstones of a modern conception of environmental policy, that have also tended to be enshrined in revised constitutions throughout the region: (i) the State has the obligation to ensure the protection of the environment; (ii) every individual has the right to a healthy environment; and (iii) that the State and private actors have the obligation to seek environmentally sound forms of development. These lofty sounding principles have significant practical consequences. The first of these is necessary to give the State the constitutional authority to restrict pollution generating private activities. The second principle has provided a basis for private litigation when existing norms or their enforcement are proving to be ineffective. The third principle provides a mandate for attempting to transform the predominant style of development in a more environmentally sustainable direction.

of this century, under the influence of conservation ideas and movements, as well as a more active role for the State; explicitly environmental legislation, of a comprehensive and systematic character did not begin to be considered until the 1970s.[16]

In evaluating the existing and proposed Chilean legislation, as well as in characterizing the debates and critiques that have been made, Brañes' (1991, pp. 48-52) distinction between legislative 'efficiency' and 'effectiveness' is helpful. 'Effectiveness' refers to the respect for and compliance with legislative norms and regulatory frameworks. 'Efficiency' refers to the compatibility between the goals of the legislation and the juridical means and regulatory instruments for achieving them. Among the potential causes of inefficient legislation are: (a) inadequate scientific treatment or definition; (b) inappropriate mechanisms and stressing corrective measures more than preventative measures; (c) sectorally inconsistent or contradictory juridical treatment of similar environmental problems; and (d) lack of integration with or incompatibility with microeconomic efficiency, and macroeconomic and industrial policy.

Phases in Environmental Policy Since 1973

In the post-1973 period and looking towards the end of this decade, three stages of environmental policy formulation and administration can be distinguished. In the light of Brañes' framework and the historical descriptions presented below, some of the initial actions following the reestablishment of democracy in March 1990 were significant enough to consider 1990 the beginning of a new era of Chilean environmental policy. The period through 1995 is one of transition. The end of the transition phase will be marked not only by the end of the transitory measures explicitly incorporated in the pending legislation and the maturing of the proposed new institutional framework. Rather, the beginning of third phase will more fundamentally be marked by the multiplication of successful examples of environmental conflict resolution achieved through negotiations between the vitally interested parties. The expected characteristics of this third phase will be sketched in the concluding section of the paper.

The different historical phases of Chilean environmental policy can be distinguished according to shifts in many dimensions, including: the type of legislation; the nominal and effective functions of the regulatory institutions; the extent of regional decentralization of regulatory administration and management; the changing roles and attitudes of the press, NGOs, universities, and the business sector; the role of the environmental impact assessment process and the participating actors; and shifting paradigms for conceptualizing the interrelationships between environment and development.

Shifting Paradigms

Another aspect of the changing environmental policy framework is the shift in the conceptual underpinnings for the policies followed. For instance, in the 1980s, the military government operated under the assumption that Chile was guilty of 'ecological dumping'. One of the fundamental shifts in thinking is the rejection of this view.

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[16] Among the Latin American countries, legislation of this type has been enacted by Columbia (1974), Venezuela (1976), Ecuador (1976), Cuba (1981), Brazil (1981), Guatemala (1986), Mexico (1988), and Peru (1990). Brañes, 1991, p. 15.

The ecological dumping argument is a variant of the conventional dumping argument that a country is engaging in an unfair trade practice by implicitly or explicitly subsidizing the production of a product that permits exporters to sell in foreign markets below the true cost of production. The ecological variant is that having lower environmental standards than those of trading partners is an implicit subsidy that places the countries with higher standards at a competitive disadvantage.

Gómez-Lobo (1992), one of the leading environmental economists in Chile, has provided a forceful critique of the ecological dumping argument, that has made an important contribution to the paradigm shift. He presents the following four-pronged critique.

First, different environmental standards between countries can be justified on the basis of different countries' environmental absorptive capacity. Even within one country, the environmental characteristics can differ dramatically between regions. The same level of pollution emissions can have markedly different environmental impacts depending on the specific local characteristics. Higher assimilative capacity should therefore be considered to be a natural comparative advantage rather than an expression of ecological dumping.

A second critique is that countries at vastly different levels of development can be expected to make different tradeoffs between environmental protection and growth if the pursuit of one objective necessarily implies the sacrifice of the other.

A third critique, based on a review of the relevant empirical studies, is that the costs of compliance with high environmental standards such as in the U.S., are negligible, and therefore cannot be considered to be a source of competitive disadvantage.[17] For the same reasons, differential environmental regulation does not seem to provide a strong incentive for foreign investment. Under the military government in Chile, the contrary had been assumed - that lax environmental standards and enforcement would stimulate foreign investment. This was a viewpoint held, ironically, in the context of direct foreign investments typically based on technologies embodying the same high environmental standards as in the country of origin.

A fourth critique is based on the estimated impact of the changing mix of Chilean industrial output on aggregate toxic emissions. The industries likely to be favoured by a free trade agreement with the U.S. (because of greater net reductions in tariffs) turn out to be industries that are less 'dirty', i.e. that contaminate less than industries likely to be less stimulated by a free trade agreement.

Transformations in the Roles of the Principal Social Actors

The first social actors to propel environmental issues into national debates were the Chilean non-governmental organizations (NGOs) involved in environmental research or activism. Unlike in most other countries, the business community began to play an active role before the various branches of government assumed responsibility for implementing a comprehensive and integrated framework for environmental policy and management. With the suppression of labour unions under the military government, it is not surprising

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[17] Gomez-Lobo cites a 1992 World Bank study based on pollution abatement expenditures in the US in 1988 which estimated that the addition cost as a share of total production costs ranged between 3.17 per cent and .01 per cent, averaging .54 per cent.

that organized labour was not a participant in environmental affairs. With the return to democracy, and particularly with growing recognition of the connection between workplace health and safety with the environmental quality of production processes, a new role for labour can be anticipated.

Environmental Activists and Research Centres

The World Bank, the Interamerican Development Bank, and other international financial institutions have in recent years recommended, as part of the process of evaluating the environmental impacts of projects making use of their funds, that local environmental non governmental organizations (NGOs) be consulted. However, up until now, governmental agencies in Chile have not, except in rare cases, adopted this practice.

In contrast, domestically funded projects and programmes have tended to lead to closer collaboration between government agencies and a number of NGOs, although some of the Chilean NGOs have been dissatisfied with the limited interaction that they have had. The examples of positive relations have tended to be driven by initiatives of the NGOs, particularly when they have sought the cooperation of government agencies from the inception of projects. Successful examples have included the experience of citizen action groups in relation to the pollution problems of Santiago, and in the areas of environmental health and environmental education.

Those NGOs or members of NGOs which have seen their role as exercising a watchdog function regarding the environmental impacts of both public and private development projects have tended to be more dissatisfied with the state of their relations with governmental agencies. In a number of cases, most notably internationally the hydroelectric project Pangue on the Bío-Bío River, environmental impact studies have been heavily criticized by NGOs, whereas the government has tended to support the position of the company in question.

The more radical NGOs have attributed the precarious relations to the failure of the government to demonstrate the will to seriously incorporate the environmental dimension into economic policies. These NGOs argue that they would need to see profound changes in economic policy before cooperative relations could be established with the government. Less radical Chilean NGOs do not question the economic model of the government, but do question the narrow sectoral and strictly economic orientation of the governmental officials who are responsible for carrying out the government's policies.

Most of the Chilean NGOs grew out of a context of economic crisis and political authoritarianism that characterized the 1970s and 1980s. The economic crisis accentuated the historical exclusion of the popular sectors and their basic demands for access to or improvements in housing, health care, education and employment opportunities. The grassroots-oriented NGOs saw their role as seeking to the extent possible to help fill the gap in social assistance, the need for which was exacerbated by the considerable reductions in government social spending during the crisis.

In the period in which most of them arose, the Chilean NGOs did not view their role as representing the interest of civil society before government bodies. In contrast, in most of the developed countries, this representational function is viewed as the essence of the idea of NGOs.

During these years, the environmental NGOs' relations with the government were nonexistent. The military government considered the lack of environmental control to be a comparative advantage which would help to attract foreign capital that the country was

dependent upon to reactivate the economy. Furthermore, at the time, environmental issues were not priorities of the international lending organizations. Moreover, environmental consciousness was essentially nonexistent.

The Chilean NGOs served a number of positive roles. First, the NGOs introduced and developed themes such as concern for the environment that would later become central parts of the discussions and proposals for development. Second, they opened spaces for pluralistic social action, in contrast to the historical tendency of the political parties to divide up these social spaces. Third, the spontaneous and decentralized multiplication of NGOs covering a great diversity of themes created the capability to later respond to the wide spectrum of basic social needs and interests. This opened the door to diversified civic action with significant ramifications for the strengthening of civil society. Fourth, the rejection of the authoritarian temperament which characterized most of those associated with the NGOs led to a method of working based on tolerance and oriented toward the production of consensus. This had great political significance because it represented a dramatic change in the traditional democratic culture of the country that had stressed ideological confrontation rather than the search for consensus.

With the restoration of democracy, the relationship between the NGOs and the national and local governments was substantially modified. The main features of the changed relationship consisted in: (a) the incorporation of many of the professionals who had been working in NGOs into the various levels of government in jobs ranging from heads of ministries to lower level bureaucrats; (b) a reorientation of the activities of many NGOs towards providing consulting services to governmental agencies or programmes; (c) the tendency of NGOs to increasingly serve as an intermediary in helping local groups and organizations to secure access to public funds; and (d) government initiatives to make it easier for NGOs to compete for domestic and foreign sources of funding for NGO projects.

A number of NGOs have been highly critical of decentralization initiatives on the grounds that this would be a setback for the environmental cause since local authorities would generally be no match for the financial resources, high-powered consultants, and experienced corporate executives from the large international and domestic corporations investing in the regions. Other Chilean NGOs, probably the majority, positively view the prospect for decentralization of decision-making authority concerning environmental issues - seeing the process as strengthening their own agendas.

Corporate Environmental Strategies

In contrast to the historical experience of the developed countries, a significant number of large Chilean corporations began to adopt serious environmental management programmes in the absence of concerted pressure to do so by the State. The compulsion had other sources: (i) policies of multinational corporations in the mining and chemical industries to adopt relatively uniform environmental standards in new investment projects throughout the world; (ii) demands of international markets for compliance with environmental quality standards for products being imported, and in some cases assurance of the environmental quality of production processes; (iii) recognition of the marketing benefits of a 'green' corporate image; and (iv) Chilean court decisions in which polluting firms were required to pay large settlements to the plaintiffs. The type of practices that are being implemented include integrating environmental policy into overall corporate strategies; increasing the internal accessibility and accountability of environmental

management staff; adopting more open and less confrontational postures with local communities; increasing the collaboration with regional universities aimed at developing new technologies for the exploitation of natural resources that minimize environmental degradation.

The State

With the suppression of democratic processes following the military coup of 1973, although the 1980 Constitution enacted by the military government declared 'the right to live in a pollution-free environment', establishment of a comprehensive legal and institutional framework for environmental protection and conservation was not an objective of national policy in Chile for 16 years. These were years in which governments throughout the rest of the world initiated legislation to protect the environment. By the time of the presidential and congressional elections of 1989, environmental consciousness was becoming increasingly prevalent, the public was beginning to manifest the growing preoccupation with the impact of environmental degradation and pollution on the quality of life, and the productive sectors were beginning to realize that Chile's competitiveness in foreign markets would increasingly be tied to adherence to international environmental standards. Within a context of free and open debate, and renewed political activity, environmental issues were placed at the core of the national political agenda.

A proposed National Environmental Policy Act was presented by the President to the Chilean Congress in September 1992. Six basic principles form the basis for this legislation: preventive measures; the 'polluter pays' principle, according to which damage and cleanup costs of pollution are borne principally by those that cause the pollution; gradualism in implementation of steps necessary for achieving pollution control; civil liabilities for environmental damages; citizen participation; and efficiency through the use of flexible regulatory instruments, emphasizing market-based mechanisms whenever these are feasible. Environmental Impact Studies are the main instrument for concretizing the emphasis on preventive measures.

The environmental action plan which was approved at the 'Earth Summit' in Río de Janeiro emphasized that active citizen participation was a vital ingredient for reaching effective solutions to environmental problems. The proposed General Environmental Law which is presently under discussion in the Chilean Congress establishes a number of mechanisms for incorporating this principle. To begin with, in the section of the law addressing the legal framework for environmental impact analysis, the Regional Environmental Commissions (or in some cases the National Environmental Commission) are instructed to 'establish mechanisms that assure the informed participation of the community in the diverse stages of the entire process of Evaluation of Environmental Impact. For this purpose, the Regional Environmental Commission should order that the interested party publish, at its cost, in a newspaper of wide circulation within the respective region, an extract of the declarations[18] or studies[19] of environmental impact,

[18] In the proposed Chilean law, a 'Declaración de Impacto Ambiental' ('Declaration of Environmental Impact') is the required document for projects for which it is reasonable to conclude that there are not likely to be significant environmental impacts. The criteria to use in making this judgment include evaluation of: health risks; extent of territory effected; proximity to fragile ecosystems; quantity and type of effluents or emissions; permanence of alterations and reversibility;

whichever is applicable, with the essential data'.[20] Furthermore, citizen organizations with legal standing, are granted the right to have all of the relevant documents presented in the proceeding (except for patentable material). These groups are also granted the right to present their observations concerning the project before the regulatory authority.

Another avenue for citizen participation incorporated in the proposed legislation is through representation on the National Environmental Commission's nine member Advisory Council, two members of which must be representatives of citizen organizations and two representative of labour organizations.[21] Among the functions of the council is to give opinions on proposed environmental laws and norms.

Environmental Policy in the Fishing Sector

In December 1989, the military government issued a Fishing Law (popularly known as Merino's Law after Admiral Merino) that was scheduled to be implemented in March 1990, the same month in which the newly elected Aylwin government assumed office. The most significant feature of Merino's Law was the differential regulation of 'full-exploitation' fisheries. A fishery was defined to be in a 'full-exploitation' phase if the rate of exploitation was offsetting the surplus productivity of the species. Access to these fisheries was to be regulated by a system of marketable fishing licenses based on Individual Transferable Quotas (ITQ). An ITQ was defined in relation to a percentage of the annual catch (measured by weight). The license gives the right to catch a specified tonnage. ITQs, in this version of the Fishing Law, were to be allocated based on the individual firm's average historical share of the total catch over the previous 3 years.

The new government halted implementation of the law on the grounds that it did not provide for necessary budgetary increases to enable adequate enforcement of the new regulatory framework, and that the proposed free-access to fisheries not defined as in a stage of 'full-exploitation' would entail over fishing of these waters and over investment. The initial Aylwin government proposal had several important modifications of Merino's Law. Firstly, the Fishing Authority (DIRECTEMAR) would require access permits for all fisheries. Secondly, additional restrictions were placed on 'full-exploitation' fisheries including limitations on the number of ships and on allowable fishing methods.[22]

The government's proposals were highly criticized by the fishing industry. A prolonged negotiating process was initiated that culminated in the modifications to Merino's Law (Law No. 18.892) which was adopted by the Congress in September 1991. The main attacks against the government's initial proposals included the following types of arguments. Constitutional issues were raised concerning the State's right to limit access

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and socioeconomic and cultural impacts.

[19] An 'Estudio de Impacto Ambiental' ('Environmental Impact Study') is the document required for projects deemed to have significant environmental impacts.

[20] República de Chile, Proyecto de Ley de Bases del Medio Ambiente, 14-9-92, Artículo 21.

[21] *Ibid.*, Artículo 65. The other five members of the council would be two university academics, two business representatives, and a representative of the Chilean President.

[22] For example, temporary fishing bans, minimum net sizes, minimum catch sizes, etc.

to fisheries and to sell property rights to fishing stocks. The ITQ scheme was criticized on fairness grounds, questioning the equity of the proposed allocation schemes, and on the basis of the infeasibility of obtaining sufficient information to enable the implementation of an efficient system. Fishing interests which had historically fished the waters of the southern regions where fish-stocks were relatively abundant, tended to support the 'historical rights' allocation criteria of the ITQ system. Owners of the northern fleets, where fish-stocks tended to be historically over-exploited were the fiercest opponents of the ITQ scheme.

The final version of the law, formally called the General Law of Fishing and Aquaculture, does not make the use of an ITQ scheme compulsory. If used, the ITQ regime is limited to apply to half of the annual quota for each species. For fisheries 'under recovery' after a period of over-exploitation or in a stage of 'infant development', ITQs are allocated by public auction, and there is no percentage limitation on their use. Title 7 of the law also establishes national and local 'Fishing Councils' (composed of business, labour, academic, and governmental representatives) that are granted 'resolution rights' pertaining to most of the pertinent regulatory issues.[23] The law established a fund oriented toward promoting artisanal fishing by: assisting in the development of infrastructure; offering training and technical assistance; repopulating or artificially cultivating species that are predominantly exploited by artisan fishermen; and assisting in the commercialization of output and the administration of production centres.

Title 6 of the General Law of Fishing and Aquaculture addresses issues concerning aquaculture. The law requires that aquaculture projects be authorized by the Subsecretary of Fishing in areas that the Subsecretary has determined, on the basis of technical studies, to be appropriate for aquaculture. The law requires 'maintaining the purity and ecological equilibrium of the zone that is subject to alteration from aquaculture activities' (p. 16). This form of cultivation can potentially have significant harmful environmental impacts such as contributing to the production of 'red tide'. Some recent research by Chilean aquaculture scientists has concluded that relatively simple changes in production methods such as changing the type of nutrients that are fed to the fish can considerably diminish harmful impacts on ecosystems. These same researchers have noted that the potentially harmful impacts of aquaculture on aquatic ecosystems pale in comparison to the impact of discharge of untreated sewage, runoff into water systems of fertilizers and pesticides,

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[23] The 17 member National Fishing Council has the following makeup. There are three governmental representatives, the Director General of DIRECTEMAR, the Director of the National Fishing Service (a Subsecretariat of the Ministry of Economy), and the Executive Director of Institute to Promote the Fishing Industry. The four representatives of the business sector are to be designated by the business associations representing the industrial shipowners, the small and medium-size shipowners, and the fish processing industries. The group selected should also represent regional interests, with at least one member representing one of the three macro zones of the country: (1) Regions I-IV; (2) Regions V-IX; and (3) Regions X-XII. There are to be four labour representatives designated by the organizations representing officers and crews; workers in fish processing plants; and artisan fishermen. The remaining six members of the council, nominated by the President and confirmed by three-fifths of the Senate, are to include at least one of each of the following professions: ecologist, lawyer, economist, marine biologist or other discipline related to ocean science. (*Diario Oficial de la Republica de Chile,* January 21, 1992, pp. 3-35.)

and the hydrographic impacts of deforestation and erosion (Buschmann, *et.al.*, 1993, p. 75).

Environmental Policy in the Forestry Sector

The first Chilean legislation regarding the forestry sector was the Forests Law of 1931 (Ley de Bosques, Decreto Supremo No. 4363). The most significant aspect of the law was the imposition of a tax on the profits realized from the exploitation of lands declared to be apt for forestry use. The 1931 law was replaced in 1974 by the Forest Production Promotion Law (Ley de Fomento Forestal, Decreto Ley 701). This law introduced a subsidy for recovering 75 per cent of the cost of planting on lands that qualified as being 'preferentially apt for forest use'. The subsidy also covered the associated costs of management and administration. The costs per hectare that could be claimed were established on an annual basis by CONAF. Taxes on profits were imposed at the time of the harvest. The law required landowners to submit Forest Management Plans and to replant at least as much as was cut. The law is credited with stimulating the rapid rate of planting. Between 1974 and 1992, the annual rate of increase of plantations averaged 10 per cent.

Among the possible alternative uses of forests or lands apt for growing forests are: planting with native or exotic species; cutting without replacement; cutting with replacement by the same or other species; forest management prior to maturity; and preservation. The justification for forest regulation in the context of private ownership of forests is the failure of market prices to reflect the externalities associated with these alternative land uses.

The economic literature concerning forests[24] has identified the following positive externalities (social benefits not reflected in market prices) of forests resources: (a) the influence on climatic change through the absorption of CO_2 and the production of oxygen; (b) the protection of water resources and river embankments, and control of erosion; (c) the opportunities offered for recreation and ecotourism based on scenic beauty or other qualities of nature contributing to human welfare; (d) the production of fruits, nuts, and other non-wood products for human or animal consumption; and (e) the preservation of genetic diversity of the flora and fauna. The first two of there externalities are features common to both native and exotic species. The remaining types are benefits much stronger for native forests. Homogenous plantations of pine or eucalyptus make no contribution to biodiversity.

Legislation concerning the forestry sector was presented by the President to the Congress in April, 1992 and is currently still pending. The proposed legislation called the 'Law for the Recuperation of Native Forests and Promotion of Forestry Development' has been the subject of heated debates, far more acrimonious than that surrounding the General Environmental Law. For ecologists groups the main concern has been related to the substitution of native forests with *pino insigne* and the use of native forests for the production of wood chips.

A number of representatives of the forest corporations have argued that the subsidy incorporated into the proposed legislation is insufficient to compensate for the opportunity cost of being prevented from substituting native species with rapid growth exotic species

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[24] For a useful synthesis and application to the Chilean case, see Jiles and Núñez, 1993.

(Cortés, 1992, p. 20). The argument is also made that the subsidy is not the most efficient manner of securing the social benefits described above. It is suggested that augmenting the native forest lands included in the National System of Protected Wild Areas (SNASPE) would be a preferable public policy.

From the government's perspective, one of the primary motivations for the legislation was the promotion of the economic potential of the native forests. Presently, although the land area with potential productive native forests is 4 to 5 times greater than the area with pine and eucalyptus plantations, its contribution to GDP is negligible. The director of CONAF, the institution with regulatory authority for the forestry sector, has indicated that promoting the economic potential of native forests is a means of diversifying the output of the sector and reducing the dependence on pine monoculture (Moya, 1992, p. 16). The presidential message accompanying the proposed legislation also stressed that the economic development of native forests provided one of the few viable means of improving the economic well-being of the rural communities located in proximity to these resources (Aylwin, p. 102). The message also noted that for many of these poor and isolated communities, exploitation of the native forests for firewood for use as a heating and cooking fuel was the only energy source available (Aylwin, p. 103). Historically, the methods of exploitation have been environmentally unsound. The presidential message called for adopting a policy of promoting the transfer of technology to small and medium sized operators working in native forests in order to stimulate the social development of these local communities in environmentally benign manners.

The proposed legislation is also intended to promote conservation, by placing restrictions on the productive use of native forests. The environmentally-based justification for the legislation expressed in the presidential message was the need to preserve and protect the diverse eco-systems present along the vast length of the Chilean territory which are quite unique in the world. More specifically, the presidential message recognized that Chilean native forests served to help: (a) promote global climatic stability; (b) protect against soil erosion; (c) regulate the flow of water from melting snow and heavy rainfall; and (d) conserve endangered species.

Business interests have tended to argue that the legislation has a relative bias towards restricting development whereas ecologists have argued exactly the opposite. Part of the conflict is based on different quantitative assessments of the size and extent of the native forests. Although well funded surveys are underway, the current official statistics are based only on estimates. According to the official estimates, there are 14.5 million hectares of native forest in Chile, of which 4.1 million are classified as potentially productive. The vast majority of the potentially productive native forests (3.4 million hectares) are privately owned. The remaining 10.4 million hectares correspond to 'Areas of Preservation' (770,000 hectares that are part of the SNAPSE) and the rest in 'Areas of Protection'. According to the College of Forestry Engineers, the proposed law is applicable to between 10 per cent to 20 per cent of the potentially productive areas. CODEFF, the Chilean environmental NGO that has offered the most detailed analysis and criticism of the proposed legislation, has argued that the law would possibly permit as much as 4 million hectares of native forest to be substituted by exotic species. Spokesmen for the forestry corporations have argued that no more than 600,000 hectares would be effected by substitution.

The proposed legislation makes distinctions among four different types of forest with important consequences for the proposed applicable policies. The first type, which can be referred to as 'untouchable' forests include those native forests in proximity to lakes,

flowing water or springs, or on slopes greater than 45 per cent. Cutting or uprooting of trees in this category is strictly prohibited. The second category, called 'non-substitutable' forests, include: those containing Araucaria, Alerce, Lenga, Guayteca Cypress, Mountain Cypress, or Chilean Palm; forests that constitute a unique habitat for flora or fauna in danger of extinction or biogenetically rare; and forests in 'protected' areas. Cutting of these forests is permitted only if it is followed by replanting of the identical species. An exception to the replanting requirement is allowed by the proposed law if the land is used for agricultural purposes. The third category contemplated by the proposed law is 'degraded' forests. In this category, up to 50 per cent of the land can be replanted with either native or exotic species. The fourth category includes those native forests not in the other three categories. Up to 25 per cent of replanting can be other native or exotic species. The remaining 75 per cent must be replanted with the original species. Any planned substitutions of more than 500 hectares require the approval of an Environmental Impact Study (Article 30, p. 120).

Replanting and related costs for forests in each of these categories, as well as for lands classified as 'preferentially apt for forestry' are eligible for a 75 per cent subsidy (similar to Decreto Ley 701 subsidy enacted in 1974). Small landowners[25] are eligible for a 85 per cent subsidy (Article 11, p. 115).

The legislation has been estimated to have the following impacts. In the first 10 years following passage of the legislation: the acreage expected to be planted will increase from 17,000 hectares in the first year to 42,000 in the tenth year; subsidies are expected to grow from a range of 5.5-13.6 million dollars to approximately 285 million dollars; and employment is expected to expand from 14,178 new workers in the first year to 35,445 new workers by the tenth year (Moya, 1992, p. 19).

Environmental Policy in the Mining Sector

Mining operations, in all phases from exploration to abandonment, have major environmental impacts. In the 1980s in Chile there was very little consciousness, including those in the opposition to the military government, concerning the impact of mining processes on the health of persons and environment quality in the regions exposed to mining emissions. In more recent years, there has been extensive analysis and close monitoring of: the types of emissions (gaseous, liquid, solid waste, radioactive, vibrations, and noise); the degradation impacts (on soils, flora, fauna, landscapes) and intersectoral ramifications (for agriculture, forestry, and fishing); and the impacts on human health.

Historically, the environmental problems generated by mining activity that have had the most significant ramifications have been: soil contamination from particulate material, and dissolved metals and salts in liquid effluents; air pollution from gas emissions and breathable particles imbued with heavy metals; the destruction of renewable natural resources from the absorption of contaminants transmitted by air, water, or through the soil; the contamination of surface and subterranean water resources through emissions of liquid wastes containing dissolved metals, salts, and acids; the destruction of landscapes, soils, and wildlife from open-pit mining; soil subsidence produced by underground mining

[25] Defined as holdings under 150 hectares (or 400 hectares in Regions I-IV, XI, and XII, as well as Palena Province in Region X).

operations; and lastly the impact of these emissions on human health in the workplace and nearby communities.

The environmental impacts of the mining sector in Chile have been measurable from the data provided by a network of monitoring stations for air, water and soil quality. The air monitoring stations at the Chuquicamata smelter in the Antofagasta Region measures sulphur dioxide, arsenic, suspended particulate material, and breathable particulate material. The monitoring stations at the smelters in other Regions (Piapote and Potrerillos in the Atacama Region; Ventanas and Chagres in the Valparaiso Region; and Caletones in the O'Higgins Region) measure sulphur dioxide and breathable particulate matter. Each of these mega-sources of emissions currently exceed the Chilean norm for sulphur dioxide of 80 milligrams per cubic metre (Pagani, *et.al.*, 1992, p. 7). The only exception is the Chagres smelter which emits concentrations in the range of 80 per cent to 100 per cent of the norm. The installation of a Flash oven, that tripled the production capacity of Chagres, has enabled the achievement of emissions below the norm. The Chuquicamata smelter also exceeds the norm for breathable particulate material. The monitoring equipment in the Santiago Metropolitan Region can measure carbon monoxide, hydrocarbons, sulphur dioxide, nitrogen oxides, ozone, and breathable particulate material.

Although the copper smelters are not the only mega-sources of sulphur dioxide emissions in Chile, they account for the lion's share (91 per cent of 960,000 tons in 1989) (Pagani, *et.al.*,1992, p. 5). Coal burning electricity plants account for 5.2 per cent of the total and petroleum refineries contribute an additional 1.4 per cent.

Several government agencies have responsibilities for monitoring environmental impacts of mining activities. Freshwater quality is the responsibility of the General Water Authority (Dirección General de Aguas) and seawater quality is controlled by the Maritime Territorial Authority (Dirección del Territorio Marítimo), a branch of the Chilean navy. The National Agricultural Research Institute (Instituto Nacional de Investigaciones Agropecuarias-INIA) monitors soil quality. Soil quality impacts have received a great deal of attention in the last year in two cases. In Huasco, a port and agricultural area in the southern part of the Atacama Region, there has been litigation regarding the impact of particulate material emitted from an iron-ore pellets factory (an activity regulated by the Ministry of Mining) on olive producers in the region. INIA analysis has also been an important source of information in the agricultural impacts from operation of Potrerillos smelter in the Valparaíso Region. The National Geological and Mining Service (Servicio Nacional de Geología y Minería-SERNAGEOMIN) has responsibilities for monitoring the environmental risks from abandoned waste water tanks used in mining operations. The major source of risk for the integrity of these holding facilities is the danger posed by earthquakes and other seismic activity. The impacts of mining operations on national parks and protected ecosystems is monitored by the National Forestry Corporation (Corporación Nacional Forestal-CONAF).

The director of the Environmental Unit of the Ministry of Mining has described the new government's mining policy as comprising: stimulating foreign investment and assuring the international competitiveness of the sector; requiring that new projects employ international standards for the protection of the environment and the health and safety of the labour force and affected communities; and promoting the sector's active participation in the nation's sustainable development project through such activities as support of research, the collaboration in the development of efficient regulatory policies, and strengthening the articulation with the local and regional economies (Solari, 1993). The concern for competitiveness among those formulating the sector's environmental policies

has been reflected in the principal of gradualness for achieving compliance with environmental norms embodied in new legislation, as well as in viewing expeditiousness as an important element of the environmental impact evaluation process.

The first important environmental legislation regarding the mining sector passed by the new government was Supreme Decree No. 185 of the Ministry of Mining (published in January 1992). It established standards for sulphur dioxide, total suspended particles, and breathable particulate material. The norm applies to sources that emit more than 3 tons per day of sulphur dioxide or 1 ton per day of particulate material. The regulation distinguishes among establishments which are or are not located in a 'saturated' zone, which is defined as an area in which the norm is exceeded. If there is only one source of emissions in a saturated zone, that establishment is required to reduce its emissions according to approved schedule specified in a decontamination plan. In the case of multiple sources, each polluter is permitted to reduce emissions in a manner proportional to its contribution to total emissions of the zone. The first emissions control plans that were required to be presented were for the Chuquicamata Division of CODELCO, and the smelter and refinery of ENAMI as well as the CHILGENER electricity generating station at Ventanas.

The emissions control plan for the industrial complex at Ventanas (in Region V) requires ENAMI to emit no greater than 62,000 metric tons per year over the period 1993 to 1997, reducing this amount to 45,000 metric tons per year in 1998. For particulate material, ENAMI is required to lower emissions from 3.4 thousand metric tons in 1993 to 2 thousand metric tons in 1998 and 1,000 metric tons in 1999. CHILGENER is required to drop emissions from 26,000 metric tons in 1993 to 3,000 metric tons by 1995.

The emissions control plan for Chuquicamata requires that norms of maximum monthly emissions of 270 metric tons for particulate material and 156 metric tons for arsenic be met by 1995. Sulphur dioxide emissions need to be cut from 21,000 metric tons per month in 1993 to 13.5 thousand metric tons by 1998.[26] To achieve these objectives CODELCO intends to invest US$ 160 million over the 5 year period in a new sulphuric acid plant that will capture sulphur dioxide emissions, and replace old furnaces with a new Teniente Converter.

It is expected that the government that will come into office in 1994 will propose mining legislation covering regulation of tailings reservoirs and water quality impacted by mining operations (Lagos, 1993). With the expected closure of coal mines in the Bío-Bío Region, and other mining operations in rather fragile ecosystems of the altiplano, there is also likely to be pressure to introduce legislation regarding standards for mine abandonment (*ibid*).

The General Environmental Law presently pending before Congress is highly relevant to the mining sector although it is not likely to dramatically change the defacto regulatory system currently functioning and the often voluntarily adopted strict environmental practices of the newer mining investments. One of the important lessons from recent experience in the mining sector is that compliance with environmental norms need not imply an increase in the cost of production. Another reason to expect no major change is that even in the absence of specific legislation requiring Environmental Impact Studies (Estudio de Impacto Ambiental-EIA), since 1992, the Environmental Unit of the Ministry of Mining has been requiring a favourable evaluation of EIAs prior to granting

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[26] *Diario Oficial*, July 9, 1993.

the permits required for proceeding. Expediting the review process has been a very explicit objective. The Environmental Commissions of the II, III, and IV Regions have each already evaluated projects using the methodological framework and timeframes of 90 to 120 days proposed by the Ministry of Mining (Solari, 1993, p. 85). Nevertheless, the National Mining Society (Sociedad Nacional de Minería-SONAMI) has criticized the proposed legislation on the grounds that: it does not adequately assure 'a level playing field' in environmental regulation, assuring equal treatment of public and private, and domestic and foreign firms; some definitions employed are too vague; there are too many separate regulatory authorities; and the envisioned roles for public participation may compromise the confidentiality of certain business information (Cerenceda, 1993).

Environmental Impact Statements for mining operations, in addition to analysing these types of problems, have begun to include evaluation of the social, economic and cultural impacts of proposed mining operations. A good example of the current state-of-the-art for environmental impact studies in Chile is that prepared for Minero Escondida's project to build a plant in the port of Coloso for production of high purity copper cathodes using an innovative leaching process. The Escondida mine, located in the Atacama desert (Region II) 160 km. southeast of the city of Antofagasta at 3,100 metres altitude is the second largest mine in the world, producing 320,00 tons of copper per year, and contributing about 1.5 per cent of the Chilean GDP. Copper concentrates mixed with water are transported by a 165 km. pipeline to the port of Coloso. From this port, which is located about 14 km. south of Antofagasta, the concentrates are shipped to various smelters throughout the world. The Cathode Project entails processing some of the mine output arriving in Coloso by the pipeline.

Of particular relevance to this study are the chapters on infrastructure and socioeconomic impacts included in the study. In the chapter 'Infrastructure and Regional Framework' the study evaluates whether the existing infrastructure (roads, airports, railroads, electricity generation and distribution, communications, housing and port facilities) are sufficient to accommodate the new demand implied by the project. The chapter 'Socioeconomic Framework' contains discussions of: national level trends in macroeconomic variables such as investment, inflation, employment, exports, foreign debt, and balance of payment; the contribution of the Antofagasta Region to the national economy; comparisons between regional and national trends in aggregate employment and unemployment; the sectoral composition of regional GDP; demographic variables at the regional, provincial, and communal levels, cross classified by urban and rural; the geographical distribution of poverty within the region; levels of educational attainment at the regional level; health statistics at the regional level; trends in regional shortage of housing; a 1990 snapshot of the availability of potable water and sewage facilities by principal cities within the region; and access to telecommunications services. In a subsection of the chapter which evaluates the impacts of the project the following factors are considered: the direct and indirect temporary absorption of employment during the construction phase (with direct employment averaging 520 workers, with a peak of 1,000 and indirect effects estimated assuming a multiplier of 1.25); the addition of 100 permanent employees at the mine due to the expansion of mining activities to supply the cathode plant and the resulting indirect employment gains assumed to take place principally within the city of Antofagasta; the contributions to the economy from higher demand for energy, business services, food, transport and communications; the school facilities required by the children of the added workers at the mine; the health and housing

requirements for the families of these 100 additional workers; and the increase in traffic associated with both the construction and operations phases of the Cathode Project.

This case shows that although socioeconomic impacts tend to be seriously evaluated as part of the environmental impact evaluation process in Chile, the type of analysis tends to rely primarily on the somewhat limited governmental statistics available, rather than on more profound original research as is typical for the evaluation of impacts on flora and fauna.

Environmental Policy for Santiago Air Quality

Among the environmental problems confronting Chile, the serious air pollution problem of Santiago is probably the most well known internationally. The set of circumstances that have generated this situation and the ways in which Santiago's problems differ from those of other cities throughout the world is probably far less known.

The air quality problems of Santiago are the result of a combination of factors: (a) geographical, topographical, and meteorological conditions; (b) the type and amount of emissions driven by the patterns of industrial development, transportation systems, and demographic growth; and (c) the failure, until recent years, to develop adequate plans and mechanisms for controlling and reducing the various sources of contamination.

Many cities of the world that have much higher emissions of pollutants are far less contaminated than Santiago. The gravity of the pollution problems of the city are in part caused by its natural setting and the climatic conditions it faces. Santiago is situated in a valley, and is almost entirely surrounded by mountains. Winds are not sufficient to help disperse pollution. The average annual rainfall of 330.2 mm. occurs primarily from May to September (autumn and winter). Temperature inversions in the winter months tend to trap pollutants to within 200 to 300 metres above the ground level. In contrast, in the summer months, the inversion layer is approximately at height of 1,000 metres. For this reason, among others, atmospheric contamination is notably worse in winter than in summer.

The types and amounts of air pollution and the measure sources of emissions are well known. Major studies were undertaken by the Ministry of Health in 1976, the University of Chile in 1981 and 1985, and by consultants engaged by the Regional government with Interamerican Development Bank funding in more recent years. The primary source of emissions of sulphur oxides (SO and SO_2) are boilers, ovens and industrial processes. Road dust, particularly from unpaved roads, is the major reason for Santiago's high quantity of suspended particulate matter. Gasoline powered vehicles are the major source of carbon monoxide emissions.

The first air quality monitoring equipment, known as the PANAIRE system, was installed in the 1960s, and operated by the Institute of Occupational Health. It was not until the creation of the Metropolitan Region Environmental Health Service in 1982, however, that a significant commitment of governmental resources was made to monitoring and controlling air quality. In this period, the PANAIRE equipment was supplemented by four automatic monitoring stations, a computerized control centre, and one mobile monitoring station, collectively called the Metropolitan Air Quality Monitoring Network (MACAM) (Muñoz, p. 181). In 1985, data on an index of carbon monoxide concentrations and suspended particles began to be collected. In 1988, two separate indices, one for concentrations of gaseous pollutants and another for suspended particles

were initiated (Ministry of Health Resolution 369). The MACAM network was further extended in 1993 with funding from the government of the Netherlands.

Chilean air quality and emissions standards have tended to be based on U.S. Environmental Protection Agency norms. Standards for suspended particles, sulphur dioxide, carbon monoxide, nitrogen dioxide and ozone were issued by the Ministry of Health in 1978 (Resolution No. 1215). An emissions standard for industrial processes, but limited to suspended particulate matter, was issued in 1979 (Ministry of Health Resolution No. 611). In 1983, the Ministry of Transportation and Telecommunications issued norms for vehicle emissions, with distinctions made for type of fuel and age of the vehicle (Decree 279).

Bus travel is the principal mode of transportation in Santiago, accounting for approximately two-thirds of all trips.[27] Because of this large proportion, investments in other technologies (a new metro line and electric trolley buses) are likely to have only moderate impacts on mitigating the air pollution problems generated by the transport sector in the short run.[28] Bus emissions are responsible for a significant portion of the particulate matter, but more importantly, for a high proportion of the breathable fraction of suspended particles. Until 1975, the bus system of Santiago was subject to strict governmental regulation. Between 1975 and 1982 the system was completely deregulated, with no control over tariffs, routes, or frequency of service. Some of the negative consequences of this policy were: a dramatic increase in the number of vehicles in service; much greater congestion in the centre of the city, in turn having a deleterious impact on travel times; and higher average ages of the bus fleet leading to deterioration in safety and an increase in the average rate of pollution emissions per vehicle (Hohmann p. 14). The positive aspects of deregulation were limited to the expansion in spatial coverage of service and notable increases in the frequency of service.

Long term and emergency plans for Santiago have been developed and instituted by the Special Commission for the Decontamination of the Metropolitan Region (CEDRM), which was created in April of 1990. The structure of the Decontamination Plan covers a broad range of governmental responsibilities and functions in: (a) maintaining and upgrading the capabilities of the atmospheric pollution monitoring network; (b) programmes of epidemiological vigilance and treatment of respiratory problems; (c) strengthening enforcement mechanisms and institutional capabilities; and (d) specific plans for lowering automobile, bus, industrial, and residential emissions and for controlling dust. Among the specific measures are: (1) plans to accelerate the retirement of old buses; (2) in coordination with the police, strengthening the capacity to monitor compliance with norms and restrictions on vehicle use; (3) starting in September of 1992, requiring new cars to have catalytical converters and use unleaded gas (Ministry of Transportation Supreme Decree No. 211, issued in 1991); (4) to control dust, increasing investment in

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[27] Thomson (1993, p. 139) presents a table comparing the distribution of transport modes for a number of Latin American cities. The data for Santiago is based on surveys conducted in 1980 and 1988. Over this period, the proportion of trips accounted for by bus decreased from 76 per cent to 65 per cent, metro use increased from 5 per cent to 12 per cent, and automobile usage increased from 16 per cent to 18 per cent.

[28] According to Hohmann, operating Santiago's planned new metro line (Line 5) will increase metro use by 150,000 trips daily, or 3.75 per cent of the estimated 4 million daily trips using public transportation.

pavement of roads and drainage systems, reforestation plans and street cleaning programmes; (5) approving the construction of a new metro line, affecting about a million persons in 5 municipalities of Santiago; (6) increasing the use of electric trolleys instead of conventional buses; (7) establishment in 1992 of emissions standards for large fixed sources (greater than 1 ton per day of breathable particulate material and 3 tons per day of sulphur dioxide, Ministry of Mining Supreme Decree No. 185); and (8) establishment of emissions norms covering 2,571 fixed sources, with stricter norms starting in 1997 (an emissions standard of 112 milligrams per cubic metre in 1993 to be lowered to 56 milligrams per cubic metre in 1997), and allowing for a system of tradable permits (Ministry of Health, Supreme Decree No. 4, issued in 1992).

When the Decree No. 4 standards went into effect in January 1993, 85 per cent of the industrial processes, boilers, and ovens that were being regulated complied with the 112 mg/m^3 standard. Of the 383 firms that were not in compliance, the regulatory authority distinguished among a 'yellow' list of companies that had made credible commitments and timetables for compliance, and a 'red' list of firms that had not undertaken any initiatives to lower their emissions. It should be noted that emissions from fixed sources is a highly concentrated problem. That is, a relatively small number of firms account for the bulk of the emissions problems. The two most egregious sources contribute an approximately 27 per cent and 13 per cent, respectively, of the estimated 18 tons of particulate material emitted daily in the Santiago Metropolitan Region (Cofré and O'Ryan, 1992).

The Emergency Plan for Santiago consists of a number of permanent preventative actions including: (a) prohibition of the use of residential chimneys during weekdays between May 15 to September 15; (b) extra street cleaning during this same period; (c) prohibition of agricultural fires between May to September; and (d) restriction of the use of 20 per cent of vehicles in the Province of Santiago and the municipalities of Puente Alto and San Bernardo from April to December. The extraordinary measures, which are implemented when the Index of Air Quality reaches critical levels, places additional restrictions on vehicle use as well as restricting the use of the larger industrial sources, starting with those on the 'red' list.

The current framework for the regulation of emissions from fixed sources is oriented toward finding the most cost effective means of achieving the air quality standards that have been set for the Santiago Metropolitan Region. The administrative feasibility and economic rationale for a number of alternative market-based regulatory mechanisms is currently under study.[29] Some of the informational prerequisites necessary for implementing a market-based system are in place. For instance, a relatively sophisticated model of dispersion of pollutants has been available since 1990. Databases of emissions sources are also available.

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[29] Cofré and O'Ryan (1992) have pointed out that among the parameters that need to be considered are: the geographical boundaries of the region, or set of zones within the region, for which the system would be applicable; which type and size of emissions sources to include; the total quantity of emissions that would be permitted; whether to set daily or monthly limits; whether to allow for seasonal variations in the parameters of the system; and finally, whether to specify a fixed duration for the system.

5. Conclusions and Outlook for Environmental Policy in Chile

Regional and local level environmental management is becoming one of the central, if not the paramount, theme in the process of regional decentralization being promoted by the present Chilean government. Effective mechanisms for resolving conflicts involving resource management and environmental impacts are fundamental requisites for both regional development and the strengthening of democracy. Uncertainties regarding the scope and duration of institutional processes involved in environmental impact assessments are beginning to significantly influence investment decisions.

The link between decentralization and the effectiveness of environmental management is based on two fundamental aspects. First, environmental problems tend to be highly territorially specific. Second, the solution of these local and regional environmental problems requires the participation of those that are directly affected by them.

In Chile, one can anticipate a tendency for environmental management to be focused on the negotiated resolution of conflicts. Various processes of contamination and degradation of renewable resources have saturated the country's ecosystems producing distinct social and temporal effects. These environmental problems, whether produced by the expansion of productive activities, demographic pressures, or the persistence of poverty, give rise to open environmental conflicts. Environmental conflicts can originate both from very large investment projects as well as from cumulative impact of many smaller projects that use and exploit environmental resources in new ways.

In the context of generalized conflicts, environmental management should include pragmatic transactions between the conflicting objectives and interests in environmental conservation and economic growth.

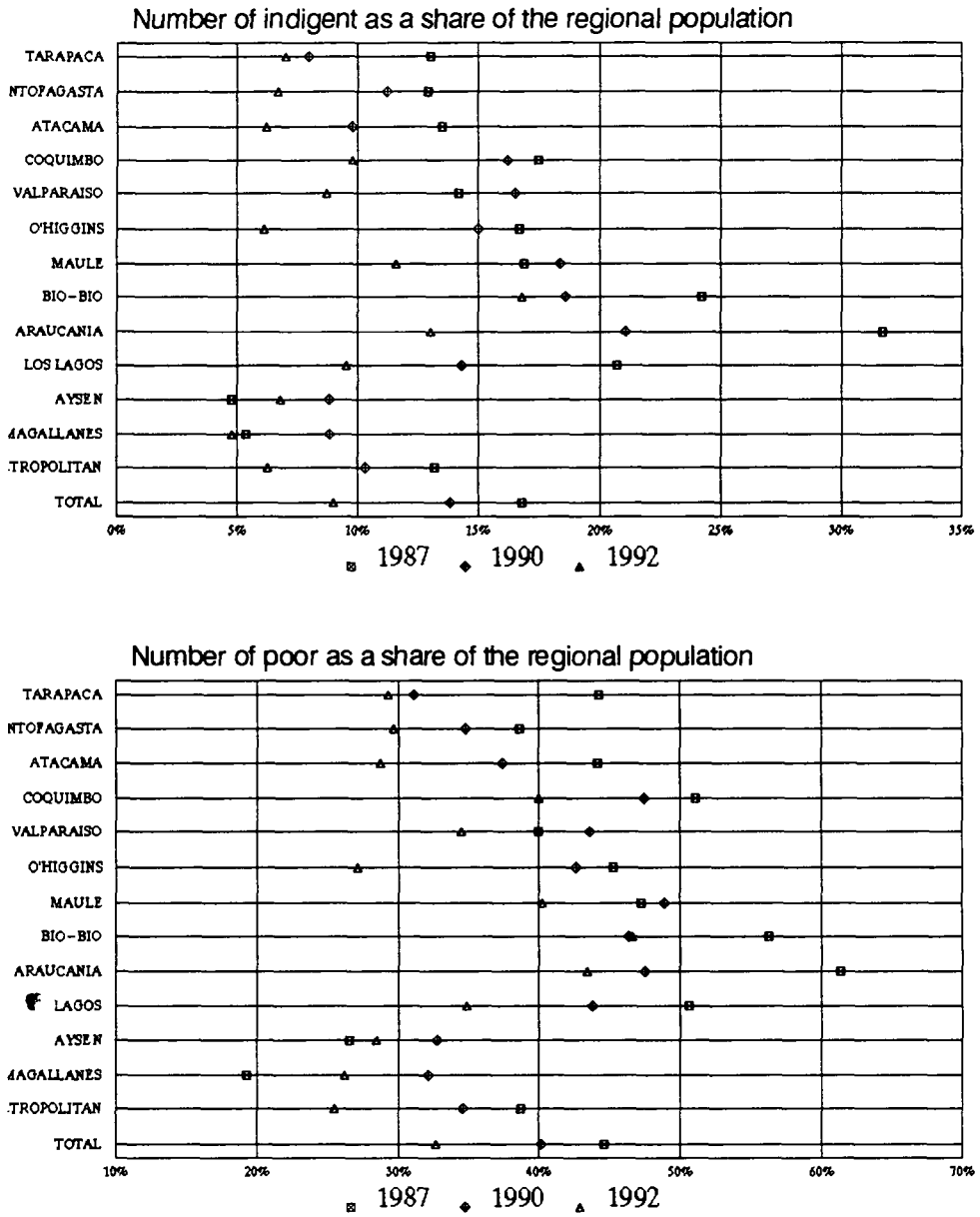
The local nature of contending interests in growth and conservation would seem to be a key aspect favouring transaction and negotiation processes. Local actors are more likely to take into consideration the dual needs for, on the one hand, creating and preserving business and employment opportunities, and, on the other hand, conserving or improving the quality of the environment. In contrast, when non-local or centralized interests enter into conflict, the contending parties are more likely to adopt 'all or nothing' postures, with polarization into economic or ecological fundamentalism.

Decentralized environmental management is not only a key ingredient in resolving environmental conflicts; it is a crucial institutional framework for promoting sustainable regional development as well. Decentralized management increases efficiencies in the formulation and administration of policies. Decision-making at the local level can avoid the inevitable bureaucratic delays of centralized decision-making processes. Decentralization also improves the likelihood of finding pragmatic solutions to environmental disputes. Since the vital interests of the entangled parties will be involved, compromises among growth and conservation objectives would be more likely to be reached as compared with situations where central authorities or non-local interests have too much weight in the decisions.

In contrast to the historical tradition in Chile of the 'internal disintegration' of the regions, resolution of environmental conflicts between groups and activities within the same region will support regional development. Environmental conflicts and their local management will increasingly connect activities and groups that have traditionally been isolated from each other. Furthermore, environmental conflicts are likely to improve the

possibilities of the regional governments to advance the regional development policies. Conflicts will enhance regional governments' roles as mediators between and negotiators with entangled interests related to the environment. Through their involvement in negotiation processes leading to resolution of conflicts, the regional authorities are likely to enhance their influence and, by balancing opposing forces, increase their room for manoeuvring.

Graph 10: Poverty and extreme poverty in the regions of Chile



Eduardo Frei, the newly elected President who will take office in March 1994, has stated that mitigation of poverty will be a high priority of his administration. In addressing environmental issues, he has drawn attention to the connection between poverty and degradation of natural resources.[30] Graph 10 shows the advances that have been made since 1987 in reducing the percentages of the population living in poverty (from 44.6 per cent of the total population in 1987 to 32.7 per cent in 1992) and in extreme poverty (from 16.8 per cent in 1987 to 9 per cent in 1987). The graph also makes clear that there is significant regional variation in the incidence of poverty, with some regions (Aysén and Magallanes) showing a worsening situation. Up until now, Chilean environmental policy has tended to focus on those environmental problems that impose the largest economic costs. Recognition of the manner in which environmental degradation impinges on the potential income generating activities of the poor, and the higher incidence on the poor of dangerous health impacts of geographical concentrations of pollution, may refocus attention on the environmental problems in areas in which there are high concentrations of poverty.

[30] *El Diario,* August 11, 1993.

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