13 INFORMATION TECHNOLOGY

13.1 Analysis of Chile's Competitiveness in IT Industry

This Chapter examines the competitive level of the IT industry in Chile compared to other countries. In this way, it will be possible to better understand Chile's strength and weakness regarding IT development in the international context.

13.1.1 Chile's IT Competitiveness in the World

The following demonstrates research that was realized utilizing statistics from the International Institute for Management Development (IMD). Fifty-two factors in the IT sector were chosen to arrive at a comparative approach of the competitive level of the IT industry in Chile. Thirteen countries (the U.S., Singapore, Finland, Ireland, Australia, Hong Kong, the U.K., Japan, New Zealand, Taiwan, Spain, Malaysia and India), distinguished by their advances in the IT field and some Latin American countries (Brazil, Mexico and Argentina) were selected for comparison.

Table 13.1.1 offers a quick glance of final rankings determined for those countries mentioned above. The competitive levels of the countries are compared according to seven principal axes of competitiveness: Openness, Government, Finance, Infrastructure, Management, Science & Technology and People. According to the Table 13.1.1, Chile's IT competitiveness is distinguished by its strength in Openness and its weakness in Science & Technology. In general, Chile's IT competitiveness is higher than other countries in Latin America (see Appendix E for further details).

Table 13.1.1 IT Competitiveness Ranking

Countries	Overall Ranking	Openness	Government	Finance	Infrastructure	Management	Science & Technology	People
U.S.	9	19	12	8	7	4	7	9
Singapore	9	10	6	14	13	6	6	9
Finland	7	5	7	4	7	12	5	6
Ireland	10	7	9	10	10	12	12	10
Australia	13	21	12	16	6	11	13	9
Hong Kong	20	19	12	32	14	17	24	22
UK	17	15	15	17	13	15	21	24
Japan	23	31	10	29	16	32	17	26
New Zealand	15	20	15	19	7	12	19	16
Taiwan	27	29	25	31	13	19	15	18
Spain	23	19	21	26	15	34	27	22
Malaysia	23	20	21	33	14	22	25	27
Chile	19	10	17	26	14	19	31	15
Brazil	29	24	29	33	32	21	29	24
Mexico	29	22	32	33	21	30	33	30
Argentina	31	19	38	31	34	37	37	33
India	29	27	27	38	21	35	30	27

Source: JICA Study Team

13.1.2 Chile's Strength and Weakness

Table 13.1.2 lists 10 of the strongest and weakest factors regarding Chile's position in the IT industry (see Appendix E for further details). Additional facts are highlighted below:

Openness

Openness is the driving force behind Chile's competitiveness level in the IT industry. The country's strength in this area is its impartial treatment towards foreign companies. Chile offers the same opportunities to both local and foreign companies regarding public sectors contracts. In this way it is apparent that all companies are treated equally. In addition, Foreign Direct Investments (FDIs) are relatively protected through legislation.

Government

In general Chile's government is recognized for its degree of credibility. In addition, some Chilean government policies are cited as instructive for other countries to promote a business environment, e.g., open trade and innovative monetary policies, employer's low social security rate contributing to IT competitiveness, etc. On the other hand, Governmental efforts, however, to create a legal environment for the development of technologies remains limited.

Finance

Venture capital for business development is not easily available. In addition, the policy of the Central Bank is poor regarding further economic development of the country. On the other hand, the strength of the Chile's financial regulation scheme is generally emphasized. For example, the Chilean recession in 1997, did not cause a fundamental domestic financial crisis. Non-performing loans were 1.0% of total loans in 1997 and 1.9% in 2000 (Source: CEPAL, 2000). The crisis, however, has affected the IT industry by crowding out small and medium-size enterprises (SMEs) and ventures from new lending.

IT Infrastructure

Chile's strength lies in the development of telecommunications, offering low electricity and international telephone costs to the industrial sector. In addition, costs regarding a mobile phone comtract, telephone lines and Internet penetration remain relatively low. Finally, low office cost may be cited as contributing to Chile's competitive level of IT infrastructure.

Science and Technology

In Chile, there is a lack of R&D and human resources in general. The little cooperation (between companies themselves and between companies and universities) is the weakest aspect regarding Science and Technology. Though qualified engineers are available and the country's labor market is skillful in the IT sector, these cannot compensate for Chile's overall weakness in this area.

Table 13.1.2 Competitive Factors of IT in Chile: Analysis of its Strengths and Weaknesses

Strengths		Rank	Weaknesses	
Factors	Categories		Factors	Categories
Public sector contracts (they are sufficiently open to foreign bidders) (1/47)	Openness	1	Total R&D personnel (in business full time equivalent per 1000 people) (42/47)	Science & Technology
Competence level (domestic and international managers have the same competence level) (3/47)	Management	2	Technological cooperation (not common between companies) (41/47)	Science & Technology
Qualified engineers (availability of qualified engineers in the country's labor market is high) (3/47)	Science & Technology	3	Venture capital (easily available for business development) (41/47)	Finance
Availability of information technology skills (qualified IT skills are available in the labor market) (3/47)	Science & Technology	4	Development and application of technology (support of the legal environment is not functioning) (38/47)	Science & Technology
Foreign and domestic companies (treated equally) (4/47)	Openness	5	Central bank policy (does not have a positive impact on the economic development of the country) (38/47)	Finance
Employer's social security contribution rate (the compulsory contribution rate is low) (5/47)	Government	6	Connections to internet (number of hosts per 1000 people) (36/47)	IT Infrastructure
Investment protection schemes (available for most foreign partner countries)	Openness	7	Telephone lines (number per 1000 inhabitants) (34/47)	IT Infrastructure
Electricity costs for industrial clients (costs are low) (8/47)	IT Infrastructure	8	Cellular mobile telephone subscribers (number per 1000 habitants) (33/47)	IT Infrastructure
International telephone costs (Basis: 3min call in peak hours /U.S. to Europe is low) (9/47)	IT Infrastructure	9	Basic research (the nurture and development of basic research to enhance long-term and technological development is not occurring) (33/47)	Science & Technology
Investment in telecommunications (high compared to GDP) (9/47)	IT Infrastructure	10	Company-university cooperation (Not enough sufficient cooperation between companies and universities) (31/47)	Science & Technology

Note: The figures in ( ) are Chile's rankings among 47 countries according to comparative research conducted by IMD
Source: JICA Study Team

13.1.3 Problems Encountered during Interviews

Interviews were conducted at the beginning of December 2000. Certain problems were revealed that might obstruct the development of the IT industry in Chile including lack of financing, professionals and incentives, and the small size of Chile's contents industry.

(1) Financing

Chile's financial sector does not easily provide loans and capital to the IT industry. Venture capital for business development is still small and difficult to obtain.

(2) Lack of IT Professionals

Chile lacks an absolute number of IT professionals. In this regard, educational programs must further focus on the IT field. In addition, IT related managerial salaries are lower than other managerial salaries in Chile. Table 13.1.3 reveals such higher salaries in Brazil and Argentina. Low salaries could likely start a vicious cycle and obstruct Chile's future IT competitiveness in the IT industry. The example of India demonstrates how high salaries for skilled IT professionals have contributed to the advancement of the country's IT sector.

Table 13.1.3 Managerial Salaries in Latin American Companies with Annual Sales US $50 Million to US $100 Million (net annual wages in US$ thousands (nominal))

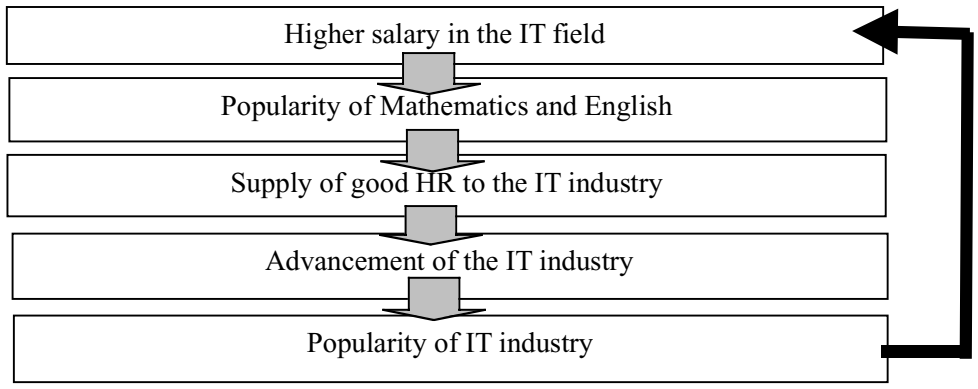
	Chile	Argentina	Brazil
General Manager	137.2	220.3	201.1
Sales Manager	90.7	112.5	90.1
Financial Manager	87.5	115.5	103.0
Production Manager	80.4	112.0	95.2
Information Manager	64.8	74.9	104.3
Human Resource Manager	73.6	93.9	102.8

Source: Pricewaterhouse Coopers, 2000

In India, high salaries are allocated to highly qualified and specialized specialists in the IT field, ultimately improving the popularity of education related to this industry. Both of these factors work in a cyclical manner to increase the availability of human resources and raise the competitive standards of India's IT industry.

Box 13.1 Case Study: India

High salaries in the IT industry attracts high levels of human resources



(3) Lack of Incentives

In general, Chile's government is said to opt for a laissez-faire policy, which has led to Chile's strength of "Openness". However, according to interviews, the private sector and especially foreign companies require increased incentives to invest in Chile.

(4) Lack of Contents

Results from the interviews conducted in December emphasize the lack of contents in general, and the unattractiveness of e-commerce contents in particular. This might explain why spending on domestic web sites in Chile is much more limited than in Brazil and Argentina (see Figure 13.1.1).

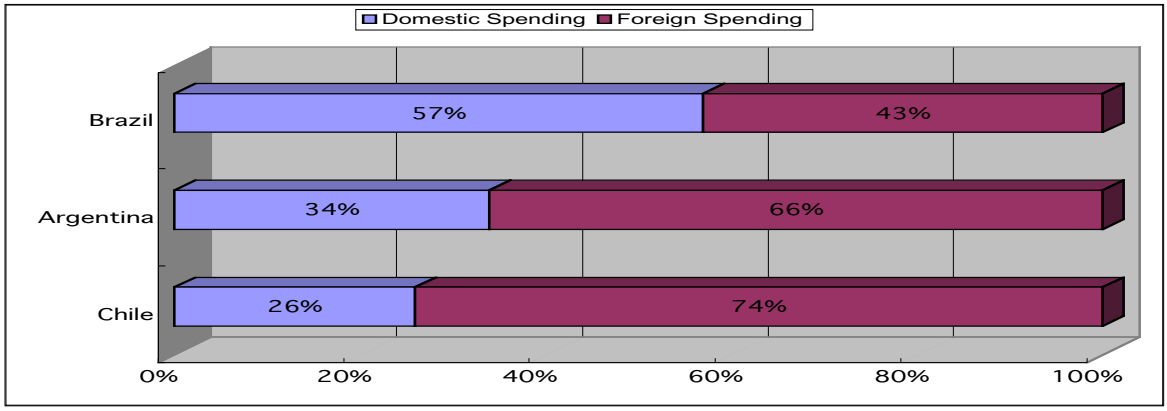


Figure 13.1.1 Domestic vs Foreign Web Spending from the Home, 3Q1999

Source: International Data Corporation, 2000

According to Associacion Latinoamericana de Integracion, Chile is generally accounted for having the second most Webpages per inhabitant, after Uruguay, in Latin America. Universidad de Chile, however, shows that almost 52 % of Chilean Web sites comprise just one single simple front page, mostly showing an e-mail address and some text. Nua Internet survey also shows that just half of Chile's "punto-cl" domains used to update Web pages last year and Chile's 100 largest Websites hosted one third of the country's pages (CEPAL, 2001).

A survey regarding Internet users in Japan suggest that majority of Japanese tend to access Internet for pleasure. With this in mind, contents must be entertaining enough to increase Internet penetration.

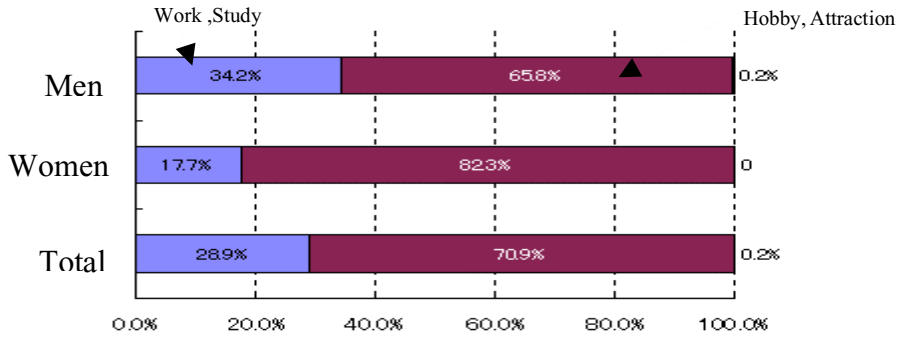


Figure 13.1.2 Reasons of Access Internet

Source: Fujitsu Research Institute, 1998

13.1.4 Policies for the Improvement of Competitiveness

Previous interviews revealed particular problems in the IT environment in Chile.

Meanwhile, other countries have adopted various policies to improve their level of IT competitiveness, which may be considered to improve the IT environment in Chile.

(1) Policies for Financing Ventures and SMEs

a. "Seed and Venture Capital Fund" in Ireland (1995-)

This program is initiated by the Department of Enterprise and Employment and is financed by Enterprise Ireland (a government agency assisting Irish SMEs and ventures by providing business partnerships and offering them access to the result of state-of-the-art R&D results). The European Regional Development Fund co-finances the program, considered in Ireland as an effective venture market enhancer. The Fund helps to provide seed capital for Irish SMEs and ventures businesses. In 1999, the Fund investment reached £20 million, the great majority directed towards companies in Dublin. The investment was divided among sectors of which 15% was directed towards software companies and 17% to communications. In addition, 20% was directed towards ventures, while 55% was directed towards ventures in a more developed stage.

b. "The Information Technology Online Program (ITOL)"by the Federal Government of Australia

This program funds projects by SMEs aimed to improve Australia's IT competitiveness and demonstrate new and innovative online solutions.

(2) Policies for Producing IT Professionals

a. The "Middle Level Technical" (MLT) and "Higher Technical and Business Skills" (HTBS) Programmes in Ireland (1994-1999)

These programs, supported by the European Structural Fund and the Irish government, provided middle and higher level technical and business skills in the IT market.

b. "New Support Scheme for Post-Doctoral Students" in Ireland (1995-)

This project provides financial support to post-doctorate students at a rate of £20 thousand per year for 2 years and assists international research collaborations with extra funding.

c. "The Start Technology Programme" (STARTECH) in Ireland (1995-)

This program helps to increase coordination between IT companies and educational institutions. In such way, IT companies are offered university graduates as trainees to ease the demand of needed human resources. At the same time, this offers graduates the opportunity to obtain ready-to-use IT skills through the training period while also fostering entrepreneurship skills.

(3) Policies Providing Incentives

a. The "International Services Programme" in Ireland (1985-)

The program provides feasibility, employment and training grants, and tax and other concessions to computer science fields, R&D, training and international services. In these ways, it has managed to attract FDI in those fields.

b. The "Measure One Scheme" in Ireland (1993-)

The scheme provides grants for foreign companies, that locate in Ireland to conduct R&D.

c. "Plan for Developing Taiwan into an Asia-Pacific Regional Operation Center" in Taiwan

This Plan is based on zoning policies providing preferential tax and grants to foreign and indigenous companies located in Technology Parks. Its aim is to develop Taiwan into an Asia-Pacific local R&D and manufacture center.

d. The "Pioneer Club Project" in Singapore

The project was developed to attract foreign and domestic companies by means of several financial incentives, e.g.corporate tax reduction for 5 to 10 years and funds and reduction of on-line costs.

(4) Projects to Promote Contents Industry

Vicinity to city amenities and network are the main characteristics of the contents industry. With this in mind, certain cities such as New York developed their own incubation systems to attract additional contents companies: development of city amenities, establishment and attraction of art related specialized schools and cooperation with universities to provide research and training. In addition, networking assistance through Public-Private-Partnership is important (see Appendix G for further details).

(5) Attracting FDIs and Assisting Indigenous Ventures

The case studies of Ireland and the Australian Technology Park (ATP) suggest two types of policies: Ireland's policy has been generally based on the attraction of FDI through generous financial incentives and active educational programs, while the ATP was promoted by the federal and state governments of Australia to assist indigenous IT ventures through a total incubation system. The governments provide assistance in R&D and act as mediators between universities and companies to provide human resources. This policy has been implemented under a strong partnership between the universities, the companies and the public sector (refer to case studies).

Box 13.2 Case Study : Republic of Ireland (see Appendix F)

- **Similarity and difference between Ireland and Chile are below**

<Comparison between Ireland and Chile>

	Ireland	Chile	Comparison
Geographic point	Gateway to Europe	Gateway to South America	Which continent has more potential? - Ireland has more
Demography	4 million	15 million	Small population is negative impact - Chile has more potential
	Under 30 consists 45% of population	Young	Share of young generation is important for countries'
Language	English	Spanish	English is common language in IT field - Ireland has more potential
Human Resources	Well-trained, skilled, hard-workers	Well-educated, skilled human resources	Needed to focus on IT field in Chile
Wage	Lower than most of European countries	Higher than other countries in Latin America	Ireland has more potential as a gateway
Assistance	European Structural Fund	ODA	How to use those assistance toward developing IT industry

- **Incentives for IT industry**

A vital pillar of Ireland's success
- Long-established policy of offering a low tax rate environment to FDI's since 1970's
- Sustained development policy of human resources since 1970's
- Focusing on R&D to promote domestic IT companys since 1990's (Policies shifted toward promotion of domestic companys as well as FDIs

Main fiscal incentives organized by the government and the Industrial Development Agency Ireland (IDA)
- Low corporate tax rate: until December 2002 tax rate for quarifying activities is 10%
- Patent royalty tax exemption
- Tax exempt government securities (Foreign companies are exempt from corporation tax in respect of interest received from certain Irish government securities)
- Capital allowances: on industrial buildings, plant and machinery
- Expenditure on scientific researches

IDA gives the grants
- Employment grants
- Feasibility grants
- Training grants
- R&D development capability grants

- **Attractiveness of Ireland**

Some foreign investors' view (IDA source)
- Availability and quality of a young, multilingual workforce
- Excellent telecommunication infrastructure
- EU market access
- Strong university base
- Attractive living condition

Box13.3 Case Study : Australia Cluster Policy and the Australian Technology Park (ATP)

What is the Australian Technology Park?

The Australian Governments restored a tourist site in Sydney (locomotive workshops built in 1887) into an advanced technology zone to generate new, 'high tech' industries and high levels of skilled employment (total investment: AUD$45 million). The ATP now accommodates more than 70 enterprises including multinationals to indigenous ventures, and has the capacity of generating some 60 thousand new jobs from 'leading edge' technology industries, and some 200 thousand jobs, as a result of the multiplier effect in the wider community. In the national economy, the direct job creation within the ATP translates into US$600 million in direct economic activity, and adds some US$6 billion to Australia's GDP through product and service-related activity (1999 data).

(Source: the Sydney Harbor Foreshore Authority)

Policy implication regarding the main characteristics of the ATP ◎Important implication △ Supplemental implication

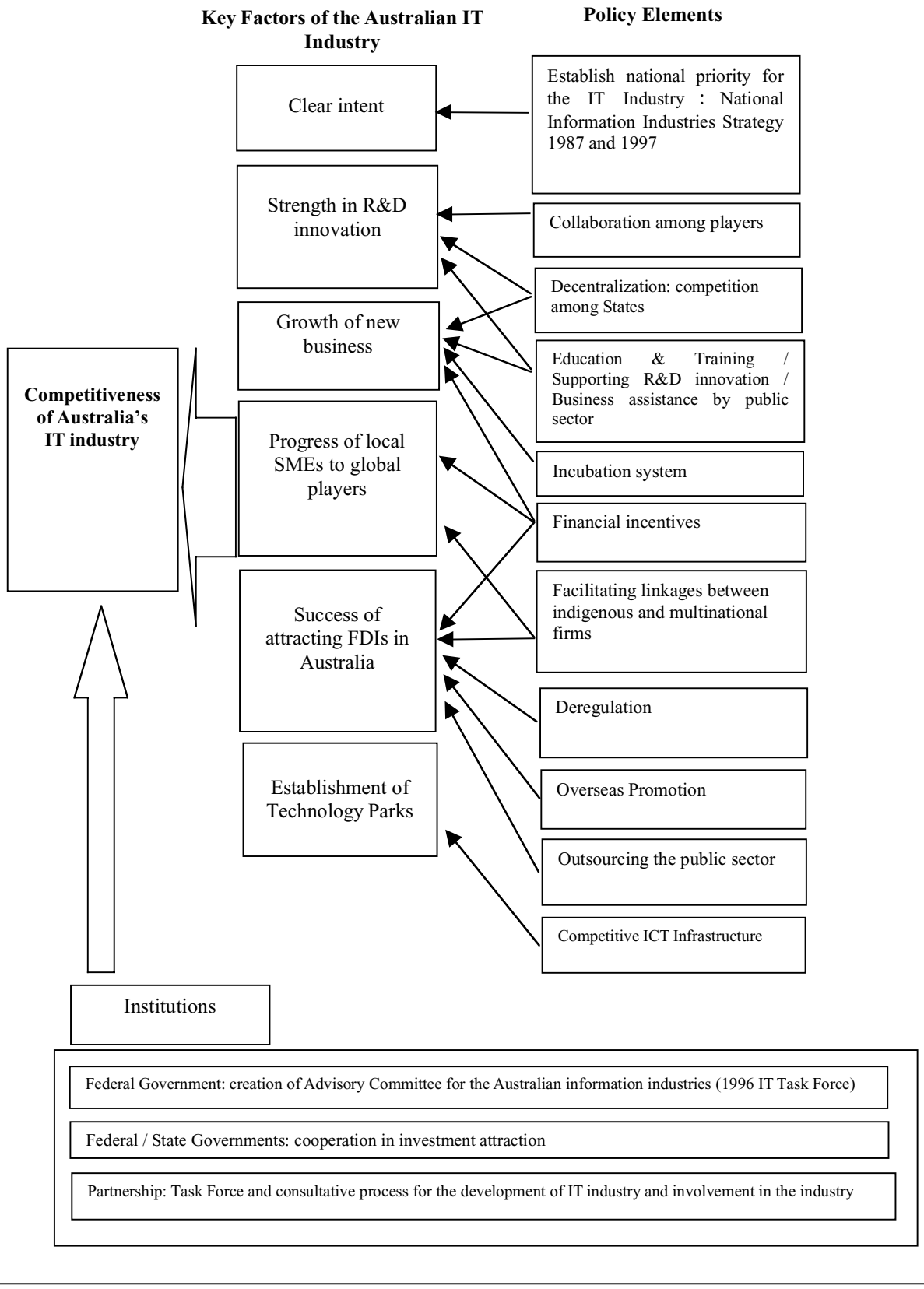
Main Factors	Federal Government		New South Wales State Government	
R&D	◎	-The Cooperative Research Centers Program -The Tax Concessions for R&D Scheme -The Strategic Assistance for Research and Development (START) Program. -The Technology Diffusion Program	◎	-Aim to create a Pathway from R&D to business -Strategic Assistance for Research and Development (START)Program
Incubator System	△	-The Venture Capital Program -Invest Australia, the Government agency provides assistance, grants and funds to the foreign industry located inside the ATP.	◎	The Incubator Program inside the ATP The ATP has a number of incubators within the National Innovation Center and International Business Center.
Government-University Partnership	△	-The Cooperative Research Centers Program -Business Plan Competition Support under the [Promoting Young Entrepreneurs initiative] to promote participation in business plan competitions by students and tertiary institutions and raise the profile of entrepreneurship in the community-	◎	-Created and assists the Australian Photonics Cooperative Research Center in the ATP with the Federal government agencies and the Universities (CRC: Cooperative Research Center). -Commercial Partnership with 7 universities to establish the Australian Center for Advanced Computing (AC) 3 at the ATP.
High Performance Computer Center	◎	-Under The Photonics Supercorridor Project: IT Infrastructure and building strong IT network -The high performance computing Center created at the ATP provides state-of-the-art-computing facility and infrastructure to develop the most advanced IT support for the leading researcher in Australia. It is linked to the Super Computing Center at San Diego.	◎	-The High Performance Computing Center at the ATP provides Sydney state-of-the-art computing facility and provides the infrastructure to develop the most advanced IT support for the leading researcher in Australia. The Government committed AUD$12 million towards the establishment of The Australian Center for Advanced Computing at the ATP. This high performance computing and communications (HPCC) facility provides a seamless, 'collaborative computing' network linking Australian skills and facilities across many universities and research centers, with connections to advanced HPCC centers overseas. This is a valuable tool for universities, researchers and industry.
International 'Eco-technology' & Environment friendly	△	-The Safeguarding the Future statement, provides funding for specialized programs with focus on renewable energy. -Renewable Energy Equity Fund Program for selective investment	◎	-ATP aim to be an international, 'Eco-technology' -The fuel cell project: Because of the Park's strong environmental emphasis, there is an incubation system for the environment as well. That is the commercial fuel cell, backed by the NSW government (NSW's Sustainable Energy Development Authority (SEDA) provided a loan for some of the shortfall) and granted US$330 thousand by the US Government's Climate Change Program. It is the southern hemisphere's only commercial fuel cell. The project is a highly significant environmental milestone. It supplies electricity to a major bio-medical research center in the technology park run by the multi-national Johnson & Johnson, and also powers the 'super computer' installation – the Australian Center for Advanced Computing and Communications. The environment incubation system is oriented towards new companies in areas such as engineering design, planning, energy, flow monitoring, geophysics, mapping, marine and coastal, and risk management.

What kind of assistance is provided within the ATP?

Commonwealth Government: - Indirect but effective to promote University-Industry-Government Partnership
- Distribution of grants and funds under easy conditions to promote competitive innovation
- Partnership type assistance offering the same management responsibilities to private sectors
- Contract type assistance requiring strict rules and terms to the liable beneficiaries (duty of report)

State Government: - Direct involvement (action and staff) and catalytic role for the development of the ATP

Box13.4 Case Study: Australia Policy Framework to Raise Competitiveness of the IT Industry



13.2 Cluster phenomenon of the IT Industry

This Chapter analyses various international IT cluster zones of which there are 2 types; the first refers to "naturally born clusters" and the second refers to "policy-led clusters".

The contents industry exemplifies a naturally born cluster. Clusters have historically been born spontaneously, such as demonstrated in the case of New York, San Francisco and Tokyo, though the contents industry tends to form a cluster at a convenient location including easy access to city amenities. Some have been artificially developed such as the case of the Australian Technology Parks where vicinity to the city of Sydney is key.

Policy-led IT industrial clusters, as exemplified in the software industry, are developed through zoning policies with state-of-the-art infrastructure, preferential tax policies and other incentives to lure foreign and domestic companies, like the case of Taiwan and Bangalore.

13.2.1 Case Studies of Some Clusters

Silicon Alley (New York)

The Silicon Alley exemplifies a contents industry cluster. The city of New York is essential to its development due to convenient access to stores that are open 24 hours and other attractive amenities. The cluster has significantly been fostered under a city development program while local authorities have created a favorable environment for venture implementation. In addition, substantial Public-Private-Partnership (PPP) initiatives has provided synergy effects to further nurture the cluster(Source: Kou Yukawa [1999], "Contents Industry Development and Policy Recommendation (in Japanese), FRI Research Report No.47).

Multimedia Gulch (San Francisco)

Multimedia Gulch is another contents industry cluster. The city of San Francisco's liberal culture and its vicinity to Silicon Valley (one hour by road) represent the principal attractions of the area. Since early stages, city authorities have acknowledged the cluster and have assisted the zone through tax favors and the creation of networks(Source: Kou Yukawa [1998], "The Regional Dependence of Content Industry in Japanese", FRI Research Report No.40).

Bit Valley (Tokyo)

This contents industry cluster appeared spontaneously and today lacks an effective policy initiated by the local and central governments. With the assistance of non - governmental organizations (NGOs), the Valley's companies aim to create an autonomous and voluntary community based on networking to further promote the cluster(Source: Kou Yukawa, "Emerging New Media Industry Cluster in Tokyo (In Japanese)", FRI Research Report No.88).

Medicon Valley (Denmark and Sweden)

The Medicon Valley is a pharmaceutical and bio-technical industrial cluster, featuring a cross-border partnership between the companies. The area already located a cluster of renowned universities and research institutions offering services and vital collaboration to the private sector(Source: http://www.mediconvalley.com/).

Bangalore City (India)
The central and local governments have started developing IT parks in Bangalore to target software industry clusters. Their zoning policy is based on creating the necessary infrastructure and giving several financial incentives to promote the export of software. (Source: Sanwa Research Institute, *IT Revolution in Asia* (in Japanese), 2001, Center of the International Cooperation for Computerization, *IT Business Environment in Asia* (in Japanese*)*, 2001.)

The Zhongguancun Area (Beijing)
The Zongguancun Area is a hardware and software industrial cluster where several renown universities and institutes exist. Teachers and alumni have created ventures sponsored by such educational institutions supporting the fact that universities, with additional assistance from the central government, has been the procipal driving force between the cluster(Source: Sanwa Research Institute, *IT Revolution in Asia* (in Japanese), 2001, Center of the International Cooperation for Computerization, *IT Business Environment in Asia* (in Japanese), 2001).

Subic Bay Free Port (Phillipines)
The Subic Bay Free Port clusters companies from diversified sectors, including the IT industry. It is a free trade zone converted from a military base. The government offers many tax favors and incentives making the best use of the free trade system(Source: Sanwa Research Institute, *IT Revolution in Asia* (in Japanese), 2001, Center of the International Cooperation for Computerization, *IT Business Environment in Asia* (in Japanese), 2001).

Call Centers in Ireland
Ireland's skilled multilingual labor force together with generous tax incentives constitutes its main attractiveness for FDI. Call centers were attracted due to low telecommunications tariffs and toll-free services (discounts for volume users), low employment costs, state-of–the-art telecommunication infrastructure (one of the most advanced in Europe) and tax incentives(Source: http://www.ida.ie/).

Hsinchu Science-based Industrial Park (Taiwan)
The Hsinchu Industrial Park clusters electronic and IT industries. The government created the Park near Taiwan's best universities, as an industrial structure emphasizing R&D and additional intentions to end "brain drain" syndrome. The Park succeeded to attract not only FDI but also returnees from IT developed areas such as Silicon Valley(Source: Sanwa Research Institute, *IT Revolution in Asia* (in Japanese), 2001, Center of the International Cooperation for Computerization, *IT Business Environment in Asia* (in Japanese), 2001).

Okinawa Prefecture (Japan)
The Okinawa Prefecture has begun to cluster contents, software and information service industries. The central and local governments aim to fill the economic gap between Mainland Japan and Okinawa Islands under a zoning policy (infrastructure development, education programs and assistance for ventures)(Source: http://www.pref.okinawa.jp/98/mmi/index.html).

MFP Australia
It was founded under a governmental partnership between Japan and Australia to create an IT venture cluster and an "IT community". Following its failure, as a result of non-interaction with the private sector, the South Australian state government realized further zoning initiatives to promote local economic development(Source: http://www.gsr.or.jp/english/example/jas001.htm).

Australia Technology Park (Australia)
The Australia Technology Park clusters high-tech, multimedia and IT industries. The Park offers a substantial incubation system for ventures. The central and state governments and universities have cooperated to create research centers to provide companies with state-of-the-art facilities and R&D results for best conversion into business(Source: http://www.atp.com.au/).

Details regarding each cluster are further elaborated in Appendix F.

13.2.2 Process to Successfully Form IT Industrial Clusters

The brief summary of the cluster zones mentioned above reveals a process regarding IT industrial clusters.

- A new cluster was born spontaneously or through public policies (technology parks and research centers). Technology innovation is standardized and becomes competitive.
- New companies are attracted to become familiar with technological innovation and share the profit of this innovation.
- To answer the needs of those IT companies, IT related service industries are attracted.
  e.g. law, accountant and consultant firms and human resources companies
- The cluster dispatches its own technological innovations and establishes a brand image.
- This brand image creates a publicity effect to attract more IT companies and related industries.
- This IT industrial cluster engenders additional business opportunities through networking leading to company business expansion.

13.2.3 Characteristics of IT Cluster

(1) Proximity to High Level Educational Institutes

A principal reason for the development of a successful cluster is its proximity to universities and other high educational institutions. Such universities and institutions provide versatile support to the R&D and management fields and long-term R&D results for business opportunities as well as human resources for the IT industry. Such proximity creates interaction between educational institutions and industries and activates information exchange to enhance innovation and productivity. This leads to the implementation of entrepreneurship among students and provides opportunities so that alumni may venture into the IT field.

In addition, some established universities organize their own IT businesses, thus gaining

a reputation that ultimately attracts more companies. For example, in Beijing at the Zhongguancun hardware and software industrial cluster zone, the University of Beijing sponsors and invests in more than 33 ventures, all created by its alumni and teachers. It has used the model exemplified by the University of Stanford and Cambridge.

(2) Zoning Policies

Clusters are often created through zoning policies undertaken by governments or local authorities. A zoning policy is based primarily on implementing special financial policies and subsidies together with the development of an infrastructure.

e.g. - Hsinchu Science-based Industrial Park (Taiwan)
- The Silicon Alley (N.Y., Re-development Plan)
- Subic Bay Free Port Area (Philippines, Free Trade Zone)

In addition to zoning policies, a management organization is required that is responsible for the sustainable development of the cluster.

(3) Attractiveness

A convenient location together with a high quality of life constitutes the main reasons for the development of a successful cluster, especially for the contents industry. Companies are attracted by a higher quality of life such as proximity to city amenities, a pleasant climate, low crime rate, good schools and affordable housing. Working conditions are also important including, for example, reasonable rent costs. Finally, proximity to large cities and resorts influences the positive development of a cluster. In this regard, examples include San Francisco City for the Multimedia Gulch, and New York City for Silicon Alley.

(4) Collaboration

To create a synergy effect, interaction between players, such as ventures and established companies, NGOs, educational institutions and the public sector, is necessary. Such interaction creates business opportunities and leads to the development of clusters. In terms of ventures, the exchange of knowledge and informal communication is crucial. An example in this regard is " First Tuesday" in Santiago. The growth of "First Tuesday" of Chile demonstrates that IT companies require increased collaboration to obtain information and foster business opportunities ("First Tuesday Chile" was founded in October 1999 and in 8 months has increased from 50 to over 800 members.).

NGOs and Public-Private-Partnership (PPP) can play an important role for local development and town management. This type of relation is not pyramidal, but rather created on the base of networking through informal face-to-face communication is important.

(5) Infrastructure

Quality telecommunication infrastructure, such as high band with and speed data communications facilities, is necessary for developing a competitive IT cluster. In addition, costs to conduct business should be reasonable, including low land and labor costs. Finally, the substantiality of basic infrastructure, such as roads, harbors, good transportation services, effective electricity supply and reasonable rent is necessary to

attract companies. It is clear that such infrastructure should be well developed and updated.

(6) Some Incentives

It is necessary that governments and local authorities provide financial support, preferential tax policies and training assistance to meet the expectation of the IT industry and thus attract foreign companies.

(7) Others

Many Jewish, Chinese and Indian people have immigrated to the Silicon Valley. Later, some may return to their native countries and contribute to the domestic IT industry. The existence of human connections, between the U.S. (the Silicon Valley and other IT cluster zones) and their home countries, will provide a foothold for technological transfer and capital flow from the U.S. market. For example, the Hsinchu Park (Taiwan) was developed with human resources provided by returnees from the Silicon Valley. Since then, The Park has maintained close contact with the Valley.

The cluster zone should be capable of making additional innovations and adapting to such changes. Typical innovation inside the cluster tends to changes according to the trend at that time. For example, the trend in Silicon Valley was software during the 1950s-60s, computers in the 1980s, and software and information technology in the 1990s. Hence, Silicon Valley has managed to maintain itself as the world leading cluster zone, while attracting FDI. In addition, some governments have managed to set up individual agencies.

To conclude, for both naturally born and policy-led clusters, government-industry-university cooperation seems to be the principal source to incubate and nurture clusters. For any cluster type, universities are the driving force to ensure dynamism and success, while cooperation with other players allows for a synergy effect.

13.3 Case Study of Valparaiso

This Chapter is dedicated to the example of Valparaiso and its potential to be the location for an IT industrial cluster. Recent interviews reveal fundamental characteristics and evaluation points regarding the city.

13.3.1 Fundamental Characteristics (Potential) of Valparaiso

The following essential points may be considered the principal strengths of Valparaiso.

(1) High Level Educational Institutes

High regarded universities are located in Valparaiso, such as the Universidad Catolica de Valparaiso and the Universidad Tecnica Federico Santa Maria. Such universities attract enough inflow of quality human resources from the rest of the country and Latin America. In this way, there are sufficient young IT engineers to offer labor to companies. The universities mentioned above have developed some collaboration with various companies for regional economic development, although those collaboration is still limited.

(2) Location Attractiveness

Valparaiso itself is very attractive, being a heritage city with many historic sites and it shows a picturesque landscape that attracts tourists, and Valparaiso is a geographical gateway of Latin America. The neighbor city of Valparaiso is Vina del Mar, one of the most popular seaside resorts in Chile.

(3) Industries

Valparaiso is Chile's most important industrial harbor and service sectors, For example, logistics, maritime and the Navy, are well established. There are several successful IT companies in Valparaiso.

(4) Infrastructure

Optic fibers links are laid for telecommunications connecting major cities in Latin America and Chile, and traveling north along the Pacific Coast from Valparaiso, in this way allowing Valparaiso to act as a gateway between the US and Latin America.

13.3.2 Evaluation Points (Competitiveness) of Valparaiso

Contrary to the positive aspects mentioned above, particular evaluation points reveal rather weak aspects regarding the city of Valparaiso.

(1) Economic Environment

Valparaiso suffers from a poor economic situation that particularly affects the SMEs. Lack of capital has impeded entrepreneurship and the motivation from SMEs to apply IT.

(2) Centralization

Chile is a strongly centralized country. Although there is the Parliament in Valparaiso, the majority of principal economic activities occur in Santiago.

(3) Collaboration

Recent interviews reveal the existence of collaboration between universities and companies acting as a fundamental element of the city of Valparaiso. Even so, however, such collaboration between universities and companies has only just begun suggesting that there still exists a gap between research and business projects.

To conclude, Valparaiso has potential, however, its competitiveness remains weak compared to Santiago

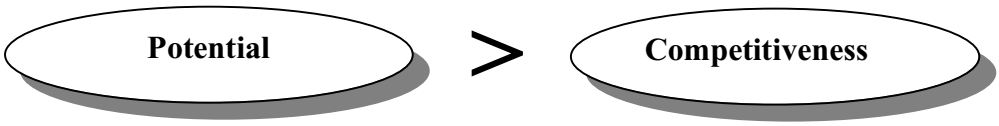


Table13.3.1 highlights the principal characteristics of an IT cluster while displaying the present situation of Valparaiso, where some of these characteristics have been identified,

i.e. proximity to high level institutions, city attractiveness and good infrastructure. Valparaiso should take full advantage of its proximity to high respected institutions. Interaction between such institutions and various companies has to be strengthened. In addition, the location itself is attractive while residents enjoy a high quality of life. Finally, infrastructure is well developed including a modern telecommunications system, an effective supply of electricity and reasonable rent.

There are 2 types of IT cluster in the world: "natural-born cluster" and "policy-led cluster". In the case of Valparaiso, there are some IT companies in the region, however, a cluster has not developed yet. To catch up with other IT developed countries, quick action is necessary, not just waiting for a cluster to be born spontaneously. To create a policy-led cluster, proper IT environment, such as zoning, state-of-the-art infrastructure, some incentives is conditional.

Table 13.3.1 Nature of IT Cluster and Valparaiso

(-- positive)

Nature of IT Cluster	Present Situation in Valparaiso
Proximity to high level educational institutes	
Training and developing the human resources	-
Interaction with industry (information exchange to enhance innovation and productivity	just started
Long-term R&D	?
University alumni to venture in the field of IT	very few
IT business done by universities themselves	?
Zoning	
Special financial policies and subsidies	×
Ideal infrastructure and environment for the high–tech industries	×
Attractiveness	
Quality of life	-
Proximity to amenities of large cities and resort	- (less than Santiago)
Collaboration	
NGO, PPP (Public-Private-Partnership) can play a important role in town management	?
Interface between entrepreneurs and companies	just started
Exchange of knowledge and informal communication are crucial for entrepreneurs	?
Infrastructure	
Good telecommunication infrastructure	-
Effective electricity supply	-
Reasonable rent	-
Some Incentives	
Financial support (subsidies)	-
Preferential tax policy	×
Training assistance to meet the expectations of the IT industry	-
Others	
Human network resources with west coast of U.S.	×

Source: JICA Study Team, 2001

The present situation may be improved by introducing the proper policies

13.4 Japanese Companies' View of Chile and Latin America

This Chapter introduces Japanese companies' view of Chile and Latin America, in particular IT companies' view, which shows their consideration as investors. These views will be future reference when Chile considers proper IT environment.

13.4.1 Chile's position in Latin America

(1) Attractiveness of Chilean Market

Japanese companies located in Chile consider that the country acts as a gateway to a market consisting of 550 million people (Latin American market and the Hispanic market in the U.S.). In this way, particular Japanese companies are attracted to Chile, because its market leads to other Latin American markets.

Chile has proven a sound test market for Latin America because it is eager to advance. In several circumstances, Chile's market has been the first or one of the first, to introduce new technology and services in Latin America including network disintegration, digital mobile telephone service, calling-party-pays system implementation and new Internet services via cable modem and ADSL. In addition, Chile offers good infrastructure and is open to FDI.

Another factor of attraction is the size of Santiago, being one of the largest cities in Latin America with approximately 5.2 million people living in the metropolitan area.

(2) Lack of Image

The majority of Japanese companies feel that Chile lacks a distinctive image in Latin America. It is necessary that Chile to promote itself outside of the country. This contrasts with Mexico who sends governmental delegations to Japan every year to attract FDI.

(3) Attractive Characters of Brazil and Mexico

There are far more Japanese companies located in Brazil and Mexico than in Chile (see Table 13.4.1). Brazil is the most attractive to Japanese companies because of its larger domestic market. Additionally, Japanese people feel stronger affinities with Brazil, due to a long history of Japanese immigration. In fact, a community of Japanese decent amounting to approximately 1.3 million, is located around the state of Sao Paulo and Parana. Mexico, on the other hand, is noted for its active promotion to attract FDIs.

Table 13.4.1 Number of Japanese Companies in Latin America

	Number of companies	Percentage (%)
Total in Latin America	655	100.0
Brazil	285	43.5
Mexico	158	24.1
Chile	55	8.4
Argentina	44	6.7
Costa Rica	19	2.9

Source: Japan External Trade Organization (JETRO), 2000

(4) Issues Faced by Japanese Companies in Latin America

Table 13.4.2 demonstrates that Chile is competent in dealing with tax issues and capital provision issues compared to other Latin America countries. On the other hand, the percentage of Japanese companies affected by the weak economy in Chile is higher than other Latin American countries.

Table 13.4.2 Top 10 Issues Faced by Japanese Companies

Main issues	Chile	Other countries in Latin America (percentage of companies affected by the issues %)				Latin America in total
		Brazil	Mexico	Argentina	Costa Rica	
1.Weak economy	48.6	42.3	18.3	40.7	37.5	36.9
2.Fluctuations in exchange	42.9	57.7	39	22.2	25	40.9
3.Competition with other companies in the same sector	31.4	53.6	37.8	44.4	12.5	44.4
4.Labor issues	20	27.8	39	7.4	37.5	25.9
5.Difficult provision of capital	11.4	29.9	14.6	14.8	12.5	20.6
5.Tax issues	11.4	48.5	37.8	63	12.5	38.4
7.Difference of habit and mentality	8.6	12.4	24.4	11.1	25	13.1
8.Difficulty to coordinate with the parent company	8.6	22.7	11.0	7.4	--	12.5
9.Difficult technology transfer	2.9	5.2	8.5	3.7	--	4.4
10.Difficult local provision of parts	--	14.4	25.6	11.1	12.5	13.8

Source: JICA Study Team based on JETRO statistics, 2000

13.4.2 View from Japanese IT Companies

(1) Current Situation of IT Companies

Different perspectives from Japanese companies dedicated to the IT industry have been verbalized through informal meetings. Such companies, for example, must face the restructuring of their overseas operation. In this way, they must focus on their core-competence. In general, high priority is not given to Latin American market.

It is important for Japanese IT companies to have some prior prospect that they will be successful before investing in Latin America. This is because compared to other regions in the world, there have been few positive business results from Latin America.

Cultural difference are becoming more crucial in the IT related service sector, mainly software, compared to the manufacturing sector. For example, it is difficult for Japanese companies to export software products to Chile because of language and management difference.

(2) What is Needed According to Japanese IT Companies

It is important for Japanese IT companies to find a proper business alliance with local companies. In Chile, it is often difficult to establish a priori prospect partner. This could be improved by looking at the following example. The Australian government had established “Invest Australia” that identifies and promotes investment opportunities in Australia and acts as a coordinator between foreign investors and appropriate public and private sector contacts. According to various IT companies, the attractiveness of a country is equivalent to the “quantity of information flow provided by the country”, which consists of “population”, “education level” and “amount of young generation”.

(3) Issues Faced by Japanese IT Related Companies in Latin America

Table 13.4.3 lists those issues of top concern to Japanese IT related companies. As shown, tax impediments are the main issue affecting the companies. The issues are in fact the same for Japanese IT companies as those faced generally by Japanese companies in Latin America.

Table 13.4.3 Top 10 Issues Faced by Japanese IT Related Companies in Latin America

Main issues	Percentage of affected companies (%)
1.Tax issues	47.2
2.Labor issues	40.0
3.Difficult local provision of parts	39.0
4.Difficulty to coordinate with the parent company	22.0
5.Quality control	20.0
6.Difficult provision of capital	20.0
7.Difference of habit and mentality	17.5
8.Language	13.0
9.Difficult technology transfer	7.0
10.Difference in the way of management	5.6

Source: JICA Study Team based on JETRO statistics, 2000

(4) Case Study: "Access Nova"

"Access Nova" is a successful collaboration project between Chilean universities and Japanese companies for the development of advanced Information Communication Technologies (ICT). It is a research collaboration program between the Universidad de Chile and the Nippon Telegraph and Telephone (NTT). In addition, Waseda Universities, Tsukuba University, the National Institution of Informatics, the University of Electro-Communications in Japan, the Universidad Tecnica Federico Santa Maria and the Universidad Catolica have become members of the project. The goal is to promote innovation and create a bridge between the results of advanced R&D and its application to businesses. The program will incubate IT ventures as well.

NTT and the National Astronomical Observatory of Japan have conducted research concerning high capacity networks between Tokyo and the astronomical observatory site in Chile. Experimental data obtained during such research proved the effectiveness of real-time communication between the two countries.

Two facts should be mentioned regarding the project. Firstly, the initiative began as the result of personal relations between NTT and Dr. Vera of the Universidad de Chile and later, developed to broader research collaboration framework between Asia and Latin America. The second point is that through the project began with ideas regarding future business, has still not developed a business scheme. For example, NTT Laboratories is the only company from the NTT conglomeration up to this point. Additionally, NTT Communications (NTT's international subsidiary company) was not involved.

A future business idea has led to relations between NTT DATA (network and system service provider) and Chile. Mr. Toshiharu Aoki (President and Chief Executive Officer of NTT DATA) and Mr. Yuji Inoue (Senior Vice President of NTT DATA) have been involved in the project. There is the possibility that NTT DATA may become a potential partner for Chile.

14 TELECOMMUNICATIONS, ENERGY AND WATER SUPPLY

14.1 Telecommunications

14.1.1 Telephone

The deregulation in the telephone service sector was started in 1982, but a multi-carrier system was introduced in 1994, substantially inserting the sector into the competitive market. Despite the relatively recent opening of the national market to the private sector (including foreign enterprises), Chile pioneered privatization activity resulting in more modern technology with 100% digital lines and advanced high-frequency wireless services. This continues to be a model for neighboring countries, many of which are just now in the process of privatization. The total number of fixed lines in 1998 was approximately 2.8 million, while the average density was 20 lines per 100 persons in 1999. This statistic is much greater than the densities in Brazil, Mexico and Peru, which have 11, 10, 7 lines per 100 persons respectively.

Table 14.1.1 Past Trend of Telephone Lines and Investment

	1990	1994	1998	Average Annual Growth Rate, 1994 - 1998
Total Fixed Lines (Thousand lines)	860	1,587	2,753	14.8%
Average Line Density (Lines/100 persons)	6.6	11.6	18.5	12.4%
Annual Investment (US dollars)	402	362	927	26.5%

Source: CEPAL (Original Source: International Telecommunications Union, Year Book of Statistics 1998, 1999)

However, the density is still low compared to approximately 60 lines per 100 persons in the USA or in Japan, suggesting increased growth of this area in the future. As a matter of fact, the annual investment by the private sector has steadily increased since 1994 when the multi-carrier system was started.

In the case of the mobile phone market, the growth in recent years is remarkably high; it has expanded from 197,000 in 1995 to 410,000 in 1997 and 964,000 in 1998. There are two systems including the cellular type and the PCS type. The competition to capture the consumers has been so fierce that SUBTEL, the governmental organization regulating the tariff rate, suggests that the cost of a mobile phone call may be cheaper than the cost of a fixed line call. As a consequence, the density of mobile phone is expected to grow from 6.5% in 1998 to approximately 10% in 1999.

The main issues in the telephone service are as follows: The former state company, Compañía de Teléfono de Chile (CTC), has a predominant share which used to be more than 95% of the total capacity. In 1999, in order to promote competition, *Comisión Nacional Competencia* decided to let CTC sell the excess capacity to other companies, such as Entel, CMET and Manquenhue. In addition to insufficient financial resources of small companies, undeveloped number portability hinders the change in the market share. Therefore, CTC's share still remains at about 90%.

Another issue is the high concentration in the Metropolitan Region, indicating that the telephone density in the rural area is at a very low level. In fact, there are still areas that lack telecommunication means. However, this issue will likely improve in the near future through the spread of mobile phones since the price is likely to decrease due

to the competitive market.

14.1.2 Television and Internet

Several foreign media conglomerates have begun to compete in broadcast television in recent years, adding international contents to an already active local television market. Chile has 134 television transmitters sending programs to approximately 2.6 million sets. Although cable television is limited primarily to the metropolitan or fifth regions, Satellite TV subscribers are expanding throughout the country. The total number of subscribers in 1999 was estimated at 14,000 persons according to the Year Book of Statistics. According to statistics, internet use accounts for 3% of all telephone traffic in 1998, and the number of subscribers reached 626,000 subscribers in 1999. The growth rate in the past three years is remarkably high at 84% annually. This year, a survey for the telecommunication technology has been conducted throughout the country by CTC in 48 urban centers from Arica to Punta Arenas. According to the survey results, though there are some differences by region, about 10% to 30% of Chileans have access to computers and 2% to 10% make use of Internet as shown in Figure 14.1.1. An additional study regarding telecommunication technology conducted by a professor of the University of Chile concludes that investment realized during the last decade has allowed Chile to have an advantage over other South American countries. The Internet market in Chile is still growing and is anticipated to grow in correspondence with the increase in the telephone density as well as the ownership of computers for personal use.

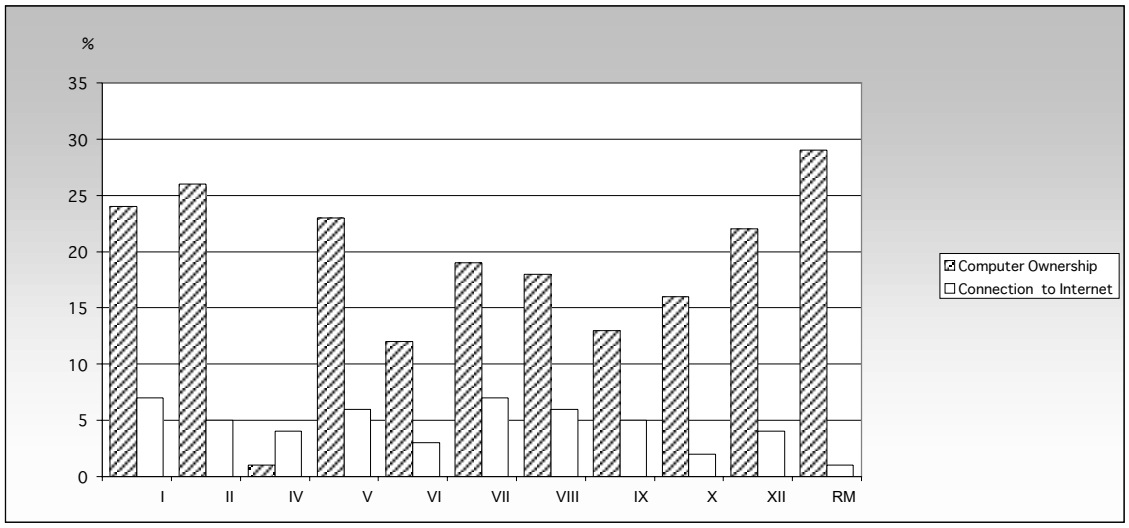


Figure 14.1.1 Internet connection in Chile by Region, 2000

Source: CTC's Survey

14.2 Energy

14.2.1 Primary Energy

(1) Summary of Energy Sector

For the most part, Chile's energy sector is privately owned. The demand for the country's energy has been increasing rapidly in recent years. From 1990 to 1998 there has been a 7.64% annual growth rate in the demand for energy used for transportation,

mining and industry, commercial, public, residential and centers of transformation. A significant portion of this growth has come from increased power demand by the mining sector and by large urban areas. The increased demand combined with limited fossil fuel resources forces Chile to be a net importer of energy (refer to Figure 14.2.1). For example, primary energy production reached 74,614 Teraclaories in 1998, while consumption reached 220,761 Teracalories. In terms of the economic value of energy sources, CNE ranked hydropower as the most inexpensive source, followed by natural gas, coal and finally, oil. However, even though hydropower is considered the least expensive, they plan to concentrate on the production of natural gas. In the Figure, "others" refers to hydroelectricity, wood and biogas.

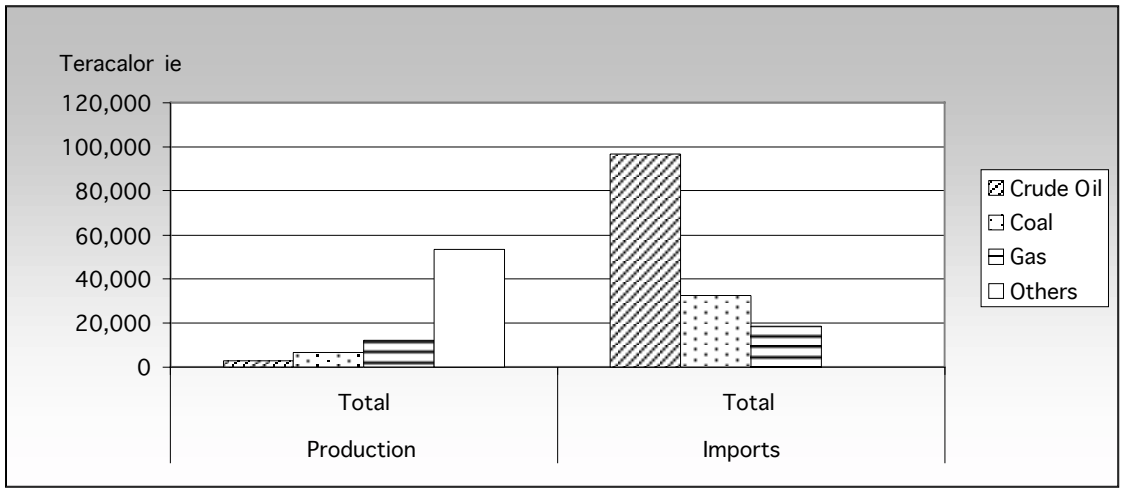


Figure 14.2.1 Total Production and Total Imports of Primary Energy, 1998

Source: Comision Nacional de Energia (Balance Nacional de Energia 1997-1998 Chile, p. 36-39)

Crude Oil

In 1998, Chilean crude oil production was estimated at 2,669 Teracalories, while demand was 99,109 Teracalories. This large gap between the production and demand of oil forces Chile to rely greatly on foreign oil. Chile's crude oil demand has almost doubled from 1988 to 1998, while production has declined from 11,659 Teracalories in 1988 to 2,669 Teracalories in 1998. Argentina supplies approximately 50% of Chile's oil imports. With Chile's inclusion in MERCOSUR and the reduction of tariffs, Argentina is expected to increase its share of Chile's imports even more. Chile's crude oil refineries include Petrox-Talcahuano (100,640 barrels/day), Concon (94,350 barrels/day) and ENAP-Gregorio (9,650 barrels/day). The total refinery capacity for crude oil is approximately 204,640 barrels/day.

Natural Gas

Chile's natural gas reserves were estimated at 3.5 trillion cubic feet (Tcf) in 1998. Total production in 1998 was 12,068 Teracalories while consumption equaled 28,243 Teracalories, leaving Chile 16,175 Teracalories short of its natural gas demand.

1. GasAndes Pipeline: Chile produces small volumes of gas, but has plans to increase imports through the GasAndes natural gas pipeline project that has the capacity of transporting 320 million cubic feet per day (mmcf/d). This capacity is expected to more than double in the near future, thus increasing the volume to 700 mmcf/d. The pipeline carries gas from Argentina's Neuquen Basin across the Andes Mountains to Santiago. The pipeline is 290 miles long, 24 inches in diameter, and is worth $325

million. In addition to this connection from Neuquen to Santiago, there is a gas pipeline running from Neuquen to Concepción.

2. Gasoducto del Pacífico: The Gasoducto del Pacífico opened in November 1999 and transports 140 million cubic feet per day (Mmcf/d) over 330 miles to southern Chile. Currently there is not enough demand to satisfy the pipeline capacity, due to the fact that electricity generation in southern Chile is mostly non-thermal (hydropower).

3. Gas Atacama & NorAndino Pipelines: Supplying natural gas across the Andes Mountains from Salta, Argentina to power plants near the copper mining center of Mejillones and Antofagasta in northern Chile has resulted in a contest between two rival consortiums: the Gas Atacama Pipeline and the NorAndino Alliance. The Gas Atacama pipeline is 583 miles in length, 20 inches in width, and worth $750 million. It is a joint venture between the U.S. firm, CMS Energy Corporation (40%), Chilean power company ENDESA (40%), Pluspetrol Energy (16%), and Repsol's Argentine Astra unit (4%). The NorAndino alliance is primarily led by Belgium's Tractebel, in addition to EDELNOR and Techint and is worth $400 million. Beginning in 1997, when the initial construction of the pipelines began, informal talks were carried out between the two consortiums towards the possibility of combining their efforts. Today, there is much competition between the two consortiums. In June 1998, Gas Atacama's total gas contracts equaled 212 mmcf/d, 70% of its total pipeline capacity. NorAndino, on the other hand, had contracts for a lesser quantity of 152 mmcf/d as of July 1998. As of May 2000, the total capacity of the pipelines mentioned above (excluding the Gasoducto del Pacífico) roughly equaled 19 million m3/day.

4. Punta Arenas: In late September 1998, ENAP awarded an Argentine-Mexican consortium a $6.5 million contract to build a second gas pipeline to Punta Arenas, from waters off Tierra del Fuego, Argentina. The 70-mile pipeline would recover offshore gas production and transport it to a methane plant owned by Canada's Methanex Corp. In addition, France's Total announced in 1998 that it would build a 250,000 metric-tons-per-year Liquified Petroleum Gas facility at Punta Arenas for Chilean consumption.

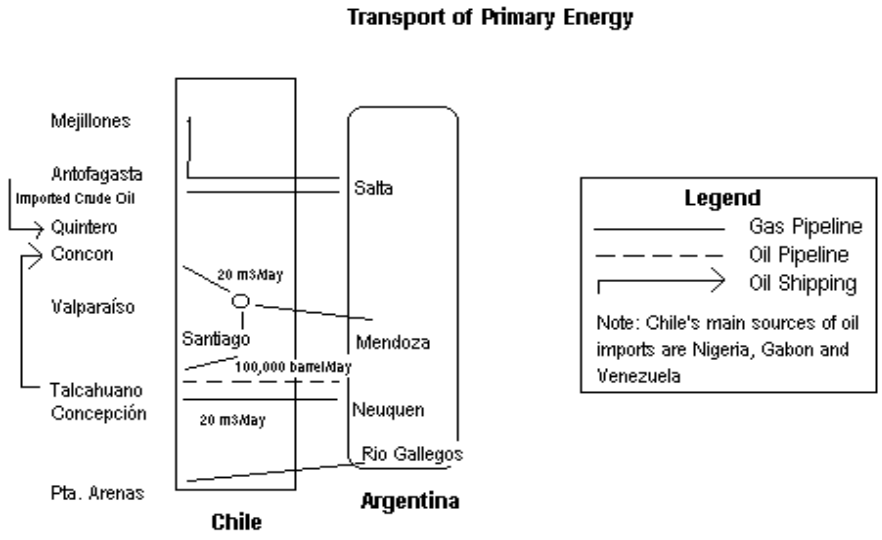


Figure 14.2.2 Transport of Primary Energy

Source: Compiled by JICA Study Team

Coal

It has been noted that Chilean coal is of poor quality and expensive to extract. In the past, however, the industry survived due to massive subsidies that were provided to maintain employment in Arauco of the eighth region. Today, with national unemployment at a lower level, the government began to cut by half approximately 6,000 personnel of the technically bankrupt coal company, *Empresa Nacional de Cargo* (ENACAR) in 1992. The result was a decrease in output from 2.58 millions short tons (mmst) in 1991 to 1.58 mmst in 1993. Local production costs remain greatly above international prices, and Chilean coal output is predicted to decline even more in future years.

Recoverable reserves of coal were estimated at 1.3 billion short tons in 1997. Coal production in 1998 was 6,587 Teracalories, while consumption was 40,287 Teracalories, signifying that Chile was forced to import approximately 33,700 Teracalories. Chile's coal company, ENACAR has been privatized completely. Domestic coal production is located in the Lota/Coronel area and in the extreme south in Tierra del Fuego. Most of the coal produced in Chile is used in the thermoelectric power plants in the North and Central regions.

Wind Energy

In recent years, various studies have been conducted regarding the potential for wind energy generation. For example in 1993, CORFO together with the Comisión Nacional de Energía carried out a study to collect and process information regarding the availability of wind in the country, with the objective of obtaining the spatial distribution of the wind energy resource. For approximately six months, a detailed analysis was conducted involving 74 stations in various parts of Chile. The results of the study demonstrate the potential for wind energy generation in the following areas of Chile:

- The Calama Zone in Region II
- The coastal sector of Region IV
- Points that penetrate towards the ocean, on the coast of the northern and central zones
- Elevated summits and open cordillera areas
- Open coastal zones of the austral sector, Regions XI and XII
- Open Transandean zones towards the Patagonian Pampas in Regions XI and XII
- Antarctic Stations
- In sporadic islands, taking advantage of the topography

The coverage of information related to the availability of wind in Chile (in area and in height) is limited. This study, however, allowed for the construction of a database including the values of the direction and the velocity of wind every hour. It should be noted that the time needed to evaluate the wind resource depends on the climatic characteristics of each region. In zones with a more stable climate (the north of Chile), the period required is less than in those areas where there is high variability throughout the year (the extreme south of Chile). Wind is a very promising resource for energy generation and may prove even more necessary as demand for energy in Chile continues to increase.

(2) Major Issues and Future Perspectives

Energy

According to CNE, the future demand for primary energy is expected to almost double

from 1998 to 2008, with a total demand of 250,920 Teracalories and 448,138 Teracalories respectively. The following figure demonstrates the predicted percentage change in the use of primary energy from 1998 to 2008.

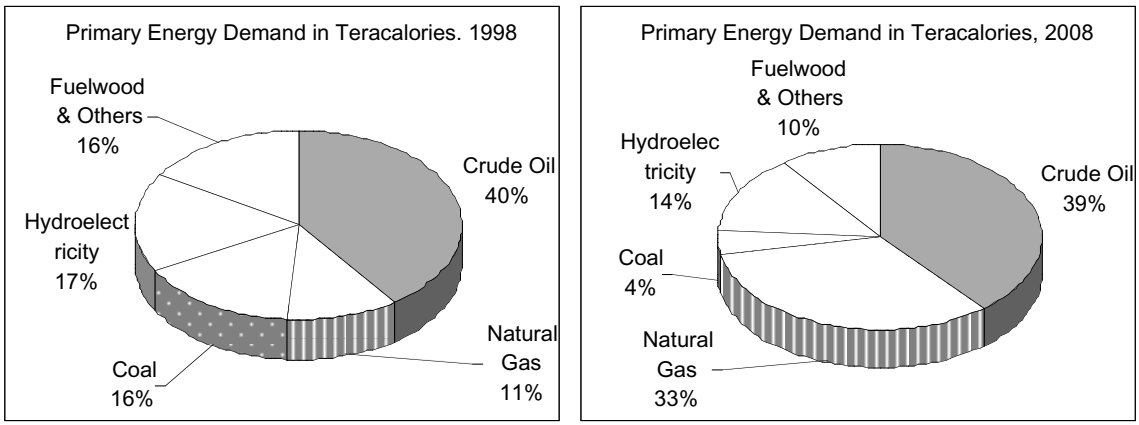


Figure 14.2.3 Primary Energy Demand, 1998 and 2008

Source: Comision Nacional de Energia Website, www.cne.cl (Consumo Energia Primaria)

***Crude Oil**:* Over the long term there are plans to privatize the Empresa Nacional de Petroleo (ENAP), although nothing has yet been finalized. ENAP's overseas subsidiary, Sipetrol, will likely be privatized in the short term (expected in late 2000).

***Natural Gas**:* Chilean natural gas demand, especially for power generation, is expected to increase quite rapidly in future years. It has been stated by specialists that natural gas could likely replace coal in the nation's energy mix.

***Coal**:* Several years ago, CNE expressed interest in acquiring clean-coal and advanced pollution control equipment, so as to increase the development of its coal reserves. Since then however, coalmines have been closed in the Coronel-Lota-Concepción region due to greater than expected recovery costs and the high sulfur content of the product. However, a new deposit of sub-bituminous coal has been discovered in the far south, along the Straits of Magellan. Therefore, continuing the development of coal power in Chile will continue to be investigated. Even so, coal consumption, most of that is imported, is expected to decline in favor of natural gas in future years.

14.2.2 Electricity

(1) Present Conditions

The electric sector is currently made up of two large independent private systems (SING and SIC) and two isolated state-owned systems (Edelaysen and Edelmag). The installed capacity of SING is 2500 megawatts (MW). This system covers Region I and the majority of Region II, where there is a high concentration of mining industries. The installed capacity of SIC is 6700 MW. It covers most of the central and south regions, from the city of Taltal in Region II to Region X in the south.

Edelaysen (17 MW) and Edelmag (64 MW) are located in Regions XI and XII in the southernmost part of the country. As of December 1999, the total capacity was approximately 9300 MW. Until 1994, the share of hydropower plants reached 60%. Since then, the rate has been declining and is currently less than 50%. The reasons are

primarily due to the following: (1) The construction of hydropower plants compared to thermal plants generally requires a longer period, while demand has grown rapidly in recent years; (2) The appropriate dam sites are decreasing; (3) Water rights must be purchased to develop a hydropower plant; (4) Gas pipelines have been installed between Chile and Argentina. From an economic viewpoint according to CNE, the thermal power generation by natural gas will increase.

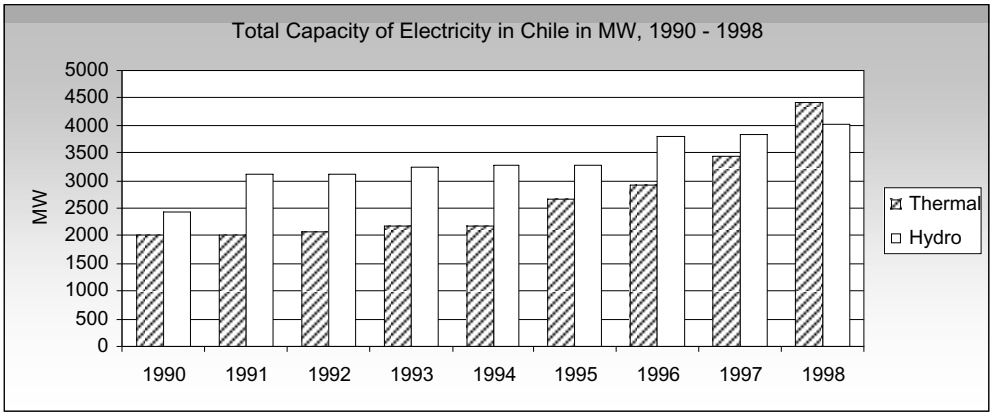


Figure 14.2.4 Capacity of Electricity in Chile, 1990-1998

Source: Comision Nacional de Energia (Balance Nacional de Energia 1979-1998, p. 205)

In 1990, the total demand for electricity was 16,428 million kWh. This figure increased substantially to 32,606 million KWh in 1998, suggesting a 10.94% annual growth rate in the total demand of electricity.

(2) Future Perspectives

It is predicted that there will be significant growth in the consumption of electricity. This is due to the country's rapidly growing industrial base, particularly in the copper mining and chemical industries, but also in the residential and commercial sectors.

The gas arriving through the GasAndes pipeline from Argentina will power several combined-cycle plants projected or being built by Chilean utilities either alone or with foreign partners. These combined-cycle plants will feed the SIC grid, which supplies Chile's cities and industries (except mining). In addition, US-Chilean joint ventures have started the construction of gas pipelines from Argentina to feed thermo electrical power plants (a total of 1,200 MW) to be connected to SING, the grid that supplies mainly the Chilean mining industry. Chile and Argentina have reached a legal and technical agreement to expand and link their electric grids. They will rely on private companies to build the connections. Interconnection could lower costs for consumers in both countries, which have complementary electricity sectors. Chile could export electricity to Argentina in the summer for example, when hydropower is quite plentiful.

The United States Department of Energy has predicted that Chile's power demand will more than double by the year 2006. As of October 1997, CNE agreed to increase 5,000 MW of capacity by the year 2006. This would include approximately 3,900 MW of combined-cycle facilities with the remaining primarily hydroelectric. With the completion of natural gas pipelines from Argentina, several highly efficient, combined-cycle natural gas turbines have been planned. The plants would add 3,526 MW of

generating capacity to mostly the central and northern parts of the country. In addition, a small thermoelectric plant fueled by natural gas is being planned for Punta Arenas.

Sixteen hydroelectric facilities are either currently being constructed, or are included in the future plans of the country. These facilities have the potential to add almost 3 gigawatts (GW) to Chile's electricity portfolio. Combined with the fossil fuel plants, Chile can expect to add over 6.5 GW of generating capacity over the next six to eight years, exceeding CNE's goal and effectively doubling current electricity production.

According to the United States Department of Energy, the growing demand for electricity is estimated at 15 percent in the next 5 years in the Northern Grid and 8.5 percent in the next 10 years in the Central Grid (industrial and domestic demand).

14.3 Water Supply

14.3.1 Current Situation of Water Consumption

Water for irrigation use represents 84.5% on a national level, with an average quantity of 546 m3/s utilized in supplying approximately 2 million hectares, located almost completely from Region IX to the north. It is estimated that 1.3 of the 2 million hectares have reasonable irrigation security. Domestic use equals 4.4% of consumption, with approximately 35 m3/s. The mining and industrial uses represent 11% of total consumption.

In the first three northern regions, there is equal competition among the domestic, mining, industrial and agricultural uses. In the Metropolitan Region and in Region V domestic use is significant, while in the rest of the country to Region IX irrigation use predominates absolutely. From Region X continuing to the south, consumption is quite limited.

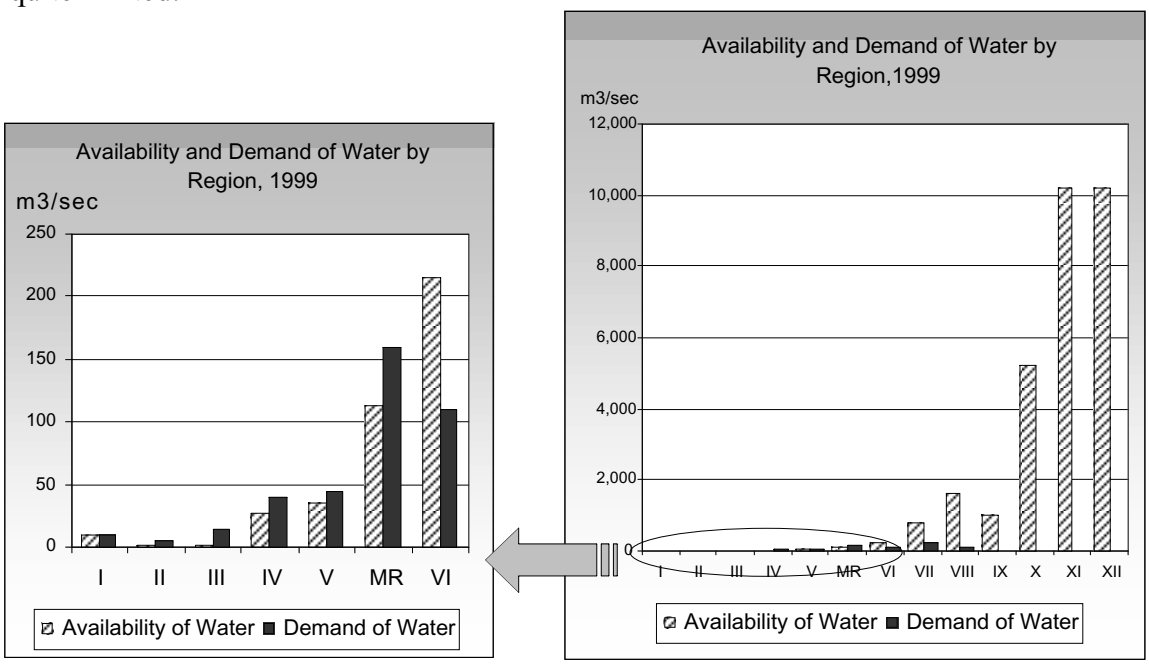


Figure 14.3.1 Availability and Demand of Water, 1999

Source: Direccion General de Aguas (Politica Nacional de Recursos Hidricos, Santiago, July 1999, Figura 4)

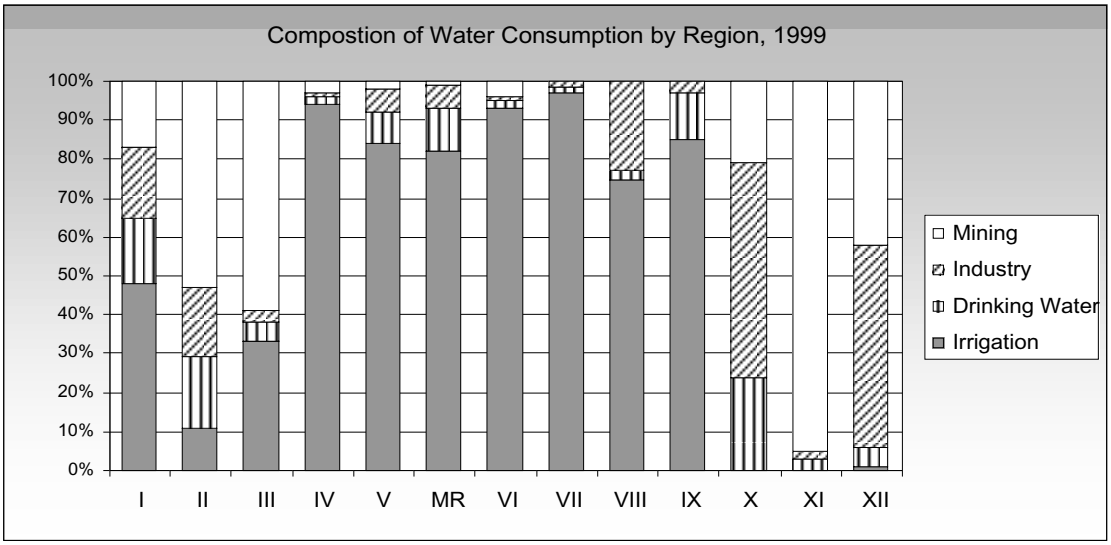


Figure 14.3.2 Composition of Water Consumption, 1999

Source: Direccion General de Aguas (Politica Nacional de Recursos Hidricos, Santiago, July 1999, Figura 2)

The existing demand for water puts extraordinary pressure on the development of water resources. In the central region including the Metropolitan Region, the chronic shortage of water supply was significantly improved by the completion of two reservoirs, El Yeso and Lagna Negra in 1998. The water is sufficient at least for public use, even if dry years continue for three years. For the northern region, however, the demand is greater than the available volume, a situation that is only explained by the repeated use of water resources throughout the course of the valleys. Thus, there is an extraordinary intensity of the use of water resources in this zone. The relation between demand/availability is substantially more favorable between Regions VI and IX. From Region X to the south, the availability greatly surpasses the demand.

14.3.2 Water Supply System for Urban Use

Currently there are 13 concession companies under CORFO, which comprise 92% of the total water supply for urban use. Four of the companies have recently been privatized. Approximately 50 public or private companies are serving the remaining 8% including Lo Castillo S.A., which has a considerably high share in the Metropolitan Region. According to SAE, a subordinate public corporation of CORFO, about 30% of the water supply is used for domestic use and the rest is for industrial/commercial use. In case of big industries such as the mining companies, some have their own water resources and thus do not depend on the public water supply system.

MOP still retains the right of supervising the water quality as well as the water price. The highest price is determined by MOP based on the cost in the past period prior to the concession agreement. Among various offers, the company setting the lowest bidding price can obtain the concession. Accordingly the water price seems to be reasonably determined, even though the monopoly system has been applied by region.

14.3.3 Major Issues and Future Perspectives

(1) Future Perspectives

Since a shortage of water is not expected in the southern region, future outlooks focus primarily on the central and northern regions. The growth rate of the demand for water for domestic use is not anticipated to be high, at approximately 3% per year in the central region. Therefore, the incremental demand for domestic use could be covered by the existing reservoirs. However, water can be short for irrigation and industrial development. According to an approximation by MOP, the water requirement for potential agricultural development is 20% more than the existing demand. In the case of industrial use, the demand will grow at a similar rate as the increase in production, though this is highly dependent on the type of industries that will be developed. Consequently, more investment is required for water resource development in the central region. Financially feasible dam sites are very limited due to geographical reasons. It is suggested that numerous multi-purpose dams should be constructed particularly for mitigating the potential for floods even if they are not profitable because of the small scale, by providing some subsidies from the Government.

As for the northern region, main water resources are small valleys and underground water, which are limited to development in the future, due to the balance with inflows. Accordingly, the water resources available will not be sufficient for future demand growth, particularly for the requirement of mining industries. The only way is to promote the re-use of waste water, or to create pure water from the ocean, considering the present recycling rate of about 17%, and the on-going desalination projects in Antofagasta.

(2) Desalination projects

There is a desalination plant in Arica, which has the production capacity of 206 lt/sec with an efficiency of 75%. The water comes from underground along the Lluta River. Taking into account the initial investment cost, operation and maintenance costs, the production cost of the desalination plant is estimated at approximately US$0.52 per m3, which is regarded to be sufficiently profitable, since the average water tariff in Region I is U$1.27 per m3 as of 1998. There are other desalination projects in Antofagasta and Mejillones. The former one is at the pre-qualification stage for selecting bidding companies. The construction will be started in 2001 by applying the BOT system. The production capacity is planned to be 150 lt/sec in the first stage, and expanding to 600 lt/sec in the final stage. The production cost will be higher than in Arica due to the lower efficiency in the desalination from ocean water. The latter is planned by a Chilean private company, Angamos, and is currently under study. As a consequence, it can be said that the water supply business has great potential for new investment.

(3) Water Rights

Under the Pinochet military government, the water property rights were handed over to private sectors at the request of concessions to use the water for consumption or other purposes based on the privatization policy. Any individual or companies without cost could claim the rights. In addition, the rights do not expire eternally and can be sold to others; furthermore, there is no penalty for holding rights without effective use, which has caused various problems. According to MOP, the majority of water rights are already in the hands of the private sector, therefore, the government is incompetent for

water resource development, even if a development plan is established. In order to cope with this situation, the government is now preparing a new law to promote effective use of water resources by introducing a penalty system for holding rights without effective use.

15 NATURAL ENVIRONMENT AND NATURAL RESOURCE MANAGEMENT

15.1 Environmental Factor in Promotion of Investment and Export: Global Context

Recently, a new perspective is emerging regarding the relation between development and environmental protection in the global framework. It has been believed for a long time that an adverse relationship exists between the environment and development. However, today, it is more commonly accepted that both environmental protection and economic efficiency can, and should, be achieved simultaneously. Also, "newly discovered" values regarding environmental factors are opening new opportunities in the world market as exemplified by sales of new products that are "environmentally friendly." Therefore, a challenge for any country today is how to minimize environmental stress caused by economic growth while maximizing the benefits of its environmental endowments. To achieve this, it needs to adapt to a new system that incorporates environmental factors into production.

15.2 Chilean Export and Investment in Relation to Natural Resource Management

15.2.1 Export and Natural Resource Management

Chile's market liberalization in 1974 has had positive effects on Chilean exports. The value of exports (fob) increased almost 7 times from US$2,151 million in 1974 to US$ 15,615 million in 1999 (Banco Central de Chile, 2000). However, the growth of exports has increased pressure on natural resources such as mines, forests and fisheries.

Table 15.2.1 Composition of Exports

(%)

	1986	1994	1995	1996	1997	1998	1999
Non processed Natural Resources	66.1	55.9	58.8	57.9	58.6	54.5	54.2
Processed Natural Resources	29.4	29.0	28.8	26.9	26.4	27.2	28.4
Processed Non Natural Resources	4.5	15.0	12.4	15.2	15.1	18.3	17.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: Calculation based on data from Banco Central for data between 1994 to 1999
Non-processed Natural Resources include: mining, agriculture-forestry-fisheries. Processed Natural Resources include products that are under category of industry but based on natural resources extracted in Chile. Processed Non-Natural Resources are products that are under category of industry but not based on natural resources extracted in Chile. Processed Natural Resources include the following: fishmeal, wood products, paper and paper products, chemicals, fisheries-related products, agricultural products related products.

Sources: Figueroa et al. "Sustainabilidad ambiental del sector exportador" en Sunkel (ed) Sustentabilidad Ambiental de Crecimiento Económico Chileno, Santiago Chile 1996
Banco Central Informe Económico y Financiero, January 2000

Table 15.2.1 shows how Chilean exports are dependent on natural resources. Although "processed non-natural resources" increased their share considerably during 1986 and 1999, Chilean exports as a whole are still highly dependent on natural resources. In 1999 "non-processed natural resources" and "processed natural resources" accounted for more than 80% of the total export value.

As for industries, a study by Schaper (1999) shows an increase in the export volume of "dirty industries (*industrias sucias*)"[1] during 1980 and 1996 from around 2 million to 4 million tons annually. This increase, according to the study, was primarily caused by substantial increases in the export of pulp, scrap paper, paper and carton and semi-manufactured copper. Their export doubled, quadrupled, tripled and doubled respectively during the same period. The increase of exports from "dirty industries" implies increased pressure on the natural environment such as air, water and soil.

Chile, in the past decade, has achieved high economic growth owing mainly to the growth of exports. However, this high export growth was achieved by the exploitation of both renewable and non-renewable natural resources.

15.2.2 Investment and Natural Resource Management

Environmental degradation is a consequence of both production and consumption within a country and within its export markets. Apart from national regulations and corporate strategies, the environmental effects of foreign direct investment (FDI) depends on a combination of macro and micro factors. At the macro level, the factors include the profile of FDI, the type of industry in which FDI takes place and especially the extent to which it involves pollution-intensive activities. At the micro level, the factors are specific decisions that transnational companies make regarding their management of production activities and applications and diffusion of environmentally sound technologies.

As mentioned in Section 1.4 above, Chile received a total of US$40,654 million FDI between 1974-1999 under DL600. The sectoral shares during the 1990s show a concentration of FDI in the natural resource sector, mainly mining, until 1995. The natural resource sector's share declined after 1996 due to the drastic increase of foreign direct investment in services (US$1,958 million in 1996), mainly the financial sector, as well as in public utilities (US$4,559 million in 1999). Nonetheless, FDI in Chile has been concentrated in those sectors that extract natural resources. This profile of FDI in Chile makes the environmental factor a crucial issue to consider in continuing its economic growth (Figure 15.2.1).

The macro profile of FDI is very much influenced by the specific decisions of individual transnational companies. Their decisions are generally influenced by the investment incentives available in Chile. Several measures have existed to increase investment in Chile. First, the Foreign Investment Statute, DL 600, has given foreign investors a facility to invest in Chile. This allows transnational corporations to invest in relatively strong sectors of Chile, such as mining. Also, the Forestry Law (*Ley Forestal*) enacted in 1974 gave back 75% of the actual cost of forest plantations to the investor together with other benefits, until 1994. This scheme increased investments in the forestry sector by expanding the areas under plantation. Furthermore, the debt-equity swap measures taken by the Central Bank of Chile facilitated the FDI by reducing investment risks during the period of 1984-88.

[1] The "dirty industry" is defined as those industries that require high expenditure to reduce and control contamination according to the U.S. standard based on information obtained in 1988. Schaper, Marianne, "Impactos ambiental de los cambios en la estructura exportadora en nueve países de América Latina y el Caribe 1980-1995" Serie de Medio Ambiente y Desarrollo no.19, CEPAL, Santiago.

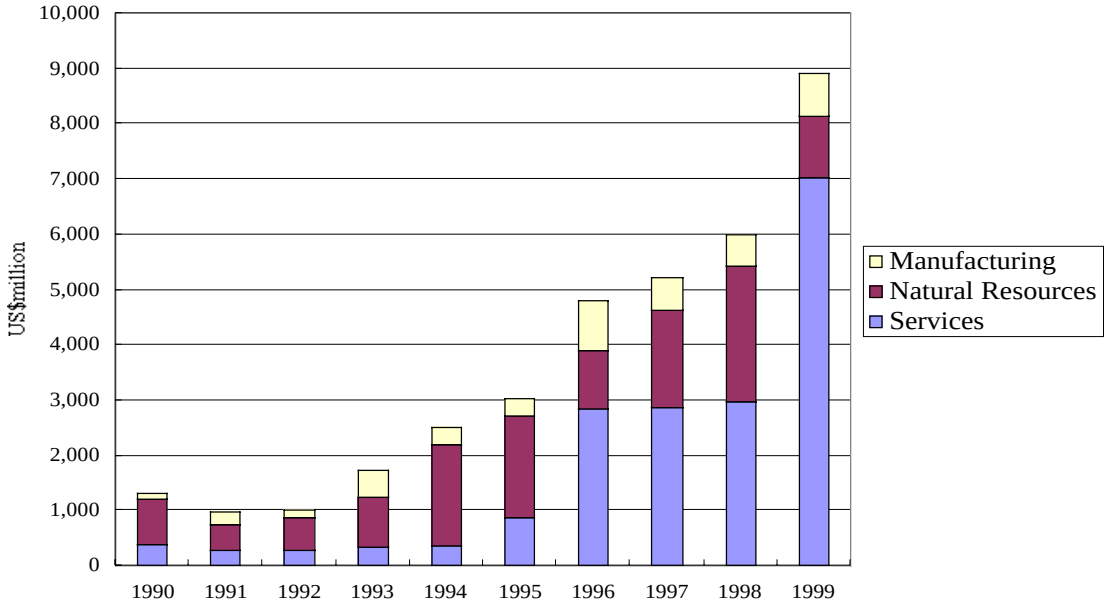


Figure 15.2.1 Evolution of Foreign Direct Investment in Chile by Sectors (DL600)

Note: Materialized base
Source: Foreign Investment Committee

Environmental regulations to protect natural resources from over-exploitation, on the other hand, were introduced much later in the 1990s. The Basic Law for Environment[2] (*Ley Bases Generales de Medio Ambiente* No.19300) and Regulation of Environmental Impact, Supreme Decree No. 30 were enacted in 1994 and 1997 respectively. The latter, Regulation of Environmental Impact, has established "Evaluation of the Environmental Impact System (*Sistema de Evaluación Impacto Ambiental*: SEIA)." This System requires that all projects or activities susceptible to causing an impact on the environment be subjected to an evaluation.[3] The General Law of Fish (*Ley General de Pesca*) was also reformed to include the conservation of fishery resources as an objective by strengthening the control measures over the volume of fish catches in 1992.

These antecedents indicate that until 1997 Chile provided investment incentives without strong measures to evaluate, control or monitor the use of natural resources and environmental damages. This may have caused negative impacts on the natural resources as well as on the environment. Considering that the Chilean economy is heavily dependent on natural resource exports, appropriate environmental regulations should be applied after careful study of current environmental conditions.

15.3 Environmental Problems in Chile

In the 1990s, Chilean economy grew at an annual average of 6.5% thanks to a strong export sector, which doubled export value in the decade to around US$16,000 million in

[2] This law regulates "the right to live in an environment free of contamination, the protection of the environment, the preservation of nature and the conservation of the environmental patrimony."
[3] An environmental impact is defined as "the alteration of the environment, directly or indirectly provoked by a project or activities in a determined area."

1999 (Ministerio de Economía, 2000). The development of trade and investment in the1990s has brought economic gains to Chile. However, like in other countries, this has resulted in environmental problems.

15.3.1 Environmental Problems in Zones

The territory of Chile is extensive, running 4,300 km from north to south. This characteristic gives Chile diversity in climate, geography and natural environment. Due to this natural condition, the environmental problems in the five zones are quite diverse.

The study done by Espinosa et al. (1994) reveals zonal differences according to the types of problems (Table 15.3.1).

Table 15.3 .1 Environmental Problems by Type and Zone

	North	Central	M.R.	South	Austral	Total	%
Deterioration of natural resources	72	65	29	140	49	355	27.4
Deterioration of constructed environment	151	74	69	166	30	490	37.9
Occurrence of contamination	128	109	38	133	41	449	34.7
Total	351	248	136	439	120	1294	100.0

Source: Based on Espinoza, Gross and Hajek, Percepción de los problemas ambientales en las regiones de Chile, CONAMA, 1994.

According to this study, Chile had 1,294 different environmental problems of which 27% correspond to the deterioration of natural resources, 35% to the occurrence of contamination and the rest, 38%, to the constructed environment or problems related to the living environment. Amongst these environmental challenges, problems related to air, water, soil and natural resources are highlighted (Figure 15.3.1).

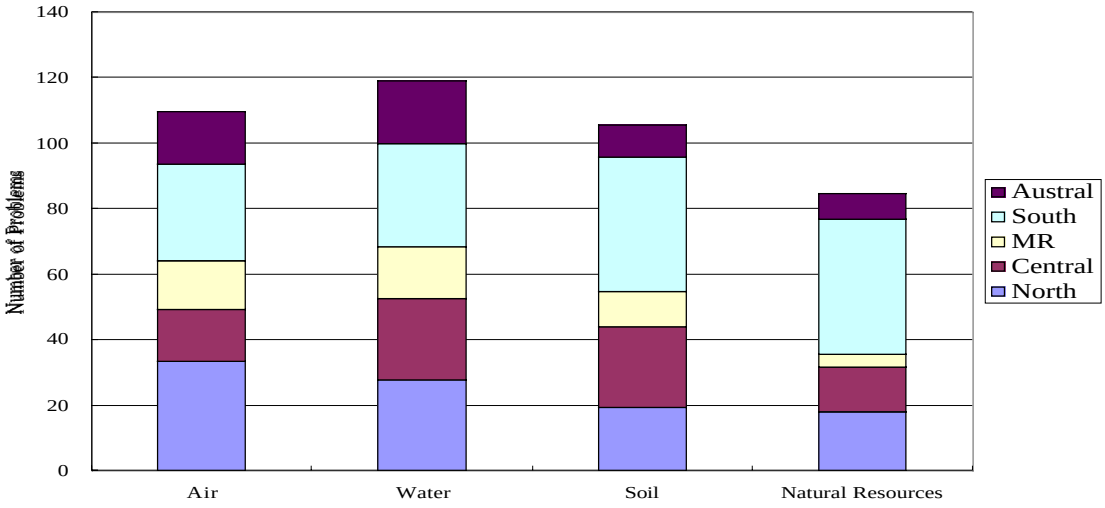


Figure 15.3.1 Major Environmental Problems by Zone

Source: Based on Espinoza, Gross and Hajek, Percepción de los problemas ambientales en las regiones de Chile Conama, 1994.

As can be observed from Figure 15.3.1, the five zones have similar types of problems. However, their composition differs due to the differences in economic activities, climate and geographical conditions of each zone. Therefore, policy and measures for solving these problems cannot be decided without considering regional or zonal factors. The National Environmental Commission (Comisión Nacional del Medio Ambiente: CONAMA), since its establishment in 1994, has worked to lay the foundations for environmental administration by establishing principles for Chilean environmental policies. Nevertheless, improvement of environmental quality cannot be achieved without taking regional realities into consideration.

Environmental problems may be better tackled at the regional level because they are basically location-specific. Even the same kind of problem may require different approaches in different localities, whose geographical, climatic, economic or social characteristics naturally differ. Therefore transferring environmental management responsibilities from the central to the local tiers of governments may result in better environmental management. It is true that there are pros and cons for decentralizing environmental management responsibilities. However, considering the difficulty of setting correct priorities and selecting flexible and cost-effective instruments based on the largest possible range of interests in a given territory, decentralization may offer new alternatives in solving environmental problems (Margulis, 1999).

CONAMA and the Regional Environmental Commission (Comisión Regional de Medio Ambiente: COREMA) are currently working together to establish a regional environmental policy that will be in line with the decentralization policy of the current government. The exercise assumes that the environmental policy must materialize in the regional contexts with the consensus and participation of local residents.

15.3.2 Environmental Problems by Sector

(1) Agriculture

Market liberalization has had a strong impact on agriculture for export. The growth of fresh fruit production was remarkable, increasing by 130% between 1990 and 1997 (ODEPA, 1998). However, the expansion of agricultural production has caused serious environmental problems through excessive and inadequate use of agro-chemicals (pesticides, fertilizers, etc.). The use of agro-chemicals raises long-term environmental risks in terms of damage to human health as well as to the natural environment, especially to soil. Therefore, in order to avoid further exploitation of and damages to the environment, a sustainable agricultural system must be incorporated.

Environmental audit and control in this area is realized by the Agriculture and Livestock Service (*Servicio Agrícola y Ganadero*: SAG) based on the Agrochemical and Contamination of Rural Environment Law (*Ley Agroqímica y Contaminación de Medio Rural)*. SAG is an organism belonging to the Ministry of Agriculture and unlike other organizations, has means of punishment in addition to audit and control. The Office of Agricultural Study and Policy (*Oficina de Estudios y Políticas Agrarias*: ODEPA), the policy making body belonging to the Ministry of Agriculture, proposes the improvement of degraded soils and clean agriculture as a new goal for the period 2000-2006 (ODEPA, 2000).

Although the issue of contamination caused by agriculture is being identified, detailed and more specific information regarding soil damage is still lacking at the regional level. Also, a recent report published by the University of Chile states that programs implemented by the Ministry of Agriculture and SAG are still limited in scope and should be expanded (University of Chile, 2000).

(2) Fisheries

The fishery sector was very dynamic in the Chilean economy during the 1990s, when this sector increased its share of GDP drastically from 2.2% in 1974 to 12% in 1994. However, this boom was achieved at the cost of over-exploitation of marine resources and the contamination of water caused by an increase in aquiculture. According to a recent report, out of 135 exploited, only one, *merluza común,* currently maintains the quantity similar to its pre-exploitation level (University of Chile, 2000). Hence, fishery production is in danger of a drastic decline in the future. This is exemplified by the case of *Jurel*, which decreased disembarks by 60% in 1998. Thus, the major issue for extractive fishery is the control of fishery resources.

Given the above conditions, aquaculture has emerged as a more stable source of income. Although aquaculture has been introduced only recently, it grew drastically in the past 10 years. A major environmental problem caused by aquaculture is water contamination resulting from wasted organic materials, use of antibiotics and other types of drugs to prevent diseases among cultivated fish. Hence, there exists control in the establishment of aquaculture.

The entities responsible to audit and control the exploitation of marine resources as well as the use of costal areas for aquaculture are the National Fishery Service (*Servicio Nacional de Pesca* :SERNAPESCA) and the General Direction of Marine Territory (*Dirección General del Territorio Marítimo y Marina Mercante)*. The latter organization is also responsible for punishing those violated within its jurisdiction. The General Law of Fishery and Aquiculture 1991 (*Ley General de Pesca y Acuicultura de 1991*) and the Supreme Decree (*Decreto Supremo*) National Policy for Use of Costal Areas of Republics (*Política Nacional de Uso del Borde Costero del Litoral de la República) are responsible for defining these functions.* Based on this law, SERNAPESCA is currently regulating the amount of disembarking of marine resources and issues the prohibition of extraction. However, due to the limitation of human resources in SERNAPESCA, complete control and audit of marine resources has been difficult to achieve. SERNAPESCA is also in charge of permitting the practice of aquiculture along the coastal areas. Due to the rapid expansion of fish cultivation, demand for permission has increased. However, SERNAPESCA is not able to answer the needs in such a short period of time due to the same reason mentioned above. Also, owing to the various uses of the coastal areas, such as port facilities, recreation and tourism in addition to fishing and aquiculture, contamination is increasing. Therefore, a clear and long-term policy regarding the use of this area is becoming increasingly necessary.

(3) Forestry

In the past decade, exports from the forestry sector doubled from US$855 million to US$1,955 million. The development of the forestry sector can also be observed in the

degree of the elaboration of products. Table 15.3.2 demonstrates a decrease in exports of low value-added products such as chips and logs and an increase in the share of more value-added products including secondary products. This increase in more value-added wood products, such as paper, cellulose, sawmills, and panel-makings, is causing more industrial pollution (water, air) and an over demand for industrial water.

The growth of plantation forestry is accompanied by several environmental concerns. One of the most serious is the loss of bio-diversity. A few types of trees dominate the plantations such as pine and eucalyptus, which threatens the existence of native forests in the south zone. The loss of bio-diversity forces the forests to become vulnerable to pests and weeds, which obliges the use of fertilizer and chemicals. These practices eventually lead to water and soil contamination.

The burning of native forests to replace them with plantation forests is often observed in the southern regions. The Government has begun a policy of preservation through collaboration between public and private sectors and environmental groups.

The National Forestry Corporation (*Corporación Nacional Forestal*: CONAF) is responsible for the audit and control of the forestry sector. This organization is in charge of the management plan for forests, the audit and control of forestry resources, the compliance of the SNASPE norm (*Areas Silvestres Protegidas del Estado: National System of Wildlife Protection*) and the management of national parks. Also, the organization that is dependent on CORFO, the *National Forestry Institute* (*Instituto Nacional de Forestal:* INFOR), controls and investigates forestry resources as well as research concerning environmental protection related to forestry. These organizations attempt to control areas for plantation as well as the conservation of native forests.

It must also be mentioned that the forestry area is under dispute among government officials, the private sector and the indigenous population in Chile regarding its ownership and management. Also, the General Law of the Forest (Ley General de Bosque) is currently under consideration especially regarding the use of native forests.

Table 15.3.2 Forestry Export 1990 and 1999

(%)

	1990	1999
Chemical Pulp	37.4	39.0
Sawn wood	15.9	8.8
Chips	12.8	6.8
Secondary Products	11.1	24.5
Papers and Cartons	9.6	10.7
Logs	8.7	2.4
Panel and Chapas	2.6	5.9
Others	2.0	1.8
Total	100.0	100.0
Total amount (US$M)	855	1,955

Source: Paredes, Gonzalo. "El Sector Forestal y el Instituto Forestal 1994-1999", March 2000.

(4) Mining

Although the relative importance of this sector has decreased from 46% of exports in

1990 to 38% in 1999 (MINECON, 2000), the mining sector still occupies an important position in the Chilean economy. Contamination caused by the sector include: water contamination due to the under-provision of treatment; air contamination due to the smelting of ore; and soil contamination due to the abandoning of industrial solid wastes such as tailings, used water and related used materials.

In general, copper mines have fewer problems than mines of other metals such as gold, silver and iron, as a result of the earlier implementation of the regulation and technological improvements made by large and often foreign-owned companies. Therefore, it could be said that small-scale and domestic companies have more difficulties to invest in environmental facilities due to the lack of capital and access to technology.

The organization in charge of the auditing and control of mining material is the *Servicio Nacional de Geología y Minería* (SERNAGIOMIN). Several reports are issued on contamination caused by mines in both water and air; however, in general, detailed investigation of damages caused by such contamination is limited. Regional institutions for health, such as the Regional Health Service, audit the contamination that affects the health of human beings at the regional level. Although large-scale enterprises claim that they are equipped with necessary environmental equipment, it is stated that very little information regarding the impact of contamination caused by large-scale mines is known and no information exists regarding medium and small-scale mines (University of Chile, 2000).

(5) Manufacturing

The manufacturing sector has grown during the 1990s. The selected types of manufacturing industries that have some environmental impact are compared in Table15.3.3. This shows an important increase in physical production with an exception of the wood industry. The growth of other sectors sited in the Table demonstrates increasing pressures demanded on the environment. The types of environmental problems caused by this sector are mainly water, air and noise pollution. These contaminations are monitored and controlled by the Metropolitan Health and Environment Service (*Servicio de Salud del Ambiente de la Región Metropolitana: SESMA*) in the Metropolitan Region, the Regional Health Service (*Servico Regionales de Salud*) in other regions and the Super Administration of Health Services (*Super Intendencia de Servicos Sanitarios).* Additionally, existing regional water companies are also involved in water treatment.

Table 15.3.3 Index of production of manufacturing Industry 1990-1998

	General index	Tabacco Industry	Wood industry except furniture	Manufacturing of furniture except metalics	Refinery of petrol	Products derived from petrol and carbon	Manufacturing industrial chemicals	Manufacturing of papder and its products
1990	101.3	104.9	118	86.9	102.8	110.8	97	104.7
1991	105.7	105.6	117.3	98.4	105.1	130.9	101.9	115.6
1992	118.4	114.9	112.9	112.3	108.9	164.6	115.6	144
1993	120.3	111.1	113.8	127.6	115.1	158.3	119.2	144.1
1994	127.9	111.1	116.8	134.1	122.4	227.4	126.1	153.3
1995	135.8	112.1	113.2	135.8	134.3	190.7	132	162.7
1996	139	119	117.4	129.6	139.8	224.1	137.7	165.6
1997	144.6	128.8	118.4	128.6	141.1	226.5	163.7	160.8
1998	143	132.8	110	119.5	155.5	252.8	175	164.5

Source: INE, 1995, 1999

It has been reported that high percentages of industrial swage are being discharged without necessary treatment causing both environmental and health damages. This is especially true for the north zone with the existence of mining industries and the south zone with the existence of pulp and food-related manufacturing industries. Some major companies are introducing water treatment systems; however, very few small and medium scale industries are introducing the system. As for air quality, some advances are observed in the Metropolitan area as a result of emission control, conversion of fuels to natural gas and the relocation of industries outside of the Metropolitan area. However, similar problems have recently appeared in other cities such as Temuco.

In order to improve pollution and contamination caused by the manufacturing sector, the Clean Production Policy (*Política de Fomento de Producción Limpia*) has been in force since 1998 with an initiative implemented by the Ministry of Economy and the participation of various public and private sector entities. This policy basically assists contaminating industries to improve their production process. For example, it provides a grace period for the implementation of environmental regulations by CONAMA and assures that sectoral agreements and commitments are realized to achieve a reduction in the level of contamination. In 2000, the pulp, foundry, sawmill, chemical, porcine and construction sectors signed an agreement with the Secretary of Clean Production under the Ministry of Economy and CORFO.

15.4 Environmental Factors to Enhance Export, Investment and Sustainable Development

As mentioned earlier, the environmental factor is restrictive to the growth of the economy on the one hand, but it could also allow new opportunities for economic development on the other.

15.4.1 Export: Introduction of New Standards and Possible New Products

Trade has been a motor of economic growth in Chile during the past decades. Although market diversification has been achieved, about 60% of Chilean exports still are directed to developed countries. Consumer preferences in such countries play an important role. In this context, rising environmental consciousness amongst consumers in developed countries will have a significant influence on Chilean export performance.

(1) International Environmental Standards

Environmental consciousness in developed countries has heightened considerably in the past decades. The first reaction for the change was reflected in the application of stricter environmental regulations at the national level. Later, these countries started to apply their standards to imported materials thereby creating non-tariff barriers to products from countries with lower environmental standards. This is due, first, to consumer preferences and protection and, second, to protection of domestic producers, who are under "stricter" environmental regulations than those producers in developing countries. The developed countries claim that developing countries are not paying the cost for environmental management thereby their products are subject to "eco-dumping".

The application of domestic regulations to the third country is clearly against rules determined by the World Trade Organization (WTO). Several cases have been studied

however the WTO generally ruled against the claim made by developed countries. As a result, developed countries have introduced new types of standards at the international level to differentiate products in a more transparent way. These standards are environmental labeling and international certification and are on a voluntary basis and non-discriminating. In this way, their application does not violate the rules set by the WTO.

Environmental labeling (eco-labeling) is a popular tool to promote environmentally preferable consumption and production patterns. The basic concept of eco-labeling is to apply the same rule to all products in the market irrespective of their origin. The environmental certification most prevalent at the global level is ISO 14000. These types of standards are on a voluntary basis and internationally recognized.

Obtaining the environmental certification mentioned above implies greater access to markets and higher market prices for the export products. Although the benefit of the certification is evident, only seven companies (Table 15.4.1) are certified with ISO 14000 in Chile (as of May 19, 2000). This number is very small compared to other Latin American exporters such as Brazil, Argentina and Mexico, which have 88, 63 and 48 certified companies respectively (as of June 1999).

Table 15.4.1 Chilean Enterprises Certified with ISO 14000

Sector	Company	Location	Products
Foresty	Licancel	VII Region	Celulosa
	Forestal Santa Fe	VIII Region	Celulosa
	Forestal Millalemu	VIII Region	Celulosa
	Forestal Monte Aguila	VIII Region	Wood
Mining	CIA Minera La Escondida	II Region	Copper
	CIA Minera Candelaria	III Region	Copper
Industry	Cemento Melon	M.R.	Cement

Source: Data obtained from ProChile as of May 19, 2000

Considering the importance of Chilean exports in the economy, it may be necessary for Chile to realize the importance of these international environmental standards in order to better compete with other countries.

(2) Opportunities for New Export Products

Changes in consumer preferences often create a market niche. The rising awareness of environmental issues among consumers in developed countries is, in reality, offering opportunities for exporting countries such as Chile.

In this context, the possibility of producing organic products[4] in Chile may be considered. As mentioned earlier, the agriculture sector requires an ecologically balanced system of production to maintain sustainable production. Hence, the possibility of organic production could prove important not only to take the advantage of new opportunities in the global market but also to maintain agricultural sustainability.

[4] Organic agriculture is defined as "an integral system of agro-fishery production based on ecologically practice, whose principal objective is to reach a sustainable productivity in conservation base and/or recuperation of natural resources and that restrict the use of products with chemical and synthetic origin" Instituo Nacional de Normanización: INN, *Norm for the Production, Processing, Labeling and Marketing of Organically Produced Foods* (NCH 2439 OF 1999).

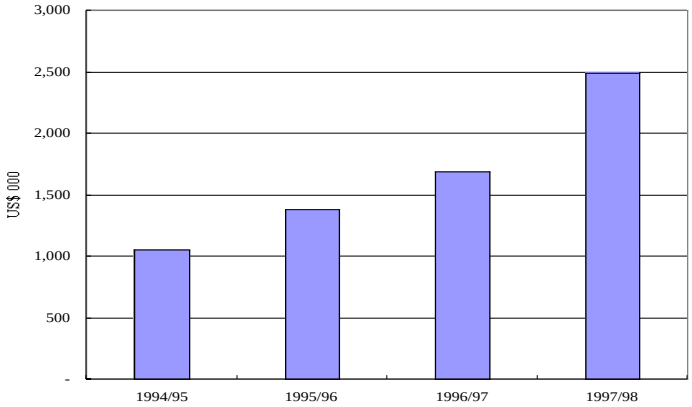


Figure 15.4.1 Value of Exports of Organic Products

Source: ProChile, Gerencia de Alimentos, 1998

It is said that the organic food market at the global level expanded 10 times during the period of 1980 to 1992 and is expected to expand at a rate of 20-30% in the next 10 years (Duhart, 1999). Chile began to produce organic products around the year 1990. Although relatively little attention has been given to the products, the Chilean export value of organic products increased by 1.5 times from 1994/5 to 1997/8 (Figure 15.4.1).

It is evident that there is a need to conduct careful market research abroad to select appropriate lines of products and destinations. Also, scientific and technological research is necessary to evaluate the natural potential of Chilean agriculture in the production of organic food.

Wood-processing products from sustainable forests are another kind of environmental product that Chile may potential to develop. It is reported that environmental conscious consumers prefer wood products that are made from trees from sustainable forests. Further market research is also essential to promote these new products.

Organic food production may be introduced to almost any type of food production that is based on natural resources such as aquaculture, livestock and lactose. Over and above, the enlargement of the production base for organic products may allow for the future development of organic industries that utilize these products as inputs (e.g., cosmetics). A study in Europe indicates that the profit margin of processed organic products is 80-150% while non-processed organic products has a profit margin of 15-30% (Rodriguez and Kern, 1996).

Finally, it should be noted that the products mentioned above would guarantee better market access and higher prices only when they are certified with or meet the international standards recognized by the importing countries. Therefore, the creation of environmentally sound new products must always proceed hand-in-hand with compliance of international standards.

15.4.2 Investment: Incentive Mechanisms for Environmentally Friendly Foreign Investment

Several studies have proved that environmental factors are not a decisive factor for a company to make investment decisions (Low and Yeats, 1992, Lucas, Wheeler and

Hettige, 1992, Birdstall and Wheeler, 1992). These studies have demonstrated that investment decisions are much more influenced by other factors rather than environment such as geographical location, cost and human resources.

However, as mentioned earlier, investment incentives from host countries can influence the type of environmental technology or policy that the investing company will apply to its operation in the host country. For instance, when it comes to managing the environment, investors have a set of strategies available to them. Their choice can be the "end-of-pipe" strategy, which primarily utilizes the "add-on" technology to dispose of the waste. It can also be the "clean-up" or "process-oriented" strategy with which environmental damage is prevented from the outset. Their choices may reflect their different perceptions of environmental challenges. If there were constraints with the resources or the technology available, the investor may choose the "end-of-pipe" strategy. In contrast, if environmental protection is viewed as a challenge and is integrated into decisions regarding business profitability, firms tend to pursue process and product-oriented strategy for environmental management.

The *World Investment Report 1999* (UNCTAD, 1999) states that the following factors may influence the choice. Those are (1) extent of environmental impact, (2) implications to the benefit of the company, (3) threat of liability, (4) host country's future intentions towards environmental issues, (5) reactions from the consumer market, and (6) home (investor's) country regulations for overseas investment.

The promotion of preventive environmental technology is in line with Chile's Clean Production Policy (*Política de Fomento de Producción Limpia*). This policy has been in force since 1998 headed by the Ministry of Economy with participation of various public and private entities. Within the framework of this policy, CORFO, together with INTEC, has been working closely with domestic enterprises, especially small- and medium-scale ones, to incorporate pollution preventive strategies in their production processes. Nevertheless, no attempts are made to link foreign investors, the source of new technologies, to this Clean Production Program.

As mentioned earlier, Chile is a country whose economy is dependent on natural resources. Hence it is in its best interest to control and monitor the quality of the environment in order to achieve continuous growth. In this context, it may be advisable for Chile to incorporate incentive mechanisms into the current regulatory framework for foreign investors. The mechanisms are to make their production activities environmentally sound through the application and diffusion of technologies that are not "end-of-pipe" but facilitate clean production (p*roducción limpia*).

Incentives for investors may become crucial for Chile to control the global environmental problem. In 1992, Chile became a party to the United Nations Framework Conventions on Climatic Change (FCCC). Since 1996, specific working groups have been formed within the Chilean government who are working towards several objectives contemplated in the convention. The objectives, among others, are to promote the ratification of the Kyoto Protocol, to have the relevant sectors and Chilean specialists participate in the discussion on economic mechanisms set forth in the Kyoto protocol, and to apply the Clean Development Mechanisms (CDM) and design basic guidelines on new ways to limit or reduce the emission of greenhouse gases in developing countries.

The Kyoto Protocol, the outcome of the third meeting of FCCC, sets the CO_2 emission quota for developed countries and contemplates the market of CO_2 emission right for adjusting the amount of emission at the global level. Issues such as sharing emission burden with developing countries as well as the emission market are still not clearly defined. However, because of its geographical and climatic conditions, Chile may benefit from many of the points inside of this framework. For instance, it will be beneficial to develop renewable energy sources (solar, wind, water) or to sell the CO_2 emission right available in the form of forestry reserves. Examples include a renewable (wind) energy project for rural electrification and an investigation on the role of forests in capturing CO_2 emission (CONAMA, 1999), both currently underway (Table 15.4.2).

Table 15.4.2 List of Projects Sponsored by CONAMA in the Capacity of Implementation

Project	Requested institution
Capture of Carbon, Rio Condor	Fundacion Chile
Capture of Carbon, Forestal Inversiones S.A	Fundacion Chile
Wind Energy in Northern Chile	CODELCO/International Institute for Energy Conservation, U.S.A
Chile Natural Gas Project	International Greenhouse Partnership Office, Australia
CHILLPAVE: Chile Cold Mix in Place Recycled Asphalt Pavement Greenhouse gas Reduction Project	Pontificia Universidad Catolica de Chile
Project on Capture of CO2 sponsored by CONAMA	
"Medicion de la Captura de Carbono en Bosques de Chile y Promocion en Mercado Munidal de Carbono" (Measurement of Carbon Capture in Chilean Forest and Promotion of World Market of Carbon)	CEFOR(Centro de Estudio Forestales)/Universidad Austral
"Demostracion del Aumento en la Captura de Carbono en Bosques de Chile Mediante Inoculacion de Plantulas" (Demonstration of Increase in Capture of Carbon by Chilean Forest through Innoculation of Seedlings)	Instituto Forestal

Source: CONAMA Primera Comunicación Nacional Bajo la Convención Marco de las Naciones Unidas sobre el Cambio Climático, 1999

These attempts are sill incipient. However, with the formation of an international consensus together with the introduction of incentive mechanisms for investment, Chile may be able to have investments and technologies that are environmentally sustainable and economically viable.

Finally, information regarding environmental regulations, laws and incentives for investors is not well documented in Chile. This kind of information may become useful in guiding investors towards more environmentally sound business practice.

REFERENCES

Banco Central de Chile. 2000. *Informe economico y financiero* al 15 de enero de 2000. (Santiago)

Birdstall, Nancy and Wheeler, David. 1992. "Trade policy and industrial pollution in Latin America: where are the pollution havens?" in *International trade and the environment.* Patric Low, ed. World Bank discussion papers no. 159. (World Bank: Washington, D.C.)

CONAMA. 1999. *Primera Comunicación Nacional: Bajo Convención Marco de las Naciones Unidad sobre el Cambio Climático.* (Santiago)

Duhart, Jacques. 1999. *Apertura for II Seminario International Comercio de Alimentos Orgánicos.* (Santiago)

Low, Patric and Yeats, Alexander. 1992. " Do dirty industries migrate?" in *International trade and the environment*. Patric Low, ed. World Bank discussion papers no. 159. (World Bank: Washington, D.C.)

Lucas, Rober; Wheeler, David and Hettige, Hermanala. 1992. "Economic development, environmental regulation and the international migration of toxic industrial pollution 1960-88." *Policy research working paper,* no. 1062. (World Bank: Washington, D.C)

Margulis, Sergio. 1999. "Decentralized environmental management." A paper presented at the Annual Bank Conference on Development in Latin America and the Caribbean. (World Bank Institute: Valdivia)

MINECON. 2000. *El desarrollo economico en la decada de los años noventa*. www.minecon.cl.

ODEPA. I997. "Frutas, hortalizas y agroindustria." *Documento de trabajo* 12. (ODEPA: Santiago)

Rodríguez, Jaime and Kern, Werther. 1996. "Perspectivas de comercialización y certificación de productos orgánicos chilenos." A paper presented at the Seminario International: *Producción y Comercialización de Productos Orgánicos*. (Universidad de Chile: Santiago)

UNCTAD. 1999. *World investment report 1999*. (The United Nations Press: New York)

University of Chile. 2000 *Informe País. Universidad de Chile, Santiago*, Chile