

# **A Structural Analysis of Chile's Long-Term Growth: History, Prospects and Policy Implications\***

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# **A Structural Analysis of Chile's Long-Term Growth: History, Prospects and Policy Implications**

## **I. Introduction**

In 1997, Chile's Gross National Product per person was \$US 5,020, which placed Chile 32nd in the world out of the 133 countries ranked by the World Bank (1998). Correcting for differences in purchasing power across countries, the World Bank's estimate of Chile's PPP GNP was \$12,080, placing Chile 27th in the world rankings. The Human Development Index (HDI) of the United Nations Development Program combines GDP per capita with two other indicators, of life expectancy and education, to create a broader-based indicator of the quality of material well being. On the HDI, Chile ranks 34th in the world out of 174 countries. Chile's life expectancy and education indicators in 1997 were slightly below the average of the high-human development countries: life expectancy at birth at 74.9 years (average, 77 years), adult literacy at 95.2 percent (average, 98.3 percent), and the combined first, second, and third-level enrolment ratio at 77 percent (average 89 percent).

These indicators therefore suggest that Chile is among the successful countries in the world (top sixth), but not among the very top. Formally, the World Bank ranks Chile as a high middle-income country, not a high-income country. Chile's economic performance has been exemplary since the mid-1980s, with average growth in real GDP per capita at 5.4 percent between 1984 and 1997, one of the fastest rates in the world. Continued rapid growth would narrow the income gap

between Chile and the richest countries rapidly, since the advanced countries have averaged per capita economic growth of around 2 percent in the same period.

The question is, then, at which speed can Chile close the gap in time, considering that in PPP terms Chile's 1997 income (\$12,080) was 42 percent of U.S. income (\$28,740). To answer this, we can use the findings of recent empirical economic research. Barro (1997) estimates a speed of convergence of 2.54 percent per year, for a sample of 100 countries in the period 1960-1990. This number refers to the average convergence of the countries in the sample, and thus probably represents a lower bound for Chile, which has been performing significantly better than the average over the past 15 years. Under this scenario and assuming that the U.S. grows at an average annual rate of 2 percent up to 2020, Chile's PPP income would reach \$28,080 in 2020, or 61.7 percent of U.S. income at that time (\$45,526). In constant dollars, this represents \$17,319, for an average growth rate of 5.4 percent.<sup>1</sup> By 2010, the bi-centennial of Chile's independence, the country's per capita income would be \$10,722.

Under a more optimistic scenario, by 2020 Chile may get to \$30,351 in PPP terms, or 70 percent of U.S. income, with a speed of convergence of 3.9 percent per year. In constant dollars, this is equivalent to \$22,308 per capita in 2020 (\$11,721 in 2010), an annual growth rate of 6.5 percent for 1997-2020.<sup>2</sup>

This paper, in its broadest sense, is about the task of continued rapid growth in Chile. The central argument is that Chile's relative economic position -- strong but below the top rank of countries -- is heavily related to its overall structural characteristics. Chile has many structural

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<sup>1</sup> Note that the 5.4% growth rate of per capita income is measured in constant dollars. The real growth rate in pesos is about 3.8% per year because as Chile grows faster than the US and "catches up" the peso appreciates by an estimated 1.8% annually.

<sup>2</sup> In this case, per capita real growth in pesos is 4.2 percent annually, and the estimated appreciation is 2.3 percent.

advantages, among them a temperate climate that supports a healthy population and high-valued added agriculture, and vast deposits of copper along with a wealth of other natural resources. Chile has some structural weaknesses as well, such as a very great distance to world markets combined with a relatively small domestic market. These characteristics have fashioned the Chilean economy, and continue to frame its possibilities. To continue Chile's successful development of the past decade and a half, we believe that long-term policy making must be more finely addressed to the structural conditions in which the country exists.

The combination of a great distance from world markets plus large natural resource endowments has long meant that the Chilean economy is heavily dependent on a narrow range of natural-resource exports, especially saltpeter (nitrates) in the period 1870-1930, and copper since then. Mining economies have their pluses (a significant stream of export earnings) but also their profound limitations, mainly a vulnerability to international shocks and a tendency towards stagnation or crisis when a traditional export sector suffers a long-term decline. Most mining-based economies have performed poorly in the long term. The thrust of this paper is that Chile will have to diversify its export base significantly, into manufactures and especially services, if it is to succeed in raising its relative standing in per capita GDP in the next two decades. Much of this will happen as a result of normal market forces, but in our view, such resource diversification also requires a broad policy framework well attuned to that goal, as well as specific public investments in support of that aim.

The current revolution in information technology (IT) can most likely be harnessed to Chile's advantage in the task of export diversification. If one of the key defining elements of Chile's structure has been a large distance from major world markets, then IT can become a great equalizer, by dramatically reducing the costs of communications, and greatly enhancing the flows of

information available at low cost to the Chilean economy. The evidence suggests, however, that Chile is relatively far behind in the mobilization of IT in industry, education, and society at large. More generally, Chile shows continuing relative weaknesses in education, science, and research and development, the social spheres that will prove to be most important in Chile's task of a broader-based, more diversified national economy, and one that is more tightly integrated with the advanced economies.

The paper is organized as follows. Part II discusses Chile's fundamental structural characteristics, and their implications for the country's long-term growth performance. Part III analyzes the worldwide evidence on natural-resource-based economies and long-term growth, and discusses some aspects of Chile's resource abundance. Part IV compares Chile in some detail with New Zealand and Australia, perhaps the two successful countries in the world with the most similar structural characteristics. Part V discusses Chile's future growth prospects over the next 25 years, including the main policy challenges to future high rates of economic growth. Section VI concludes.

## **II. Structural Factors in Chilean Economic Growth**

In recent years, many mainstream economists have tended to see national economic performance as a function of economic policies and political struggle, and have typically neglected the deeper structural factors impinging on an economy. When an economy performs below average, the search gets underway for the alleged policy failures that led to the sub-standard performance. And when an economy outperforms the average, the typical presumption is that brilliant economic policies have won the day. Good economic policies are, indeed, essential. A longer tradition in economics, however, holds that *structural factors* play a crucial role along side economic policy

choices. Such structural variables include climate, natural resource endowments, location in the world economy, ethnic and cultural fractionalization, political situation, and other such variables.

Structural variables have much to teach. Put simply, they are highly explanatory of comparative economic performance, across countries at a point in time, and over time within economies. Consider one important example. Tropical countries are almost uniformly poor, with a couple of small notable exceptions such as Hong Kong and Singapore. Indeed, in the Human Development Index rankings, of the top forty countries, all are temperate-zone economies except for a handful of very small islands (in order of ranking: Barbados, Hong Kong, Singapore, Antigua and Barbuda, Trinidad and Tobago) and one tiny oil-rich state (Brunei Darussalam). On the other side, temperate-zone economies tend to be within the high-human-development category, with the exception of socialist or post-socialist states, war-torn economies, or very isolated economies such as landlocked economies in Central Asia.

The importance of the tropical-temperate distinction is well captured in Figures 1 and 2, which show the average per capita income of human populations residing at various  $10^\circ$  latitude bands. For each country in the world with a population above 1 million, we use a digitized world population map to assign the country's population among the various  $10^\circ$  population bands. As we know the average per capita income for each country, but not the average per capita income across regions of the country, we make the simplifying assumption that all persons within a country have the average per capita income of the country. Thus, within-country regional income differences are neglected (this is for convenience, but is not entirely unreasonable, since internal population migration within a country sharply reduces cross-latitude variations in per capita income). The result in Figure 1 is striking. Per capita incomes are systematically highest in the mid-and-high

latitudes -- that is the temperate-zone economies -- and lowest in the tropics.<sup>3</sup> This result at the worldwide scale also holds within continents. In Figure 2, for example, we see that in the Americas, the Temperate Zone northern and southern regions are the richest, while the tropical band is the poorest. While Chile extends from the tropics (around 18° S at the most Northern point) through the Temperate Zone to the sub-arctic climate of Tierra del Fuego (at 55° S Latitude), most of the population is in the Temperate Zone. Chile's relatively high-income level reflects its basic character as a temperate-zone economy.

Among Chile's fundamental structural characteristics we would include the following four broad categories:

- (1) its diverse climatic zones and physical topography, with population centered in the temperate zone;
- (2) the limited scope of the market, due to: (a) significant geographical barriers to neighboring markets, (b) the very long distance to the major Northern Hemisphere markets, and (c) the modest domestic population;
- (3) significant natural resource endowments; and
- (4) cultural and socioeconomic conditions, including: (a) demographic patterns, (b) long-standing inequalities in wealth and assets, (c) ethnic and cultural homogeneity.

This combination of conditions is of course distinctive. While they offer certain advantages to development, they also pose special barriers as well, and many of these have not been properly addressed in Chile's economic strategies. These structural conditions also suggest some useful comparison cases, including Australia, New Zealand, and Iceland among other countries. These

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<sup>3</sup>Formally, the tropical band is from 23.5° N Latitude (Tropic of Cancer) to 23.5° S Latitude (Tropic of Capricorn). In the Figures, we use 10° bands, so that the tropical band is approximately from 20° N to 20° S.

three countries all exhibit the key conditions of natural resource dependence, a small local market, and great geographical distance from the main markets in North America, Europe, and East Asia.

## *II.1 Climate Zones*

Partly because of its remarkable latitudinal extent of 4,350 km as well as its remarkable altitudinal range (from Sea level to the Andean peaks above 6,800 m.), Chile displays a wide range of climates, shown in Figure 3. In the North, stretching from Peru to around 30° S, lies the desert climate of the Atacama (BW in the Koeppen-Geiger classification shown in the Figure), one of the driest locations on earth. This area contains the richest copper reserves, as well as the nitrate deposits, which constituted Chile's main exports from around 1870 to the First World War. South of the Atacama desert, from around 32° to 37° S, and from the coastal mountain chain to the Andes mountain chain approximately 170 km inland, lies a temperate ecozone, with a large part characterized by a Mediterranean climate of wet winters and warm dry summers (Cs). This region is known as the Central Valley, or the Central Nucleus. The Mediterranean ecozone is almost the Southern Hemisphere mirror image of the California climate, and indeed the current agricultural production of the region -- wines, fresh fruits, other horticulture -- may broadly be characterized as "off-season" California agricultural production. The Central Valley is also suitable for grains (wheat, maize) and temperate-zone vegetables. Further to the interior lies the Andes mountain range, with its tundra climate at higher altitude (H). South of the Mediterranean climate, along the coast lies a sub-arctic, rainy climate, only very sparsely populated and of little economic value (Cf).

Vegetation cover matches the climate zones, with prairie scrub in the coastal north; Mediterranean scrub in the center coastal area; and mountain and tundra vegetation in the far South

and in the Mountain range. Crop cultivation depends on climate zone, soil fertility, and water availability. About 30 percent of the cropland, virtually all of which is in the Central Valley, is irrigated. In addition to croplands, Chile used and uses the scrub lands to the north and at higher elevations, for pasturage.

Table 1 shows the proportions of land area and population within each of these ecozones. The main point to emphasize is that the population is almost entirely concentrated in the temperate Central Valley, with more than 80 percent of the entire population and almost all of the agricultural production, though only 10.5 percent of the land area. The desert, sub-arctic, and mountain regions are only sparsely populated, though the desert region has played a crucial role in minerals exploitation, first in nitrates then in copper.

## ***II.2 Scope of the Market***

The prospects for economic development of any region depend crucially on the scope of the market, not only measured by domestic sales but also by access to world markets. World markets count for several fundamental reasons: most technology and ideas will inevitably be imported rather than produced domestically; for this reason, a large proportion of capital goods must be imported rather than produced at home. A small domestic market will not support an extensive division of labor in manufacturing (and perhaps services) because of fixed costs of production and therefore the imperative to specialize in order to be profitable and to reach an efficient scale of production.

In addition to trade policy, several intrinsic geographical factors determine the scope of the market. The first is the availability and fertility of land for local food production, as this strongly influences the size of the population, and the proportion of the population employed in food

production. The second is the physical conditions for local transport. Coastlines and navigable rivers are important in reducing transport costs *within* the domestic market. A flat topography aids in road building and road maintenance, especially between population centers, agricultural producing centers, and ports. The third is the proximity and transport costs to neighboring markets, as well as the scope of the market in the neighboring economies. The fourth is the proximity and transport costs to major world market centers, such as Western Europe, the United States, and Pacific Asia. Of course, transport costs will depend partly on the kinds of goods that are being shipped, while the choice of goods will depend on transport conditions. The fifth is the availability of high-value-added per unit weight commodities, which can readily be exported to all parts of the world without major effect of transport costs.

Chile has relatively unfavorable conditions on all counts except the last. Though Chile has 749,000 km<sup>2</sup> of total land area, almost the combined size of France (550,000 km<sup>2</sup>) and the United Kingdom (242,000 km<sup>2</sup>), only a small part of the total land is economically useful for food production. Cropland constitutes just 6 percent of the total area (45,000 km<sup>2</sup>), compared with around 32 percent (253,000 km<sup>2</sup>) in the combined area of France and the U.K. As a result, local food production is substantially less in Chile. Chile's population stands at 15 million (or roughly 333 people per km<sup>2</sup> of cropland), one eighth of the 118 million population of France and the U.K. (or roughly 466 people per km<sup>2</sup> of cropland). No doubt part of the limit on Chile's population has resulted from the limited availability of local food production.

Local transport cost conditions are adequate but problematic. On the positive side, a very large proportion of the population is relatively densely concentrated in the Central Valley, which offers low-cost transport between urban areas and croplands. This region, however, is separated from other markets by high costs. The path to the coast, though not far in kilometers, passes through

the coastal mountain range, sharply raising the costs of roads and rail (e.g. requiring expensive tunneling). Only one city of moderate size, Valparaiso (est. population, 283,489 in 1997), exists on the coast, and serves as the major port of the Central Valley. Other main port cities, Antofagasta (est. population 243,038 in 1997) and Iquique (est. population 152,000), serve the mining and fishing operations in the north. Overland costs to the main population centers in Peru are extremely high, with a distance of 3,250 km from Santiago to Lima, and necessary passage through the Atacama desert. Overland trade with Argentina and Brazil, is similarly impeded by the Andes mountains and by very large distances, and so much is undertaken by ship or plane. These neighboring markets are themselves of only moderate size, and have also been in chronic crisis for most of the past quarter century. Their relative improvement in economic condition in the 1990s may prove to be significant for Chile in the future, as discussed below.

Chile has always relied heavily on the major world markets in Europe, the United States, and more recently, Pacific Asia. Yet these markets are very far away. The shipping distance from Valparaiso to New York is 8,454.5 km (19 days 1 h at 10 knots speed), and to Los Angeles is 9,037.3 km (20 days 8h). The approximate shipping distance to Rotterdam is 13,897.2 km (31 days 7h). The only countries facing comparable distances in trade are other Southern Hemisphere countries, including South Africa (Cape Town to Rotterdam 11,558.8 km (26 days 1h)), New Zealand (Wellington to Rotterdam 24,114.7 km (54 days 8h); Wellington to Tokyo 9,338.8 km (21 days 1 h)), and Australia (Melbourne to Rotterdam 25,668.7 km (57 days 20h); Melbourne to Tokyo 8,284.3 km (18 days 16h)). Some countries successfully export a wide range of products to markets very far away, but in most cases, such countries are on major sea lanes (e.g. Singapore) or are close to their major suppliers. Thus, Taiwan and Korea were successful in establishing export-led growth to the U.S. market, relying heavily on nearby Japanese suppliers. Chile was briefly on an important

international sea lane in the mid-19th century, when ships from the East Coast of the U.S. circled to Cape Horn to supply the Western U.S. Valparaiso was, at that time, a major port of call. The combination of the Panama Canal (1914), and the transcontinental railway in the U.S., ended this brief period of trading glory, although the Panama Canal brought Chile substantially closer to Europe and the U.S. Atlantic coast.

### ***II.3 Natural Resource Endowments***

Chile's economic history is highlighted by the exploitation of a few natural resources, especially mining and some agricultural commodities. While copper far and away dominates Chile's mining exports today, that role was played by nitrates in the period between the 1880s and up till World War I, before the discovery in Europe of processes to manufacture synthetic fertilizers. Other lesser mining exports include iron and molybdenum. Before nitrates, Chile briefly exported grains (especially wheat) to neighboring Peru and to California and Australia following their respective gold rushes during the 1840s to the 1860s. However, once grain production began in earnest in the Argentina Pampas, Canada, Australia, and the West Coast of the United States, Chile quickly lost competitiveness in grains. Since the turn of the 20th century, Chile has been a grain importer and, more recently, an exporter of Mediterranean-climate fruits and wines. Chile also exports pulp and paper, based on its endowments of temperate-zone forests (including hardwoods such as laurel and softwoods such as pine).

Indeed, although the climatic and soil conditions have always been present, fruit and wine exports have only become significant in the last two decades. Fresh fruits represented less than 1 percent of total exports up to the mid-1970s. By 1980, however, fruits had climbed to 5 percent of

exports and in the mid to late 1990s they approached 10 percent of the total. The significance of wine exports is even more recent. As recently as 1981-86, wine exports were consistently below \$20 million per year, or less than 0.5 percent of total exports. In 1998, however, exports of wine surpassed \$500 million, or about 3.5 percent of total Chilean exports.

Chile's almost total export dependence on natural resources, a major theme of this essay, is a reflection of two conjoint forces. On the one hand are the plentiful endowments of raw materials, including perhaps one fourth of the world's reserves of copper. On the other hand are the very high transport costs, which have limited the internal division of labor in Chile, and which have permitted the profitable export only of those goods with a relatively low division of labor and a relatively high value added per unit weight so that they could overcome the transport cost barriers.

#### ***II.4 Population, Culture, and Ethnic Patterns***

Unlike the other regions of the temperate-zone Americas (North America, Argentina, Uruguay, Southern Brazil) and Oceania (Australia and New Zealand), Chile was *not* a land of new settlement. Almost all of the current Chilean population is a mixture of original inhabitants (the Amerindian population) and Spanish settlers.

At the end of the 18th century, the total population of the country was estimated at around 600,000 people, of which 350,000 were indigenous, 40,000 black (pure or mixed blood), 30,000 Spanish, and about 160,000 whites of mixed origin. Immigration other than from Spain was greatly restricted during colonial times. Even after independence in the 19th century, Chile did not attract a large number of immigrants compared to other countries: only some 37,300 foreigners settled in Chile between 1850 and 1900. The comparable figures are: Argentina: 1,437,000 (1875-94), Brazil:

776,215 (1855-89), Uruguay: 33,138 (1835-42) and 349,583 (1866-90). The period of maximum immigration was during the Balmaceda administration (1886-91), with 25,000 immigrants. A new wave arrived during the period 1906-1910, with about 20,000 more foreigners. At its peak in 1907, foreigners living in Chile represented 4.1 percent of the total population (134,147 out of 3,249,279). At that time, the nationality of the foreign population was quite diverse: 20 percent Peruvian, 16 percent Bolivian (many of whom did not stay), 14 percent Spanish, 10 percent Italian, 8 percent German, 7 percent French, 7 percent British, 5 percent Argentines, and 3 percent Yugoslavs. Immigration thereafter was small; there was an influx of Spanish around the time of their Civil War (1936-39), and some Jewish immigration before and after WWII. By 1952, the largest group of immigrants were Spanish (22 percent), followed by Germans (13 percent), Italians (11 percent), Argentines (9 percent), Bolivians (5 percent), Peruvians (4 percent), Yugoslavians (4 percent), Palestinians (2 percent), and Syrians (1 percent). In the late 1950s, Chile signed an international agreement to bring in 2,000 Europeans with technical skills from Poland, Hungary and Yugoslavia.

Immigration took place mostly promoted by the State, in an organized way, rather than spontaneously. There were two different stages in the immigration policy:

- 1) 1820-1880: During this period, the immigration policy sought mostly farmers to colonize the South, and targeted different European nationalities, especially Germans. The first immigration law was passed in 1845. Among other things, it offered property to new immigrants and the right to become Chilean simply by registering in the new settlement and renouncing to their rights as foreigners. A manifesto from Sociedad Nacional de Agricultura encouraged this type of immigration. Very limited migration occurred until 1852, when the settlements in Valdivia, Osorno and Llanquihue took place. During this period, mostly Germans and a few British

arrived.

- 2) 1880-1914: Immigration policy was revised, favoring Europeans with technical skills. There was still an active interest in agriculture colonization for the Araucanía and Magallanes regions, recently incorporated to the country. The Sociedad de Fomento Fabril played an important role in promoting this type of immigration. The Agencia General de Colonización e Inmigración de Chile was created in Paris (with representation in other European cities) in 1882, then closed in 1904. Immigration policy during this period tried to avoid concentration of immigrants of a unique nationality, as in the previous phase with Germans in the south. During this period mostly Spanish, Italians and Slavs arrived. Before 1888, only a few Yugoslavs lived in Punta Arenas. With the discovery of gold on that date, their number quickly reached 500 in 1890. By 1893-94, the gold had exhausted, but many remained, becoming engaged in trade, industries and crafts, and cattle raising. In 1914, there were still 2000 Yugoslavs living in the area, mostly from the isle of Brac.

Although distance and limited agricultural productivity were no doubt the main factors why fewer immigrants were attracted to Chile than to Argentina, Brazil, and even Uruguay, ineffective immigration policy was also an important element. The organization for new immigrants was poor. Much of what they had been promised was not delivered. Some of the lands given were either infertile or too small to be profitable. The communications infrastructure was not there and took a long time to develop. As a result, many of those who arrived left the original settlements and moved to Santiago or Valparaiso, or left for Argentina or other countries where it was easier to make a living. The 1970 census showed that foreigners constituted just 1 percent of the population. This is

quite small compared to countries like the US and Canada that have an active immigration policy.<sup>4</sup>

There is little empirical evidence on the benefits of immigration for the receiving country. Borjas (1995) suggests that benefits would be derived from the complementarity with other productive factors in the host country and would be outweighed by welfare costs imposed on the system. He finds small benefits relative to costs in the case of the US, but suggests they would be larger with more skilled immigrants.<sup>5</sup> Esquivel (1997) suggests that the benefits of immigration are highly dependent on the country's factor endowments. In this respect, low-skilled immigrants may be welfare improving in areas with a relative dearth of this type of worker. Friedberg and Hunt (1995) also suggest that the connection between immigration and economic growth depends on the human capital level of the immigrants, but there is lack of empirical evidence in this area.

Thus, Chile was not an "empty frontier" waiting for settlement in the mid-to-late 19th century, as were Argentina, the U.S., Canada, and Australia.<sup>6</sup> As Bauer (1975, p. 150) reports for the years 1875-92, Central Chile had around 300 people per km<sup>2</sup> of wheat-growing lands, while Victoria, Australia had 32 people per km<sup>2</sup>, and San Joaquin Valley, California had 23 people per km<sup>2</sup>. Bauer (p. 148) describes Central Chile in this period as "an area with plentiful of idle hands." Even today, when compared to these lands of new settlement, Chile is *densely populated*, if measured by population per km<sup>2</sup> of cropland. While Chile supports 333 inhabitants per km<sup>2</sup>, in Argentina there are only 131 per km<sup>2</sup>, in Australia 41 per km<sup>2</sup>, in New Zealand 125 per km<sup>2</sup>, in

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<sup>4</sup> According to the 1991 Canadian Census, 16 percent of the population were immigrants. Immigration policy has changed in both countries from an earlier system based on country-of-origin quotas to a system heavily influenced by family reunification in the US, and to a point system in Canada. In the Canadian system, a minimum score is needed: age, language, education and other socioeconomic factors are taken into account. Since the reform of both systems in the 1960s, immigrants to Canada have been more skilled than to the US.

<sup>5</sup> Borjas (1993) finds that more skilled immigrants are generally more successful, but concludes that the skill differences between immigrants to the US and Canadian are mostly due to the country-of-origin mix. In another work, Borjas (1994) finds that ethnic spillovers exist and may last for several generations.

<sup>6</sup> In 1891, Canada had 4.8 million people (3.5 in 1867), Australia 3.2 million (0.4 in 1861), and the U.S. 64 million (32.4 in 1861).

Canada 65 per km<sup>2</sup>, and in the United States, 139 per km<sup>2</sup>. We surmise that Chile was never “underpopulated” in the course of its history.<sup>7</sup> Its higher population density (in relation to available cropland) at any point in recent history probably corresponds with its lower per capita income, because of the declining marginal productivity of agricultural land. We return to this theme later.

As a result of the lack of immigration, the high death rates of the original Amerindian populations, and the genetic mixing of the original Amerindian population with the Spanish settlers, Chile is a remarkably homogenous society, overwhelmingly Spanish descent and mestizo, and with a population that has long and deep roots in the country. The population is overwhelmingly Catholic and culturally homogenous. Spanish is the main language for virtually the entire population. Only one distinctive Amerindian population, the Mapuche, remains intact, living in frontier regions, and constituting less than 7 percent of the population.

Chile is notably urbanized, with around 84 percent of the population living in urban areas in 1997. This high degree of urbanization is characteristic of modern temperate-zone economies (because of the *relatively* high productivity of agriculture, which supports a large urban population) and especially of mining economies (since the rents from mining lead to a large demand for urban services). Nonetheless, Chile supports only one large city, Santiago (est. population of 4.6 million in 1997). The other major cities are much smaller (Valparaiso, 283,489; Viña del Mar, 330,736; Concepción, 362,589).<sup>8</sup> The dominance of the capital city reflects several interconnected factors: the large amount of mining rents, which for more than a century have passed through the public budget, and thereby supported the development of the capital city; the long legacy of inward-looking

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<sup>7</sup>By underpopulated we mean sufficiently labor-scarce to encourage international immigration. Thus, underpopulation must be judged in relation to transport costs, agricultural productivity, and alternative income levels available in Europe or other potential sources of labor migration. Our hypothesis is that Chile was *never* labor scarce in the 19th or 20th century.

industrialization in this century; the importance of the *internal* market in view of Chile's great distance to other trading areas, and thus, the much smaller size and economic role of Chile's port cities; and Santiago's strategic location within the relatively compact Central Valley. It is interesting to note that before the nitrate boom in the 19th century, Santiago was a small city, of some 115,000 people in 1865, growing to around 700,000 by 1930 (Bauer, 1975, p. 75).

### ***II.5 Inequality: Historical and Political-Economy Aspects***

As in the rest of Latin America, Chile bears a deep legacy of inequality in the distribution of land occasioned by the style of the original Spanish settlement and its aftermath. Original land settlements were on the basis of royal land grants and were passed on from generation to generation, principally to the oldest son, an institution known as *mayorazgo*. Amerindians and mestizos were incorporated into these large estates through institutions of forced labor, such as the *encomienda*. The process created an elite class of large landowners, with much of the population subsisting on small land holdings or as tenant farmers. Land concentration increased tremendously in the 19th century, cementing a legacy of high social and economic inequality. Bauer (pp. 127-128), for example, discusses the land tenure in the department of Caupolicán. In 1854, 2.4 percent of the owners had farms in excess of 1,000 hectares, and these farms constituted 79.7 percent of the farm land. By contrast, 71.6 percent of the owners had farms of less than 20 hectares, constituting just 3.1 percent of the total farm land. In 1916, the extreme inequality remained. The large farms (of over 1,000 hectares) were owned by 0.9 percent of the farmers, and constituted 69.1 percent of the land. The small farms, under 20 hectares, were owned by 88.6 percent of the farm owners, and constituted

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<sup>8</sup> All population figures from Instituto Nacional de Estadísticas (INE), 1997.

3.9 percent of the land. Of course, a very large proportion of rural peasants lacked land altogether, and worked and lived in farms as laborers (known as *inquilinos*), a practice that remained until well into the 20th century.

It is worth reviewing these facts, since land inequality (and, in general, economic and social inequality) has persisted until the present day. Chile's 1996 household inequality, measured by a Gini coefficient of 50.7, is among the highest in the world; new figures for 1998 show no change in the Gini coefficient and an almost identical income distribution than in 1996.<sup>9</sup> The World Bank's 1998 World Development Report reports Gini coefficients for 90 countries. Chile's Gini of 50.7 is the 14th highest (more unequal), notably lagging behind a few Latin American countries (Brazil, 60.1; Paraguay, 59.1; Guatemala, 59.6; Colombia, 57.2; Panama, 56.8; and Honduras, 53.7) and a few African countries (Sierra Leone, 62.9; South Africa, 58.4; Kenya, 57.5; Zimbabwe, 56.8; Lesotho, 56; and Guinea-Bissau, 53.2). If income inequality is measured as the ratio of income of the top to bottom quintiles, the result is similar. Chile's ratio of 17.4 is only slightly below the average for Latin America, the region with the highest income inequality in the world, about double the ratio for the industrialized countries, and almost three times the ratio for Asia (Table 2). In our view, this inequality finds one of its most important macroeconomic expressions in *unequal educational access and educational attainments*, one of the key obstacles that must be overcome for successful economic growth in the future. Larraín and Vergara (1998), for example, present empirical evidence about the detrimental effects of income inequality on economic growth for a group of 45 countries. And Leamer et al. (1999) find evidence that income inequality is higher in natural resource abundant countries.

In view of the importance that we attach later to the continuing income inequalities in Chile,

it is worth linking the income inequalities to a long-standing issue of political economy. During most of the 19th century, large landowners dominated Chilean politics. The vast majority of landless or impoverished peasants exercised no political power. Even after the start of the nitrate boom, the dominance of major landowners did not change, since the mines themselves were substantially owned and controlled by foreigners, therefore the mining interests did not gain *direct* political power. Chile's landowning class, however, had long had a solid urban base in Santiago, and this urban base was strengthened during the nitrate era, with the dramatic growth of Santiago and the surge of urban industry and services. Landowning families divided their time and their investments between rural and urban pursuits, so that no great social or political divide occurred between industry and agriculture. Even with the rise of an urban proletariat, which often challenged the interests of the urban elite, the powerlessness of the *rural* poor did not change until very recently.

As Bauer (1975, p. 230) describes the period between 1930 and 1970:

Under these circumstances, the industrialists, the proletariat and the landowners struck a mutually beneficial bargain at the expense of the rural workers; the landowners agreed to accept controls on agricultural prices in return for a hands-off policy in the countryside.”

## ***II.6 Main Implications of these Structural Features***

Chile's economic performance is strongly conditioned by these structural factors. As a small economy with relatively high transport costs, even to neighboring states, and great distances to the main markets in the Northern Hemisphere, Chile has never developed a significant indigenous industry or a complex division of labor in manufacturing. Industrialization has been based on

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<sup>9</sup> According to the CASEN survey (1996, 1999); the figure reported in the World Bank refers to 1994.

mineral resources (nitrates, copper), local light industry (food processing, textiles and apparel), and a few protected heavy industries. There has been little domestic research and development, or science-based industrialization. Unlike the Nordic countries, which like Chile were for a long time “peripheral” to the main markets of Europe and North America, Chile did not develop a strong engineering tradition, which eventually led to world-class industries in Norway (shipbuilding), Finland and Sweden (machinery and electronics). Of course, Chile’s distance to the main markets is much greater than that of the Nordic countries. Chile’s failure to develop a world-class manufacturing sector was also hindered, no doubt, by the weakness of public education and by the high-income inequalities in the country, which prevented much of the population from self-financing an investment in human capital.

Therefore, Chile became integrated into the world economic system not as an independent innovator or producer of cutting-edge technology, but as a provider of a few valued natural resources (whose value per unit weight, of course, was high enough to overcome the severe transport hurdles). Thus, Chile’s long-term vocation in the past 150 years has been as a provider of natural resources, including temperate-zone agriculture, forestry, fishing, and most importantly mining. One of the main themes of this essay is that these sectors are almost surely not sufficient to carry Chile all the way to high-income status. Either Chile will have to diversify its export base, or it will most likely suffer a serious slowdown in growth.

### **III. Chile’s Long-term Growth Record in International Comparison**

When we summarize the key structural factors, in Table 3, we see three main pluses -- temperate climate, homogenous population, and abundant natural resource endowments -- and three

main negatives -- small scope of the internal market, very high transport costs to other markets, and high economic inequality. These factors have conditioned Chile's long-term economic performance (measured by the level and growth of per capita GDP), which is better than the world average, but well below the achievements of other temperate-zone economies, for example in Scandinavia and North America.

The relevant comparisons for Chile are *temperate-zone, low-population* economies relatively far from major markets. Such economies tend to have favorable resource conditions in agriculture (including farming and forestry) and perhaps in non-agriculture resources such as mining, but suffer from small internal markets and high transport costs. Obvious comparison cases include Argentina, Australia, and New Zealand. Other interesting cases are the Nordic countries, especially Norway, Sweden, and Finland. Before 1900, the Nordic economies were relatively poor economies on the periphery of Europe, depending on fishing, forestry, and mining exports. Now these countries are among the richest in the world. Canada is another possible comparison case, as a far Northern resource-based economy, but its overwhelming characteristic is proximity to the U.S., with 90 percent of the Canadian population living within 100 km of the U.S. border. Another interesting special case is Iceland, a country of just 272,000 people in the far North Atlantic, near the Arctic Circle, with a per capita PPP GDP of \$22,500 in 1997 (roughly 86 percent higher than Chile) and heavily dependent on fishing.

As shown in Table 4, since at least the start of this century, Chile was poorer than Argentina, Australia, and New Zealand. According to the Maddison data (1900-94), Chile remained at around one-half of the Australian and New Zealand GDP throughout the century, and rose from around 70 percent of Argentine GDP in 1900 to around 93 percent in 1994. By contrast, the Nordic countries grew much more rapidly than Chile in the course of the century. Norway and Finland began poorer

than Chile (with Chile's per capita income 111 and 120 percent of Norway's and Finland's, respectively), but ended up much richer by 1994 (with Chile's per capita income just 42 and 52 percent of Norway's and Finland's, respectively). Chile's income was about 75 percent of Sweden's income during 1900-1930, but then fell to around 46 percent by 1994.

More recent World Bank data show a significant increase in Chile's relative income by 1997, surpassing Argentina in PPP per capita income, and rising significantly relative to earlier years vis-a-vis the other economies. There may well be a lack of comparability of the Maddison and World Bank data, overstating the change in relative incomes in 1997, but part of the rise accurately reflects Chile's growth boom during the second half of the 1980s and in the 1990s, when per capita GDP growth was 5.7 percent, far outstripping the growth of the other economies.

Why did the Nordic countries outstrip Chile's economic growth after 1930, and why did Chile fail to narrow the gap significantly with Australia and New Zealand in the course of the entire century? *In our view, the fundamental difference in long-term performance among the economies is the extent to which the respective economies succeeded in diversifying their economic base, especially their export sectors, beyond natural-resource-based development.* The extent of diversification reflects, no doubt, a combination of underlying policies, physical endowments, and geographic considerations. For example, though the Nordic countries were indeed peripheral to Western Europe until this century, they are still far closer to the main Western European markets than are the Southern Hemisphere countries.

Let us start first with Argentina, Australia, and New Zealand. Here, the key point is that Chile started poorer, and remained poorer, than all three countries during the 20th century. These countries were lands of new settlement. They enjoyed a very favorable land-labor ratio, which meant that labor productivity and hence per capita incomes were very high from the start. This was

true *despite* the large distances that separated these countries from their main markets in Europe. Since these were immigrant countries with open frontiers, they faced an elastic supply of labor. Immigrants arrived until the per capita income was equalized with that of the source countries (mainly Britain in the case of Australia and New Zealand, and Spain and Italy in the case of Argentina). Transport costs mainly determined the amount of immigration, rather than the per capita income level. Thus, the sharp declines in oceanic trading costs (including steam ships and refrigerated cargo), and the extension of railroads, in the second half of the 19th century greatly expanded the area of profitable agriculture in these countries, and thereby massively spurred immigration. But during this whole process, per capita incomes were continuously high, indeed high enough to attract labor from Europe. In Chile, by contrast, land-labor ratios were much lower (as we have pointed out earlier), and per capita incomes were not high enough to attract immigration, even with the nitrate boom of the late 19th century. The new urban and mining employment was drawn mainly from the low-wage peasant labor in the countryside.

It is hard to argue that Argentina, Australia, and New Zealand dramatically outperformed Chile in the 20th century, at least in the sense of the average growth rate between 1900 and 1994. The percentage income gap between Chile and these other countries remained roughly constant (in the case of Oceania) or narrowed (in the case of Argentina). None of the four countries made a decisive breakthrough towards diversified exports until the past 20 years, when Australia and New Zealand began to succeed in technology-intensive exports. Australia and New Zealand did succeed in sustaining positive economic growth, unlike Argentina, but these countries also lagged the growth rates in Europe and the United States for long periods, so that the income gap with the highest income countries actually widened during the 20th century. Note that on Maddison's estimates, both Australia and New Zealand actually began the century with per capita incomes higher than the U.S.

(not because of their inherent superiority or increased efficiency, but because of their extraordinarily favorable land-labor ratios)! By 1994, Australia was just 70 percent of the U.S. per capita income, and New Zealand was just 58 percent of the U.S. level. In essence, Chile probably did as well as Oceania, but started and ended the period with a lower land-labor ratio and a lower per capita GDP. We return to the cases of Australia and New Zealand later in the essay.

Probably more revealing at this point are the experiences of the Nordic countries. Like Chile, the cases of Norway, Sweden, and Finland (as well as Iceland, for which we do not have data from Maddison) involve geographically “peripheral” countries that relied heavily on natural resource exports early in this century. Also, like Chile, the Nordic countries are long, narrow countries that extend from the temperate zone to the Arctic; are ethnically homogenous; and have small populations and small local markets. Like Chile, these countries have depended on foreign trade for their economic viability and development. Unlike Chile, however, all four countries became highly competitive exporters of manufactures in the course of this century.<sup>10</sup>

Sweden began the century with exports dominated by iron ore and lumber. As late as 1900, 75 percent of the population was rural and linked with agriculture, and more than 90 percent of exports were primary commodities. Sweden experienced a remarkable structural change beginning around World War I, when industrial production and exports became far more diversified. Sweden became a leading exporter of machinery, transport equipment, industrial commodities, and a range of consumer goods. Currently, manufactures constitute around 80 percent of merchandise trade, compared with 15 percent in Chile and 30 percent in Argentina. Sweden’s leading single employer and exporter is Ericsson, a world leader in telecommunications equipment.

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<sup>10</sup> Iceland does not have a high share of manufacturing exports (11 percent in 1996), but these have greatly increased from 3 percent in 1970.

Norway, similarly, began the century concentrated in a few primary commodities, including fishing, timber, metal ores, but also in shipping services. In the late 19th century, Norway began to develop an important merchant marine, which by World War I was the fourth largest in the world. As late as 1973, when the proportion began to drop, Norway was shipping around 10 percent of total world tonnage, and shipping services provided about one third of total foreign exchange earnings. Despite a very small population (around 2 million at the start of this century), Norway developed a powerful engineering sector, and its strength in engineering and shipping services combined to produce one of the world's leading shipbuilding industries. Thus, by the mid-20th century, Norway had substantially reduced its reliance on natural resource exports. Interestingly, with the discovery and development of North Sea oil and gas in the 1970s and 1980s, Norway is once again heavily dependent on natural resource exports, which now account for around 80 percent of total exports. This has compensated for the recent decline in shipping, but has led to less export diversification and strong dependency on oil and gas.

Finland, the third Nordic country of present interest, was similarly dependent on agricultural commodities at the start of the century, and with a small population of just 2.6 million. As late as 1918, 70 percent of the workforce was engaged in agriculture and forestry, and in 1940, the figure was still as high as 57 percent. While basically self sufficient in foodstuffs, Finland's major natural resource export has been its forestry, with additional earnings from fisheries and some mining. While pulp, paper, lumber, and wood furniture and other wood products were long Finland's major exports, by mid-century, Finland became an exporter of various kinds of manufactures, including electrical appliances and machinery. In the 1990s, Finland's leading employer is Nokia, like Sweden's Ericsson, a world leader in telecommunications equipment. As recently as twenty years ago, Nokia was a producer of rubber, cables and paper. Now it accounts for close to 25 percent of

the world market in cellular phones. Nokia managed to transform itself by identifying future opportunities for success and investing heavily in R& D.<sup>11</sup> As of 1997, manufactures accounted for 83 percent of Finland's exports, with high-tech products ahead of paper and pulp and machinery and metal products.

These achievements are in high contrast with Chile's experience. Over 50 years of copper dependence have generated very limited integration with other productive activities, and certainly no exports of machinery or sophisticated technological goods. Copper has very limited backward and forward linkages.

An important hint as to the sources of Nordic success in "overcoming" geography, in comparison with Chile and Argentina, is provided by the **Global Competitiveness Report (GCR) 1998** of the World Economic Forum in conjunction with the Harvard Institute for International Development. Business executives are asked, among other questions, whether "the geography and location of your country are competitive advantages." As shown in Table 5, the countries we have been considering are ranked near the very bottom. Out of 53 countries, Chile's geographical "advantage" is ranked 50th and Argentina's 47th, while Finland, Norway, and Sweden are 49th, 52nd and 53rd respectively. Yet Finland, Norway, and Sweden (in that order) are ranked first through third in the use of cellular telephones (number per 1,000 population), while Chile ranks 33rd and Argentina 37th.<sup>12</sup> Similarly, Finland, Norway, and Sweden rank first, fourth, and sixth respectively, in the number of Internet hosts per 1,000,000 inhabitants, while Chile ranks 35th and Argentina ranks 39th.

The Nordic countries are also among the nations with more widespread use of English as a

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<sup>11</sup> See The Economist (1999). The creation of a large town, a university, and a science park around the small village of Oulu in Finland is also an interesting experience of the combination of public and private efforts.

second language among their populations, and with highest number of R&D scientists and technicians per 1,000 people: 5.1 in Norway, 6.8 in Sweden, 4.8 in Finland, and 4.4 in Iceland, well above the average for high-human development countries (3.8).<sup>13</sup> The 1999 GCR has Finland in first place in commitment of *public* funds to R&D, Sweden 11th and Norway 16<sup>th</sup>, while Chile is 38<sup>th</sup>. In commitment of *private* funds to R&D, the three Nordic countries are again in top positions: Sweden is 4th, Finland 6th, and Norway 16th, while Chile remains in the bottom half (33<sup>rd</sup>). According to the 1999 GCR, actual spending on R&D as a percentage of GDP in 1997-98 was 3.6 in Sweden, 2.7 in Finland, 1.6 in Norway and only 0.7 in Chile. Collaboration between universities and industries is also very close according to the GCR: Finland comes first, Sweden third, Norway 18<sup>th</sup>, while Chile's rank is 31st.

Thus, the Nordic countries are among the world's most heavy R&D investors and most avid users of the new information technologies, which not only provide important export earnings (via the likes of Ericsson and Nokia), but also help these countries to overcome distance in order to secure industrial competitiveness. Of course, lying behind this success in information technology is half a century or more of prowess in advanced engineering. We return to this theme later.

#### **IV. Natural Resource Dependence and Long-Term Economic Growth**

As noted, natural resource dependence has been a feature of Chile for more than a century. Rich nitrate deposits were an important source of foreign exchange for the country in the late 19th century and early 20th century. Chile was the world's largest producer of nitrate, which accounted

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<sup>12</sup> In the 1999 GCR, which includes six additional countries, the ranking is Mauritius 1st, followed by Finland, Norway and Sweden and Chile in 36th position.

for roughly 50 percent of total Chilean exports around 1890. A collapse in the nitrate industry followed Germany's discovery of synthetic nitrate during the First World War. Not much time elapsed before copper replaced nitrate as Chile's main generator of foreign exchange. Indeed, copper production had already developed in the late 19th century, and was ready to take the slack after the nitrate collapse.

Chile's copper dependency has lasted longer, for over half a century. In the early 1970s copper accounted for 80 percent of Chile's exports. In spite of a major drive for export diversification that started in the mid-1970s, by the mid-1990s copper still accounted for about 40 percent of Chile's exports. The resilience of the copper industry partly stems from huge foreign investments going into copper exploration and exploitation since the mid-1970s and from the sheer size of Chilean reserves. Chile is the main copper producer in the world with close to 34 percent of world production in 1998 and 25 percent of proven world's reserves. In fact, the private sector -- especially foreign investors-- has taken a clear lead away from the state giant, CODELCO. Chile is richly endowed with other natural resources as well, including fishmeal, fresh fish, cellulose and fresh fruits. While Chile's GDP growth has exceeded 7 percent a year in the period 1985-97, its industrial export base is only about 15 percent of total exports. In contrast, natural resource exports are about 80 percent of the total.

This natural resource dependence has led to a questioning of the sustainability of Chile's development strategy, as there are few (if any) cases of countries going all the way to development purely on the basis of natural resources. As we have discussed, the successful economies that started from a rich natural resource base (Australia, Canada, Finland, New Zealand, Sweden, and the U.S.) diversified into manufacturing and services as income per capita increased, and the natural resource

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<sup>13</sup> The figures correspond to the average for the period 1990-96 and are taken from Human Development Report (1999).

sector lost relative importance. This pattern is not yet noticeable in Chile. The skepticism on natural resource abundance as the basis of long-term growth partly comes from recent research that discovers a robust negative relationship between natural resource composition of exports and long-term growth. The point here is forward looking. It is clear that natural resources have been an important base of Chile's success over the last two decades, rendering Chile as a kind of exception to the overall pattern. The question is whether Chile should rely on natural resources as a basis of sustained growth over the next two decades.

Besides this long-term concern over development strategy, however, there is an important short-term consideration as well. On October 22, 1998, Standard & Poor's released its risk rating for Chile. The rating was held at A-, no minor achievement at times of economic upheaval in Latin America and the world economy. S&P explicitly said, however, that natural resource dependence was an obstacle to an improvement in Chile's rating. In Standard & Poor's words, Chile's rating is constrained by...:

“...a comparatively narrow and concentrated export base for a small economy, contributing to the sizable current account imbalance. At about 25 % of GDP, the export sector is half the size of the single-'A' median. Moreover, an intense concentration in commodities -- with copper alone representing 40% of total exports -- exposes the balance of payments to fluctuations in commodity prices. Partly as a result, Chile's current account deficit is the highest, not only in the region, but in the single-'A' category.”

In this section we ask whether Chile will have to diversify its exports away from primary commodities in order to achieve sustained rapid economic growth over the next decades. For 150 years, Chile has remained essentially a natural resource exporter, first in agriculture, then nitrates,

and now minerals and agriculture. During the past 20 years of rapid economic growth in Chile, there has been little evidence of diversification into manufacturing and service exports<sup>14</sup>, though there has been a shift away from copper dependence towards agriculture and forestry.<sup>15</sup> We examine whether the continuing natural resource dependence is likely to provide a sufficient base for continued long-term growth. Our answer is that, although Chile should continue exploiting its competitive advantage in natural resources, diversification will be necessary, and will have to be supported by appropriate policies, which we discuss in the following section.

#### ***IV.1 Economic Development and Export Diversification***

Table 6 shows a basic pattern of economic development. In 20 of the 26 countries ranked as “high income” by the World Bank in 1997, *manufactured goods constitute at least sixty percent of total merchandise exports*. One exception is the United Arab Emirates (UAE), a small oil-rich state of just 600,000 residents (and only 125,000 UAE citizens, the rest being guest workers). We have already discussed the other three exceptions: Australia, New Zealand, and Norway. Australia and New Zealand are among the poorest of the high-income group (after having been perhaps the second and third highest income countries in the world in 1900, just behind the U.K.). Nonetheless, even in

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<sup>14</sup> Service exports were similar to Australia’s as a percentage of GDP (around 4.5 percent) but lower than in New Zealand, Finland, and Sweden (between 6 and 7 percent). And while these countries have experienced a continued increase in the share of service exports since the late 1980s, in Chile this share has declined since 1991.

<sup>15</sup> Recently, Chile has increased its share of refined versus blister copper. Although this represents higher value added from exports, the prices of the two varieties are highly correlated (above 0.9 for 1977-96); thus, export revenues are still dependent on the evolution of one main natural resource export: copper.

these two cases with still a high concentration in natural resources, there has been substantial diversification over the last three decades. Between 1965 and 1996, the share of manufacturing exports in total exports increased from 12 percent to 30 percent in Australia, and from 5 percent to 29 percent in New Zealand. Norway is among the richest countries, and earns almost \$9,000 per capita in oil and gas exports. In the case of Norway, the natural resource share of exports was much lower before the 1980s, when the oil and gas fields came on line.

Table 7 shows 3 additional measures of export diversification for Chile and the industrialized countries: the Herfindhal index and the share in total exports of the top 4 and top 8 exports. In all these measures, Chile appears among the least diversified countries, only surpassed by Kuwait, the UAE, and Norway.

The most basic point is that natural resource endowment and exports are rarely sufficient in a country to support a high level of income. Consider the following illustrative calculation. For small and medium sized high-income countries, exports average 22 percent of GDP. For the largest countries, Japan and the United States, the ratio is lower, around 10 percent of GDP, but for smaller economies the ratio is typically well above 20 percent. At an income level of \$20,000 per capita, and an export ratio of 22 percent, exports per capita are around \$4,400 per capita. Few countries have natural resource endowments that are remotely as high as this. In Chile, copper exports in 1997 were about \$450 per capita, and in 1999 they will be significantly less because of the steep fall in world prices. In a few small countries with extraordinary resource endowments, the requisite natural-resource-based exports may be present. Thus, Norway's oil and gas is sufficient to supply most of Norway's foreign exchange needs, as are the UAE's. Iceland, a country of just 270,000 people, enjoys ownership of one of the world's most productive fisheries, which thereby yields export earnings of around \$5,000 per person, and a cheap and clean source of energy, geothermal

energy. But aside from these examples, natural resources are rarely enough to come close to the \$4,400 per capita level of exports.

The question, then, is how much a country can compress exports relative to GDP and still achieve a high level of development. The worldwide experience suggests “not very much.” The basic problem is that small countries (indeed all countries with the possible exceptions of the U.S. and Japan) lack the range of technology and the scale of domestic market to produce the preponderance of capital and intermediate goods that the economy needs for efficient production. Countries that attempted, through import substitution, to reduce their import needs sharply relative to GDP, found that they lacked the domestic technologies needed for sustained economic growth. Imports were compressed at the cost of economic stagnation. While the U.S. can get along with an export-to-GDP ratio of around 10 percent, the U.S. is perhaps the only country that can do so at a high level of efficiency.

If import compression is not possible -- and that is the lesson of the import-substitution era -- then *export growth* becomes vital. Indeed, a mountain of evidence suggests that export growth and overall economic growth have been highly correlated in the developing world in the past 25 years. Table 8 measures economic performance in two ways. First, it looks at manufacturing export growth, measured as the real growth in constant \$ of manufacturing exports for the period 1970-90. Second, it measures annual growth in per capita GDP in PPP terms (from the Summers-Heston data set) during the same time interval. Countries are divided into manufacturing exporter successes and failures, depending on whether the annual average growth in manufactured exports is greater or less than 5 percent. Countries are ranked as fast and slow growers depending on whether average per capita GDP growth is above or below 3 percent of GDP. Many of the manufacturing export success cases (14 out of 57) were also fast growers. But most suggestively, almost all manufacturing export

“failures” (14 out of 15) were also slow growers.

If we take the period 1985-1997 Chile is an exception to this general rule. Here, after all, is a fast-growing country (at about 5.5 percent per year, well above the 3 percent mark) that has not had substantial growth in manufacturing exports. Note that Chile is *not* an exception over a longer time period (say 1970 to the present, since the longer-term growth performance has not been that strong). Our question in this essay is whether Chile will continue to be an exception of fast economic growth without strong manufacturing expansion, or whether Chile must have some success in manufacturing exports to keep up its rapid growth in the future.

There are, as we have noted, a few examples of countries that have been able to maintain rapid growth, and reach high levels of development, without major export diversification. These examples -- of which we would put New Zealand, Norway, Iceland, and United Arab Emirates as key cases among rich countries, and Botswana as a key case among much poorer countries -- have two characteristics. First, they tend to have very small populations. Second, they tend to have an extraordinary resource endowment of some sort relative to that population. Thus, New Zealand has the fertile land and climate of the United Kingdom, but only one-eighteenth the population. New Zealand, in essence, is rich and agricultural because there are so few New Zealanders. Put another way, though it has been an immigrant country, New Zealand could attract few Europeans since larger inflows of population would have driven down the income levels to a point that made immigration unattractive (and indeed many New Zealanders went to Australia in recent decades, to benefit from the relatively larger market). Iceland happens to sit on a broad ocean shelf resplendent with ground-fish, due to the confluence of ocean currents and the fortuitous extent of the underwater shelf. As a result, Iceland has been able to export around \$5,000 of fish per Icelander (of which there are some 270,000). Norway and the UAE, of course, sit on vast stocks of hydrocarbons. Botswana,

a previously impoverished desert economy, has 1.4 million people and some of the richest diamond mines in the world (with diamonds accounting for 76 percent of total exports in 1997).

***IV. 2 Can Chile achieve \$4,000 to \$5,150 per capita exports of (mainly) primary products by 2020?***

A key question is, then, whether Chile can attain high-income levels based mainly on natural resource exports. To answer this, let us attempt the following exercise. How much natural resource exports (NRX) must Chile attain in 2020 to reach \$17,319 per capita, in the conservative scenario, or \$22,308 in the optimistic one, given an export-GNP ratio of 23 percent. Two reasons justify the choice of the 23 percent figure: on the one hand, this was precisely Chile's export ratio in 1997; on the other hand, this almost coincides with the average export ratio of small and medium-sized rich countries on that same year (22 percent).

To simplify the analysis, we base the calculations only on Chile's principal three NRXs: copper, pulp and fishmeal. Table 9a shows Chile's main NRXs in 1980 and 1997, with copper, fishmeal, pulp, and fresh fruit amounting to 57 percent of total exports.

Over the period 1980-97, Chile's nominal dollar exports have grown at the very fast pace of 7.6 percent average annual rate, or 5.5 percent in real terms. Given Chile's GNP per capita of \$5,020 in 1997, a per capita income of \$17,319 by 2020 would imply a per capita annual growth rate of 5.38 percent, and \$4,000 in exports per capita, given an export-GNP ratio of 23 percent. In the more optimistic scenario, Chile would achieve \$22,308 GNP per capita in 2020, which would require \$5,151 per capita, a per capita average growth rate of 6.48 percent.

As shown in table 9b, assuming a population growth of 1.09 percent for the period 1997-

2020 (CELADE), this would represent a real growth of 6.48 percent for total real export revenues, in the conservative scenario, or 7.58 in the more optimistic, that is, 1 to 2 percentage points above the average of 1980-97. This appears extremely ambitious, given that it requires a large increase in export growth over and above the most successful period for export expansion in recent Chilean history.

Let us now look in some detail at Chile's three most important natural resource exports -- copper, fishmeal, and pulp. If we assume that their export shares in 2020 would be the same as in 1997, this would imply that real export revenues for each of them must grow at 6.48 or 7.58 percent, in each of the two scenarios.

### *Copper*

Copper production grew at 6.8 percent annually during the period 1980-97, twice the rate for 1960-80, and has grown even faster since 1990 (10.8 percent per year). According to CODELCO's own estimates, copper production will grow at 9.2 percent between 1997 and 2000.<sup>16</sup>

Real copper prices, however, have exhibited a declining trend for the period 1960-96. If this trend were to continue into the future, physical copper production would need to grow at 8.1 percent per year in our conservative scenario and 9.2 percent in the optimistic one. Table 9c shows that this would require 242 to 286 million tons of copper reserves.<sup>17</sup>

Current known Chilean reserves are estimated at between 138 and 175 million metric tons, depending on the source. The EIU Country Report (1998, 4<sup>th</sup> Q) puts them at a quarter of world

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<sup>16</sup> Domestic consumption of copper is fairly low, therefore most of the copper produced is exported. This is also true for pulp and fishmeal.

reserves, of 456 million tons; the US Geological Survey at around 138 million; Chile's Ministerio de Minería at 28 percent of world's reserves, while Semageomin estimates they represent 37.7 percent of world's reserves. Hence, under all these scenarios, the continued expansion rate of copper exports at such fast rates would mean the exhaustion of Chile's copper reserves well before 2020. In other words, it appears unlikely that copper exports could grow for over 20 years at the rates required to support the projected per capita income even in the conservative scenario.

Of course, it is quite possible that new reserves may be discovered. Whether new reserves discoveries may be sufficient to cover a gap of about 100 million tons is, however, doubtful. It may also happen that the steep drop in copper prices since 1996 is partially (or totally) reversed, but we did not consider this into the declining trend used for projections in Table 9c (the 1.65 percent annual decline corresponds to the period 1960-96). It may even be argued that, as Chile's copper reserves fall, the world price is likely to increase. But this may encourage copper exploitation by higher cost producers in other countries, exploration for new reserves, and the development of copper substitutes.

### ***Pulp***

The U.S. and Canada are the world's largest producers and exporters of pulp. In 1987, they accounted for almost 50 percent of the world's production. For the period 1987-96, capacity in these two countries has grown at around 1.3 percent annual average rate. During the same period, Chile has been one of the countries with the fastest growth in production capacity, at 12.1 percent

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<sup>17</sup> Note, though, that the assumed decline in copper prices in one of the scenarios of Table 9c does not incorporate the dramatic drop in prices of 1997-99.

annually. Only Thailand, at 16 percent per year, surpasses this.

From 1980 to 1996, pulp production in Chile grew at 6.1 percent in volume (21.8 percent in Indonesia, and almost 13 percent in Thailand). For both Indonesia and Thailand, production was virtually nonexistent in 1980; in 1996, Indonesia produced 2.6 million tons, and Thailand half a million tons. Chile's production of 2.1 million tons places it as the world's 12th largest producer of pulp and the 6th largest exporter. Unlike some of the top pulp producers, most of Chile's production is dedicated to exports.

Latin America is considered one of the fastest growing emerging markets for pulp and paper. Chile's climate favors rapid tree growth, and its tree species, pine radiata and eucalyptus, are considered of very high quality. Chile is the 2nd largest producer and exporter of Latin America behind Brazil, which in 1996 produced 6.2 million tons, and exported 2.2 million. Brazil's production, however, has grown at an average 3.6 percent annually from 1980 to 1996.

Chile's exports have grown in volume at 23.3 percent per year from 1987 to 1996, to 1.3 million tons. The other two main exporters with similar rates of growth are Indonesia, 30.6 percent, but which still exports less than Chile (1.1 million tons), and Brazil, 29.1 percent (2.1 million tons). Chile's export revenues in dollars have grown at an average rate of 8.3 percent from 1980 to 1997. About 50 percent of Chile's pulp exports used to go to Asia, until recently one of the fastest regions in consumption, production, and trade.

Pulp is the main input in paper production. Worldwide demand is expected to increase significantly. Paper consumption per capita in Chile, like in most countries in Latin America, is very low, at 37 kg per capita, especially if compared to North America (310 kg.), Japan (245 kg.), and the European Union (171 kg.). Thus, potential growth for the pulp and paper market in Latin America and other developing countries is enormous. Asian countries have experienced very fast growth in

their consumption per capita as their per capita income increased. Between 1987 and 1996, consumption grew 15.7 percent annually in Malaysia (to 99 kg per capita), 12.8 percent in Indonesia (to 14.6 kg.), and 8.9 percent in Korea (to 154 kg.).

Chile's entrepreneurs have made large investments in plant and equipment to increase production and raise efficiency. Two of the largest producers have plans to increase pulp mill capacity over the next 5 years by 950,000 tons, almost 46 percent above current levels. In addition, they have invested in new plants and machinery in Argentina and Peru.

Real pulp prices neither show a declining trend nor a clearly increasing trend for the period 1960-94, although this period does not consider large price declines since 1996. Assuming no trend in prices until year 2020, Chile's pulp exports would need to increase between 6.48 and 7.58 percent per year in the two scenarios considered, to a level of 6.1 to 7.9 million tons of pulp, respectively. This seems feasible given past growth trends, current investment, and the expected demand trends. In fact, if we look at Brazil's pulp output growth, from 3.5 million tons in 1980 to 6.2 in 1996 or Swedish production in 1996 of 9.8 million tons, 7 million tons is not a number out of reach for Chile. Moreover, most of the top pulp-producing countries also produce paper, and usually in the same installations. Chile's paper production and exports (mostly newsprint and tissue) are currently low by comparison. It seems that Chile could probably increase its paper production by expanding and adapting current pulp installations for paper production. This seems to be happening already.

### ***Fishmeal***

Fishmeal is used as feed for animals and as feed in aquaculture. As such, it is a substitute of grainfeeds like soybeans, and is subject to the large volatility of this market. Aquaculture output,

where Asia is the largest producer, has been growing relatively fast, at a rate of 10 percent for the period 1984-95, and will likely continue strong growth into the future. FAO forecasts a 4.8 percent average growth rate for the period 1995-2000. In the aquaculture industry, Chile is now the world's second-largest exporter of farmed salmon, after Norway.

Global fishmeal production, however, has been growing at more modest rates: 1.1 percent per year between 1984 and 1995. And its demand is forecasted to remain largely stable, around 30-33 million tons (FAO). Worldwide fishmeal physical production declined by an average of 5.5 percent between 1986 and 1994. Although production increased in 1997, the forecast for 1998 was another decline.

Fishmeal production faces constraints from the supply side. It is made out of different varieties of fish, and thus it is subject to the same problems of world fish supplies. For instance, in 1998 the Chilean government imposed bans on the capture of several of the fish species used in the production of fishmeal. The reason was the effect of El Niño on the stocks. This had a drastic effect on the level of production. Aquaculture is moving toward use of other feeds not derived from fish supplies, such as soybean meal and animal compounds.

Peru and Chile account for about 50 percent of world exports and close to 30 percent of world production. By itself, Chile represents close to 22 percent of world exports. Chile's revenues from fishmeal exports have grown at 6.7 percent in nominal terms for the period 1980-96. Most of its exports go to Asia (Taiwan, Japan, and more recently China).

Fishmeal prices are highly volatile. There have been large price increases in response to the recent cuts in production. Real prices of fishmeal (deflated by the U.S. wholesale index) had a declining trend of about 1.25 percent for the period 1970-96, but it is quite difficult to predict their future evolution. If the declining trend continues into year 2020, export volume would have to grow

at 7.7 in the conservative scenario, or 8.8 in the optimistic one, and fishmeal exports would have to reach 5.8 to 7.5 million tons by 2020. If prices were to remain constant, 4.4 to 5.6 million tons would suffice. Given the recent past evolution of output, a 2.75 percent annual average increase for the period 1988-95, and the characteristics of the industry, these volumes are probably too high.

### *Adding up the pieces*

This section has analyzed whether Chile's natural resource sector is likely to support through high export growth the convergence in per capita income that could be expected of the country over the next two decades, based on recent empirical evidence. This translates into a per capita income between \$17,319 (conservative scenario) and \$22,308 (optimistic) in 2020.

Our answer is basically negative. Analyzing Chile's three main natural resource exports, it looks quite unlikely that copper and fishmeal could grow at the rates required to support even the conservative scenario. The case of pulp is different, as it appears feasible that this sector could attain the required growth rates. Nonetheless, the game is played mainly on copper, which accounts for over 40 percent of the country's exports. Even if the answer would have been positive for both pulp and fishmeal (which is not the case), they could not make up for the likely shortfall in copper, because of their much smaller weight in Chile's exports. The overall conclusion is, then, that Chile will have to rely on exports other than natural resources in order to attain per capita income in the range of \$17,300 and \$22,300 in 2020.

### *IV.3 Export Composition and the Volatility of Export Earnings.*

One of the likely consequences of Chile's heavy reliance on a few natural resources is the high variation in export earnings, due to fluctuations in world prices for Chile's export commodities. Such fluctuations, in turn, cause undesirable swings in Chilean GDP. In this section we explore briefly some of the quantitative implications of export concentration and export earnings.

To illustrate the issues, write the expression for the variance of export revenues under the assumption that there are only two goods ( $x_1$  and  $x_2$ )

$$\text{Var}(p_1 * x_1 + p_2 * x_2) \cong \text{Var}(p_1 * x_1) + \text{Var}(p_2 * x_2) + 2 * \text{Cov}(p_1 * x_1, p_2 * x_2)$$

The question is how much variance reduction can be achieved by changing the  $x$ 's. The answer depends on the covariances and the own-variances of both prices and quantities. (It is, of course straightforward to write the general expression for any number of goods). Here we focus on the variance and covariances of prices.

Consider a basket of export goods that includes copper as well as a group of manufactured goods that are currently exported, including: pulp and waste paper, alcoholic beverages, alcohols, phenols, phenol-alcohols, & their derivatives, paper, paperboard, printed matter and furniture. How much variance reduction would be achieved by reducing the export dependence on copper and increasing the export shares of the manufactured goods? Part of the answer depends on the variances and covariances of the prices of the manufactured products and of copper. In general, for variance reduction, one would want to choose an export basket with small own-variances and *negative* covariances with the rest of the basket. In what follows, we try to assess this by looking at the recent variances and covariances of international prices of this group of commodities. For this purpose, we look at data on the prices of U.S. exports.

The variance-covariance matrix of these prices is presented in Table 10. Two points stand out from this table. First, it is not the case that copper has the highest variance (see the diagonal entries). In this recent period, pulp and alcohol-related products had higher variance than copper. This points out that it is not always true that manufacturing products have less variable prices than natural resources. The second point is that the covariance between copper and some of these manufacturing products can be positive and quite large. This evidence, taken at face value, would suggest that the largest reduction in variance would occur with increased export shares of printed matter and furniture, since the own-variances are small and the covariances with copper are negative. Obviously, this conclusion is contingent on the sample period and the data we are looking at, so it is only an illustration. To compare these covariances on a unit-free basis, we also present the correlation matrix in Table 11.

The next question is how much variance reduction Chile could expect to achieve from shifting its export basket away from copper and towards other goods. As a start to answering this question, it is worth seeing how much export variability Chile now experiences. Total exports in Chile exhibit positive growth and also variability around this trend. What we want to calculate is the variability after taking into account the positive growth trend. Hence we estimated a simple linear regression of export revenue on a linear time trend. The standard deviation of the residuals is about 11 percent of average exports. This is a rough benchmark measure of export variability. Since total exports are about one-quarter of GDP, the standard deviation of de-trended exports divided by GDP rather than exports would be about 3 percent of GDP.

Now we look at variability with different export baskets. We normalize all export prices to be 1.0 in 1995. Then we calculate what the quantities would have to be to match total export revenues in 1995 for each category. This gives us units for our export quantities. Then we adjust

export quantities so that we achieve different export baskets in 1995. Finally, we simulate the variability of each of these baskets over time by combining the fixed quantities with actual data on prices, which vary over time. Note that these simulations are designed to have no trend growth because the quantities are held fixed over time. The variability comes exclusively from the variability in prices. Hence these are analogous, but not exactly comparable, to looking at the variability of de-trended exports.

As a reference point, the basket with 50 percent copper and equal shares for the five other exports: Pulp, Paper, Alcohol, Printed matter, and Furniture, achieves a coefficient of variation of 10.28 percent. This is close to the 11 percent figure above for export variability. Table 12 shows that the variability can actually rise to 14.61 percent if a high weight is placed on paper and pulp. The variability can fall substantially to 5.94 percent if a high weight is placed on printed matter and furniture. If all products were equally weighted, the variability would fall to 8.54 percent. In conclusion, variance reduction is possible, though not guaranteed. In the scenario with lowest export variance – the basket heavily weighted towards printed matter and furniture -- the variance falls by about 50 percent compared to the reference basket. In terms of GDP, the coefficient of variation of exports would fall by about 1.5 percent of GDP, a fairly substantial change. This is the case when diversification is heavily biased toward printed matter and furniture.

One cannot draw immediate policy inferences from these calculations. We do not know with any precision the macroeconomic and social costs of export variability, though these costs are probably real. Export diversification is just one way to reduce the burden of export variability, and might be a highly inefficient way, especially if heavy-handed policies were used to shift resources into the new export sectors. In addition, both the public and private sector can take alternative actions (e.g. financial market hedging, insurance, counter-cyclical fiscal policies) to ameliorate the

negative effects of export variability, and these alternatives might be more cost effective than export diversification per se. Our single conclusion here is that Chile's export bundle is relatively volatile, and a less natural-resource-based basket would be likely to diminish that volatility.

#### ***IV.4 Are Natural Resources a Hindrance to Growth?***

So far we have argued that Chile is unlikely to succeed in achieving a high level of development unless it diversifies its exports beyond natural resources. In this section we ask a different question: whether the natural resource abundance in Chile (especially in copper and forestry products) might actually be a *hindrance* to development. In other words, copper abundance may not only be insufficient for growth, but an actual barrier to growth. This somewhat counterintuitive question is based on an empirical observation: that natural resource abundant countries, especially the oil-rich countries but also other mining countries, have performed especially poorly in the past forty years, and that the resource abundance itself might be a kind of Midas curse rather than blessing.

One of the most interesting aspects about global economic development in the past 30 years is that the enormously successful countries of East Asia, namely Japan, Korea, Hong Kong, Taiwan and Singapore were all poor in natural resources at the start of their economic miracles. If nothing else, the example of these countries has shown that lack of resources is not a serious impediment to economic development. From the literature that has developed around these countries, we now have a much clearer understanding of how to achieve rapid growth under conditions of natural resource scarcity.

At the same time, it is interesting to note that developing countries with abundant natural

resources have not done nearly as well as the resource-poor economies. Indeed, there are relatively few recent cases of successful development under conditions of resource abundance. This is somewhat paradoxical. After all, natural resource abundance is usually cited in historical textbooks as a crucial ingredient for economic development. The American economy in the 19th century, it is often said, was blessed with abundant natural resources. This enabled it to grow and eventually overtake the economies of the Old World, whose access to resources was more constrained. But history also suggests there is a darker side to resource abundance. In the seventeenth century, resource-poor Netherlands eclipsed Spain, despite the overflow of gold and silver from the Spanish colonies in the New World.

The late 20th century has seen many resource-abundant economies in crisis. Mexico led the world into the developing country debt-crisis of the 1980's. Nigeria and Venezuela are in a state of chronic economic crisis. The oil-abundant economies have some of the lowest growth rates in the entire developing world, despite an increase in the real price of oil since the 1960's. Paradoxically, this is true even following periods of booming prices or new discoveries of natural resources: the growth rates after these booms are typically disappointingly low. Is there a curse to easy riches in the developing world?

Sachs and Warner (1995) have presented evidence that there may well be such a curse in a study of cross-country growth, which reports a robust negative association between growth and natural resource abundance. This negative association holds true even after controlling for a number of other variables such as initial per capita income, trade policy, government efficiency, investment rates, and human capital accumulation.

In view of these observations, there are at least four hypotheses that we explore briefly in this section:

1. Natural resource abundance creates a strong currency, which in turn inhibits the development of the manufacturing sector (the so-called Dutch disease argument). *If the manufacturing sector is characterized by some form of dynamic increasing returns to scale, especially increasing returns to scale not internalized in the firm, then the result could be a permanent decrement to growth.*
2. Natural resource abundance leads to undue rent seeking, and real resources are squandered in the quest for the rents, or in the dissipation of rents (e.g. a bloated public sector). As a result of a poor policy framework, the country ends up with a lower level of income than if it lacked natural resources altogether.
3. Natural resource earnings are subject to extremely high volatility in international markets. In the absence of efficient risk-spreading, the result is high instability of the domestic economy, with a significant cost to the rate of growth.
4. Natural resources create a temporarily strong exchange rate, one that must depreciate over time (either because of resource depletion, declining terms of trade, or the inelastic export supply of the resource, all of which may push the economy towards real depreciation). The period of declining real exchange rate puts great stress on political and social stability, as it is accompanied by stagnant or falling real wages.<sup>18</sup>

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<sup>18</sup> Consider a case, for example from Sachs (1998), in which resource endowments are inelastically supplied at a fixed world price, so that export earnings of natural resources are fixed. At the initial equilibrium, the exchange rate is too strong to permit a competitive tradeable manufacturing sector. As per capita income grows (or as population grows) there will be an excess demand for foreign exchange, as domestic agents seek to purchase a larger amount of capital goods and intermediate goods from abroad. The real exchange rate will have to depreciate. Eventually, it will depreciate

In all cases, we should point out, the natural resources are desirable *if* accompanied by appropriate policies to counteract the (alleged) negative effects of the resource endowment. This is a standard kind of second-best argument in welfare economics. Thus, an optimal response to the Dutch Disease argument might involve *subsidization* of the manufacturing sector, to capture the dynamic increasing returns to scale that are not captured by market forces. The appropriate response to the rent-seeking argument would be sound institutional design in the ownership and management of the natural resource endowment to reduce the amount of rent-seeking. The appropriate response to the high volatility would be ways to share the risks of terms of trade fluctuations. One obvious possibility, for example, would be for foreign firms to own the equity in the copper deposits, in return for Chileans owning equity in a worldwide, diversified portfolio of assets. The appropriate response to the declining real exchange rate might be flexible labor market institutions and redistributive taxes and transfers to spread the adjustment burdens more equitably.

Even before proceeding, we should note that macro-scale risks associated with natural resource endowments are not merely a hypothetical concern in view of Chile's own history. Chile's dominant export sector of the early 20th century, the nitrate sector, simply collapsed in a few years after the discovery in Europe of synthetic ways to produce nitrogen-based fertilizers. There have been, from time to time, concerns that the same phenomenon could affect copper. Already copper wiring is being displaced by fiber optic cable in a significant part of telecommunications and data transmission equipment. There are, no doubt, many other areas where copper will be substituted by new synthetic materials in the years ahead.

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enough to make domestic manufactures competitive on world markets. The prolonged period of real exchange rate depreciation may cause economic and political stress, however, since urban wages in real terms will be under siege during the transition to manufacturing competitiveness. Thus, there may be an economically viable path to export competitiveness in manufactures, but it may involve a prolonged period of *falling real wages*, and this may generate social and political instability, as well as a resort to misguided policies.

#### ***IV.5 A Brief Literature Review on the Linkages of Natural Resources and Growth***

The negative association between resource abundance and growth poses a conceptual puzzle. After all, natural resources raise the wealth and the purchasing power over imports, so that resource abundance might be expected to raise an economy's investment and growth rates as well. Many oil-rich countries have aimed to use their vast oil revenues to finance diversified investments and a *big push* in industrial development. Venezuelans called this *sowing the seeds of oil revenues*.

Williamson and DeLong (1994) have recently pointed out that when a natural resource has high transport costs, then its physical availability within the economy may be essential for the introduction of a new industry or a new technology. As a key historical example, coal and iron ore deposits were **sine qua non** for the development of an indigenous steel industry in the late nineteenth century. In that case, resource-rich economies such as Britain, Germany, and the U.S., experienced particularly rapid industrial development at the end of the last century. With falling transport costs, however, the physical availability of resources within the national economy is rarely as decisive today as it was a century ago. Thus, Japan and Korea have succeeded in become world-class steel producers despite their virtual complete dependence on imports of iron ore. Even if natural resources are no longer a decisive advantage to economic growth, it is surely surprising that they might pose an actual disadvantage. Is there a curse to easy riches?

Many previous researchers have noted the failure of resource-led growth in the 1970s and 1980s, though to the best of our knowledge, none has confirmed the adverse effects of resource abundance on growth on the basis of a worldwide, comparative study of growth, as we do in this

paper. Important earlier findings of the failures of resource-led development include several outstanding works by Gelb, culminating in Gelb (1988), and several key studies by Auty, most comprehensively in Auty (1990). These studies suggest many of the economic and political factors that may have played a role in the disappointing performance of resource-abundant economies, and so provide a basis for some of the hypotheses tested later in the paper on the cross-country data. A recent and fascinating paper by Berge *et. al.* (1994) is similar in motivation, and also points to the adverse role of natural resource endowments (measured mainly by land and population density) on growth and manufacturing exports.

As we noted above, there are indeed a large number of hypotheses that can be raised to link resource abundance and poor growth performance (in addition to the hypothesis that the negative relationship is purely spurious). One early explanation of the phenomenon is social: that easy riches lead to sloth. The sixteenth century French political philosopher Jean Bodin (1576, reprinted 1962) asserted as much when he claimed that:

“...men of a fat and fertile soil, are most commonly effeminate and cowards; whereas contrariwise a barren country make men temperate by necessity, and by consequence careful, vigilant, and industrious.” (V, I, 565)<sup>19</sup>

An alternative approach lies in the area of political economy. Lane and Tornell (1995) have recently argued in a formal model that resource-rich economies are subject to more extreme rent-seeking behavior than resource-poor economies, as national politics is oriented to grabbing the rents earned by the natural resource endowments. In their model, a windfall coming from a terms-of-trade

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<sup>19</sup> Cited in Stephen Holmes, *Passions and Constraints*, Chicago: University of Chicago Press, 1995, p. 109, from Jean Bodin, *The Six Books of a Commonwealth [Les six livres de la republique]*, trans. Robert Knolles, ed. K. D. McRae

improvement or a discovery of natural resource deposits can lead to a *feeding frenzy* in which competing factions fight for the natural resource rents, and end up inefficiently exhausting the public good. The case studies in Gelb (1988) and Auty (1990) lend much support to these political channels of influence.

Another set of possibilities is strictly economic, drawing upon the ideas widespread in the development literature in the 1940s and 1950s, and in the Dutch Disease models more recently. One important tradition in the development literature, associated with Raul Prebisch and Hans Singer, argued that resource-based growth would be ineffective because the world prices of primary exports relative to manufactures show a deep tendency towards secular decline. Closely related views held that world demand for manufactures would grow faster than demand for primary products or that the rich countries would be more protectionist against primary imports than manufacturing imports.

According to the "Prebisch hypothesis," later promoted by the United Nations Economic Commissions in Latin America, Africa, and Asia, the practical policy implication was that developing countries should shun their dependency on natural resource exports, through state-led industrialization. The great historical mistake of this thinking, however, was to recommend industrialization through prolonged import-substitution behind tariff and quota barriers, rather than through export promotion. State-led industrialization foundered almost everywhere that it was attempted (see Sachs and Warner 1995 for a recent cross-country analysis of the adverse effects of protectionism on long-term growth).

A second set of economic arguments against natural-resource-based growth involved the purported characteristics of the domestic economy rather than the international economy. The work

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(Cambridge: Harvard University Press, 1962).

of Hirschman (1958), Seers (1964), and Baldwin (1966) encouraged the view that beneficial "forward and backward linkages" from primary exports to the rest of the economy would be small. The basic idea was that manufacturing, as opposed to natural-resource production, leads to a more complex division of labor and hence to a higher standard of living. The negative assessment of resource-based development in due course led to a revisionist literature describing successful cases of staples-led growth. See for example Roemer (1970) on Peru, and further success cases reviewed in Lewis (1989).

Recently, Neary and Van Wijnbergen (1986), Krugman (1987) and Matsuyama (1992) have provided formal models of the "linkages approach." This study follows Matsuyama's framework. Matsuyama examines the role of agriculture in economic development in a model in which manufacturing is characterized by learning-by-doing. Matsuyama's model has two sectors, agriculture and manufacturing. Manufacturing is characterized by learning-by-doing that is external to the enterprise but internal to the manufacturing sector as a whole. In other words, learning is proportional to total sectoral production, not to the production of an individual firm. Forces which push the economy away from manufacturing and towards agriculture lower the growth rate of the economy, by reducing the learning-induced growth of manufacturing. The market equilibrium is not efficient because the learning effects are external to the firm. In this context, Matsuyama shows that trade liberalization in a land-intensive economy could actually slow economic growth by inducing the economy to shift resources away from manufacturing and towards agriculture.

In Matsuyama's model, the adverse effects of agricultural production arise because the agricultural sector directly employs the factors of production that otherwise would be in manufacturing. Such a framework may be useful for studying labor-intensive production of natural resources, such as in agriculture, but it is less relevant for a natural resource sector like oil

production, which use very little labor, and therefore does not directly draw employment from manufacturing. Fortunately, as shown in Sachs and Warner (1995), it is easy to extend Matsuyama's same point in a more realistic and general setting.

In the Dutch disease model, the economy has three sectors: a tradeable natural resource sector, a tradeable (non-resource) manufacturing sector, and a non-traded sector. The greater the natural resource endowment, the higher is the demand for non-tradeable goods, and consequently, the smaller will be the allocation of labor and capital to the manufacturing sector. Therefore, when natural resources are abundant, tradeables production is concentrated in natural resources rather than manufacturing, and capital and labor that otherwise might be employed in manufacturing are pulled into the non-traded goods sector. As a corollary, when an economy experiences a resource boom (either a terms-of-trade improvement, or a resource discovery), the manufacturing sector tends to shrink and the non-traded goods sector tends to expand.

The shrinkage of the manufacturing sector is dubbed the *disease*, though there is nothing *harmful* about the decline in manufacturing if neoclassical, competitive conditions prevail in the economy. The Dutch Disease can be a real disease, however -- and a source of chronic slow growth -- if there is something special about the sources of growth in manufacturing, such as the "backward and forward linkages" stressed by Hirschman, and others, or the learning-by-doing stressed by Neary and Van Wijnbergen, and Matsuyama. If manufacturing is characterized by externalities in production, then the shrinkage of the manufacturing sector caused by resource abundance can lead to a socially inefficient decline in growth. The economy loses the benefits of the external economies or IRS to manufacturing. The studies by Gelb confirm the importance of general Dutch Disease effects of resource booms, i.e. in the squeeze of manufactures in the face of resource booms. Timmer (1982) similarly provides evidence that agriculture is squeezed by an increase of energy exports.

The links of these Dutch Disease effects to the loss of production externalities, however, remains speculative and as yet unproven.

#### ***IV. 6 Has Chile Suffered from Dutch Disease?***

If Chile has suffered from Dutch disease in the twentieth century, most likely it has been related to copper. Although there are several other natural resources in Chile's export basket (wood pulp, fishmeal), the sheer weight of copper in the country's export basket (up to 80 percent in the early 1970s, down to 40 percent by 1997) would make it highly unlikely that a Dutch disease episode may have occurred *without* a boom in copper prices. Moreover, other commodity prices have tended to boom when copper boomed, as shown in Table 13. During most of the boom years in copper prices, there were also large increases in fishmeal and wood pulp. And the prices of these three commodities showed a particularly high positive correlation during the period 1980-95. Thus, looking at copper prices only is a good proxy for the overall situation of Chile's commodity export prices.

Therefore, we have studied the Chilean economy over the last four decades, searching for episodes in which copper prices have boomed, then investigating the movements in other key prices and quantities. As a result of this investigation, we have identified five episodes as candidates for Dutch disease. Table 14 shows these five periods, with their corresponding increases in real copper prices: 1964-66, when copper prices increased 124 percent, 1987-89 (85 percent), 1973 (47 percent), 1994-95 (46 percent), and 1979-80 (25 percent).

Of these five episodes, we leave out 1973 due to the economic crisis (GDP declined over 5 percent), an inflationary explosion and huge political turmoil. Only one of the other four periods

shows clear signs of Dutch Disease. In 1994-95, there was a boom not only in copper prices but also in quantities: in volume terms, copper production increased by 21 percent (there has been a continued expansion in copper production since 1980), a result of an investment boom in copper mining throughout most of the 1990s. Foreign investment in mining in 1994 and 1995, was above \$1.7 billion, almost twice as much as in 1993 (\$880 million). In 1994 and 1995, it represented 70 percent and 56 percent of foreign investment in Chile, respectively.<sup>20</sup>

Over 1994-95, the real exchange rate appreciated almost 13 percent and employment fell by 1.6 percent in agriculture and 1.4 percent in industry, while it increased by 1.7 percent in the services sector. Agriculture and industry reduced their share in GDP as well (by 0.03 percent and 0.5 percent, respectively). The effect on export shares was even more pronounced: both agriculture and industry reduced their share by 2.8 percent, while mining increased its share by 5.6 percent. These figures highlight the boom in copper exports in 1994-95.<sup>21</sup>

In 1979-80, copper prices surged by 25 percent and the real exchange rate appreciated by a huge 27 percent. Nonetheless, it would not be correct to attribute the exchange rate movement solely to the boom in copper prices. In June 1979, the Chilean economic authorities fixed the nominal exchange rate at Ch\$39 per US\$, at a time when local inflation was some 20 percentage points higher than international inflation and significant inflationary inertia existed in the Chilean economy due to the existence of mandatory wage indexation of 100 percent of past inflation.<sup>22</sup> In addition, the capital account was significantly liberalized in 1979, prompting a massive capital inflow to arbitrage

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<sup>20</sup> Foreign investment in mining started booming during the period 1985-1990, when it increased from \$81 million to \$803 million.

<sup>21</sup> In fact, copper prices reached a recent peak of \$1.33 per pound in 1995, the highest price in real terms over the last 6 years (since 1989).

<sup>22</sup> It has been pointed out that the effects of 100% indexation were limited, as it applied only to collective bargaining, which covered less than 20% of the labor force. This argument fails to consider the role of collective bargaining arrangements as leaders in wage setting throughout the economy.

a wide interest rate differential between local and international rates. It is the conjunction of these issues --the boom in copper prices, the fixing of the exchange rate, the widespread indexation and the liberalization of the capital account-- that can explain the massive appreciation of 1979-80.

The 1979-80 episode, however, is not a case of Dutch Disease in terms of the expected movements in prices and quantities, except for the change in the real exchange rate. Although agricultural employment was stagnant, industrial employment increased by 3.8 percent, and employment in mining -- paradoxically -- declined by 1.6 percent.<sup>23</sup> At the same time, both agriculture and mining reduced their share in total exports, while industry's share increased.

Spilimbergo(1999) finds appreciation of the real exchange rate in response to increases in copper prices and strong influence of copper prices in short-term fluctuations of the Chilean economy, but also points a conclusion from Morandé and Quiroz (1996): that the capital-intensity of the mining industry and its reliance on foreign capital goods reduces the possibility of Dutch disease.

The analysis of particular episodes can be put into the broader context of the evolution of the different economic sectors in Chile over the last four decades. At least since the early work of Clark (1937), going through the pioneering work of Chennery and Syrquin (1975), it has been established that developing countries go through clearly identified stages in their path to development. Agriculture reduces its share in GDP through time, while industry first increases its share, then reaches a plateau, then slowly starts to decline as services steadily increase their share in overall output. The experience of Chile over the last four decades tends to support this view.

Table 15 shows the evolution of agriculture, mining, industry and services since 1960, measured as shares of GDP in constant prices. The evidence indicates that agriculture has dropped

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<sup>23</sup> This may have been due to a modernization of the mining industry due to a surge of foreign investment in the late 1980s.

from almost 11 percent of GDP in 1960 to 9.6 percent over the same basis in 1996. Industry first increased its share, from 23 percent of GDP in 1960 to almost 28 percent in 1972, and then declined to 19.5 percent of GDP in 1996. At the same time, the service sector has consistently increased its share, starting at 58 percent of GDP and ending at almost 64 percent of GDP in 1994. Mining has shown a mildly declining trend over the period.

If this exercise is made using current prices, as in Table 15, the overall picture does not change, and the sectoral picture is pretty similar, with one exception: agriculture. Measured in current prices, agriculture's share of nominal GDP declines faster than in Table 14, from 10.7 percent of GDP in 1960 to 7.1 percent over the same basis in 1996. This is clear evidence that relative prices have moved against agricultural products over the last few decades.

In terms of exports, the picture looks different, as shown in Table 16. If shipments are divided into the main three categories (agriculture, mining and industry), it appears that agricultural exports languished from the mid-1960s to 1973, when they reached their trough at less than 2 percent of exports. After 1973, agricultural exports went into a sustained expansion towards a peak close to 15 percent of total shipments in the late 1980s and very early 1990s, and then decelerated, reducing its share to around 10 percent in the mid 1990s. Mining exports, on the other hand, from almost 90 percent of the total in the late 1960s and early 1970s went to less than 50 percent in the mid 1990s. Industry's share of exports has increased notably from less than 8 percent of the total in 1973 to over 40 percent in 1995. This trend is greatly influenced, however, by the inclusion of some products with a high natural resource component, such as cellulose and fishmeal, among industrial exports. A corrected measure of industrial exports<sup>24</sup> that excludes cellulose and fishmeal, shows that

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<sup>24</sup> Groups 5, 6, excluding items in 68, 7, and 8, of the SITC classification. [The World Bank definition of manufacturing exports includes groups 5-9, except 68]

non-natural-resource-based industrial exports account only for 13 percent of the total exports in 1995.

#### ***IV.7 The International Evidence on the Adverse Effects of Natural Resources on Growth***

##### *Natural Resource Intensity and Overall Growth*

In this section we begin by presenting a number of empirical observations that serve as the motivation for the rest of the study. The most basic motivating observation is that countries that have a high share of primary commodity exports in GDP have tended to grow more slowly than other countries. Figure 4 shows this general tendency. This inverse association between commodity intensity and growth experience has been previously documented and examined in Sachs and Warner (1997).

We now show the data for individual countries in Tables 17 to 20. What we have done in these tables is to divide the world into four categories: (a) countries that are rich in natural resources; (b) countries that are poor in natural resources; (c) countries that increased their resource intensity substantially; and (d) countries that reduced their resource intensity substantially. Natural resource intensity is measured as exports of natural resources divided by GDP in 1970. Natural resource exports in turn include primary agriculture, fuels and minerals, corresponding to SITC categories 0, 1, 2, 4, and 68. We measure exports of natural resources rather than production of natural resources because production data is not reliably available for a large sample of countries. Most natural resource intensive countries export a very high share of their natural resources, so that in practice exports are a very good proxy for total domestic production. Table 17 shows that Oman was the

most natural resource intensive country in 1970, with exports of fuels accounting for 89 percent of GDP. At the other end of the scale in Table 18, Japan was the least natural resource intensive country with NRX amounting to less than 1 percent of GDP.

The resource rich countries (Table 17) grew at an average rate of just 0.02 percent between 1970 and 1990, while the resource poor countries grew at 1.83 percent (Table 18). This is another way to show the large difference in growth between the two groups of countries.

The countries that changed their resource intensity substantially over this period are shown in tables 19 and 20. The main countries where resource intensity declined are in Table 19: Malaysia, Mauritius, Sri Lanka, Dominican Republic and the Philippines. In Malaysia, for example, natural resource intensity declined from 37 percent of GDP to 25 percent. The main countries where natural resource intensity increased include Norway, Ecuador, Nigeria and Botswana (Table 20). Botswana is the most dramatic example. Major discoveries of diamonds increased its natural resource intensity from 5 percent to 35 percent.

Chile's natural resource intensity was 14.9 percent of GDP in 1970 and 20.7 percent in 1990. This level of natural resource intensity is high, being slightly above the mean, but not *extremely* high. This raises the question of whether the inverse association documented in Figure 4 also holds for more moderate levels of resource intensity. In Figure 5 we show that it does (the countries in this figure are all countries with commodity exports as a share of GDP of 25 percent or less). The inverse relationship displayed in Figure 4 is not driven by a few low-growth, highly natural-resource-intensive economies.

A second way to measure natural resource intensity is through export composition, that is, as a percent of exports rather than of GDP. For the moment we divide exports into two categories: natural resources and manufactures. In Table 21, we show manufacturing exports as a share of total

exports in 1970 and 1990 (the natural resource share would, of course, be 100 minus these shares). In Figure 6 we show that the inverse relation between natural resource intensity and growth also holds when commodity intensity is measured as a share of exports rather than as a share of GDP.

So far, the results we have presented are about exports of broad classes of commodities and subsequent growth, rather than domestic production. Regarding natural resources, the difference between exports and production is small, but this is not the case with manufacturing. Therefore, it is worth pointing out that while the share of manufacturing *exports* (in total exports) is positively related to subsequent growth, the share of manufacturing *value-added* (in total GDP) is not as clearly related to growth (Figure 7). This is suggestive that there is something special about the exporting that lies behind the natural resources-growth relation.

A further basic fact about natural resources is that no country with high natural resources has reached an income per-capita close to the richest countries in the world. In Table 22, we show a list of the 15 richest countries in terms of *per-capita exports of natural resources*. Very few of the richest countries are on this list. Brunei earns about 60 percent of its income from natural resources; Oman earns about 50 percent; and some of the other oil-rich states earn about 40 percent. But these are clearly very unusual cases. Other than these cases, countries simply do not earn high income from natural resources. Norway is the only high-income country that earns more than 10 percent of its income from natural resources.

In the same vein, it is worth pointing out that the high-income countries tend to specialize in manufacturing exports rather than in natural resources. Such countries also tend to have high shares of their value added in manufacturing. In Figure 8 we show the positive, but weak, relation between income levels and the share of manufactures exports in total exports. Two notable exceptions to this tendency are Australia and New Zealand, whose exports are not highly concentrated in

manufactures, but who nevertheless have high incomes. In Figure 9 we show the relation between the share of value added in manufacturing and income levels. Both figures show a slight positive relation between income levels and manufacturing.

To summarize the discussion so far, we first showed a number of results that argued that prior resource abundance tended to be negatively associated with subsequent growth. Next we showed data to argue that high-income countries are typically not specialized in natural resources. Instead, they tend to have slightly higher manufacturing sectors than poorer countries. However, manufacturing includes a wide diversity of products, so it may be more accurate to conclude simply that rich countries tend to have diversified production structures. The important issue is whether natural resource abundance prevents the diversification that accompanies economic growth.

#### *Natural Resource Intensity, Export Growth and Productivity Growth*

We now turn to more specific observations that shed light on the consequences of natural resource intensity. First, it is possible to extend the previous results about growth to growth of exports and growth of productivity. In Figures 10 and 11 we show that natural resource intensive economies tended to have slower export growth. This is true both of the full sample of countries where data is available (Figure 10) and a subset of countries that excludes those with extremely high natural resource intensity (Figure 11). To the extent that exports are an important engine of growth for the successful developing countries, this is suggestive that natural resource intensity may block growth by blocking overall export growth.

In addition, if we think about decomposing growth into the separate contributions from capital accumulation, labor force growth, and total factor productivity, natural resource intensity is

more related to slower productivity growth than to slower capital accumulation. In Figure 12 we show the inverse relation between natural resource intensity and subsequent total factor productivity growth. The relationship is negative, but somewhat weaker than it is for overall growth. Two countries that deviated from the inverse relationship are Mauritius and Iceland, which both had relatively high natural resource exports and high total factor productivity growth.

#### ***IV.8 Commodity Prices: Trends and Volatility***

We now look to the evidence on whether price trends in the global economy have been adverse for natural resources. This question has been examined extensively by other authors, and we confine ourselves here to a summary of the main results. First, as shown in Figure 13, it is clear that global commodity prices declined since the mid-1970s relative to broad indexes of prices in industrial countries (both indexes are very broad aggregate indexes from the International Financial Statistics of the International Monetary Fund). It is also the case that terms of trade indexes of non-oil developing countries have declined gradually since the 1950's (see Figure 14). Over longer time periods, the data do not show clear trends. In Figure 15, we show six graphs, each of which contains long time series of the ratio of prices of manufactures to prices of crude materials, in logarithmic scale. All prices are either export price indexes or import price indexes from U.S. historical data. These data show long periods where manufacturing prices actually decline substantially, showing that the recent decline in commodity prices (rise in manufacturing prices) is not necessarily a long-run trend.

The January 1999 issue of *Global Commodity Markets*, published by the World Bank, forecasts an increase in commodity prices for the period 2000-2010, compared to their low values in

1997-98. In real terms, however, prices are expected to remain low, in many cases below their 1997 levels. This is the expected scenario for copper prices. The report raises the possibility that the recent declines in commodity prices may be of a more permanent nature. These drops would not only be due to lower demand due to the world economic situation, but also to increases in supply caused by declining production costs generated by technological improvements and more efficient production methods. If this is the case, “commodity prices may have taken another step down in the long history of declining prices relative to those of manufactured goods.”

Regarding volatility in commodity prices, Figure 16 shows the relation between the standard deviation of the terms of trade indexes (de-trended) and natural resource intensity. Note that natural resource intensive countries tend to have higher volatility, but much of this relationship is due to the oil-intensive countries such as Oman, Libya, Kuwait and United Arab Emirates. Without the oil-intensive economies the relation is much weaker.

Figure 17 shows the same relation with volatility in the real effective exchange rate rather than the terms of trade. There is a positive relationship between this measure of price instability and natural resource intensity. Again, a few outlying countries dominate the relationship; without these countries, it is difficult to discern a strong pattern.

Finally, since there has been a trend decline in natural resource prices at the global level in the past 20 years, we check to see whether this has translated into long-term depreciation for natural resource intensive economies. We estimated regressions to determine a subset of countries that experienced significant trends in their real effective exchange rate. For this subset of countries, we look at the relation between the trend and natural resource intensity (Figure 18). Overall, it is difficult to see any dominant pattern.

#### *IV.9 Transitions*

This section examines recent transitions from exports of natural resources to exports of manufactures. In Table 23, we rank 111 countries by their change in the fraction of exports in manufactures between the years 1970 and 1990. The countries are ranked with the largest increase in the share of manufacturing exports at the top. The final column contains the change in the share. What is interesting from this table is that so many countries have seen an increase in the share of manufacturing exports. The average increase is 15 percentage points. Only seven countries have recorded a drop in the share of manufacturing of more than 5 percentage points, and several of these are data errors. In general, we have found three kinds of errors in these data. In some cases, the apparent shift into manufacturing is actually a shift into an "unidentified products" category. In other cases, minerals are not separated out from manufacturing. And finally, in some other cases there are major discrepancies between these data (from the World Bank) and more detailed trade data for the year in which they overlap, 1980.

Table 23 records these cases in the final column. After excluding these cases there are only two major countries where the manufacturing share of exports declined significantly: Norway and Angola. Of these, Angola had a civil war and Norway discovered natural gas, so the decline in manufacturing in these examples was related to events that are not easily replicable. Without these countries, virtually the whole world has seen its export composition shift to manufactures.

The global shift to manufactures is displayed in Figure 19. There are essentially three groups of countries. First, there are countries that already had a high share of manufactures, so there was little scope for increase. Second, there is a large mass of countries where both the increase and the initial share was fairly small. And finally, there is a group of countries with large increases and

small initial shares. We will focus on this last group as the interesting examples to be explained.

What accounts for the large increase in manufacturing exports of this group? We list four possibilities: a decline in natural resource exports, leaving manufacturing as the remaining export; a shift in a single manufacturing product; a shift to manufactures that are closely related to a natural resource; and a shift to a broad base of manufactures. The second of these, namely a shift to apparel and clothing is the most important way to account for these data. In Table 24 below, we show that this single sector explains the bulk of the transition in the Dominican Republic, Mauritius, Sri Lanka, Thailand, Turkey, Haiti, Tunisia, and Morocco. Note that because of data availability we are looking at the 1980-1990 change here, rather than the 1970-1990 change as in Table 23 and Figure 19 above.

A collapse of natural resources explains very little of these large transitions. In most countries, the detailed trade data show that real exports of natural resources increased during the period when manufacturing was rising. Of the countries in Table 24, only Indonesia, Sri Lanka and Haiti saw a decline in real natural resource exports. There is little general support for the idea that transitions were forced upon countries by negative natural resource shocks.

There are a few examples of countries shifting towards manufactures that are closely related to a natural resource endowment, but not many. Morocco and Tunisia increased exports of fertilizers, Indonesia increased exports of wood and cork products, and Brazil increased exports of leather products, paper and iron. Nevertheless, these examples account for only a modest share of the overall increase. This argues against the idea that light processing of natural resources is the most viable path for countries seeking to diversify out of natural resources. This kind of transition has not been dominant in the past 30 years.

It is also worth mentioning that a broad-based movement towards greater diversity has

occurred in about five of these countries: Singapore, Malaysia, Ireland, Brazil, and the Philippines. In the first three of these countries, export diversification was accompanied by rapid growth. In Brazil, growth has been unstable, to say the least, but this seems related in part to the fact that Brazilian exports still remain a very small fraction of GDP. In the Philippines, it indeed seems that in recent years, rapid export growth from export processing zones has provided an important new impetus to overall GDP growth.

## **V. Policy Implications of the Structural Analysis**

Let us accept, on the basis of arguments to this point, that Chile will have to achieve export competitiveness in a diversified set of manufacturing and service sectors in order to maintain the rapid economic growth of recent years. What, then, are the policy implications of this finding? Will market forces, by themselves, generate the necessary competitiveness in manufacturing and service exports, or must other public actions be directed to this goal? This section considers this issue in the Chilean context. There are eight areas of concern: (1) exchange rate policy; (2) export and foreign investment policy; (3) infrastructure; (4) information technology; (5) public investments in education; (6) science and technology policy; (7) intertemporal management of resource endowments; and (8) spreading risks associated with the resource endowments.

### ***V.1 Exchange Rate Policy***

As a natural resource exporter in need of diversification, Chile should recognize that it may very well require a real exchange rate depreciation -- that is, a rise in the price of tradeable

manufacturing goods relative to non-tradeable goods -- to promote international competitiveness of its currently small tradeable sectors in manufactures and services. Of course, if technological change in tradeable goods is sufficiently fast, then the tradeable goods sector may grow even with an unchanging or appreciating real exchange rate. But the Chilean Government should not rely on that possibility. The exchange rate should remain flexible, as it has been for many years, so that the Peso may depreciate, if necessary, to support competitiveness of a nascent tradeables sector in manufactures and services. This point is *a fortiori* true when the natural resource suffers a sharp terms-of-trade deterioration, as in 1998.<sup>25</sup> Then the case for real depreciation becomes overwhelming, and the advantages of exchange rate flexibility are most apparent.<sup>26</sup> Thus, the natural-resource abundant economies of Australia, Canada, Chile, and New Zealand all rightly allowed their currencies to depreciate gradually, but markedly, throughout the past year. And because all of these countries had flexible exchange rate regimes in place, the depreciation did not occasion any financial market panic.

Many resource abundant economies -- including Argentina and Venezuela in Chile's own neighborhood -- have made it a habit of allowing the currency to remain overvalued for years at a time. This results from a kind of optical illusion. Since the non-resource tradeable sector is so small in those countries (with oil accounting for 85 percent or more of Venezuela's exports), it appears that there is no responsiveness of export supply to changes in the exchange rate. The natural resource supply is essentially inelastic *at any point in time*, and the non-traditional sector is too small to count. For this reason, it may seem economically useless, and politically unwise, to tamper with an overvalued currency. Alas, the result is almost self-fulfilling: the non-traditional tradeable sector

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<sup>25</sup> In this sense, the recent decision by the Central Bank of Chile to abandon the exchange rate band in September 1999, intervening only in exceptional cases, is a clear step in the right direction. The nominal exchange rate

never develops, and the assertion that the economy is simply uncompetitive in non-resource sectors seems to be supported.

As Figure 20 shows, East Asian economies have maintained stable real exchange rates through periods of very rapid growth. Their currencies have been weaker than the Chilean Peso for long periods of time. Only in the late 1990s there was a slippage into real exchange appreciation that ended in the currency crises of 1997 in some economies, or severe recession in the case of Hong-Kong. Australia, Canada and New Zealand have also kept weaker currencies than Chile in the last thirty years. Certainly, a weak currency does not harm in promoting competitiveness.

The corollary to the need for exchange rate flexibility is the need for real wage flexibility, for example by limiting the use of indexation in wage contracting. A major function of real depreciation, after all, is to reduce the international value of the wage sufficiently to ensure international cost competitiveness. Again, if technological progress is proceeding rapidly enough, real wages might rise continuously through a shift towards manufacturing and service exports. It may be the case, however, that real wages will be stagnant, or even declining, during part of the transition away from natural resource dependence. In any event, to minimize any unnecessary income losses during the transition, real wages should be flexible.

## ***V.2 A State-of-the-Art Export Policy***

At a broad level, good overall economic policy is certainly the best export policy.

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depreciated about 1 percent following this decision.

<sup>26</sup> Arellano and Larraín (1996) develop and estimate a model of real exchange rate determination for Chile.

Macroeconomic stability, open trade, high saving rates, moderate taxation, stability of property rights, transparency in government, are all elements that ease the way to export competitiveness in manufactures and services. But this is not all. Most success stories in manufacturing and service sector exports in the developing world have supporting them a policy aimed at promoting export diversification. This policy is not a case of “picking winners,” which has proven a recipe for failure except in a small minority of cases. It is, rather, a case of providing the institutional infrastructure to support emerging sectors.

### *Creating an Export Platform*

The main theme of modern, “state-of-the-art” export policy is the role of *international networks* in high-productivity sectors in manufacturing and services. Aside from manufacturing activities based on Chile’s natural resources (e.g. pulp and paper production, or copper wiring), most non-resource-based manufacturing activities involve a network of international production processes, usually mediated by one or more multinational enterprises. Thus, consumer electronics or computer production requires close linkages with major semiconductor firms, such as Intel. It would not make sense for Chile, or any other developing country, to try to break into the computer industry from a cold start. Almost inevitably, a developing country becomes a part of global electronics industry through a range of institutions that link domestic production with multinational firms. Such linkages may be formed through foreign direct investment; outsourcing; original equipment manufactures, or OEM (according to which a local manufacturer produces under specifications and name brand of an international firm); strategic alliances between domestic and international firms, and so forth. In all cases, an active policy is needed rather than just reliance on the market to bring in

these activities to the country.

Each of these alternatives requires specific, and often novel, institutional forms to make such activities profitable, especially since they must be carried out over vast distances, with production in one market aimed for consumers many thousands of miles away. With fairly homogeneous commodities, such as copper, or pulp and paper, this distance can be bridged without a deep knowledge of consumer markets abroad. With specialized activities, whether in manufactures or services, the bridging almost inevitably requires the kind of alternative linkages just mentioned.

A common policy across all successful manufactured exports in Asia was the establishment of export platforms, i.e. an area that favors production for foreign markets and offers producers a competitive environment in the world economy (export processing zones (EPZs), bonded warehouses, and duty exemption systems are different components of an export platform). EPZs in Asia have been especially successful in the creation of linkages with the rest of the economy and have managed to evolve into higher value-added goods. Most manufactured exports in those countries come from these areas. At the same time, EPZ location seems to be a key factor for its success. The cases of Singapore and Thailand have been especially successful.<sup>27</sup> Jenkins, Esquivel and Larrain (1998) reviews the costs and benefits of EPZs and points the success of Costa Rica in export diversification by attracting foreign firms to specific sub-sectors of the electronic industry. Locating EPZs in remote areas for regional development purposes, however, has been a general failure.

*The Role of Foreign Direct Investment*

Chile is not deeply experienced with these forms of activity, and thus has little track record of attracting foreign multinational activities other than in the resource sectors or in sectors aiming to serve the local market (e.g. foreign banks establishing branches in Chile). In fact, if we look at the sectoral distribution of foreign investment into Chile, we see that the lion's share has gone to the natural resource sector, with much smaller amounts directed towards manufactures and services. Part of the manufactures is for the domestic market, and part is for natural resource processing, so that the amount left over for export-oriented non-resource-based manufacturing is tiny.

The figures on foreign investment in Tables 25 and 26 are revealing. Most foreign investment in Chile today takes place through DL600, the statute approved in 1974. Over the period 1974-89, total DL600 investment reached \$4.9 billion; between 1990 and 1998 this figure increased almost six-fold to \$26.4 billion (average annual growth rate of 18.9 percent). As a share of GDP, FDI has increased from 2.8 percent in 1991 to 7.9 percent in 1998.

Up to 1995, mining attracted the lion's share of foreign investment, with almost 60 percent of the total in the 1986-95 period. In the last three years, however, there has been a substantial increase in the share of the service sector, whose average share has been over 30 percent. A large part of this has been concentrated in the financial sector. Mining has declined in relative terms in 1996-98, though total investment suffered a large decline only in 1996. Transport and telecommunication shows a similar trend to the service sector, with large investments since 1995, mostly concentrated in the telecom sector. The manufacturing sector has received a small share of foreign investment (13 percent on average for 1986-98), and has not benefited from the diversification out of mining since 1995. Note that in spite of the collapse of commodity prices in 1998, investment in mining reached a record level of \$2.4 billion for the year, representing 40 percent of total foreign investment. Thus,

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<sup>27</sup> See Wen Ho and Teck Hoon (1998) for Singapore and Poapongsakorn (1998) for Thailand.

though mining has reduced its share of the total, it is still the main recipient of foreign investment in Chile.<sup>28</sup>

The benefits of FDI are clear. It brings foreign capital into a capital scarce economy. In so doing, it generally improves the welfare of domestic residents and may induce some positive externalities as demand spillovers on upstream and downstream domestic industries. These benefits can be magnified if FDI goes into technologically advanced sectors, which increase the human capital of the labor force and may lead to learning by doing in other sectors. By targeting activities where training is an important component and just-in-time contracts with local companies are significant, these benefits would be further exploited. Warden (1998) reviews Mexico's experience with maquiladoras and points some of the problems that can be avoided.

The well-known 1993 report from the World Bank on the Asian Miracle suggests that the large increase in manufacturing exports in these countries would not have happened spontaneously as a result of competitive advantage. The creation of appropriate institutions for collaboration among the public and private sector played a key role in the development of an important IT sector. Hanna et al. (1996) reviews the instruments used by Asian countries in the creation of large IT sectors in their countries. Industrial parks, institutions to bridge communication gaps between public and private sector, government sponsored research institutions, IT education and training, venture capital fund for IT business, and foreign-local joint-ventures are some of the most relevant ones. Contests based on export performance were also used successfully in most of these countries. Diffusion programs through civil service training and public sector IT plans were also important. Asians invested heavily in the creation of the necessary infrastructure. Rapid financial deepening and credit

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<sup>28</sup> It is likely, however, that the continued collapse in copper prices will keep reducing the share of foreign investment going into mining.

to exporters were also found to have been an important factor, as well a general macroeconomic stability and positive real interest rates that generated a large pool of savings. Interest rate subsidies were small, although there was credit targeting of different sectors, not always successfully.

Singapore created the Economic Development Board (EDB), a key institution that eliminated bureaucracy, established networks with multinational corporations (*think-tank breakfasts*, contacts through offices in multiple countries have been used to bring feed back about international investors needs), and created a flexible way to train new workers as new skills were demanded by foreign investors. Tax-exemptions has been one of the instruments it has used. Later, the EDB spun other organisms in charge of some of its functions .The National Computer Board has also been especially important in the strategic planning of the IT industry in Singapore.

While Chile cannot and need not pick industrial “winners”, it should certainly be better prepared to attract major firms in key sectors, understanding the nature of institutional mechanisms that are associated with attracting investments from each of the sectors. Consider the case of electronics, for example. When a major firm such as Intel undertakes a new overseas investment, there are usually several short-listed countries in contention for attracting the investment. The countries actually launch a veritable campaign to land the investment, discussing with Intel the range of concerns over taxation, infrastructure, availability of skilled labor, property rights protections, and so forth. In a recent competition for a \$600 million investment in a semiconductor production facility, four locations were in the final round of competition: Costa Rica, Ireland, Malaysia, and Mexico. After extensive discussions with the respective governments, Intel ended up selecting Costa Rica, based in part on commitments of guarantees on infrastructure, plans for reform of the

engineering curriculum in the local university, and tax concessions.<sup>29</sup> The investment conditions formed a package. In the semiconductor industry, enterprise needs and heated international competition over the choice of locations, jointly determine the terms of FDI. A similar competition to attract key companies happens between states in the U.S.

To summarize, Chile needs to gain expertise in attracting “networked” international activities outside of the natural resource sector, both in manufactures and services. Chile’s outstanding general economic performance and its potential role as a stable export platform for the rest of Latin America, make it a potentially highly attractive host for such activities. It is perfectly feasible to be more aggressive in the attraction of strategic high-tech foreign investments respecting Chile’s generally orthodox economic policies. *We, thus, recommend that Chile’s investment promotion agency gain expertise on a sector-by-sector basis, examining options and polling international firms, regarding the following issues:*

- (1) The role of tax policy, including the possible role of tax concessions in the case of large projects in which Chile is in competition with alternative locations;
- (2) The concerns over infrastructure, including: sea port facilities, air port facilities, telecommunications and data transmission (including broad bandwidth transmission)
- (3) The supply of skilled labor, and the appropriateness of University curricula in technical fields
- (4) The role of export processing zones, bonded warehouses, industrial parks, and so forth, in providing the physical location for FDI activities
- (5) Laws governing the protection of property rights, as a possible incentive or disincentive to activities

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<sup>29</sup> Larraín, López-Calva and Rodríguez (1999) review the experience of Costa Rica attracting Intel.

- (6) Laws governing the range of networking relations (strategic alliances, joint ventures, foreign-owned firms)
- (7) Labor legislation, including the terms governing expatriate labor
- (8) The regulatory environment surrounding information technologies

An issue remains from the discussion of the preceding section? Should Chile, in some way, actively promote the export-oriented manufacturing and service sectors to overcome the real possibility of a long-term Dutch disease effect? Our answer is yes.<sup>30</sup> Chilean manufacturing exporters face a host of structural impediments: great distance, a narrow home market, a generally strong currency, and political economy attuned to the needs of the mining sector, but not necessarily the export-oriented manufacturing sector. Given these difficulties, policy makers should be extremely attuned to the needs and untapped potential in export-oriented manufacturing and services. There is probably a case for support of leading-edge non-traditional exporters through public promotion of the supporting infrastructure, education, and R&D, which will feed into the competitiveness of those new sectors. The idea of initial tax holidays or other tax inducements (e.g. accelerated depreciation allowances, generous loss carry forwards, low or zero capital gains taxation) to initial investments in these non-traditional areas may also be studied, though we ourselves find potentially significant problems in these incentives.<sup>31</sup> Probably the best recommendation is to make a cross-country benchmarking of current practices in areas of potential Chilean competitiveness.

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<sup>30</sup> The Presidential Commission Report on information technology in Chile sets the goal of attracting foreign investment in IT sectors (see Box 1), but is short on specific policies to achieve this goal.

### ***V.3 Infrastructure***

The infrastructure sector -- power, roads, rail, ports, airports, telecommunications and data transmission -- is the critical nexus which links domestic production with international markets (as well as ensuring a unified internal market). Poor infrastructure may be merely a nuisance when it involves the domestic production network, but it can be catastrophic when it involves the connection between domestic firms and international firms. As Chile moves beyond raw materials exports to manufacturing and service sector exports, the quality of infrastructure takes on an increasing importance.

Business perceptions of Chile's infrastructure are disquieting, as reported in the World Economic Forum's 1999 Global Competitiveness Report (GCR). Chile gets relatively high marks in one area, albeit a very important one: telecommunications. While the number of phone lines in 1997 was a low 17.9 per 100 inhabitants<sup>32</sup> (compared, for example, with Sweden's 67.9, France 57.5 lines, Australia 50.5, Italy 44.7, Spain 40.3, or Malaysia 19.5), there is evidence of a rapid improvement in telecommunications usage and investment. The percentage annual growth in telephone usage is estimated at 24 percent per year between 1991 and 1997, a very high rate compared to other developed countries. In addition, Chile's telephone network is fully digital since 1992.

In judging the *affordability* of international telephone service, the GCR business survey placed Chile 4th from the top. This is clearly due to the 1994 deregulation, which opened long distance services to free competition on a per call basis. As a result, prices declined dramatically, foreign investment increased, and investment in fiber optic created a large telecommunications

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<sup>31</sup> Tax concessions have two kinds of problems: a) They create a source of loopholes; and b) they may transfer resources to a foreign revenue service (when taxes paid in Chile are deductible from taxes at the headquarters of the multinational).

backbone in the country. In 1995, local phone systems were opened for competition.

Cellular phone usage has grown fast in recent years, but in 1997 there were only 2.8 subscribers per 100 inhabitants in 1997, compared to 42 in Finland, 38 in Norway, 21 in the U.S., 15 in Portugal, 11 in Malaysia and Spain, and 10 in France.

In almost all other areas of infrastructure, however, Chile ranked much lower, as shown in Table 27. Road infrastructure was deemed to be especially weak, placing Chile 44th in the rankings. Chile likewise placed very low in rails (50th) and in ports (37th). On objective indicators, Chile ranked very low on road and rail density. Thus, in spite of the significant growth in private infrastructure investment after the implementation of the concessions law in the early 1990s, the gap in these areas is still very large and requires continued attention so that the infrastructure bottleneck on Chile's growth path is removed.

#### ***V.4 Information Technology***

For geographically remote countries, the new information technologies are probably the best hope for conquering the disadvantages of distance. It is noteworthy that the "peripheral" countries of Northern Europe are among the world's heaviest users per capita in the Internet, computers, cellular phones, and other instruments of the new network technologies. Australia and New Zealand similarly are heavy users of the new technologies. Chile, on the other hand, lags far behind these other regions. This is shown in Table 28.

As of July 1997, Chile had an estimated 13.1 Internet host sites per 10,000 population (22.06 in July 1999, according to the latest survey from the Internet Software Consortium), compared for

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<sup>32</sup> Given the level of inequality in Chile, this probably translates to a much higher number in the Central Valley area.

example with 424.3 Internet host sites per 10,000 population in New Zealand. A survey on the use of the Internet in Santiago (August 1996, see Mendoza et al.), showed that 3 percent of households had access to the Internet. Of those connected, 47 percent were upper middle income, 23 percent middle income, and 30 percent lower middle income. In those same segments, 68 percent had access from home, 59 percent from work, 56 percent from an educational institution. Overall, more than 60 percent of users do not pay for their connection. The typical profile of a user was a young male, highly educated and with a high-income level.

There can be little doubt that Chile has so far failed to take best advantage of the new technologies. In the advanced economies, electronic commerce, computerization of the service sector, pervasive IT applications to manufacturing and agriculture, have led to massive investments in IT hardware and software in recent years. The U.S. Commerce Department estimates that as much as one third of all U.S. business investment in recent years has been on IT applications. The 1999 United Nations Human Development Report estimates the value of e-commerce worldwide at \$2.6 billion in 1996 and forecasts \$300 billion by 2002. It also highlights the potential for developing countries. Indian software exports, for example, a market traditionally belonging to OECD countries, have increased rapidly in the last years. A recent survey in *The Economist* (June 26 1999) focuses on the impact of the Internet on business, which not only reduces costs but also changes dramatically the interaction of firms both with customers (other firms and final customers) and suppliers. New business models are emerging and transforming the organization of companies. Cisco Systems, a large US IT manufacturer, estimates its savings from using the web at \$500m a year. IBM expects sales over the Internet in 1999 to reach \$15 billion, almost five times the level in 1998. GE is buying close to \$1 billion from 1,400 suppliers on-line. Because IT and the Internet are complementary technologies and enjoy large network externalities, as the number of users increase

other companies and countries will be forced to adopt them or be passed over in favor of other technology users.

In comparison, Chile is years behind. Interestingly, Chilean-based business leaders responding to the 1998 World Economic Forum survey report that “managers in your country use computers and information technology extensively” (Chile ranked 4th out of 53), but either this perception is misplaced, or there is an enormous disproportion between the use of computers by managers and by the rest of society. The Santiago survey tends to support the latter interpretation.

In 1997, Chile had 5.04 computers per 100 inhabitants, well above Argentina’s 1.34 and the Latin American average of 1.22. Nonetheless, this number is very low when compared to developed countries: 44.2 in the U.S., above 30 in the Nordic countries, 31.1 in Australia, 16.7 in Belgium, 14.5 in Ireland, 12.8 in Japan, 9.23 in Italy, and 9.42 in Spain. Given Chile’s income inequality, however, the business and academic communities have probably a much larger access to computer than the average.

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### **Box 1: The Presidential Commission Report on IT**

The government seems to be aware of Chile’s shortcoming in IT. In January 1999, the Comisión Presidencial de Nuevas Tecnologías e Información produced a report reviewing the current IT situation and made a detailed number of proposals (a total of 61) to achieve different goals in IT policy. The proposals refer to a variety of issues: the legal framework, regulation of costs and access, training, a new network for universities, total connectivity for schools, avoiding inequality in access to the Internet, reform and connectivity of the State, health, etc.

The largest group of proposals refers to universal access to the Internet: by 2006, every

teacher in the country should be knowledgeable in the new technologies, and should be able to use them in the classroom; every high-school in the country and fifty percent of the public subsidized schools should be connected (this extends the “Enlaces Program,” started in 1993 in regions VIII, IX and X, which in 1995 linked 100 public schools to the Internet)<sup>33</sup>; information booths and tele-centers should be created in every village in the country starting with the poorer and more backward communities, after a trial period in 1999-2000; promote the creation of content in Spanish in the Internet and at the same time promote the learning of English; promote citizen participation through new technologies; promote virtual schools and education; creation of new degrees in multimedia and education; promote R&D in new technologies, communications and networks; integrate every university and research institute in REUNA2, a high-speed network exclusively for academics that started working in 1998 and is the fastest network in Latin America; development of a new and modern statistical system using the new technologies; avoid excessive regulation of the Internet, promoting self-regulation and parental control instead; promote the interrelation of health and new technologies: telemedicine, access to health databases about quality care, treatments and cost options.

A second group of proposals refers to the legal issues raised by the new technologies: adapt anti-trust law to prevent concentration of ownership of media and contents; change legal framework to guarantee access to Internet Service Providers (ISPs) and promote competition; guarantee market transparency through separate accounts for phone companies to avoid cross-subsidies; force telephone companies to give information to other carriers and ISPs without discrimination; validity of electronic documents, digital signature and electronic notarization; study international experience

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<sup>33</sup> In 1998, the Chilean Telecommunications Company (CTC) committed to connect for free every school and high-school in the country.

on tax legislation for electronic commerce; regulate protection of Personal Data; regulate intellectual property; create a National Committee on Cryptography; promote consumer rights in e-commerce (direct or indirect).

Another block of proposals regards the reform of the public sector in relation to the new technologies: make public information accessible (free or charge depending on the value-added content); by 2003, provide all relevant public services through electronic booths; new electronic forms for foreign trade; creation of a unique intranet for the state; make stand-alone databases available; new financing for projects with innovative and high technology content; develop an electronic system of public purchases and contracting; continue the promotion of electronic filing of different taxes.

The rest of the proposals refer to incentives to develop the use of new technologies in the private sector, achievement of world quality human resources, sectoral development and decentralization: allow firms to conduct electronically their most burdensome transactions with the public administration; use engineering students internships to promote new technologies in small and medium firms; create networks connecting public institutions, consulting companies, and firms; use new technologies for ProChile to connect Chilean and foreign firms; promote distance education with new technologies; create a National Digital Network to obtain tax rebates for training (SENCE); reform of the education system: revise curricula to create qualified human resources, especially in IT; creation of excellence IT centers geared towards firms needs; promote IT intensive sectors like culture, tourism and productive systems; create a program to attract new foreign investment with high intensity in IT or communications; develop the second phase of MUNITEL, connecting local governments to public institutions; creation of a National Infrastructure of digital maps with geo-referencing; set up a special program to develop infrastructure and information for

extreme regions (I, XI and XII); and promote a national debate about all take-off initiatives 1999-2000.

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The global evidence suggests that IT will pervade all areas of technical change in the near future, not just areas directly related to telecommunications and data management. Multinational firms rely increasingly on electronic “marketplaces” for managing consumer and supplier relations. Exporters are increasingly coordinating the timing and specification of shipments of all types of commodities via IT systems. Farmers are managing planting, harvesting, and marketing decisions through increasingly complex information systems, that harness information on weather, shipping costs and timing, and even microclimate and micronutrient information within the farm itself. Even in areas as remote as rural Kenya, farm communities are in continuous electronic contact with London buyers to coordinate the shipments of horticultural products.

The Presidential Commission Report (see Box 1) is a good start, but much needs to be done in going from the goals set forth in the Report to the policies and actions needed to achieve those goals. We recommend a careful benchmarking of all aspects of the IT sector in Chile, with a view towards public policies to spur the adoption of IT technologies and the enhancement of IT capabilities within the country. This review would include regulatory systems (intellectual property rights, taxation of e-commerce, competition policy in cable, telephony, data transmission); education (computer use in the primary and secondary schools; programs in electrical engineering and computer programming at vocational schools and universities); infrastructure (availability of wide bandwidth to enterprises and households, regional coordination regarding South American fiber optic systems); tax incentives towards the adoption of IT technologies; IT fairs with demonstrations

to potential users of the benefits of the new technologies ; extensive use by the State of the new technologies, and related matters.

### ***V. 5 Education Policy***

In education more than any other social sphere, the legacy of Chile's highly unequal development path continues to burden the economy and society. The 19th century inequalities in land ownership have been extended into the late 20th century as inequalities in educational attainments. Both quantitative and qualitative indicators suggest that a significant portion of the Chilean society remains undereducated, and therefore unequipped for the high-technology challenges that lie ahead. The lackluster performance in public education no doubt will hinder Chile's capacity to gain competitiveness in new manufacturing and service sectors.

In the 1999 *Global Competitiveness Report*, business executives were asked to assess whether "the average number of years of schooling in the labor force is sufficient to support highly competitive companies." As shown in the first column of Table 29, Chile ranks 36th out of 59 countries. On the question of whether "the school system in your country excels in math, and basic science education," Chile ranks 46th out of 59 countries, while Singapore ranks 1st and Taiwan 3rd. The opinions of foreign investors and executives helped Singapore develop flexible training systems oriented to increasing the skills of the labor force in tune with the future needs of companies. Vocational schools and good technical curricula at university level have been very important in Asian countries. For small countries, a system of grants to study in foreign universities (with provisions to avoid brain drain) may have a higher benefit-cost ratio. Unfortunately, the quantitative measures garnered by the 1998 World Development Report (WDR) of the World Bank tell a similar

story. The WDR reports that only 55 percent of the secondary-school age cohort are actually enrolled. This compares with more than 90 percent in the counterpart countries of Oceania and Northern Europe. According to the WDR, public expenditure on education is only 2.9 percent of GDP, again far lower than the counterpart countries, which are all above 5 percent of GDP, and in fact all above 6 percent of GDP except for Australia. While it is true that Chile boasts a purportedly high level of *private* spending on education, the low public expenditures no doubt leave a large part of youth without adequate education, and no doubt help to sustain the continuing high inequality of Chilean society.<sup>34</sup>

Education is particularly important for growth and convergence. Barro (1995) finds that a 1 percent increase in government spending on education raises growth by 2.2 percent, and an additional year of male secondary schooling by 1.6 percent.

## ***V.6 Science and Technology Policy***

In general, Latin America lags far behind the advanced countries in science and technology, and Chile is no exception to this pattern. Notably, the global share of Latin America's scientific contributions is apparently far below the share of world GDP. According to UNESCO's *1998 World Science Report*, Latin America contributed approximately 8.4 percent of world GDP (in purchasing power terms) in 1994, but contributed only 1.9 percent of world spending on research and development. By contrast, the "triad" of Western Europe, North America, and Japan and the Asian NICs contributed approximately 55.8 percent of world GDP, but 84.5 percent of

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<sup>34</sup> For an analysis of education and inequality, and the impact on inequality and growth of investing in different educational levels see Birdsall et al. (1997).

global spending on R&D. The relative commitments to R&D are reflected in the share of world scientific publications. Latin America's share is 1.6 percent, compared with the triad's share of 84.3 percent. The gap in patents is even starker. Within Europe, the triad accounts for 97.4 percent of all patents (!), and in the United States, the triad accounts for 98.7 percent of all patents.

Chile certainly shares in this overall regional lag in scientific effort and output. According to the 1998 WDR (Table 19, p. 226), Chile had only 364 scientists and engineers in R&D activities during 1981-95, compared with 2,477 in Australia, and 1,778 in New Zealand. Finland, Norway, and Sweden each have more than 3,000. The 1999 Global Competitiveness Report reports the views of businessmen regarding the strength of Chile's scientific institutions (rank 41st out of 59), the high quality of scientists and engineers (rank 31st), excellence in math and science in the school system (rank 46th), public resources committed to spending in R&D (rank 38th), private sector commitment to spending in R&D (rank 33rd), and research cooperation between universities and industry (rank 31st). The ability of companies to absorb new technology is also low (Chile is 32nd) compared to Finland, 2nd, Taiwan, 4th, Iceland 5th, Sweden 7th, or Singapore 9th. Regarding Internet use by companies, Chile clearly lags behind: 35th in the use of the Internet for customer service, 22nd for supplier relations, 47th for general information and 50th for not using the Internet at all. There are a few brighter spots. The business respondents suggested that engineering "greatly attracts young talent" (rank 3rd). In terms of the protection of intellectual property rights, Chile ranked in the middle (28th).<sup>35</sup>

The evidence on science is consistent with the general evidence on IT and education. Chile remains deficient in the development of human capital linked to the advanced sectors of the world economy. Chile's ability to compete in non-traditional manufacturing and service sectors will

depend greatly on improved performance in these spheres.

### ***V.7 Intertemporal Management of Natural Resource Endowments***

Non-renewable natural resources typically provide a large stream of income, but only for a given period of time, up to depletion. The optimal spending of these resources generally follows a different path. Revenues from the resource may be accumulated in a long-term fund, from which they would be drawn according to the optimal spending pattern. This scheme aims to achieve *intertemporal smoothing*. Norway has recently created such a fund, to which we return later. Another characteristic of non-renewable natural resources is high revenue volatility. This is usually a source of macroeconomic problems: fiscal revenues and public expenditure become volatile, usually in undesirable ways; price booms may lead to real appreciation and loss of competitiveness for the non-resource tradable sector of the economy. Chile has dealt with this problem, through the creation of the Copper Stabilization Fund, but has not implemented an optimal depletion fund.

#### *The Chilean Copper Stabilization Fund*

Chile's Copper Stabilization Fund was established in 1985 as part of a structural adjustment loan with the World Bank, and started working in 1987. Its two main goals are the stabilization of fiscal revenues and the stabilization of available foreign reserves. Prior to the existence of the fund, when copper prices were above a reference level, the additional revenues were deposited in a special account with the Treasury and were used to buy back public debt. The reference price was

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<sup>35</sup> These last 2 issues come from the 1998 GCR; they were not included in the 1999 GCR.

determined by the Ministerio de Hacienda, with a cap based on the average London Metal Exchange (LME) price during the six previous years, adjusted by the US wholesale price index.

The Fund, applied only to CODELCO's exports, works as follows: every three months, the state calculates the difference between the estimated reference "trend" copper price,<sup>36</sup> on which the national budget is based, and the actual average market price, based on a weighed average of CODELCO's FOB exports. If the actual price is higher than the trend price, the first 4 cents go to the state, the following 6 cents are divided equally between the state and the fund, and anything above those 10 cents goes entirely into the fund. Similarly, whenever the price is below the set level, the government can draw on the Fund, using the same rule. The Fund is deposited in a special account at the Central Bank, which pays LIBOR - 0.125 percent.

The government drew from the Fund in 1988 and 1989 to prepay debt that the Treasury had contracted with the Central Bank (corresponding to private external debt that was assumed by the government after the banking crisis of 1982), and in 1990 to pay for larger imports than expected due to an expansionary policy by the previous government prior to the 1989 elections.

Basch and Engel (1993) have criticized the Fund on 2 main counts:

- 1) the level of savings existing in the fund is not considered at the time of making the saving decision for the following year
- 2) the decision to save should not only depend on the difference between the current and the long-run price of copper, but should also take into consideration the expected evolution of the price in

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<sup>36</sup> Basch and Engel (1993) argue that it is not clear how this price is obtained.

the short run<sup>37</sup>

In spite of the criticism that the Fund has received, we believe that it has served a useful purpose in mitigating the fiscal cycle during copper booms and busts. While copper prices remained high in the mid 1990s, the Fund accumulated resources. When copper prices collapsed in 1998 the government started drawing from the Fund to finance part of its planned spending. It is clear from its rules, however, that the Fund does not operate as an optimal depletion Fund. And, of course, the Fund can only mitigate the copper cycle, but does not shield Chile from the income effects of changes in copper prices.

#### *The Norwegian Government Petroleum Fund*

Norway is the world's second largest oil exporter with oil and natural gas accounting for 35-40 percent of total exports of goods and services. Its petroleum sector represents 18 percent of GDP but only 3.5 percent of employment. Taxes and royalties from petroleum cover 8 percent of central government revenues, but with other oil related revenues it goes up to 16 percent of revenue, or 6 percent of GDP.

The Government Petroleum Fund (GPF) was established in June 1990. It was originally conceived as a fiscal management tool whose assets should reflect past and current central government surpluses. Long-term considerations were the main motivation for the creation of the

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<sup>37</sup> If current prices are higher than those expected in the immediate future, it would be better to save (and viceversa). The current rule does not take into account that the more distant the time of spending the funds, the less of an incentive there is to save even in a time of boom. It is not enough to know the difference between current price and long-run value, but also the expected length of the cycle when the decision is taken. For more on this see Basch and Engel (1993). They conclude that the reference price should include the anticipated prices for an immediate future rather than a long-run estimate.

GPF: the long-term path of future oil revenues would be declining while the long-term path of government expenditures on pensions would be increasing. Basically, the fund was established as an instrument to manage savings. The Ministry of Finance was the original manager of the fund. In 1996, however, when the fund's assets had increased substantially, it delegated this function to the Central Bank, which manages the fund following the guidelines issued by the Ministry of Finance.

The GPF's income comes from petroleum revenues from the central government budget and the return on the fund's capital. The annual allocation to the fund is set as the difference between the revenues from oil and the government budget deficit, excluding oil and gas revenues (there is an annual transfer to the Treasury for the amount of petroleum revenues to be used in the fiscal budget). In addition, the GPF is allowed to cover up to half of the central government's remaining net financing requirement. It cannot be used for any other purposes. Following these rules, there were no net allocations to the GPF during the period 1990-95. The fund's assets need to have a certain degree of liquidity and have to be invested abroad as a way to stabilize the Norwegian economy and to diversify the economy's investments.

Formally, the fund was set up as a krone account with the Central Bank<sup>38</sup> which was invested in foreign currencies and low risk foreign fixed income securities in the Bank's name. The currency distribution was determined according to Norway's import weights, in order to minimize exchange rate risks among the currencies in which the fund invested. A change in the regulation of the fund in 1997 disposed of this requirement, given its drawbacks and the new guidelines for the Fund explained below.

In 1996, the initial estimates for the allocation of the fund, \$7-8 billion, were surpassed by

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<sup>38</sup> The government formulates the monetary policy mandate of the Central Bank. Exchange rate stability has been an important mandate.

the end of the year, reaching \$40-45 billion in total assets. This created new demands on the Central Bank. Given the size of the Bank's reserves, it was decided to transfer management of some of them to external managers, as a way to share expertise and as a basis of comparison with the Bank's performance as a manager. On April 1997, and given the evolution of the fund and the projections for the future, the Central Bank recommended a change in strategy for the investment of the fund, allowing for equity investments. Several reasons were given for equity investments: historically, stocks have provided better insurance against inflation, oil is less correlated with stocks than with bonds, risk spreading, and higher historical returns from stocks. The proposal was included in the Revised National Budget presented by the minister of Finance on May 1997 and endorsed by the Norwegian Parliament in June of that year. The movement towards equities happened relatively fast: as of March 1998 the equity portfolio was 26.6 percent of the fund, and by June equities had reached 40 percent.

The Ministry of Finance issued new guidelines on October 1997 addressing the differing implications of the new scheme of equity investments. The guidelines determined that between 30 and 50 percent of the fund would be invested in foreign equity markets and the remaining mostly in bonds. The equity share reflects the government's own risk preferences. The purchases would be spread over time to avoid affecting prices. The fund would only invest in developed markets, and investments would be only portfolio investments with a cap of 1 percent per company. The regional distribution would move within the following limits: The Americas (USA and Canada): 20-40 per cent; Europe (Belgium, Denmark, Finland, France, Italy, Ireland, the Netherlands, Portugal, Spain, the UK, Switzerland, Sweden, Germany, and Austria): 40-60 per cent; Asia and Oceania (Australia, Hong Kong, Japan, New Zealand, and Singapore): 10-30 per cent.

Investments must be made in countries with which Norway has ties and where Norwegian

companies invest, with complete disclosure to the Norwegian Parliament at the time of the presentation of central government accounts. Information about the Fund's value is also available through the monthly report from the Central Bank on assets and liabilities.

A new unit within the Bank was created for the management of the fund, Norges Bank Investment Management. The regulations also allowed for the appointment of external managers, based on commercial criteria, among both Norwegian and international managers subject to internal ethical guidelines. In 1998, there were four external equity managers: Bankers Trust (New York), Barclays Global Investors (London), Gartmore Investment Management (London), and State Street Global Advisors (Boston), while Chase Manhattan Bank acts as the global custodian of the equity portfolio.

The Fund is not free from political pressures, however: "In the spring of 1997 the Labour government decided to switch up to 40 percent of fund investment from bonds into equities in a number of low-risk countries. However, there was increased public pressure to allocate a greater share to immediate spending in areas such as the health service, and this was one of the factors which led to the election of a new centrist coalition government committed to increasing public spending in selected areas." (EIU Country Report 1998-1999)

In essence, the GPF was not really conceived as a stabilization fund, even though this goal is one of the safeguards of the fund. The regulations of the fund have been quite flexible adapting to the new circumstances: it has moved from passive management of foreign fixed income instruments to external management of a diversified portfolio with a large equity component. Given the fact that it is also a buffer fund from which the government can draw to finance non-oil deficits, it can be subject to large political pressures. Basically, there is no rule that limits drawings upon the fund, in the sense that nothing prevents a government of running a large fiscal deficit and financing it

through the fund.

### ***V.8 Spreading the Risks Associated with Resource Endowments***

We have thus far documented that the international prices of natural resources present not only high variability, but also a secular trend of decline. This poses considerable challenges for a country such as Chile, where copper accounts for over 40 percent of total export revenue. While copper revenues are a relatively small fraction of the central government's total revenues, an average of 5 percent over the period 1988-97, they are highly volatile. As table 30 shows, the volatility of copper revenues, measured as the coefficient of variation of either the share of copper revenues over total revenues (0.36), or copper revenues as a share of GDP (0.38), is five times larger than the volatility of net tax revenues. This creates considerable additional challenges for fiscal budgeting.

From a pure perspective of optimal financial management (without dealing with political considerations) Chile should spread the ownership of the copper resources worldwide, via securitization of CODELCO's income stream through privatization of CODELCO equity, and use the proceeds to invest in an internationally diversified financial portfolio. This would diversify much of the terms-of-trade risk. If this is done, Chile could consume out of the "permanent-income stream" from that international portfolio, using a payout ratio as in pension management, or university endowment management.

We are aware, however, that there are many political economy problems with this approach: (1) There is considerable domestic opposition to privatizing the state-owned copper company, CODELCO. If privatization is politically unfeasible, the government may perhaps consider selling only a fraction of equity (though this strategy has considerable drawbacks, especially regarding its ability to attract minority stockholders in a state-owned company);

(2) Even if privatization would be possible, it would likely happen after prolonged discussions, with some groups fiercely opposed to the idea. In such a case, fear of expropriation by potential buyers may drive down the sales price, making a sale of the assets unadvisable. In other words, because of the inability of the government to commit not to expropriate, the second-best might be for the government to continue to own the resources. But the first best continues to be privatization, if a credible commitment not to expropriate is made.

(3) After privatization, there remains the possibility that the international portfolio would be over-consumed, or would be politically manipulated. Thus, there *could* be some inter-temporal advantage in leaving the copper in the ground, so that the national patrimony is not exhausted too soon.

All of this suggests that a privatization cum diversification strategy would require very careful institutional design, a fascinating and important theme, but alas one that goes well beyond the scope of this paper. There are, to be sure, alternative approaches to risk spreading, among them: (a) issuing copper-linked international bonds, and (b) future sales. Each of these, however, has their own problems. Issuing copper bonds is hard because of Chile's large presence in the world market. Future sales are complicated by the repercussions of the scandal with CODELCO's copper futures, which cost the company in excess of \$200mm, and by the difficulty of enforcing long-term international commodities contracts. Overall, a carefully designed privatization strategy remains the first best.

## **VI. Conclusions**

Chile's relative economic position -- strong but below the top rank of countries -- is heavily related to its overall structural characteristics, which have fashioned the Chilean economy, and

continue to frame its possibilities. To continue Chile's successful development of the past decade and a half, we believe that long-term policy making must be more finely addressed to the structural conditions in which the country exists.

For 150 years, Chile has remained essentially a natural resource exporter, first in agriculture, then nitrates, and now, minerals and agriculture. During the past 15 years of rapid economic growth, Chile has shown little evidence of diversification into manufacturing and service exports, though there has been a shift away from copper dependence towards agriculture and forestry. Natural resource endowments and exports are rarely sufficient in a country to support a high level of income. The few countries that have been able to maintain rapid growth, and reach high levels of development, without major export diversification have two characteristics. First, they tend to have very small populations. Second, they tend to have an extraordinary resource endowment of some sort relative to that population. In 20 of the 26 countries ranked as "high income" by the World Bank in 1997, manufactured goods constitute at least sixty percent of total merchandise exports. In addition, Chile's export bundle is relatively volatile, and a less natural-resource-based basket would reduce that volatility.

Our empirical analysis, based on a cross-section of countries, shows that natural resources may well be a hindrance to growth. Measured either as a share of GDP or as a share of exports, natural resource intensity is negatively associated with growth. Resource intensive economies tend to have slower export growth as well. If exports are an important engine of growth for developing countries, as the evidence indicates, natural resource intensity may limit overall growth by slowing export growth.

The analysis set forth in this paper has allowed us to obtain some important lessons from a group of countries that present major structural similarities to Chile and that, at the same time, were

able to successfully develop. Why did the Nordic countries outstrip Chile's economic growth after 1930, and why did Chile fail to narrow the gap significantly with Australia and New Zealand in the course of the entire century? We believe that the fundamental difference in long-term performance among these countries is the extent to which their respective economies succeeded in diversifying their economic base, especially their export sectors, beyond natural-resource-based development.

Australia and New Zealand reached a "dead end" based on natural resources in the 1970s and 1980s. Like Chile, their distance to Europe, small markets, and natural resource dependence had resulted in a small manufacturing base as of the beginning of this century. At least since the Great Depression until the mid-1970s, these countries adopted protectionist policies to try to promote inward-looking industrialization. Like in Chile, they did not get very many "infant industries" growing up to be internationally competitive. Thus, beginning in the 1980s, they scrapped the protectionism, and began to search for new export-oriented opportunities. Both countries went into the IT sector in a big way, for example, as we have documented in this paper, and both expanded their exports markedly to the rest of Asia. This has proved to be moderately successful, achieving substantial export diversification over the last 30 years: between 1965 and 1996, the share of manufacturing in total exports increased in New Zealand and Australia from 5 percent and 12 percent respectively, to almost 30 percent in both.

The Nordic countries are somewhat different. Sweden and Norway have traditionally been free-trading countries, and Finland has been a more-or-less free trader since the early 1960s. All three have used excellent technical education, in science and technology, to support small but world-competitive manufacturing export sectors. All three countries are extremely high users of IT, and are pioneers in consumer-based IT systems (e.g. Ericsson and Nokia). Norway has become, once again, mainly a raw-material exporter, but only by the recent "accident" of the North Sea oil and gas.

Before that, Norway was a major exporter of sophisticated manufacturing (ships) and services (shipping).

How will Chile diversify its exports in the future? There is no single answer to this question; work is required in a number of areas. As a natural resource exporter in need of diversification, Chile requires a competitive real exchange rate to promote international competitiveness of its currently small tradeable sectors in manufactures and services. The exchange rate should remain flexible, so that the *peso* may depreciate, if necessary, to support competitiveness of a nascent tradeables sector in manufactures and services. The corollary to the need for exchange rate flexibility is the need for real wage flexibility. Also, there is probably a case for supporting leading-edge non-traditional exporters through public promotion of the supporting infrastructure, education, and R&D, which will feed into the competitiveness of those new sectors.

Despite significant growth in private infrastructure investment, the gap revealed by the Global Competitiveness Report is still very large and requires continued attention. On the other hand, the current revolution in information technology (IT) can most likely be harnessed to Chile's advantage in the task of export diversification. If one of the key defining elements of Chile's structure has been a large distance from major world markets, then IT can become a great equalizer, by dramatically reducing the costs of communications, and greatly enhancing the flows of information available at low cost to the Chilean economy. The evidence suggests, however, that Chile is relatively far behind in the mobilization of IT in industry, education, and society at large.

Chile also shows relative weaknesses in education, science, and research and development, the social spheres that will prove to be most important in Chile's task of a broader-based, more diversified national economy, and one that is more tightly integrated with the advanced economies. The Presidential Commission Report on New Information Technologies is a good start, but much

needs to be done in going from the goals set forth in the Report to the policies and actions needed to achieve those goals. We recommend a careful benchmarking of all aspects of the IT sector in Chile, with a view towards public policies to spur the adoption of IT technologies and the enhancement of IT capabilities within the country.

Optimal financial management of copper resources suggests that Chile should spread the ownership of the copper resources worldwide, via securitization of CODELCO's income stream through privatization of CODELCO equity, using the proceeds to invest in an internationally diversified financial portfolio. This would reduce much of the terms-of-trade risk for the country.

To succeed in this diversification process, Chile needs to gain expertise in attracting "networked" international activities outside of the natural resource sector, both in manufactures and services. Chile's outstanding general economic performance over the past 15 years, and its potential role as a stable export platform for the rest of Latin America, make it a potentially highly attractive host for such activities. It is perfectly feasible to be more aggressive in the attraction of strategic high-tech foreign investments respecting Chile's generally orthodox economic policies.

Chile has big regional advantages over Argentina and Brazil in stability, rule of law, etc., all of which suggest a deep comparative advantage in the provision of high-technology services, including banking, insurance, education, and health. Based on the GCR (Table 31), Chile's higher institutional stability shows in its ranking of 22 in "low probability of change in the legal and political institutions in the next five years," ahead of Argentina (32), and Brazil (34). Regarding administrative regulations that constrain businesses, Chile was 17 in minimal regulations, also ahead of Argentina (24) and Brazil (51). Chile also ranked 8 in low government bureaucracy, while Argentina was 34 and Brazil 46. Starting a new business is easier in Chile (rank 26) than in Argentina (40) or Brazil (41). Chile's public policies are perceived as largely independent from

pressure groups (rank 9), well ahead of Argentina (39) and Brazil (42). Chile's civil service also appears as more independent than in Argentina or Brazil. And tax evasion is much lower in Chile. On the negative side, the competence of public sector personnel appears as low, with Chile ranking 48th, Argentina 58th, and Brazil 40th. Based on these strengths, Chile could augment its exports of resources and resource-based manufactures, with the export of advanced services. To do this, indeed to introduce non-traditional exports of any major variety, however, will require a concerted improvement in infrastructure, education, R&D, etc.

This is all a long effort. Progress will be gradual, but the investment is worth undertaking now.

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