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Mineral Resource Trade in Chile

CONTRIBUTION TO DEVELOPMENT AND POLICY IMPLICATIONS

Jane Korinek



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MINERAL RESOURCE TRADE IN CHILE:
CONTRIBUTION TO DEVELOPMENT AND POLICY IMPLICATIONS

Jane Korinek, OECD

Abstract

Mineral resources present a formidable source of wealth but a formidable challenge to regulate in order to maximize social welfare from their extraction. Some resource-rich countries, such as Chile, have been successful in developing their economies and managing their revenue streams effectively. Strong institutions and regulatory oversight have helped to capitalize on the benefits of the mining sector for economy-wide growth and development in Chile. This paper identifies some of the good practice areas in mining regulation in Chile whose economy has shown strong growth over most of the last two decades. Some of the areas touched on in this paper are the taxation of the minerals sector, management of the tax revenue, and policies designed to foster spillovers into other sectors of the economy and make the most of Chile's comparative advantage as a long-time global leader in the copper industry. The paper concludes that there is much to be learned from the Chilean experience in regulating its mining sector and many areas where it could be well used as a model for other mineral rich economies wishing to develop their mining sectors to enhance economy-wide growth.

Keywords: Chile, mining, copper, regulation, taxation, royalties, tax revenue management, export restrictions, spillovers, capital-intensive, innovation, extractive industries, sovereign wealth funds, SWF, mining services, natural resources, industry standards, world-class suppliers, price volatility, exchange rate, fiscal responsibility, legal framework, structural balance rule, Ley Reservada del Cobre, non-renewable, resource curse debate, geological service, mineral deposits, exploration, exploitation permits, government revenue, resource-rich, mineral wealth.

JEL Classification : Q32, Q33, Q37, Q38, O13, O19.

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Executive Summary

Mineral resources present a formidable source of wealth but a formidable challenge to regulate in order to maximize social welfare from their extraction. Some resource-rich countries, such as Chile, have been successful in developing their economies and managing their revenue streams effectively. Strong institutions and regulatory oversight have helped to capitalize on the benefits of the mining sector for economy-wide growth and development in Chile. The country is benefitting from its natural resource wealth in part due to:

- tax revenue that contributes substantially to the central budget;
- forward-looking management of tax revenue; and
- policies that foster positive linkages and spillovers into other sectors of the economy.

This paper identifies some of the good practice areas in mining regulation in Chile whose economy has shown strong growth over most of the last two decades. Part of this strong performance can be attributed to the country's mineral resources sector, a sector that has witnessed major reform efforts that proved to be effective and attractive for foreign investment.

One of the main ways in which wealth from the mining sector is shared and can be used to promote growth throughout the economy is through taxation and the investment and redistribution of tax revenue. Chile's system of taxation of its extractive industries seems transparent, predictable, balanced and within a range acceptable to the firms with international reach that inhabit the sector. The mining law is progressive, including higher tax rates during times of very large profits (14% in the case that the profit margin is 85% of total revenue). It is also progressive in that it does not apply to small and some medium-sized mining firms. From 2006 to 2010, taxes paid by mining sector firms and profit contributed by the state-owned mining company provided 27% of tax revenue collected by the central government whereas the mining sector accounts for about 15% of GDP. Reform of the unpublished Ley Reservada del Cobre could enhance both government oversight and efficiency of revenue collection and disbursement.

Equally important as the appropriate level of taxation is how the tax revenues are distributed and managed. Chile's Fiscal Responsibility Law (FRL) has provided a predictable, formula-based policy framework for managing tax revenue which lessens the possibility of capture for short-term political gain. The FRL enacted the structural balance rule which involves estimating the fiscal income that would be obtained net of the impact of the economic cycle, and in particular commodity price cycles, and spending only the amount compatible with that longer-term level of income. In practice, this means saving during economic highs, when revenue known to be of a temporary nature is received, and spending the revenue in situations when fiscal income drops. Government revenue collected during periods of economic highs is invested in two sovereign wealth funds: the Pension Reserve Fund, to fund future old-age and disability solidarity pensions and solidarity pension contributions arising from the pension reform; and the Economic and Social Stabilization Fund (ESSF), to ensure stable government spending during times of lower growth.

Implementing its structural balance rule has helped Chile to stabilise its government expenditure. Curbing excess spending during boom years has also helped Chile manage the exchange rate of the peso. In addition, the sovereign wealth funds that invest excess tax revenue during times of high commodity prices are held in foreign currencies, thereby partially offsetting the upward pressure on the peso. This has helped to avoid "crowding out" other industries and exports that may have trouble competing globally if they are confronted with high and volatile exchange rates, and has also helped to diversify risk. Chile's counter-cyclical fiscal policy has reduced uncertainty in its medium-term performance which has contributed to lowering the sovereign risk premium it pays when borrowing on international markets.

The mining sector has the potential to create a multiplier effect by contributing to the development of mining-related activities that cater to domestic and international firms. The demand for new technologies and adaptation of existing ones has grown and will continue to do so. Environmental sustainability requirements, the need to drill deeper to get to new deposits, and exploitation of more complex or lower-grade minerals pose new challenges and open up vast potential for technological development and the provision of specialized, knowledge-intensive services. Chile is introducing policies that aim to tap into the vast potential for technological development and the provision of specialised knowledge-intensive services to mining activities. There is some recent evidence of successful partnerships between large mining firms and specialized, contracted firms to develop innovative adaptations of existing technologies to the demands of Chilean mines and build on Chile's comparative advantage of proximity to mining operations.

One way in which the public sector can facilitate information flows and decision making processes in the extractive industries is through provision of good, public and up-to-date geological information. Chile's geological service, Sernageomin, holds information on the claims that have been staked for exploration and exploitation but has not consolidated detailed information concerning the size and quality of deposits.[1]

[1] The Chilean authorities have indicated that work is progressing in this area.

1. Introduction

A significant body of work is building within OECD on the existence, use and impact of a specific trade policy instrument, export restrictions, on minerals and metals. The mining sector is subject to a relatively large proportion of total export restrictions. Some producers of industrial raw materials use export restrictions to achieve policy objectives such as:[2]

- fostering spillovers to other sectors thereby promoting development of downstream or upstream industries;
- increasing revenue, in particular government revenue coming from the extractive industries;
- offsetting exchange rate impacts caused by substantial exports of a small number of raw materials that are potentially volatile;
- controlling illegal exports or other activities, thereby responding to concerns of lack of effective governance;
- environmental protection, or protection of citizens' health;
- attempting to realize optimum mineral extraction levels, when conditions are deemed to create an incentive to extract too rapidly.

However, it has been shown that export restrictions are not necessarily the most efficient way of achieving these stated policy goals.[3] Many countries with large mining sectors and important natural resource reserves prefer to regulate mining operations using alternative approaches.

The extent of the task, however, should not be underestimated. Mineral resources present a formidable source of wealth but a formidable challenge to regulate in order to maximize social welfare from their extraction. Some resource-rich countries have been very successful in developing their economies and managing their revenue streams effectively; others have faced major challenges in doing so. One hypothesis suggests that mineral resources are the cause of slower or biased growth rather than increased growth and development (see Box 1 on the resource curse debate). Some further hypotheses suggest that weaker institutions, lower spending on education or the volatility that comes with relying on exports of mineral resources are the causes for the correlation between resource wealth and low growth in some countries.

2 See Fliess and Mard (2012).

3. See, for example, Korinek and Kim (2010) or the WTO World Trade Report 2010, p. 123-130.

Box 1. The resource curse debate

Resource abundance does not always lead to sustained economic growth and development; it can have the opposite effect in some cases. There are a number of reasons why this may be true, relating to the ways in which natural resource wealth differs from other sources of wealth. Unlike other sources of wealth, natural resources do not need to be produced: they simply need to be extracted, although there is often nothing simple about the extraction process (Humphreys, Sachs and Stiglitz, 2007, p.4). The generation of natural resource wealth can therefore occur quite independently of other economic processes, without major linkages to the rest of economic activity and without the participation of large parts of the labour force. This may explain why some studies show that resource-rich countries often under-invest in education for example (Ibid, p.10).

Resource-rich countries that experience a decline in pre-existing sectors of the economy are said to have contracted the "Dutch disease".[1] The "disease" spreads as follows. A sudden rise in the value of natural resource exports produces an appreciation in the real exchange rate. This, in turn, makes exporting non-natural resource commodities more difficult and competing with imports across a wide range of commodities almost impossible. Foreign exchange earned through resource exports is easily used to buy cheaper imports, at the expense of domestic manufactures and agricultural goods (called the "spending effect"). Simultaneously, domestic resources such as labor and materials are shifted to the natural resource sector (called the "resource pull" effect). Consequently, the cost of these resources on the domestic market rises, thereby increasing costs to competing sectors (Humphreys, Sachs and Stiglitz, 2007, p. 5). In this way, the extraction of natural resources sets into motion a dynamic that gives primacy to two domestic sectors – the natural resource sector and the non-tradable sector.

There exists a large body of empirical studies that have examined different aspects of the resource curse. In a pioneering study, Sachs and Warner (1995) find that resource-rich economies generally grow at a slower pace. Using a cross-section of 52 countries, they show that resource-intense countries had slower growth in manufacturing exports than those that were resource-poor, after holding constant the initial share of manufacturing exports in total exports. Stijns (2003) uses a gravity model to estimate the impact of a natural resources boom on real manufacturing exports and finds the resource curse hypothesis to be empirically relevant.[2]

The resource curse seems to operate in some contexts more fully than in others. In attempting to explain these differences, some theories stressing political economy considerations such as rent-seeking behavior and the importance of institutions have gained prominence. Studies suggest that resource abundance can hamper economic growth in the presence of weak institutions such as poorly defined property rights, poorly functioning legal systems, weak rule of law and autocracy (WTO, 2010, p. 93). Sala-i-Martin and Subramanian (2003) demonstrate that natural resource extraction has a strong negative effect on long-term growth through the effect on the weakening of political and social institutions. Mehlum et al. (2006) find that in countries with institutions of sufficient quality there is no resource curse. The most severe manifestation of the resource curse is the onset or continuation of civil conflict. In this case, warring groups within resource-producing societies obtain money through resource extraction, or extortion of those who do, in order to fund violent action. This has brought about a number of initiatives including the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas.[3]

Another strain of the resource curse debate suggests that non-renewable resource rich countries that collect a substantial share of revenue from direct or indirect resource taxation may develop weaker non-resource tax systems. In some cases, this may be a rational choice whereby lower taxes are a means to share the wealth of natural resources with the current generation of taxpayers, but in others this may result from political economy considerations, in particular if the resource extracting firms are small in number and incorporated abroad. It has been seen in some resource rich countries that personal income tax collected, for example, is lower than would be expected given the level of development and other factors (see for example Luong and Weinthal, 2006).

Some of the empirical work documenting the resource curse hypothesis has been called into question on grounds of endogeneity (Alexeev and Conrad, 2009, or Wright and Czelusta, 2007) or omitted variables (Manzano and Rigobon, 2007). Endogeneity may be an issue due to the two-way relationship between a country's economic growth and its natural resources exports. The omitted variable argument suggests that the GDP to debt ratio has not been properly accounted for and that the problem is public debt and risk management rather than resource abundance. Some opposition to the resource curse hypothesis comes from economic historians. Wright and Czelusta (2004 and 2007) document the development of the United States which was for decades based on resource extraction. Similar cases can be made for Australia, Canada, Finland, Norway, and — of particular relevance in this context — Chile.

Both proponents of the resource curse hypothesis and its detractors agree that the context of the country in which resources are extracted determines how and whether broader economic development takes place. The importance of strong institutions like balanced and enforced tax collection, oversight of the use of tax revenue, a climate of transparency and accountability, investment in education in order to allow economies to diversify, small and medium enterprise promotion in order to foster backward and forward linkages, property rights including those of the natural resources, policy stability and political democracy cannot be overstated.

1. This is in reference to the problem that beset the Netherlands in the 1970s after discovering natural gas in the North Sea. The Dutch manufacturing sector started performing more poorly than anticipated.
2. There exists too much literature for this section to be exhaustive. For a more in-depth description of the empirical studies in this area see, for example, Humphreys, Sachs and Stiglitz (2007) or WTO (2010).
3. http://www.oecd.org/document/36/0,3746,en_2649_34889_44307940_1_1_1_1,00.html

Although there is some debate over the role of resource extraction in growth, there is no debate about the importance of institutions and regulatory oversight to capitalize on the benefits of the mining sector for economy-wide growth and development. Natural resource wealth can benefit countries in which it is found through appropriate taxation and use of tax revenue, linkages and spillovers into other sectors of the economy and increasing investment flows. Understanding how some countries have managed to grow, in part thanks to their mineral resources sector, can provide lessons for others.[4]

One such country case is Chile. "Chile is a clear example that natural resources are not necessarily a curse" (Draper et al., 2009). Chile has formidable mineral wealth, which contributes a substantial share of its exports, and is known for its high level of regulatory quality and institutional rigor. This paper examines Chile's experience collecting and managing the substantial revenue it receives from its mining sector, and supporting initiatives to develop mining-related sectors. There are many other areas where Chilean economic policy is supportive of growth. Chile is an open economy, exhibiting low and uniform import tariff levels. Chile has not resorted to using export restrictions or taxes to achieve its policy objectives. Additionally, Chile attracts large amount of foreign direct investment (FDI), much of it to the mining sector. "For the past ten years, the ratio of FDI to GDP has averaged 6-8%, higher than the OECD average and any other Latin American country" (Draper et al., 2009). This is in part due to investment regulation in the form of the Decree Law 600 that has been in force since the 1970s and ensures non-discriminatory treatment and tax invariability, through a contract between the foreign investor and the State of Chile. The investment regime has been seen as a guarantee of stability for foreign investors and one of the reasons Chile has been a leader in attracting foreign investment, including in the mining sector. Despite the many instances of good practice in Chile, investment policy is not covered in this study in order to avoid overlap with other work. A recent publication by UNCTAD, *Best Practices in Investment for Development, How to Attract and Benefit from FDI in Mining: Lessons from Canada and Chile*, 2011, covers this policy area.

The paper is structured as follows. Section 2 provides the context for this case study. Section 3 outlines the institutions that comprise the mining sector in Chile: there is a complex web of private sector firms, state owned enterprise, regulatory and government agencies that constitute the main participants and actors. Section 4 describes the taxation of natural resources: the level, and especially the design, of tax systems create incentives for producers. Section 5 expands on the Chilean management of tax revenue with a view to stabilization, partially offsetting the volatility that pervades global resources markets and dampening exchange rate impacts. Section 6 describes ways in which Chile has improved linkages and spillovers into mining-related goods and services – and notes what remains to be done. Section 7 concludes with policy lessons that can be learned from the Chilean case.[5]

4 This is often the case. For example, Peru has modelled its regulation of the mining sector on that of Chile. Some of the countries of West Africa are re-working their Mining Codes and have called on the West African Economic and Monetary Union (WAEMU) to help in this task and to harmonize their treatment of foreign mining interests (according to conversations with officials at the OECD Workshop on Regulatory Transparency in Trade in Raw Materials, 10-11 May 2012).

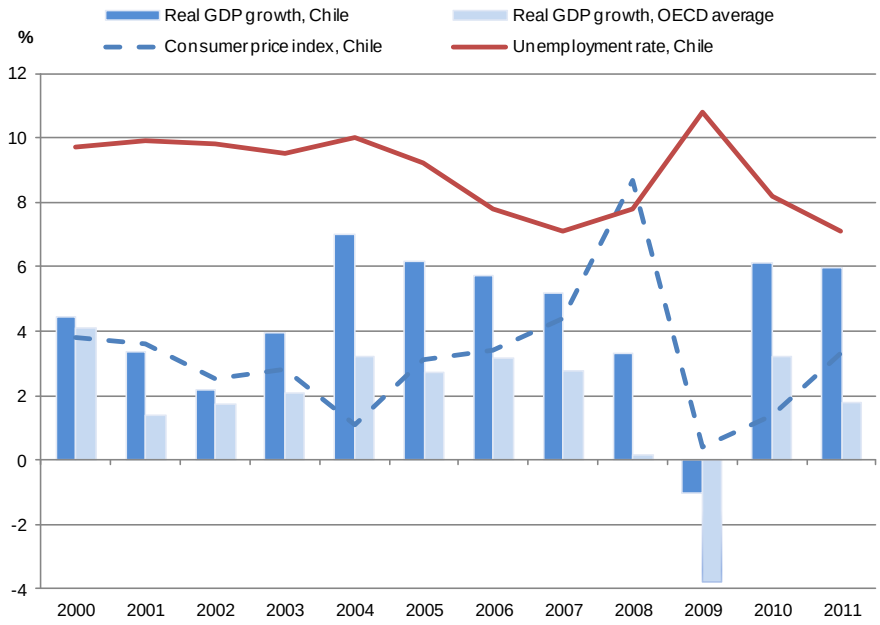
5 This paper has benefited from cooperation with the Chilean authorities and with participants in its mining sector.

2. Context: Chile's economy and the mining sector

Chile is a relatively small economy that has been growing swiftly for over two decades. Chile has a population of 17.2 million, comparable to the Netherlands or Angola (Annex Table 1). Chile's gross domestic product (GDP) reached USD 298 billion in 2011, comparable to that of Norway and slightly greater than that of the Czech Republic (Annex Table 2). Its GDP per capita was USD 15 107 in 2010, similar to that of Mexico or Turkey. The Chilean economy has experienced dynamic growth over the last decade. The average annual GDP growth was 4.4% in 2000-2011 and growth was higher than the OECD average in every year during that period, averaging almost 6% in the last three years. As a result Chile's GDP per capita in 2011 was USD 17 312 one of the highest in South America. It has nearly doubled from its level in 2000 of USD 9 572 (Annex Table 2).[6] Indicators show a brisk recovery after the economic slowdown in 2009 and the 2010 earthquake and tsunami.

Recent unemployment figures underline the recovery since the global slowdown. Since 2000, unemployment has fluctuated between 6 and 11%, reaching an average of 7.1% in 2011 and falling to 6.1% in the last quarter of 2012 (Annex Table 1). [7] The Chilean authorities have suggested that the structural unemployment rate for the country is between 6 and 7%, so the country may be considered close to full employment levels.[8]

Figure 1. Real GDP growth and unemployment



CPI: growth from same period, previous year.

Source: OECD.Stat database.

6 In current USD and current PPPs, OECD and International Monetary Fund, World Economic Outlook Database.

7 OECD, Main economic indicators.

8 Instituto Nacional de Estadísticas (INE), Chile

Chile is an open economy. It has few export restrictions other than those falling under international agreements in areas such as protection of endangered species or prevention of the spread of dangerous materials or weapons. Chile has a flat import tariff of 6%. Since it has negotiated preferential trade agreements with many of its major trading partners, the average applied tariff on imported goods was 1% in 2012. Chile imposes no export restrictions either in the form of export taxes, quantitative restrictions, or restrictive licensing arrangements other than those falling under international agreements. Trade represents 74% of Chile's GDP: exports represented USD 70 billion, similar to those of South Africa or Finland; imports represented USD 56 billion in 2010, similar to those of Argentina or Venezuela (Annex Table 2).

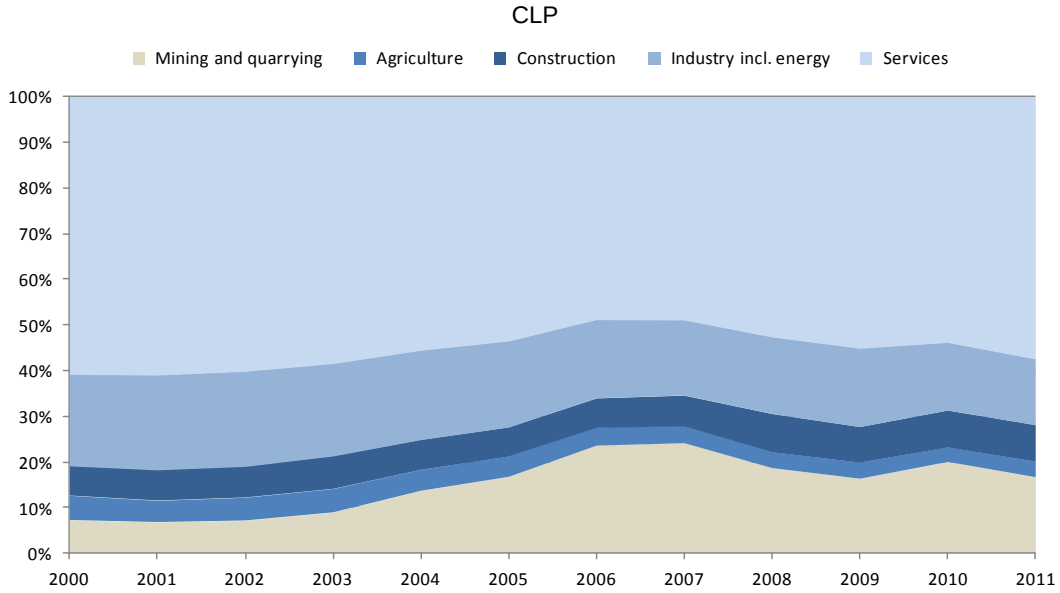
Chile has had a trade surplus every year for the last ten years. Both exports and imports have tripled in value in a decade. Primary export products are from the mining and agriculture sectors: copper, gold, molybdenum, iron, grapes, apples and fish (UN Comtrade database). Main imports to Chile are fuels (petroleum, liquefied gas, bituminous coal) and manufactured goods (personal vehicles, telephones, radios, televisions, investment goods for the mining industry, computers).

The growth of Chilean economy has been largely export driven and has in recent years been led by exports of mining products, mainly copper. Chile is the world's leading copper producer and exporter with more than one third of the world's copper production originating in Chile. Chile is the leading copper exporter with the share of 40% of total world copper trade (Annex Table 3).

The mining sector in the Chilean economy

The sectoral composition of gross domestic product has evolved in value terms over the last decade. The share of the mining sector in GDP has expanded from 7.2% in 2000 to 16.6% in 2011 while agriculture and manufacturing have decreased from 5.3% to 3.4% and from 17% to 11.9% respectively (Figure 2). As in many OECD economies, services account for over half of economic activity in Chile.

Figure 2. GDP by sector of activity



ISIC Rev. 3 classification of sectors of activity.
Source: OECD, Central Bank of Chile for 2011 figures.

Mineral extraction is primarily an export-oriented activity. Mining composes 60% of Chile's exports. Manufacturing represents 34% of exports and agriculture, 6% (Table 1).

The share of copper ore and copper products in the total exports of Chile is 52% first three quarters of 2012. Chile exports unrefined and unprocessed copper ore and concentrate, which accounted for one-third of copper exports in 2010, and also refined copper, or cathodes, that have undergone the first stage of processing, which accounted for 64% of copper exports in 2010. The detailed composition of copper exports by stage of production can be found in Annex Table 5. Conversations with Chilean copper industry participants suggest that a widely held view is that Chile has no comparative advantage in developing downstream industries in copper mining. There are a number of reasons for this: margins from processing (smelting) copper are low; there is excess global capacity in this area; Chile does not have economies of scale necessary for competitive smelting; transport of processed metal would be more expensive as it would be shipped in containers as opposed to bulk; product development is generally done closer to final markets; and processing requires substantial inputs in terms of energy that Chile does not have in excess.

Table 1. Exports of goods by economic activity

(Million USD FOB and sectoral share %)

Year	Mining	Agriculture, hunting and forestry, fishing	Industry	Total
2003	8 773	2 145	10 733	21 651
%	40.5	9.9	49.6	100.0
2004	16 701	2 414	13 911	33 025
%	50.6	7.3	42.1	100.0
2005	21 972	2 562	17 440	41 974
%	52.3	6.1	41.6	100.0
2006	36 438	2 809	20 133	59 380
%	61.4	4.7	33.9	100.0
2007	42 445	3 287	22 829	68 561
%	61.9	4.8	33.3	100.0
2008	34 294	4 066	26 150	64 510
%	53.2	6.3	40.5	100.0
2009	31 877	3 668	19 918	55 463
%	57.5	6.6	35.9	100.0
2010	44 360	4 366	22 171	70 897
%	62.6	6.2	31.3	100.0
2011	48 865	5 066	27 480	81 411
%	60.0	6.2	33.8	100.0

Source: Central Bank of Chile.

Chile has the world's largest copper reserves, holding 28% of the world reserves with 190 billion tons of copper reserves.[9] This is more than twice the remaining reserves of Peru, the second largest global copper producer.

The Hirschman Herfindahl index confirms that Chile's export portfolio is not very diversified. Chile's index in 2010 is 0.1830 which is comparable to that of Norway —

9. US Geological Survey, Mineral Commodity Summaries, January 2012.

0.1738 whose exports consist mainly of crude petroleum and petroleum gases (57%).[10] Other OECD countries with strong mining sectors have index values closer to zero, indicating that their export portfolios are more diversified: Australia 0.0905, Canada, 0.0319 and United States 0.0396.

The export specialization index (ES)[11] shows that a great share of Chile's exports flows to a small number of countries. The biggest copper ore markets are China (5.96), Japan (3.11), Brazil (2.27), Germany (2.07), India (1.32) and Republic of Korea (1.05). Refined copper products flow to the USA (11.61), China (7.06), European Union[12], Canada (3.89), Republic of Korea (3.19), Mexico (2.72), Australia (2.30), Brazil (2.03) Hong Kong (1.97) and Japan(1.50). Also for other main export items such as chemical wood pulp and some agricultural goods, the share of exports going to a a very small set of countries is high.

Mining continues to be Chile's foremost recipient of foreign direct investment receiving 38.3% of the total amount invested in 2010 (USD 883 million) and with an annual average of USD 707 million (33%) between 1974 and 2010 (Figure 3).[13] Comparisons with other countries with strong mining sectors shows that Australia's and South Africa's mining sectors share of FDI were at a similarly high level with that of Chile: 32 % [14] and 33.4% [15] respectively. Norway's mining sector received 28% and Canada's

10 The Hirschman Herfindahl index is a sum of the squared shares of each product in total exports. The index varies between 0 and 1. A country with perfectly diversified export portfolio will have an index close to zero. Chile's export diversification index has been derived from UN COMTRADE at SITC Rev 3, 4-digit level.

11 In the export specialization index, the denominator is usually measured by specific markets or partners. It provides product information on revealed specialization in the export sector of a country and is calculated as the ratio of the share of a product in a country's total exports to the share of this product in imports to specific markets or partners rather than its share in world exports: ES = (xij/Xit) / (mkj/Mkt), Where xij and Xit are export values of country i in product j, respectively, and where mkj and Mkt are the import values of product j in market k and total imports in market k. A value of the index less than unity indicates a comparative disadvantage and a value above unity represents specialization in this market. Chile's export specialization index has been derived from UN COMTRADE at SITC Rev 3, 4-digit level.

12 France (5.09), Netherlands (3.54), Italy (3.36), Spain (2.09), Belgium (2.53)

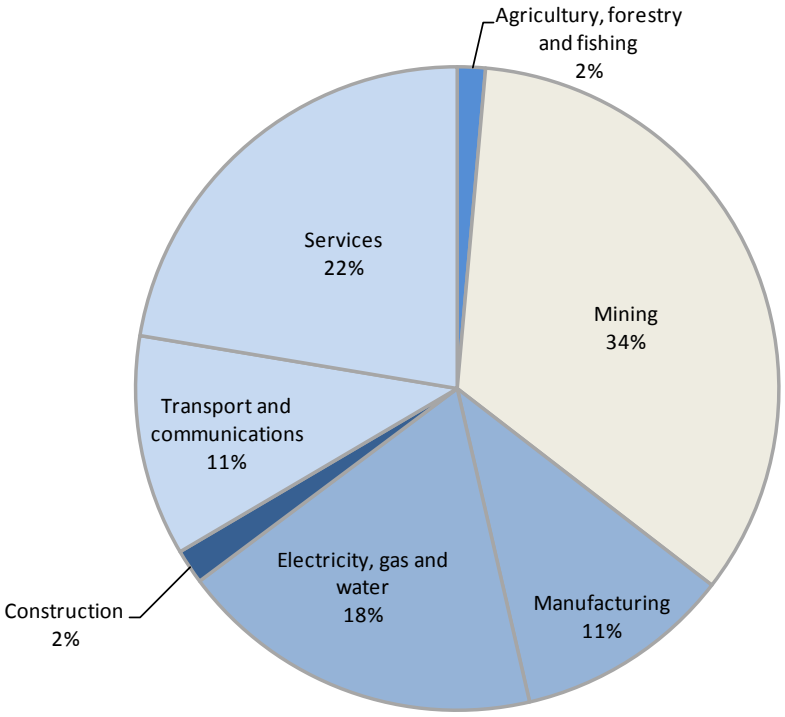
13 The total amount of materialised investment in Chile from 1974 to 2010 was USD 77,261 million (Foreign Investment Committee, provisional figures as of December 31, 2010, www.foreigninvestment.cl/index.php?option=com_content&view=article&id=45).

14 Australian Bureau of Statistics, Cat. No. 5352.0, 2008, www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5352.0Calendar%20year%202010?OpenDocument.

15 Data for 2009. South Africa Survey 2010/2011, SA Institute of Race Relations (SAIRR) quoted in Mail & Guardian online mg.co.za/article/2012-01-16-mining-sees-highest-foreign-direct-investment-for-2009/.

16% of the FDI in 2010.[16] India's mining sector received only 0.62% of the FDI[17] and in China the share of cumulative FDI in the mining sector was 0.26% in 2010.[18]

Figure 3. FDI by sector of activity, 1974-2011



Source: Foreign Investment Committee, provisional figures as of 31 December 2010.

Chile remains a highly attractive country for foreign investment in mining. Chile is the only jurisdiction outside North America and Northern Europe that ranks consistently in the top ten countries for mining exploration in the Fraser Institute's Policy potential index (PPI).[19] In another comparison, Chile ranks third out of sixty countries in attractiveness for mining investment in 2011 (Behre Dolbaer 2011 Ranking of Countries for Mining Investment, Where "not to invest"). "Chile together with Brazil, Colombia and Peru have

16 OECD, FDI positions by industry.

17 Data for the financial year 2010-2011. Department of Industrial Policy & Promotion, Ministry of Commerce and Industry, http://dipp.nic.in/English/Publications/FDI_Statistics/2011/india_FDI_March2011.pdf.

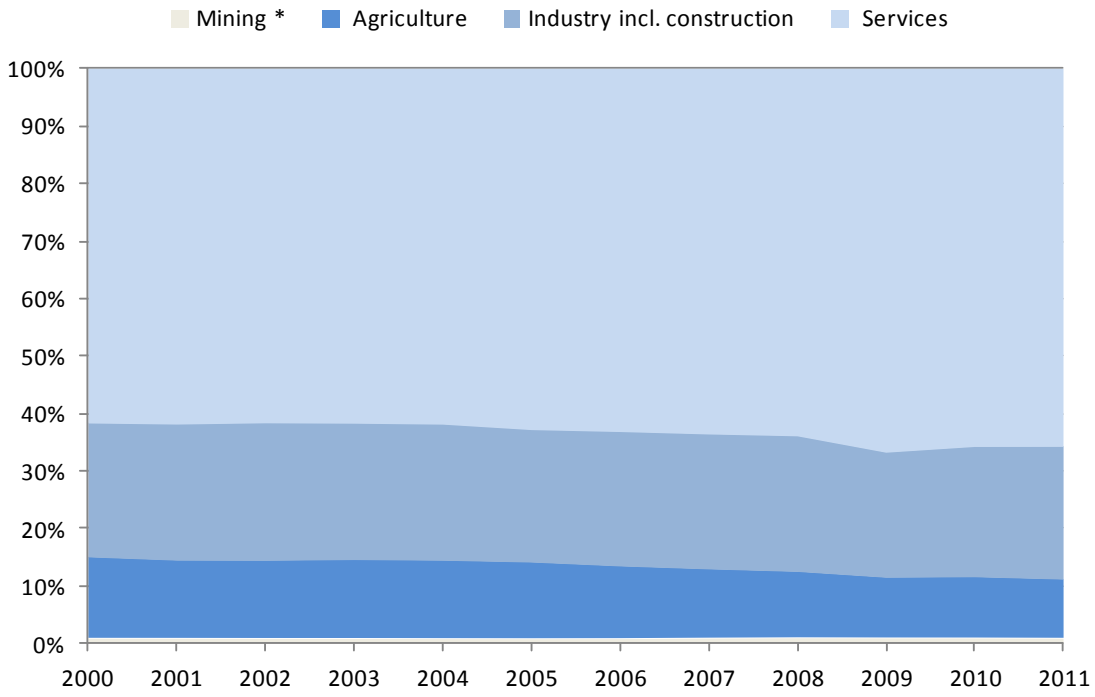
18 Invest in China, Ministry of Commerce, www.fdi.gov.cn/pub/FDI_EN/Statistics/AnnualStatisticsData/AnnualFDIData/FDIStatistics,2010/t20120202_140779.htm.

19 The PPI measures the effects on exploration of government policies including uncertainty of the administration, existing regulations including environmental regulations; regulatory duplication and inconsistencies; taxation; uncertainty concerning native land claims and protected areas; infrastructure; socioeconomic agreements; political stability; labour issues; geological database; security; reliability of legal system; trade barriers and uncertainty (Fraser Institute Annual Survey of Mining Companies 2011/2012).

led pragmatic mineral development policies and as a result their economies and standards of living are improving" (Ibid).

The mining sector provides Chile with significant scope for revenue creation, but limited opportunities for direct employment. The services sector continues to be the main employer in Chile with 66.4% share of employment in 2011. Shares of agriculture and industry (including mining, manufacturing and energy) have fallen slightly from 16.2% (in 2000) to 15.2% (in 2011) and 14.1% (in 2000) to 10.2% (in 2011) respectively. Despite mining's sustantial share in GDP (17%), direct employment in mining was 77 920 persons in 1991 and 66 063 in 2010, representing 1.72% and 0.98% of total employment respectively (Figure 4). [2021] In the chart below, the share of employment in mining is the almost-invisible white space close to the horizontal axis. The share of copper mining in employment was only 0.76% in 2010. Annex Table 6 provides employment data in mining sector.

Figure 4. Employment by sector of activity



Note: 2011 data are estimated.

**Source*: OECD/MEI, ISIC Rev.3; Yearbook: Copper and Other Mineral Statistics 1991-2010, Cochilco, Comision Chilena del Cobre.

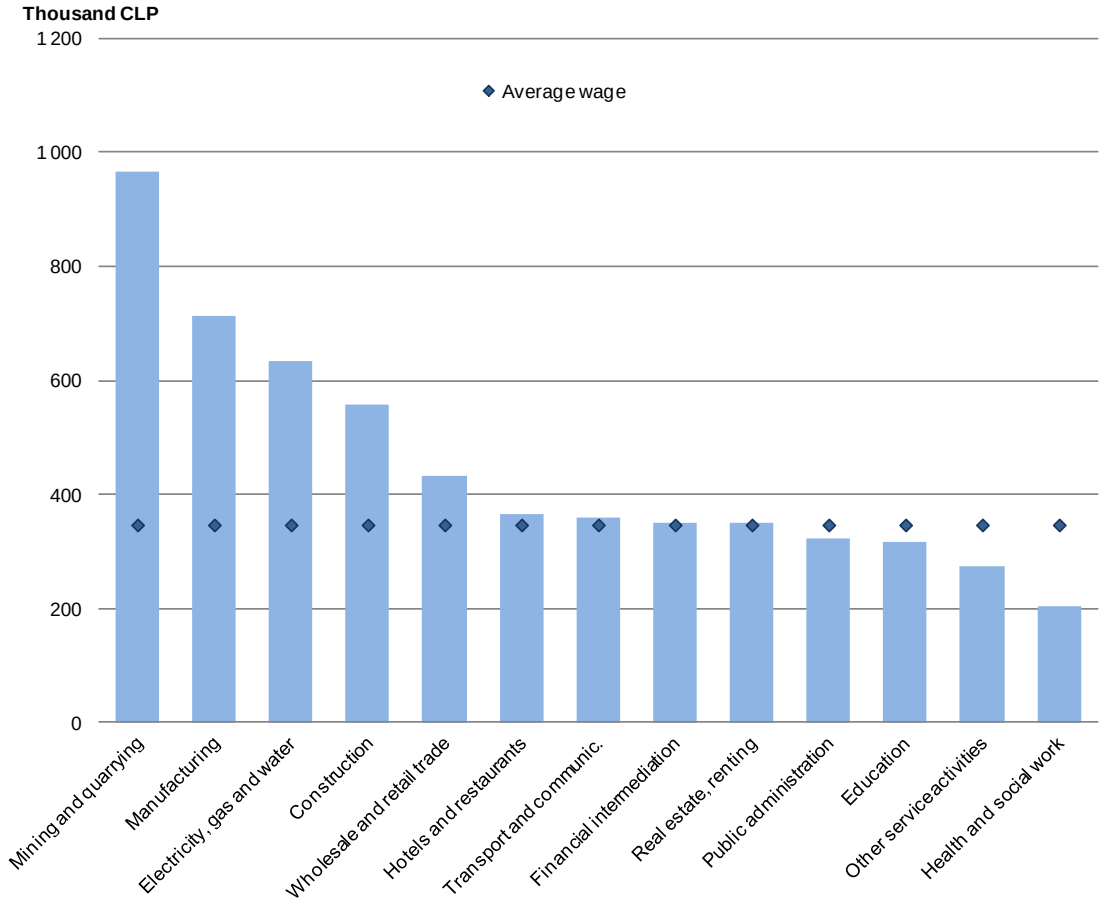
20. Note that total employment figures in Copper and Other Mineral Statistics Yearbook differ from OECD figures. OECD does not provide data for the mining sector separately. Therefore the mining sector share is slightly different when counted as a share of the total figures from the two sources.

21. Source: Copper and Other Mineral Statistics 1991-2010, Cochilco, Comision Chilena del Cobre. Note that this figure refers to direct employment in mining firms. The figure is substantially higher — 180 000 workers, if contractors are included.

Wages in the mining sector were the highest of all economic activities in 2008 by a significant margin (Figure 5). The mining sector, highly capital intensive and demanding of a highly skilled work force, pays its employees far above the average wage in Chile. The average worker in the mining sector in Chile has had 14 years of formal education and has completed post-secondary training. Issues of employment and training in the extractive industries are more fully covered later in this paper in the section Creating a Multiplier Effect: Development of Mining-related Activities.

Figure 5. Wages by sector of activity

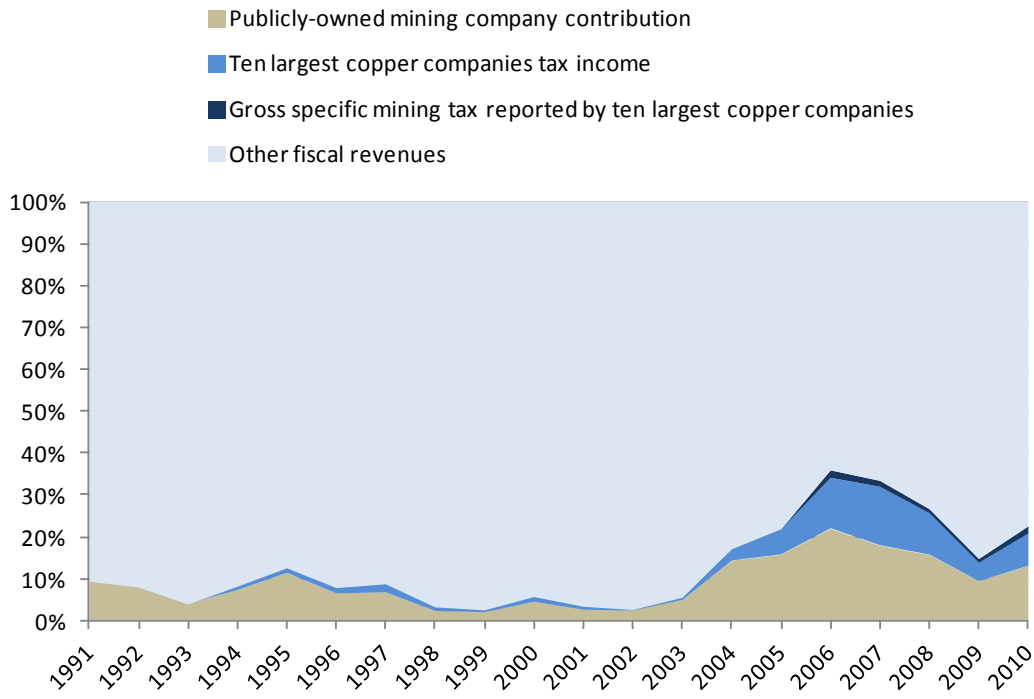
Earnings per month in April 2008



Source: ILO Laborsta.

The mining sector contributes to Chilean government revenue substantially, particularly in recent years. From 2006 to 2010, taxes paid by mining sector firms and profit contributed by Codelco, the state-owned mining company, provided 26.7% of tax revenue collected by the central government. This percentage is substantially higher than the revenue collected earlier: the mining sector contributed only 5.8% of government revenue from 1995-2003 on average (Figure 6). The evolution in revenue is due to high prices for copper, and therefore higher taxable profits for mining firms, in recent periods, and a change in the mining taxation policy as well as an evolution in some of the major mining projects that have matured and are now at a time in their life cycle where they pay a greater proportion of tax due to lower depreciation and interest deductions.

Figure 6. Contribution of mining sector to government revenue



Note: Ten largest copper companies which are operating under Decree-Law 600 FDI contracts.
Source: Yearbook: Copper and Other Mineral Statistics 1991-2010, Cochilco, Comision Chilena del Cobre.

3. Institutions framing the mining sector in Chile

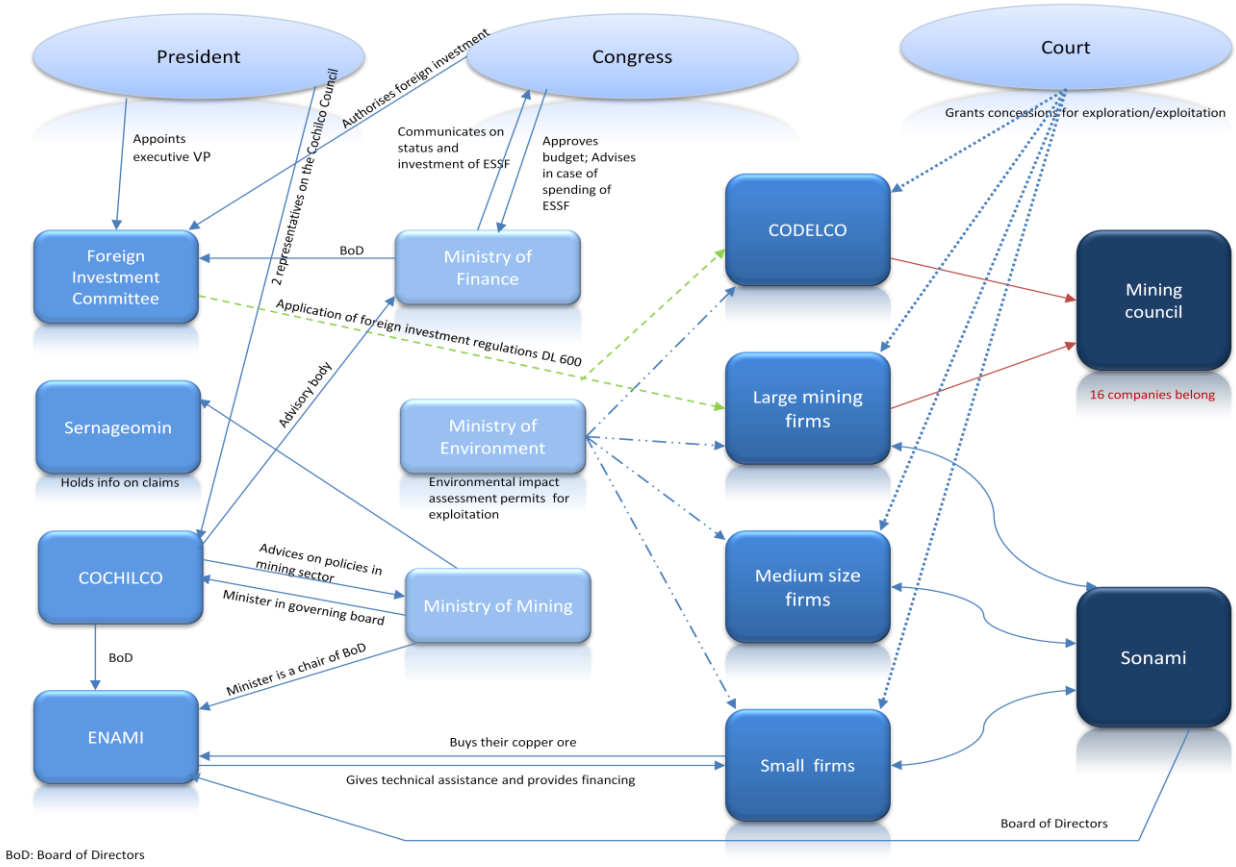
One of the lessons learned from the natural resource curse debate is that "institutions matter". Strong institutions enable resource-rich countries to reap the benefits from the exploitation of their mineral resources while fostering sustainable rates of extraction. As with other economic activities, it is important to develop and maintain a governance framework based on the rule of law, and supporting institutions that provide an environment in which firms have incentives to invest in productive activities (UNCTAD, 2007). Beyond the overall governance framework and sound macroeconomic policies and institutions, countries need institutions and policies geared specifically to the extractive industries. Key elements of a specific policy mix for extractive industries should include (UNCTAD, 2007; Otto et al., 2006):

- A knowledge base of a country's mineral endowments through geological surveys.
- A legal framework governing the exploration and exploitation of mineral resources that establishes mineral ownership rights.
- An administrative framework for the extraction of mineral resources. This involves the issuing of licenses, defining under what conditions exploration or extraction may take place and developing mining-right cadastres (i.e. compilations of current exploration and mining activities in the country and their ownership).
- Policies relating to the production of minerals that regulate the activities of industrial and artisanal mining.

- A system of revenue management. This concerns the sharing and distribution of the rents from mineral extraction.
- Policies related to the health and safety of workers, protection of the environment and the rights of local communities.

The frameworks described above are administered, regulated, managed, and subject to oversight by a number of different entities from various arms of government, regulatory agencies, industry associations and public and private sector firms. There is no one way to do this, and the complex web of relationships is often to a certain extent a function of historical evolutions. This web of relationships often determines, however, whether the necessary frameworks are in place to provide oversight without stifling the enterprise of productive actors. A view of the different institutions with a decision-making role in the mining sector in Chile, and an overview of their interactions, is shown in the following chart.

Figure 7. Decision-making institutions in the Chilean mining sector and their interactions



The great majority of the copper produced in Chile – 82% in 2010 — is done by the five largest enterprises: Codelco, the state-owned firm, BHP-Billiton, Anglo-American, Antofagasta Minerals and Collahuasi, a joint venture between Xstrata, Anglo-American and Mitsui Corp. Apart from Codelco, the state-owned enterprise, all firms are incorporated outside of Chile. Antofagasta Minerals, a Chilean-based company, is listed on the London Stock Exchange. This is a typical practice even among smaller firms: only three out of over

200 companies involved in mining in Chile are listed in the country. Part of the reason for this is the small number of Chilean firms that incorporate: most exist under limited liability or natural persons status.

The smallest firms are supported by the Empresa Nacional de Mineria (ENAMI). ENAMI´s mission is to promote small and medium size private sector mining in Chile, by providing technical, financial, and metallurgical production and trading services that firms require in order to be competitive with the objective of correcting market failures (www.enami.cl/english-overview/english-overview.html). ENAMI's Board of Directors is made up of the Minister of Mining, a representative of the Minister of Finance, a representative of the President, a representative of COCHILCO, the copper advisory agency and SONAMI, an industry association comprising small, medium-sized and large copper producers (Figure 7). Its efforts are concentrated on 2000 small sized private sector firms. ENAMI buys unprocessed copper from small mining firms at a rate negotiated with SONAMI. Small firms thereby profit from ENAMI's buying and selling at a larger scale. ENAMI buys unprocessed copper and refines it for sale on the international market. It is the sixth largest copper exporter in Chile. ENAMI also provides financing to small mining firms and provides technical assistance (Figure 7).

An important element in the framework of mining operations is the ownership of resources and the permission to prospect and exploit them. As in many countries, mineral resources are owned by the state in Chile and this ownership is established in the Chilean Constitution. Concessions for exploration and exploitation are granted by the court rather than a government agency which is thought to limit potential administrative discretion (Figure 7). Exploration permits are granted for a period of two years, renewable for another two years. Permit holders for exploration are given priority in transforming to an exploitation concession (UNCTAD, 2011). Once a permit has been granted for exploitation, the owner can keep it as long as an annual fee is acquitted, regardless of whether exploitation is actually undertaken.[22] Exploitation can be sub-contracted by the permit holder. It has been suggested that this situation may induce rent-seeking behavior or sub-optimal extraction levels since a permit holder has no incentive to relinquish the permit. Indeed, almost all potential areas have been staked and over half of claims belong either to Codelco or BHP-Billiton.[23]

Mining development can be best managed by drawing on substantial geological information regarding the size and quality of potential deposits. In some resource-rich countries, there is a wealth of publicly available information.[24] Chile's geological service, Sernageomin, holds information on the claims that have been staked for exploration and exploitation (Figure 7). Sernageomin however has not consolidated detailed information concerning the size and quality of deposits. Since Sernageomin has no obligation to provide such consolidated information, a comprehensive picture of the size, location and grade of

22 The fee is relatively little: USD 5 per hectare for exploration and USD 8 per hectare in the case of exploitation. The exploitation permit is tax deductible.

23 This information comes from conversations with regulatory agency officials and private sector managers. A contrasting view suggested that 80% of potentially viable claims had been staked by Codelco. Codelco holds more claims than it has the capacity to exploit. Indeed, it has signed agreements with several companies (Antofagasta Minerals, Rio Tinto, etc.) to exploit some of its concessions. The fact that there is some discrepancy between sources as to the share of concessions held points to a lack of publicly-available information regarding the concessions granted.

24 An excellent example is the United States Geological Service (USGS).

deposits is not available in the public domain. This is one area where the Chilean institutions may not provide an optimal structure within which to develop the mining sector. Indeed, a survey by the Fraser Institute of 494 mining companies ranked Chile fairly low (29 out of 79) in terms of availability of geological data. Four percent of respondents indicated that this was a strong deterrent to investment in the sector and 11% indicated that it was a mild deterrent.[25] There have been some recent moves to strengthen the public availability of information. In particular, a recent law, published in November 2011, on mine closure financing, the *Ley de Cierre de Faenas* (Mine Closure Act), includes some provisions for sharing information on exploitation plans.

4. Sharing the benefits of the mining sector: Taxation

One of the main ways by which wealth from the mining sector is shared and can be used to promote growth throughout the economy is through taxation and investment and redistribution of tax revenue. An appropriate level of taxation implies that the government receives an equitable share of the profits from the mining sector while fostering a sustainable level of production and sufficient investment in the mining sector. If the sector is taxed too heavily, investment and production are sub-optimal; if it is not taxed enough, an important source of fiscal revenue is needlessly foregone. Finding the optimal level and design of taxation of mineral resources can, however, prove challenging. In designing a tax system, it is necessary to compare the tax costs to the mining sector with those in other countries since firms will integrate such costs in their decisions to invest and expand in terms of their relative profit function – how much their investments will yield relative to comparable yields in other countries or regions.

Natural resources taxation may be particularly challenging, not only because of the potential for rent-seeking behavior and political capture (see Box 1 for a discussion of these issues that are addressed in the context of the resource curse debate), but also because the extractive industries have particular characteristics that may make them more vulnerable to or easily impacted by sub-optimal policies. Some of the reasons for this, and specificities of the resources sectors that must be borne in mind when reviewing taxation policy, are outlined below.

Specificities in the natural resources sectors[26]

Extractive industries are characterized, firstly, by high sunk costs and long production periods. Exploration, development, and exploitation of a mine can last decades and cost many hundreds of millions of dollars. Much of the investment occurs before any production processes have started. Once an enterprise has invested heavily, if the tax regime changes the investor has little choice – as long as variable costs are covered, production is more profitable than ceasing activity. This problem of time consistency implies that investors in the extractive industries, wary of potential regulatory "hold up", consider with particular importance the regulatory and political stability in host countries.

Natural resource extraction industries are also characterized by potentially substantial rents. This is particularly the case when mineral and metal prices are high, as they have been for much of the last eight years. A resource project's life can be divided into

25 http://www.fraserinstitute.org/uploadedFiles/fraser-ca/Content/research-news/research/publications/mining-survey-2010-2011.pdf.

26 This section draws substantially on the work of Broadway and Keen, "Perspectives on resource tax design", in Daniel et al. (2010).

three stages: exploration, development and extraction. The first two stages require substantial investment; the first stage also implies uncertainty about the size and existence of potential deposits. Taxable income only occurs in the third stage, therefore, but tax design must account for exploration and development of the project, and also the substantial risk involved in the exploration stage.

Tax revenue can be substantial, and can make up a significant portion of government revenue. Given the sheer scale of potential government receipts, tax receipts are not simply a side benefit of resource extraction but one of the core benefits. Proper tax design is therefore even more important in the area of resource extraction than in other sectors. The prospect of significant rents can also contribute to the problems of rent-seeking and corruption described in Box 1.

Firms in extractive industries are often multinationals based outside the country where they are operating and have sizeable market power. The relative scarcity of technical skills, access to funding and the ability to assume risk over the long term implies that few firms worldwide are able to compete in large mining ventures. International firms often face tax liabilities in numerous jurisdictions and whether they can obtain tax credit in their home country for taxes paid in the country of operation impacts the potential return on a project. Awareness of the interactions between the various tax systems can therefore inform proper tax design.

One particular characteristic of the extractive industries is the exhaustibility of the non-renewable natural resources. This does not mean that new deposits are not found; and the extent to which deposits are exploited depends on a large number of elements. It does mean, however, that optimal extraction rates calculated at present are a function of optimal extraction rates in future: there is a trade-off between present and future production and consumption. These trade-offs are of considerable importance when considering the impact of tax level and design on firm behavior and incentives.

Some considerations regarding taxation of extractive industries

In most countries, the mining sector is subjected to a variety of different types of taxes. What is important is their combined impact, which motivates firm behavior. Both the level and design of tax instruments impact decisions by mining firms concerning potential investments, the extent to which they undertake high risk and high reward exploration, the extent to which they develop operations, and exploitation decisions in present and future.

The optimal level of taxation is not easy to determine (Otto et al, 2006). It requires knowledge about firm behavior in the present and potential trade-offs in future, as well as future revenue streams which depend on future metal prices and production costs. Excessive taxes will result in firms refusing to invest or undertaking sub-optimal extraction or exploration. Taxes that are too low will represent foregone income for the government of the host country.

Many different types of taxes are applied to the minerals sector (Box 2). The optimal mix of these policies implies finding a balance between advantages and disadvantages of each instrument with respect to economic efficiency; trade-offs between development at different stages of mining operations; and the division of risks and rewards between the state and the exploiting enterprises. In terms of implementation of the tax regime, many other considerations come into play such as the ease of administration and the information gap between tax administrators and mining enterprise officials.

Box 2. Most common taxes levied in the mining sector

A number of different types of taxes are levied on extracted minerals. Both the tax rate and the tax basis are important. Taxes are generally assessed either on the quantity of the mineral deposit or against the inputs or actions needed to exploit it; or on some definition of the net revenue extracted from the minerals, usually revenue minus qualifying costs (Otto et al., 2006).

Income tax: not specific to the mineral sector, the tax rate is commonly uniform for all tax payers, or for all tax payers at a given level of profit. In many countries, commercial tax payers are subject to a uniform tax rate; some countries have a progressive tax regime that imposes a higher rate to commercial entities with higher levels of profit. Tax policy often evolves through changes in the tax base rather than the tax rate.

Royalties: a payment made for use of a property or natural resource.[1] This can be in the form of a tax on the amount of minerals extracted, either per physical unit of production – a specific royalty, or a percentage of the value of the mineral extracted – an ad valorem royalty. In some cases, the government collects a percentage of the value of production on a sliding scale based on price, i.e. a higher commodity price triggers a higher tax rate, which is referred to as a graduated price-based windfall tax. In the wider definition of profit-based royalties, the government taxes a share of the project's profit (Hogan and Goldsworthy in Daniel et al. 2010).

Surface rentals: in some countries, a fee is levied on economic activities that use land such as extractive industries. Such fees are often based on land area and are calculated by multiplying some standard rate for the type of activity by the land area being used. In some jurisdictions, this tax only applies to public land use (Otto, 2000).

Withholding taxes: many countries impose a withholding tax on remitted dividends. This generally takes the form of a percentage of dividends paid and can be a significant percentage in some cases. Although some governments define a high withholding tax rate, perhaps with the objective of promoting reinvestment, many enter into bilateral investment treaties or dual tax treaties of special arrangements with enterprises headquartered in key partner countries (Otto, 2000). Other types of withholding taxes are taxes paid on interest payments to foreign lenders and interest on payments for foreign services.

Import duties: Mining operations are capital intensive and the sophisticated machinery and equipment necessary for exploration, development and production are manufactured in few countries and generally imported. Import duties on such machinery have a direct impact on project feasibility in the early years of a mining project, i.e. before the exploitation stage.

Export taxes: In the middle of the last century, governments commonly imposed export duties on minerals in order to increase revenue and because their administrative reach did not allow calculations of profit or revenue (Otto, 2000). Export taxes have become more widely used, in particular on products of extractive industries, in recent years for a number of reasons (see Fliess and Mard, 2012).

1. Royalties are often placed on extractive industry firms since they exploit a non-renewable resource that they do not own. In most countries, minerals are owned by the state. Alternatively, the minerals are owned by the landowner of the land where they are found. Royalties are often seen as a form of compensation for the transfer of the property right.

The choice and design of tax instruments affect firms' decisions in many ways. An output-based royalty, for example, will create the incentive for firms to exploit mines that offer high-grade ore, but to stop exploitation once only lower-grade ores remain. Mining operations may therefore be closed sooner, and some mines will be underexploited, than in the case of a profit-based tax. Depending on how they are structured, however, profit-based taxes can impinge on the economic attractiveness of new projects.

The design of tax instruments impacts the distribution of risk between firms and the state. Mining is a particularly risky activity. The probability of finding new, exploitable deposits at the exploration stage is low. Metals prices are volatile and can make a seemingly good investment unprofitable. The development of new mines is a long-term activity which requires making assessments about a number of elements, including investment and regulatory climate, future production costs and political and economic stability in the host country. Generally, unit-based or value-based royalties shift more of the

risk to exploiting firms. Profit-based corporate taxes share risk more evenly between firms and the state (Otto, 2000).

Different tax instruments affect mining operations along the life cycle of a project. Import duties on exploration and development equipment tax mining firms before they are at the exploitation stage and therefore before they generate revenue. Such taxes do, however, provide government revenue before the project reaches the exploitation stage. Revenue from unit- or value-based royalties commences as soon as operations enter the production stage. Profit-based royalties or corporate profit taxes provide revenue when exploitation is profitable. All of these instruments offer different incentives for firms to invest and exploit deposits.

Tax regime stability is one important element of firms' decisions to invest in a mineral project. Firms that are considering investing hundreds of millions or even billions of dollars in a new mine are very wary of possible changes in the tax burden after their investment is made and no longer mobile (Otto et al, 2006). Firms are well aware of the difficulties of promising tax regime stability. Firstly, a new government may be voted in once the project has started. Secondly, the bargaining power of mining firms is reduced once they have invested in the exploration and development stages and invested capital is sunk and cannot be withdrawn from the country. This shift is called obsolescing bargain (Vernon, 1972) and is well-documented with respect to the mining sector.

Tax stability may be somewhat easier to ensure if the fiscal regime includes an element of progressivity. "There may be circumstances – as with the very high oil and minerals prices of mid-2008, perhaps – in which outcomes are so extraordinary, relative to what might have been conceived when tax arrangements were entered into, that some renegotiation is seen even by investors as generally reasonable" (Broadway and Keen, in Daniel et al, 2010, p. 57). The very substantial profits that are made by firms, many of them multinationals, may bring a strong reaction from local populations for higher taxation. A progressive tax, or additional tax, when profits are very high may be one way of foreseeing such situations. In practice, however, many fiscal regimes for the extractive industries are regressive rather than progressive implying that the government's share falls as profitability improves (Land, 2007, referenced in UNCTAD, 2007). It is difficult to ascertain why this has occurred – potentially due to weaknesses in tax administrations (UNCTAD, 2007).

Generating confidence in the stability of tax structures is very important for the sector, but is not always simple to achieve. Countries that have achieved high levels of perceived governance overall are in a much better position to reap such benefits.

Transparency of taxation systems and requirements are of great importance in the sector, as are guarantees that tax revenue is used for government services. The Extractive Industries Transparency Initiative (EITI) is a multi-stakeholder effort to strengthen governance by improving transparency and accountability in the extractive sector. Firms agree to publish all payments they make to governments and governments reveal all revenue that they have collected from extractive firms (www.eiti.org). Payments and revenues are reconciled by an independent auditor. Such initiatives are of particular importance in countries where governance has been challenged in the past.[27]

The administrative capability of the tax authorities determines in part the optimal tax design. Even for well-performing tax administrations, some tax instruments can prove challenging due to the asymmetric information regarding revenue, marginal and fixed costs,

27 In practice, few OECD countries have signed on to the initiative. At present, among OECD countries, only Norway is EITI compliant.

etc. Profit- and income-based taxes are more difficult to implement than unit- and value-based royalties. In the case of profit-based taxes, auditors will be needed to confirm levels of revenue and of costs that can be deducted. Since these require handling more complex issues, including assigning a value to depreciation of capital, they are better implemented by more sophisticated tax authorities.

Since extractive industries are often dominated by large multinational firms, they will make investment decisions concerning their global operations cognizant of differing tax regulations in countries in which they operate. Although this is only one of many inputs into such decisions, some countries have chosen to coordinate their taxation of extractive industries on a regional level. The West African Economic and Monetary Union (WAEMU) has adopted a mining code that specifies some tax benefits that may serve to limit members' ability to compete by offering stronger tax incentives (Broadway and Keen, in Daniel et al, 2010). There has been discussion of adopting common limits on tax benefits in the South African Development Community (SADC). A case for coordination could also be made for enforcing maximum common rates, rather than minimum requirements.

Taxation of the mining sector in Chile

Taxation of the mining sector in Chile falls under four main categories:

- Tax on profits of Codelco, the state-owned copper mining firm
- Corporate taxes on private mining firms
- A mining tax instituted in 2006
- A tax on copper exports of Codelco-owned mines that goes directly to the Ministry of Defence.

Codelco is entirely state-owned and finances a substantial share of the government budget (see Figure 6 above). In addition to the corporate profit tax and the mining tax paid by all mining firms, Codelco is subject to an additional profit tax of 40% and a 10% tax on exports. Finally, Codelco pays dividends to the government, normally set at 100% of profits. As a result, Codelco has had to rely on debt financing to fund a significant part of its capital needs. Although Codelco does not benefit from an explicit government guarantee, it has access to preferential rates due to its high credit rating. Its current large investment program may however be incompatible with the zero retained earnings policy that has prevailed in the past.[28]

Corporate taxes apply to mining firms as they do to other firms operating in Chile. The corporate tax rate is 20%. This was increased from 17% after the 2010 earthquake, applicable on income in 2011(Ernst and Young, 2011).[29] The tax is applied to accrued income on a yearly basis. It is paid on profit after acquittal of the specific mining tax.

An additional tax of 35% is applied to income that is withdrawn, distributed as dividends or remitted abroad by non-resident individuals or legal entities. However, the legal entity receives a tax credit for the tax paid as corporate tax.

28 In recent years, however, the Chilean government has authorized Codelco to capitalize profits in order to finance new projects

29 In September 2012, Congress approved a permanent increase in the corporate tax to 20% in order to finance the education system, supporting pre-schools and providing better funding for university students.

The tax base in Chile allows for deduction of accelerated depreciation and cumulative losses as well as interest payments in the total tax bill. Since the mining industry uses expensive capital inputs, the accelerated depreciation deduction is significant. This deduction allows capital intensive enterprises to recoup a portion of their equipment costs by claiming large depreciation deductions in the early years of the life of the expected life of the equipment. Allowing deductions for interest payments gives firms the incentive to finance projects with debt rather than equity. These regulations are particularly significant for the capital-intensive mining industry.

The mining tax was instituted in 2006 and applies to metallic and non metallic mining. Before that time, there existed no specific tax or royalty on the products of the mining sector. The tax is progressive and is paid on profit, or operating income. The tax is between 0 and 14% depending on the firm's profit. This tax is not paid by small mining firms. The size of firms is defined as follows:

- Small mining firms: sales equivalent to 12 000 tonnes of refined copper per year or less.
- Medium sized firms: sales equivalent to between 12 000 and 50 000 tonnes per year.
- Large firms: sales equivalent to 50 000 tonnes of refined copper per year.

The minimum threshold for imposition of the mining tax is a yearly output of 12 000 tons. It is progressive, ranging from 0.5 to 4.5%, up to an output level of 50 000 tons. For firms producing 50 000 tons of refined metal equivalent or more, i.e. large firms, the tax rate is 5% if their operating margin is less than or equal to 35% according to the mining tax law passed in 2010. The tax is applied in a progressive fashion with a maximum tax rate of 14% for firms where the operating margins are higher than 85%. Under a previous version of the mining tax law, which was in place from 2006 to 2010, the tax rate varied from 4 to 9% depending on the firm's profit share.

When the new amendment to the mining tax law was passed in 2010, firms were allowed to continue with the previous tax rate for eight years. If they chose to apply the new tax rates immediately, however, they would pay the higher tax rate of 5% (in the lower profit margin bracket) for three years, and then revert to the previous sliding scale of 4-9% for the following eight years. The reason for this "invariability clause" has to do with the foreign investment statute that under certain conditions guarantee an invariability of tax conditions after a contract is signed at the time of the investment while generating needed revenue after the 2010 disastrous earthquake hit Chile.

Finally, the tax of 10% on Codelco's exports is procured directly by the Ministry of Defence (see Box 3 on the Ley Reservada del Cobre and Marcel (2012) for a full discussion of the implications of the law). A legal proposal to reform this method of financing is under discussion in the Chilean Congress.[30]

30 See www.camara.cl/prensa/noticias_detalle.aspx?prmid=49471.

Box 3. Ley Reservada del Cobre[1]

The Chilean legal system includes some unpublished laws.[2] One such law is number 13.196, the Ley Reservada del Cobre (LRC). The Ley Reservada commandeers 10% of Codelco's sales abroad in foreign currency to be disbursed directly to the Ministry of Defense for use in financing equipment. In addition, the law establishes a minimum financial transfer of USD 180 million. If 10% of Codelco's exports are not enough to cover this minimum threshold, the shortfall must be provided by the State.

The tax revenue, in US dollars, is deposited yearly in three separate accounts (used by the army, air force and navy) at the Central Bank of Chile. These accounts are maintained outside the treasury single account and are not subjected to congressional oversight.[3]

In the 20 years since the return to democracy in Chile, many congress people, political leaders and analysts have recognized the need to repeal or reform the Ley Reservada del Cobre. An initiative was proposed in 2009 which was to finance the armed forces on a yearly basis through the general budget but it was not approved. A new legal initiative was announced on 11 May 2011 to overturn this law and replace it with a multi-annual budget for the armed forces. In his 21 May 2012 public address, President Piñera pledged to repeal the law by the end of his term in office (www.gob.cl/destacados/2012/05/21/mensaje-presidencial-21-de-mayo-2012-chile-cumple-y-avanza-hacia-el-desarrollo.htm).

1. Note that the information included in this box is the best available but cannot be confirmed due to the secret nature of the legislation described.

2. In August 2003, legislators introduced a bill that would declassify the secret decrees and laws enacted between 11 September 1973 and 10 March 1990. A year later, it was approved by the lower house and passed on to the Senate but has been held up in a Senate commission since that time. The bill however includes some exceptions to the declassification process, among them the Ley Reservada del Cobre. A somewhat puzzling section of the bill calls for declassifying these exceptions by 7 July 2014 (http://www.globalpost.com/dispatch/chile/090317/chiles-secret-laws?page=0,1).

3. A 2004 OECD publication indicated this budgetary formulation was "highly inappropriate from a budgetary point of view", while recognising that this is "a very sensitive area" (Blöndel and Curristine, 2004).

Taxation of the mining sector: International comparisons

Mining operations are often undertaken by large, multinational firms. In the headquarters of these firms, investment decisions regarding operations in their different subsidiaries are based on a comparative assessment of the availability and quality of the ore, future production costs, various risk factors, and the regulatory environment, of which the tax system is one element. Firms try to compare potential projects in one jurisdiction with those in another, and evaluate taxation alongside all the other factors that affect their estimate of potential returns from, and risks of, the various projects.

Comparing different countries' and jurisdictions' tax systems is a challenging undertaking. Tax rates in different countries are applied to different tax bases. Deductions can be substantial, particularly capital depreciation and interest payments. The amount of taxable income can depend on how much firms invest and how much they pay in dividends. Some taxes can be used as credit against others. The tax burden faced by a foreign firm may depend on the terms of a bilateral tax treaty between its home country and the country of operations.

Different estimates exist of the effective tax rate in the mining sector. COCHILCO, Chile's copper mining advisory body, estimates that the effective tax rate for the top ten mining firms over the last 15 years was 31%.[31] A senior analyst from a major Chilean consulting firm suggested that the tax rate on major mining firms in Chile is 25-35% of

31 Private interviews with COCHILCO representatives.

profits, depending on how much firms invest and the extent to which they distribute dividends. This analyst suggested that on average, this is less than other countries in the region. Comparable figures in Mexico are 36%; in Peru, they are 30% plus additional mining royalties, the analyst suggested.[32]

Unsurprisingly, conversations with private mining firm executives offer a somewhat different view. They suggest that taxes on mining firms in Chile are not particularly low: 39-40% if firms invest little. Furthermore, they stress that costs other than tax requirements determine the feasibility and return on projects. They suggest that some other inputs in Chilean mining are expensive: high energy costs; decreasing ore grades; high labor costs;[33] and the necessity for desalination of water since there is little available fresh water in many mining areas. Some information provided by a private mining firm operating in Chile, while impossible to verify, suggests that Chile is the second most expensive copper mining country in Latin America, after Brazil. In terms of cash costs per pound of copper extracted, Chile would rank higher than Mexico, Ecuador, Panama, Peru, and, least expensive in the region, Argentina (information provided by Brook Hunt www.woodmacresearch.com but not verified). According to the information provided, cash cost in Chile per pound of copper extracted is slightly more than US 100 cents per pound of copper cathode in 2007.[34]

Cochilco, the copper advisory body in Chile, reports the unit production cost of producing copper cathode in different regions using a similar methodology. In Table 2 below, the cost of producing copper cathode in Chile can be compared with that in other countries in Latin America, as well as on other continents. Chilean costs are higher than those in other Latin American countries and Asia, on average, but lower than those facing copper producers in North America, Oceania, Africa and Europe (Table 2).

Table 2. Unit production cost of copper cathodes

In US cents/lb., USD2009

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chile	83.3	85.0	81.2	74.2	78.2	105.4	103.0	130.8	141.1	144.1
Africa	122.4	121.3	113.8	144.1	137.0	163.2	178.1	200.8	219.4	178.6
Asia	62.1	55.7	48.0	81.1	77.4	138.9	92.6	127.2	45.8	55.8
Latin America	84.8	84.1	80.1	71.8	73.1	100.1	93.6	120.7	131.6	133.1
North America	118.2	122.5	98.9	96.3	74.2	111.2	144.6	179.6	162.2	150.7
Oceania	86.3	97.0	98.1	106.7	116.9	148.2	158.2	172.8	165.3	153.1
Western Europe	92.6	95.9	99.6	98.6	106.4	112.8	146.1	143.9	182.1	179.1
Average	90.0	89.5	83.2	83.7	84.5	113.7	113.7	143.1	138.3	134.3

1. The methodology used is Brook Hunt's Composite Total Cost (C3) which includes Direct cash cost, depreciation, interest and indirect costs.

Source: Yearbook: Copper and Other Mineral Statistics 1991-2010, Cochilco, Comision Chilena del Cobre.

Lessons from Chile: Taxation

An overview of Chile's system of taxation of its mining sector suggests that it is transparent, predictable, balanced and within a range acceptable to the firms with

32 Private interview with a senior analyst at LarrainVial.

33 "A truck driver in Chile earns the same as a truck driver in the United States," informed one mining sector executive.

34 For comparison purposes, copper traded at 3.70 USD/pound on world markets on April 10, 2012 (http://www.metalprices.com/pubcharts/Public/Copper_Price_Charts.asp?WeightSelect=LB&SizeSelect=M&ccs=1011&cid=0).

international reach that inhabit the sector. The mining law (Ley no. 20.469) that imposes the mining tax is progressive, including higher tax rates during times of very large profits (14% in the case that the profit margin is 85% of total revenue). This may make the tax particularly politically palatable in the case of very high copper prices such as those that have been in place since 2006.[35] In the case of high metals prices, profits can be very substantial and political economy concerns that the state, the ultimate owner of the minerals, is not obtaining a "fair share" of profits may come to the fore. The mining tax, although a tax on operating income, serves its purpose as a royalty given that it applies only to the mining sector.

Taxation of the mining sector, including the new taxes imposed and changes to the tax regime, have not curtailed foreign investment in the sector: mining received 38% of FDI entering the country in 2010, and significantly more than other countries in the region. Surveys of the mining industry corroborate evidence that Chile remains a favorable country in which to invest in mining. Moreover, the mining sector contributes significantly to government revenue, providing 21% of all tax revenue in 2010, of which CODELCO contributed 13.1% of total government revenue. For comparison, mining accounted for 17% of GDP in Chile in 2011 (See section 2 above on Context).

The mining tax is also progressive in that it does not apply to small mining firms. In this way, small firms that may not benefit from economies of scale, and may not hold concessions, are supported in their mining efforts. The mining sector offers some employment opportunities in some remote regions of Chile where few alternatives exist. Such enterprises are supported through technical assistance initiative through ENAMI.

It is difficult to compare effective tax rates across countries. The corporate income tax rate of 20% applies to all firms currently. Firms are allowed accelerated depreciation deductions, particularly important to the mining sector. Firms however do not look at the tax system in isolation: they compare production costs overall in the different jurisdictions where they operate. It seems that unit costs of production of copper mining firms in Chile are neither the most nor least onerous compared to those in other countries. According to some estimates, the cost of energy and water in particular, are higher in Chile than some other countries, which may serve to offset potentially lower tax rates.[36]

The change in the mining tax was instituted gradually, allowing firms to opt in voluntarily, or to continue with previous rates for a number of years. Chile's good governance is recognized globally; despite this, or perhaps adding to this is the consultation process that officials undertook with private enterprises. In some ways, this was aided by the overlapping institutional structures where the Ministry of Mining and COCHILCO, the copper advisory body, are in close contact with private mining firms as well as ENAMI and SONAMI through the Mining Council. They are required to "have an ear to the ground" when decisions are made regarding the internal price of copper (at which ore is purchased by ENAMI, for example). The fact that the largest firm is state-owned, as well as the "invariability clause" which implied a certain tax stability, may have facilitated the relatively consensual process undertaken by regulators of the Chilean mining sector.

One area where Chilean collection of government revenue warrants review is the Ley Reservada del Cobre, where the state-owned enterprise shifts 10% of its export

35 A mining industry spokesman said "Copper mining is the most profitable business in existence at this time – of any legal operations" (October, 2011).

36 This is a very significant issue for the mining industry operating in Chile since the energy inputs in the sector are extensive. It requires a more in-depth analysis than is possible to provide here.

earnings to the Ministry of Defence. Financial transfers with little oversight seem anathema to Chile's present-day vibrant democracy; a proposal to change this military financing mechanism is under discussion in the Chilean Congress.

4. Sharing the benefits of the mining sector: Tax revenue management

Although much of the public debate over mineral taxes focuses on the appropriate level of taxation, equally important is how the tax revenues are distributed and ultimately used. One of the conclusions emerging from the resource curse debate is that mineral production can both foster and hinder economic growth, with the outcome in part determined by how governments use the taxes and other funds they receive from the mineral sector (Otto et al., 2006).

There are a number of challenges to economies relying on income from natural resource extraction due to volatile metals prices and the presence of potentially substantial rents from mineral extraction. Volatile international prices for metals imply that profits from mineral extraction are at times low or negative and at other times very high. Government revenue from taxation of the sector is therefore also cyclically linked to metals prices: tax revenue is high when metals prices are high and low when they fall. This may have a de-stabilizing effect on the economy overall due to greater consumption and government spending during the boom, and low consumption, high unemployment and, possibly, the inability to continue government outlays during the bust. In order to resolve this time inconsistency problem, strong mechanisms for revenue management are essential. Moreover, in the case that economies are heavily reliant on their metal exports, their exchange rate may be strongly affected by a substantial rise in the value of their exports.

During commodity price booms, governments in countries with large mining sectors have access to greater funds, both from higher tax revenue and from more favorable lending conditions on international markets. These create strong incentives to increase spending significantly, but money spent in this way is often poorly spent; there are huge economic costs to such macroeconomic volatility (Humphreys, Sachs and Stiglitz, 2007, p.325). One way of countering this incentive is to create a stabilization fund, in order to stabilize present and future government revenue. In order for such funds to be effective, however, "incentives need to be built in so that political leaders are not tempted to raid them" (Ibid). Stabilization funds are put into place in some countries in order to create stable conditions over time for government expenditure.

Strong increases (and decreases) in exports affect the exchange rate with the resulting impact of "crowding out" other sectors of the economy by what is referred to as the Dutch disease. When the international price of metals increases significantly (e.g. in the last 5-6 years the price of copper quadrupled, then fell somewhat), the quantity demanded of the metal on the international market may fall, but overall export values may increase substantially. In the case that such exports constitute a major share of the total, and they are valued in a reserve currency such as the United States dollar, the local currency will be impacted. The local currency will strengthen during the boom times and weaken during the bust. A strong local currency will make exporting of other products, that are unaffected by the increase in metals prices, more difficult. Exports of other sectors will therefore fall and diversification of productive sectors will diminish. Coupled with a potentially higher demand created by the mining sector for additional services, the sectors of the economy that are not related to the extractive industries may be "crowded out" (see Box 1 for a fuller discussion). When commodity prices fall and the national income generated from the extractive industries consequently falls, there remain fewer export sectors on which the economy may rely.

There are a number of ways that governments can diminish the effect of the Dutch disease. One is through investment of government revenue "in alternative export sectors, in agriculture, and in education [to] help sustain growth and diversify risk" (Humphreys, Sachs and Stiglitz, 2007, p.325). However, engaging in strong expenditure domestically during the boom period can exacerbate the exchange problem, so it is necessary to pace investments. Another way governments can partially counter the exchange rate phenomenon is by investing tax revenue overseas in foreign currencies. In this way, collection of tax revenue does not exacerbate the demand for local currency, and when it is spent in a counter-cyclical fashion, helps to stabilize the exchange rate.

In all cases of revenue management, it is important to ensure transparency of the use and distribution of tax revenue. This is particularly important in cases of very large potential rents. Better information on how the proceeds from extractive rents are distributed and according to what aims is of great importance, particularly once the revenue falls. The EITI, mentioned above, gives guidelines for the reporting of revenue from the extractive industries and suggests how to better involve stakeholders in the often contentious debate about their distribution (www.eiti.org). As regards transparency in the management of sovereign wealth funds, the Generally Accepted Principles and Practices (GAPP) or "Santiago Principles" offer guidelines on operational controls, disclosure requirements and risk management and accountability.

Management of tax revenue in Chile[37]

In September 2006, the Chilean Congress approved a new Fiscal Responsibility Law (FRL) which was an important step in strengthening its fiscal framework (de Mello, 2008). The FRL created a legal framework for the structural balance rule; created a Pension Reserve Fund (PRF) to address pension-related contingencies; transformed the Copper Stabilization Fund into a broader sovereign wealth fund called the Economic and Social Stabilization Fund (ESSF) and introduced explicit, formal mechanisms for capitalizing the central bank. The Ministry of Finance regulates the investment of revenue collected through taxes with the advice of a Financial Committee. The Central Bank of Chile is delegated as asset manager. Detailed reporting on the investments undertaken, return on investments, and the positions of the funds is done monthly by the Ministry of Finance.[38]

A 2001 policy paper by Chile's Budget Directorate outlines Chile's structural balance rule (Marcel et al., 2001). The structural balance rule was introduced in Chile in 2001 and raised to law by enactment of the Fiscal Responsibility Law in 2006. The structural balance rule involves estimating the fiscal income that would be obtained net of the impact of the economic cycle, and in particular of commodity price cycles, and spending only the amount that would be compatible with that level of income. In practice, this means saving during economic highs, when revenues known to be of a temporary nature are received, and spending the revenue in situations when fiscal income drops (Rodríguez et al, 2007).[39]

37 A broader view and a historical analysis of this question can be found in Arellano (2006).

38 Detailed information about the Chilean SWFs can be found at www.hacienda.cl/fondos-soberanos.html.

39 Note that the aim of this policy is to smooth revenue fluctuations over the business cycle and not, as is the case for some other sovereign wealth funds that are created to manage revenue from natural resource extraction, to provide a vehicle for sharing non-renewable natural resource wealth across generations. A positive example of the latter type of fund is that created by Norway from oil revenues.

The structural balance indicator used in Chile calculates a measure of government revenue net of the cyclical impact of three variables: the level of economic activity and the prices of copper and molybdenum, a by-product in the production of copper. Thus the structural balance reflects the financial results that the central government would have shown in a particular year if GDP had been at its trend level and copper and molybdenum prices were at their estimated long-term level. It imposes discipline on government expenditure in times of high revenue intake, providing for stable sources of revenue during periods of low government income. From 2001-07, successive governments held themselves to budget surpluses of 1% of GDP. In 2008, the surplus was 0.5% of GDP. In 2009, when the financial crisis was most strongly felt, the budget was in an actual deficit of about 4%.[40]

The structural balance rule therefore is calculated using projected government revenue when copper and molybdenum prices are at a sustainable level over the long-term, defined as ten years, and GDP growth is at a sustainable medium-term rate. These rates are determined by an independent panel of 20 persons from the private sector and academia as well as (in the case of the copper price) representatives of COCHILCO, the copper advisory agency, and CODELCO. Every year, at least three members of this Committee are replaced so as to ensure a minimum turnover. In 2011, the long-term copper price was determined to be USD 3.02 per pound of copper cathode (LME copper price for cathode "grade A"); in 2010, it was USD 2.59/lb.; in 2009 it was USD 2.13/lb.[41] The long-term 2011 price can be compared to a spot price which was USD 4.45/lb. at the start of 2011 and USD 3.43/lb. at the end of 2011 (www.metalprices.com). In 2011, the medium-term growth rate of the Chilean economy projected by the panel of experts was 5%. These estimates serve to determine the theoretical long-term projections of government revenue thereby establishing the basis on which to calculate government expenditures.[42]

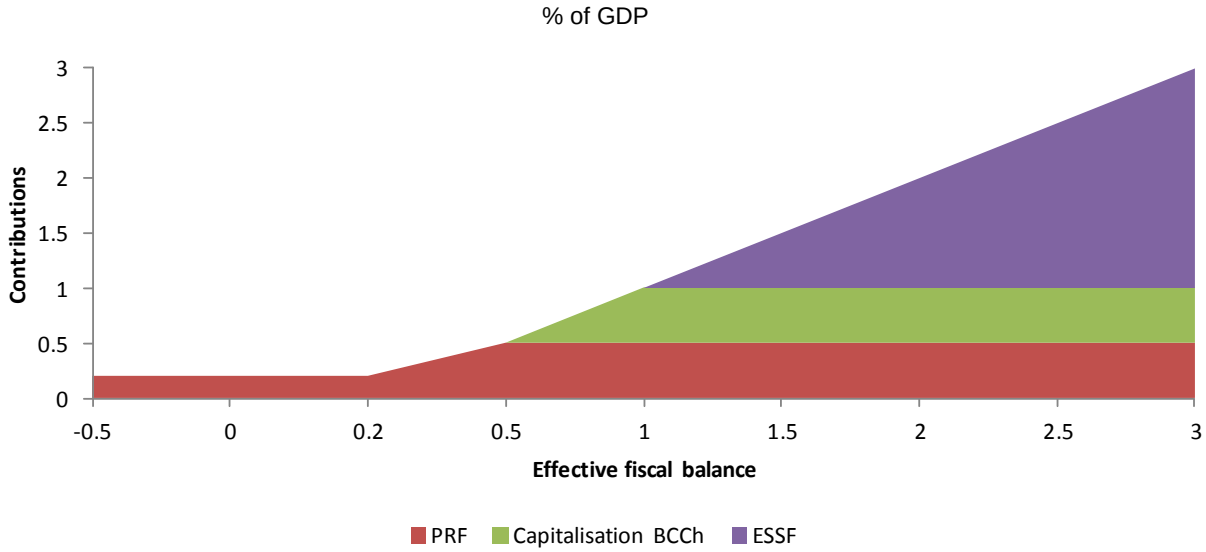
The fiscal saving rule implies that government revenue is allocated to different funds, depending on the extent of the fiscal surplus. If the current fiscal surplus is 0.5% or less, it is allocated to the Pension Reserve Fund (PRF); surpluses from 0.5 to 1% could serve to re-capitalize the Central Bank of Chile (through 2011); revenue from surpluses above 0.5% are deposited in the ESSF since 2012 (Figure 8).

40 Fiscal policy is continually open to debate and review in Chile. A report has been released by the Corbo Commission that assisted the current government in reviewing the fiscal rule. A discussion of some of the possible refinements can be found in *Corbo Commission's Report: Towards a Better Fiscal Policy* (Libertad y Desarrollo, www.lyd.org, 8 July 2011). The review was commissioned in part because the counter-cyclical nature of the current fiscal rule was found to be insufficient in the face of a large crisis such as that in 2008 and 2009.

41 It has been suggested in the OECD Economic Survey of Chile 2010 that in order to further insulate Chile's economy from commodity price volatility, it may be preferable to convene the panel of experts that determine the copper and molybdenum prices less frequently, preferably at the end of a full commodity cycle (OECD, 2010).

42 For a detailed overview of the conceptual issues underlying the structural balance policy and the formula used to determine the structural balance indicator, see Arellano (2006), Marcel and Vega (2010) and Rodríguez et al. (2007).

Figure 8. Allocation of fiscal savings by destination



Note that the recapitalisation of the Central Bank of Chile ended in 2011.

Source: Ministry of Finance of Chile.

The aim of the PRF is to support financing of government obligations arising from the government's guarantee to basic old-age and disability solidarity pensions and solidarity pension contributions arising from the pension reform. Accordingly, this fund serves as a supplementary source for the funding of future pension contingencies. The fund seeks to spread over time the future projected increases in these expenditures and explicitly incorporate this responsibility in state finances. No withdrawals of principal are allowed on the PRF before 2016 when capital accumulation is assessed to have reached sufficient levels.[43]

The ESSF is designed to provide the government with a stable financial horizon by ensuring that part of fiscal surpluses are saved during times of high growth and strong commodity prices in order to finance the budget during times of lower than average growth and low commodity prices. In this way, the fund insulates social spending from the swings of the economic cycle and of the prices of copper and molybdenum, while harnessing public saving in order to strengthen the Chilean economy's competitiveness (Rodriguez et al, 2007).

The ESSF was established on 6 March 2007 with an initial contribution of USD 2.58 billion, much of which was derived from the old Copper Stabilisation Fund, which was replaced by the ESSF (Ministry of Finance, www.hacienda.cl/english/sovereign-wealth-funds/economic-and-social-stabilization-fund.html). As of December 2012, the market value of the ESSF was USD 15 billion. Contributions to the ESSF since its creation totaled USD 21.2 billion and withdrawals from the fund totaled USD 9.4 billion. The investments have generated additional resources for the total amount of USD 3.2 billion since the fund's inception.

At the end of 2009 the two sovereign wealth funds (SWFs) represented around 48% of total financial assets held by the central government and were equivalent to about 125% of the country's public debt (Marcel and Vega, 2010). Measuring the net position of

43 As of December 2012, the market value of the PRF was USD 5.1 billion.

government finances is key for the management of fiscal policy. Since 2003 Chile adopted IMF's Government Finance Statistics Manual of 2001 (GFSM 2001). The GFSM 2001 integrates in a consistent manner stocks and flows, using the accrual basis criterion for assessing government transactions. It strengthens the methodology behind government accounting and increases consistency with private accounting practices and national accounts (Marcel and Vega, 2010).

Withdrawals from the ESSF to cover budget deficits in times of lower government revenue require approval from the Chilean Congress. Some withdrawals were made in 2009 to counter the negative effects of the financial crisis. Congress approves withdrawal and spending of the ESSF; the investment of the sovereign wealth funds is however managed by the Central Bank. A Financial Advisory Committee assists the Finance Minister in designing an investment strategy.

Until January 2012, the sovereign wealth funds (PRF and ESSF) were exclusively invested abroad in low-risk asset classes, similar to those used for international reserves. The strategic asset allocation for the ESSF is made up of 66.5% in sovereign bonds, 30% in money market instruments, and 3.5% in inflation-indexed sovereign bonds. As of 2012, the portfolio composition of the PRF is 15% in global stocks, 20% in global corporate bonds and 65% in global sovereign bonds. The currency composition of the funds is broken down as follows: 50% USD, 40% Euro, and 10% Japanese Yen (Ministry of Finance, www.hacienda.cl/english/sovereign-wealth-funds/investment-policy.html).

It should be noted that revenue from the mining sector is not earmarked for the jurisdictions (municipalities, regional governments) of the territories where the mining industries are based, as is found in some other natural resource rich countries. The distribution of revenue at a societal level in Chile may help to increase its efficiency, flexibility and strategic use. However, the way in which tax revenue is distributed in natural resource rich countries — at the local, regional or national level — is very much a factor of local conditions (location of resources, population in mining areas, history of mining in the country, etc.)

Lessons from Chile: Tax revenue management

Chile has risen to the challenge of managing an economy that experiences large swings due to changes in international commodity prices. Such volatility affects overall consumption as well as the level of government revenue. By implementing its structural balance rule, Chile has stabilized its government expenditure, saving during boom years and spending its excess tax revenue collected during such times when income drops. In this way, government expenditure is stable and predictable over the medium term. "With macroeconomic stabilization its primary objective, the ESSF should be in a position to finance government expenditure even under a sharp decline in revenues" (IMF, 2008). The necessity of the stabilization fund was proven in 2009 when the Chilean government used some of the funds from the ESSF to cover its expenses due to lower tax income during the global financial crisis. The existence of the stabilization fund has ensured the financial sustainability of social policies, facilitating their long-term planning. The greater sustainability of public spending is a consequence of tying it to structural rather than effective income which is far more volatile.[44]

44 It is of course not possible to shield the economy entirely from the volatility induced by commodity exports. The commodity boom brought increases in costs, in particular wages, and strong investment inflows. The economy showed signs of overheating in 2008. When world trade and commodity prices collapsed, the investment boom came to a halt (OECD, 2010). The OECD

Curbing excess spending during boom years also helps to hold down the exchange rate of the peso which would tend to appreciate during such times. The sovereign wealth funds that receive excess tax revenue during times of high commodity prices are held in assets denominated in foreign currencies, thereby partially offsetting the upward pressure on the peso.[45] This helps to avoid "crowding out" of other industries and exports that may have trouble competing globally if they undergo a high exchange rate. Investing in sovereign wealth funds abroad also helps to diversify risk.[46]

The legal framework for the Fiscal Responsibility Law and the checks and balances that are in place help to ensure that the structural balance policies are followed. The Fiscal Responsibility Law institutes a formula for determining a long-term sustainable level of government revenue. This is based on estimates of GDP growth trend and long-term prices of copper and molybdenum that are determined by an independent panel of experts. This information is input into a formula which suggests a sustainable level of government spending. During surplus years, excess tax revenue and profits from CODELCO are put into the two sovereign wealth funds according to formula approaches. During deficit years, when the stabilization fund is used to cover government expenditure, the Chilean Congress approves expenses. The funds are managed by the Chilean Central Bank according to indications from the Ministry of Finance.

These mechanisms contribute to the sharing of political responsibilities and make it easier for policymakers to bear the political burden of not being able to meet social demands in a low-revenue environment and to limit the benefit of spending revenue windfalls in boom years (Arellano, 2006). By setting a formal budget target, the budget rule reduces discretion. The automatic nature of the rule has helped to lock in the counter-cyclical rigor in Chile's finances.

"Chile's SWFs are being managed transparently, and the government is committed to best practices in this area" (IMF, 2008, p.19). The authorities publish monthly reports on the size and portfolio composition of both funds, and more extensive quarterly reports discussing performance relative to financial market developments and established benchmarks. Moreover, both the Chilean authorities and their Financial Advisory Committee are committed to public discussion of the funds' strategies, and all asset income and use of assets are included in the annual budget reports.

Chile's counter-cyclical fiscal policy has reduced uncertainty as to its medium-term performance. It has reduced its need for foreign financing and has reduced the sovereign risk premium it has to pay when the country borrows on international markets (Figure 9). This is one direct benefit that Chile has experienced from its sound management of tax revenue.

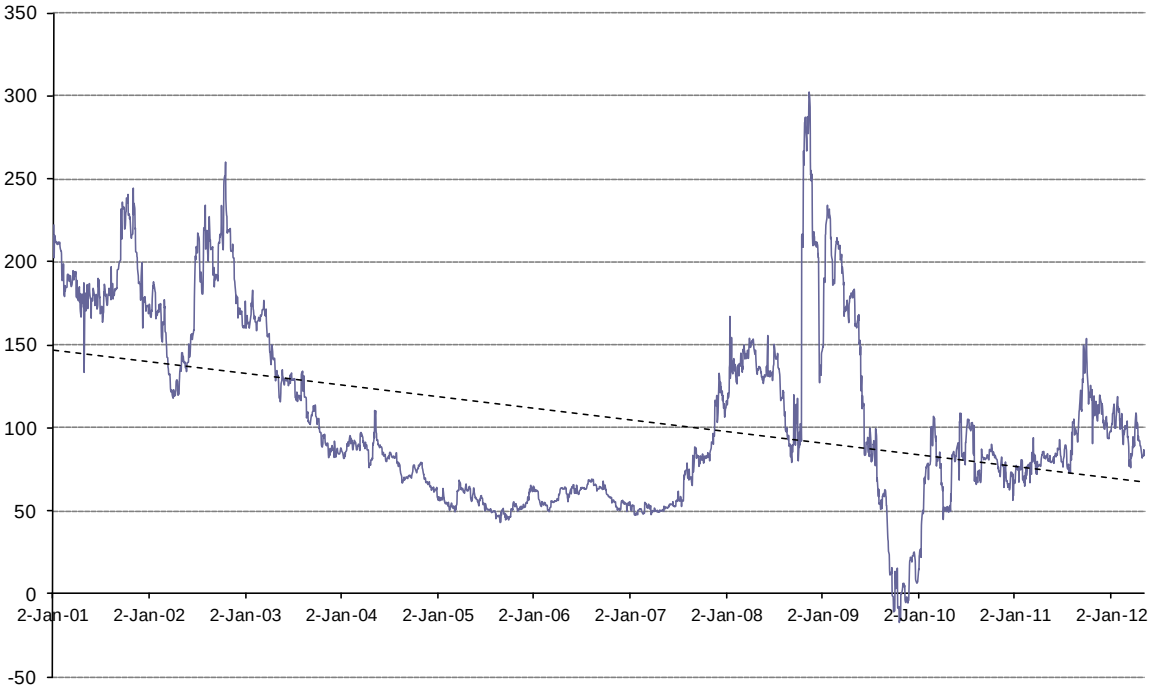
Economic Survey of Chile 2010 includes a number of suggestions for further insulating the economy from such shocks while introducing some additional flexibility (OECD, 2010, p.44-50).

45. There is some debate over whether or not tax revenue from natural resources should be invested abroad or within the country of extraction. The Natural Resource Charter, a set of principles for governments and societies on how to best harness the opportunities created by extractive resources for development, suggest that wealth created from taxation of mineral rents should be invested in the country, not in sovereign wealth funds (www.naturalresourcecharter.org).

46 Given Chile's decision to invest PRF funds abroad, another option would be for the fund to invest in fixed-income securities denominated in currencies that co-move with the peso, such as those of other natural resource exporters (IMF, 2008).

Figure 9. Chile sovereign spread since the structural balance policy

Basis points



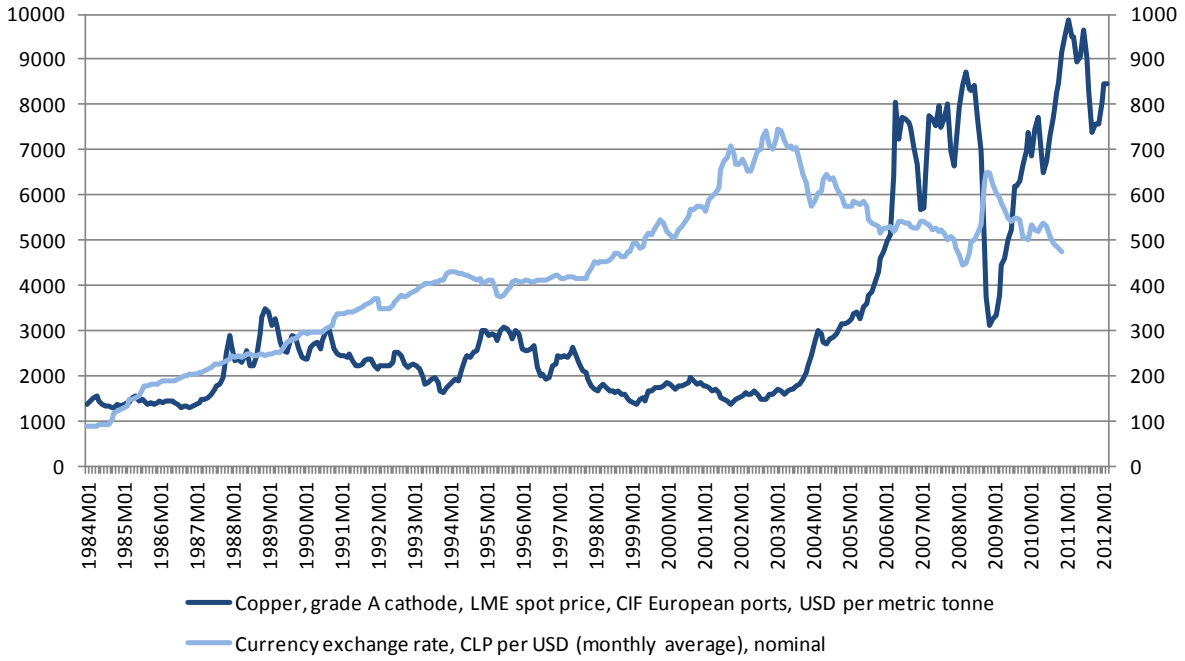
Source: JP Morgan.

The stable, predictable, balanced policies put into place by Chile have been reflected in its top ranking in surveys of mining firms and investors. Its well-established democratic system with tested mining legislation and lack of governmental or other arbitrary policies has received the highest score in the Behre Dolbaer 2011 ranking of countries for mining investment, along with Canada and the United States. Chile was ranked number one out of 79 countries in terms of their absence of uncertainty concerning the administration, interpretation and enforcement of existing regulation by the Fraser Institute survey of mining companies in 2010/11.[47]

Chile's counter-cyclical policies with respect to the exchange rate have helped to decrease volatility in the exchange rate, especially during recent years when copper prices were high (Figure 10). Chile was rated highly (eight out of ten) in terms of currency stability in the Behre Dolbaer 2011 ranking of countries for mining investment (www.dolbear.com/).

47 The survey was conducted in Q4/2010. Responses were received from 494 mining companies. Respondents are from exploration companies (53%), producer companies less than USD 50M (8%), and producer companies more than USD 50M (20%), consulting companies (14%) and other companies (5%). www.fraserinstitute.org/uploadedFiles/fraser-ca/Content/research-news/research/publications/mining-survey-2010-2011.pdf

Figure 10. Chilean peso nominal exchange rate and copper prices



Source: IMF and OECD.

5. Creating a multiplier effect: Development of mining-related activities[48]

Beyond the direct impact on resources covered in the previous section, the mining sector has the potential to create a multiplier effect by contributing to the development of mining-related activities that cater to domestic and international firms. This is called a mining cluster. [49] There are examples of such clusters in other countries that, starting with mineral wealth or wealth in other natural resources, have developed services, capital goods and intermediate goods industries that support mining activities.

In Chile, as in many countries, increasing the contribution of the mineral sector to the country's development has frequently been associated with vertical integration.[50] One hypothesis suggests that in order to develop, the sector must strive to take production beyond copper concentrate, increasing the share of refined and ideally manufactured copper products. These are capital-intensive and energy-intensive activities, which must be large-scale in order to be competitive and which have a lower return than production of ore and concentrate. Despite the fact that there are activities in this part of the production chain that can be profitable, there is a wider sphere of opportunities with lower capital requirements

48 This section was authored by José Pablo Arellano, former CEO of Codelco, presently at the Corporation of Studies for Latin America (CIEPLAN).

49 M. Porter's definition of a cluster is a group of geographically concentrated, interconnected companies, universities and other related entities, arising as a result of externalities in the industry. Joseph Ramos (1999) "*Una estrategia de desarrollo a partir de los complejos productivos (clusters) en torno a los recursos naturales ¿una estrategia prometedora*?" discusses the advantages of clusters around natural resources.

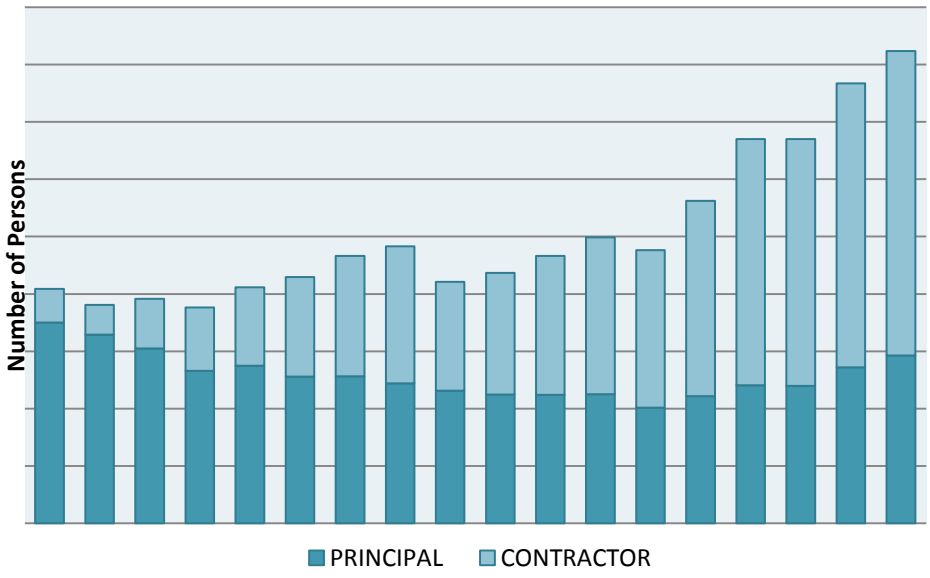
50 See a full account of this debate in Chile in Meller (2002) *Dilemas y Debates en torno al Cobre*, in particular the article by the same author, *El cobre chileno y la política minera*.

and greater multiplier effects in mining-related services and intermediate goods; from these activities a production cluster can be formed.

Developing mining-related goods and services in Chile

Organisational change has made it more feasible today than in the past to develop a cluster that serves local mining activities and exports goods and services to the global mining industry. In mining in particular, firms have become more focused on their core business and have outsourced their remaining activities. In the past, mining companies were self-sufficient and supplied the majority of intermediate goods and services that they required. Thirty years ago, Codelco, the state-owned copper enterprise, had one employee from a contracting company for every five employees. Currently, for every five Codelco employees, seven contracted employees provide services in company facilities. This is the same ratio found in large, private mining companies (Figure 11). The trend towards outsourcing in Chilean mining, and the role of service providers, is more pronounced than in other countries. In Chile, the proportion of contracted workers with respect to the total mining labor force is over 60%; in Australia and Canada, it is 24%, and in the United States, 8% (Fundación Chile, 2011). This evolution in mining companies' organization has allowed a number of Chilean companies specializing in the provision of services to develop competitively. Indeed, several of them have started to export their services.

Figure 11. Employees and contracted staff in copper mining



Source: SERNAGEOMIN.

Apart from the changes in company organization, the demand for new technologies and knowledge has been growing and will continue to do so. Exploited minerals are of a lower grade with a more complex mineralogy, and they are deeper and will require underground mining, which is increasingly operated remotely. Also, environmental sustainability requirements demand more efficient use of basic resources such as water and energy, and better treatment of waste and emissions. This poses new challenges and requirements and opens up vast potential for technological development and the provision of specialized services. These are knowledge intensive services due to their highly specialized nature and because of the need for continuous innovation and incorporation of

technologies in order to find new, more efficient solutions for mining projects and operations (Urzua, 2007).

There are a number of successful experiences in the development of mining-related activities. Several countries rich in mining resources have developed industries based on and around mining. In the United States and Canada a mining equipment industry emerged; in Finland metallurgy and technology services industries have developed; and Australia has an active program to develop the mining software and technology industry (Box 4). Using the size of the mining sector as an indication of the potential for exports of mining-related goods and services suggests that compared to Australia, the United States or Canada, Chilean exports of mining-related goods and services could significantly surpass current levels. If Chile attained the same level of mining-related activity exports as a percentage of total mining exports that Canada has achieved, this would imply an increase of more than ten times the current level.

Chile is in the process of developing the mining services industry. Historically, the first step was to substitute imports of intermediate goods and services.[51] In the second half of the 20th century, the proportion of domestic intermediate goods rose from less than 25% in the 1950s to around 60% towards the end of the century.[52] This expertise led to greater export of supplies to the mining sector. In the last 12 years, mining provider exports grew from less than five to almost USD 300 million (Table 3).

Exports of engineering services, which were approaching USD 10 million at the beginning of the 21st century, exceeded USD 200 million in 2011 (Figure 12). Growth is even greater if we consider the previous import substitution of these services. The engineering of large mining projects built in the 1980s and 1990s was carried out abroad, while in the last 15 years, it has been carried out primarily in Chile. The activity of engineering companies, measured in person-hours, increased by 20% between 1992 and 2003, and between 2003 and 2011 grew by 115%. The main growth by far has been seen in mining-contracted engineering, which represented more than 50% of the total in 2011.[53]

51 From the 1950s until the mid 1970s, when the economy opened to imports, international trade policies sought to promote this substitution, with varying results. See the account of Ffrench Davis (1974) "Integración de la gran minería a la economía nacional: el rol de las políticas públicas"in Ffrench Davis and Tironi El Cobre *En el desarrollo nacional*.

52 See Ramos Joseph 1998 Una estrategia de desarrollo a partir de los complejos productivos en torno a los recursos naturales, Revista de la Cepal No. 66 Diciembre. See Lagos Gustavo and Edgar Blanco (2010) Mining and development in the region of Antofagasta, *Resources Policy* 35.

53 Association of engineering services (AIC) Activity index engineering consulting sector 2011, constructed from a sample of mining firms.

Box 4. Success stories in mining-related activities: Examples for Chile

Some countries have been particularly successful in developing and exporting mining-related goods and services. Their experiences can help to identify what can be done in Chile and other natural resource exporting countries to advance in this direction.

Australia is developing a mining technology services industry in parallel with its mining activity. Australian companies provide more than 60% of software used in mining globally. Exports from the mining technology and services sector surpass USD 3 billion. This activity is less capital intensive than mining and creates quality jobs. A study of the mining technology services industry in Australia reports that in 2001, even before the current commodity boom, this industry was made up of more than 500 companies with sales of over USD 2 billion and double-digit growth rates, employing more than 17 000 people, most of them highly specialized (OECD, 2005).

In Canada, more than 3 100 companies provided mining services in 2009, among which 238 companies provided consulting services on environmental issues, 152 on finance and management issues and 140 on exploration.[1]

Finland has a longstanding tradition in mining and has gained a leading position in the mining technology sector. Finnish mining technology companies began operating in the early 20th century with the opening of new mines, leading to the development of metallurgy. These companies now export mining services and technology globally. Metso currently has 27 000 professionals worldwide and works not only in mining but also on solutions for the forest and energy sectors. Outotec employs more than 3 000 professionals. Finland supports the development of these companies by fostering close collaboration between producing firms, the public sector and universities.

1. Data from Global Infomine cited by "Mining Sector 2010: An Underground Payload".

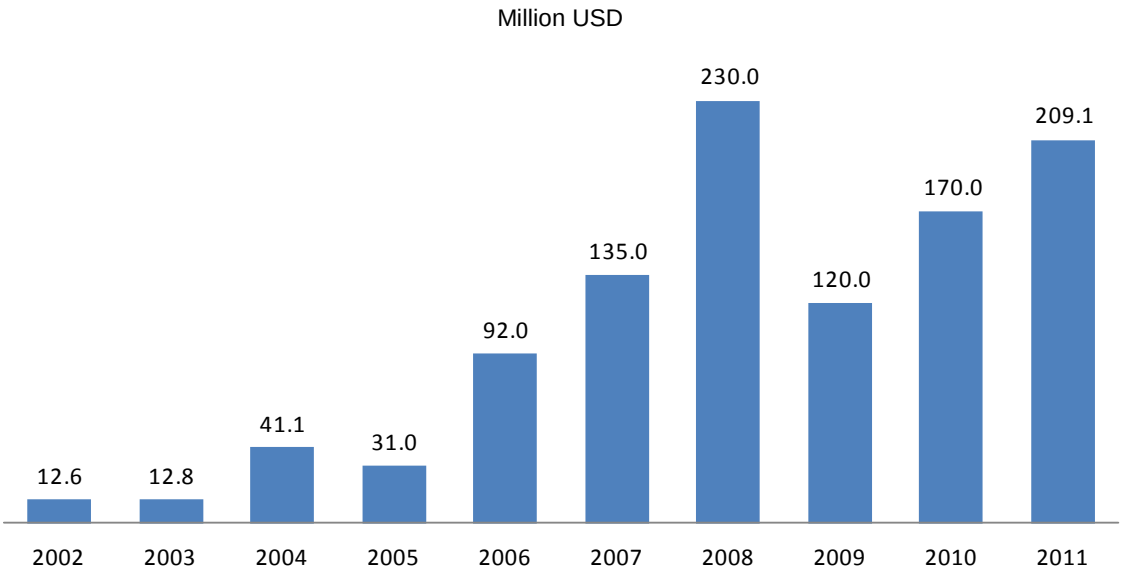
Table 3. Main exports of suppliers of Chilean mining

Millions USD FOB

	2001	2004	2006	2008	2009	2010	2011
Grinding rolls	0.2	25.3	41.0	134.1	83.8	88.3	135.7
Machinery and equipment	0.0	7.0	27.7	31.4	31.1	33.6	40.4
Spare parts for machinery	0.0	9.5	81.6	31.3	25.7	36.8	48.8
Equipment for mineral processing	3.2	7.4	22.0	16.0	16.9	13.9	18.7
Machinery and tubes for perforation and drilling	0.0	1.2	10.9	20.8	15.3	21.8	50.9
Total industry 2001-2011	3.4	50.4	183.2	233.6	172.8	194.5	294.6

Source: National Customs service.

Figure 12. Chilean exports of engineering services



Source: AIC (Association of engineering services).

According to a recent study of the Engineering services in the Americas by a team from Duke University, "[the] Chilean engineering sector is strongly positioned within the Americas to take advantage of new opportunities emerging in the region. Chilean engineers are widely recognized by leading global firms for their excellent technical skills and they are considered to be world leaders in engineering for mining" (Fernandez-Stark, Bamber and Gereffi, 2010a and 2010b). Chile is host to a number of global Centres of Excellence and firms draw on their Chilean staff to make decisions on projects around the world. Starting in the 1990s, several international firms began subcontracting local Chilean firms or forming joint ventures. Fluor, Bechtel, SNC Lavalin, AMEC and SKM Minmetals are among the firms that established greenfield operations in Chile and grew their offices organically. Currently there are around 16 000 professionals working in the engineering consulting industry in the country, 70% of them in mining projects.

Developing a qualified workforce for the sector

Chilean engineers, and local engineering companies, are well qualified but not sufficient in number to respond to domestic and international demand. Human resource training is a critical factor to explain the differing success that countries have had in increasing the impact of mining on their development. A recent study of human resource needs for the 2011-20 period commissioned by the association of large mining companies, concludes that "the gaps (or projected deficits) of the qualified labor force constitutes, probably, the greatest challenge that Chilean large-scale mining is facing for the 2011-2020 decade" (Fundación Chile, 2011). It is estimated that mining companies and large-scale mining contractors will have to increase their resources by 53% between 2012 and 2020, considering only extraction, processing and maintenance operations, a situation that becomes especially critical at specific levels and positions.

Although Chile saw significant development in higher education during the 20th century, providing massive access in recent decades, insufficient numbers of young people are enrolled in technological fields, and particularly in programmers related to mining, metallurgy and geology. This is a potentially serious limitation for the cluster's

development and may even prove to be a limitation for existing mining operations. Chilean engineers are well qualified but low in number to fulfill domestic and international demand.[54] When Bechtel decided to hire extensively in 2007, for example, the labor pool for engineers in the mining sector did not meet the demand. Another factor that must be considered is the international deficit in this area and the fact that many foreign companies recruit professionals in Chile.[55]

There is a clear need for higher education institutions to work in close contact with the industry to increase enrolment. In order to increase the impact on the development of its mining resources, it will become necessary to raise one or two consortia of Chilean universities to a high level of excellence, bringing in the best students from Chile and from abroad. These programs could be associated with some of the best centers in the area worldwide. Master's and Doctorate programs related to mining increased from 14 in 2002 to 27 in 2006. However, the substantial increase shows an excessive multiplication of programmers and a fragmentation of efforts. It would be advisable to have one or two world-class programmers drawing both Chilean and foreign students.[56]

Public-private initiatives for mining development

In Chile, the government and the productive sector have only recently begun promoting initiatives that contribute to the development of the mining cluster. During the first decade of the 21st century, a series of diagnostic studies were conducted on the current state and potential of this cluster and how to best promote it. A low level of cooperation among stake holders was observed, as was the absence of a shared vision of how best to develop the sector (Boston Consulting Group, 2007). Moreover, it was considered that without the active participation of large mining firms the cluster is unlikely to develop (Meller and Lima, 2003). These include policies supported by CORFO, the state development agency, and a promotional effort from the Ministry of Mining.[57] These studies have provided valuable information for diagnosis and for proposing some action initiatives in order to develop the mining and related sectors. They suggest that export and development opportunities can be found in niches of the value chain that are not being served by the large, global firms that currently supply the core goods for the mining

54 One way to increase the numbers of students in higher education is to streamline and extend student loans and scholarship schemes, making them available to every student of accredited institutions. The *OECD Economic Survey: Chile* 2010 and 2012 suggest a number of recommendations to achieve this aim.

55 See, for example, the report on the reality in Australia in "Staffing the Supercycle: Labour Force Outlook in the Minerals Sector, 2005 to 2015" (2006) commissioned by the Minerals Industry National Skills Shortages Strategy (NSSS) financed by the Department of Education, Science and Training of Australia. In the case of Canada one can see many studies and projections done by MiHR, see www.mihr.ca/en/publications/MiHRPublications.asp, among others, "Ontario Labour Market Demand Projections Mining industry workforce information network" presented to the Ontario Mining Association by the Mining Industry Human Resources (MiHR) Council in August 2009.

56 This is the trend in other places; one example is the program of six university schools for mining in Europe (Federation of European Mining Programs, FEMP), which offer a joint Master's from these schools in four other European countries, the European Mining, Minerals and Environmental Program (EMMEP).

57 A Consejo Nacional Estratégico del Cluster Minero was formed, see the account of the Ministro de Mineria from January 2010, www.innovamineria.cl/archivos/Cuenta_Publica_Ministerio_Mineria.pdf

industry. It was estimated that exports in such niche goods and services, if they were to be exploited by new or existing Chilean firms, could more than triple in five years to reach USD 1 billion (Boston Consulting Group, 2007).

A substantial share of the innovation undertaken by the Chilean firms is adaptive.[58][59] Local firms, working closely with teams in the large mining firms, solve the challenges they face during their operations on the ground. Such innovation by proximity is one niche that global firms that manufacture mining equipment cannot serve. A partnership between BHP-Billiton, Codelco and Chilean equipment and services providers is built on these opportunities (Box 5). Another example where proximity and adaptive innovation have played a role in the mining sector has been to respond to challenges created by the specific geography and/or geology of each mine. For example, Codelco operates the El Teniente mine which is by far the largest underground copper mine in the world. Codelco has leveraged its comparative advantage in the knowledge of some of the technological developments in operating such a large underground mine and developed local research and development capacity in that area. Codelco signed an agreement with Rio Tinto, a leading international mining group, three years ago to jointly invest in such development to solve some common challenges.

When the mining royalty was introduced in 2005, one of the rationales was to increase resources to foster innovation, research and development in order to increase competitiveness and diversify the productive base. Eyzaguirre et al. (2005) outlines the strategy for fostering innovation using the royalties collected. Firstly, a large effort to promote innovation was suggested, including an increase in spending in this area to 2.4% of GDP. A number of initiatives were announced including the creation of a national innovation council, preparing a national innovation strategy, and unifying the allocation of resources for innovation, research and development. The strategy underlines the areas of innovation and human capital as lagging in Chile's development (Eyzaguirre et al., 2005).

58 This is the case in many emerging markets. BRIC countries, for example, produce highly educated researchers but do not generally have sufficiently large and satisfactory research structures in order to generate major new innovations. They too are concentrating on incremental, as opposed to radical, innovation (*Les Rencontres Économiques* conference, session on innovation, 6-8 July 2012).

59 This policy has been recognized in Chile for some time: in a 2005 policy paper, N. Eyzaguirre, then Minister of Finance, and colleagues, suggested that too much of the Chilean funding for research and innovation was going to basic research. The authors suggest that the innovation effort in Chile should not be focused primarily on the creation of new technologies but should rather concentrate on adopting and adapting foreign technologies, which is a strategy that comes at a lower cost (Eyzaguirre et al., 2005).

Box 5. BHP-Billiton, Codelco programme to develop world-class suppliers[1]

This programme, originally designed by BHP-Billiton, aims to increase the capacity of domestic suppliers and contribute to Chilean economic development, while increasing the competitiveness of its own mining operations. World-class suppliers are defined by their ability to export knowledge intensive services and technology to other mining countries and sectors of the Chilean economy.

The programme brings together suppliers with development potential in order to solve, together with the mining firm, the challenging problems that have been previously identified and prioritised by mining operational areas. In this way the programme seeks to create development opportunities in local firms, encouraging and preparing them to compete globally.

After identifying needs for specific innovative solutions and selecting participants from among the potential providers, the programme provides a framework to test out ideas within real- time operations. In addition, it provides external consulting to give suppliers advice and training on competencies required to achieve world-class business performance, and promote links with local research centres and universities.

Thus the programme aims to achieve a win-win result for the mining firm itself and for the development of the domestic economy. It seeks not merely to draw on the existing competences of suppliers but to strengthen both their innovative and wider business capacities. This process should enable these firms to capture a larger share of the rising demand for knowledge-intensive goods and services both in Chile and internationally.

BHP-Billiton started this programme in 2008 and the first five projects began in 2009, following a problem identification and supplier selection process. Early in 2010, Codelco joined the programme. At the beginning of 2012, more than 60 suppliers were participating in the programme. By 2020, the programme aims to have developed more than 250 world-class suppliers.

The supplier identification process can be exemplified by Codelco's experience. It originally identified 177 "problems" or challenges that required technological solutions to be presented to the suppliers. It then prioritised 35, of which 11 currently have a supplier working towards a solution.

The 60 projects on which the suppliers are currently working address various kinds of challenges. These include: dust reduction and management, water, energy, equipment maintenance, human resources, and leaching. Nine of these projects are defined by the leaders of the programme as "disruptive," i.e. with a high level of complexity; the other 53 are classified as "incremental," implying a medium level of complexity.

The programme builds on the commitment of mining firms to use their strong purchasing capacity to leverage the development of local providers, transforming or developing them into world-class suppliers. In order to do this the mining companies have had to partially modify their usual procurement process. Their procurement process is designed to obtain the lowest-cost goods and services efficiently and on a highly reliable basis. This system is not designed to purchase new solutions with less standardised specifications. It tends to avoid less well-known and less predictable suppliers, as may initially be the case with the providers that the programme aims to promote. These changes in procurement processes require commitment and trust from the leaders of the mining firms, and in the medium to long term this process should have a win-win result.

It is early to evaluate the results of the programme. However, it is noteworthy that after four years there are 60 suppliers working with two of the world's largest mining firms using a methodology that was specially designed and successfully tested to identify specific demands and to select and support the potential suppliers. This process has required the collaboration of the mining firm’s operations teams, both in the production and procurement processes. It also involved the participation of universities and technological centres. Also participating was a team of external advisers, mainly from Fundación Chile (a public- private institution that promotes innovation), which has developed capacity to support the new suppliers.

The programme is a valuable achievement in terms of collaboration among different stakeholders. It is expected that other mining firms will take part in the programme as sponsors, and some of the large international providers of mining equipment could also sponsor part of this initiative. So far this has been a private initiative (although Codelco is a state-owned company) but the government has recently committed resources to the programme to fund external advisers. It is hoped that other firms may contribute to the programme in future.

1. Osvaldo Urzua, who has led this program provided information about the progress made by the program during the last two years. A policy note written by Barnett and Bell (2011) provides valuable information.

The Chilean government has sought to encourage innovation at the start-up level with a view to attracting entrepreneurs worldwide that are keen to expand from a base within Chile. ***Start-Up Chile*** is a program created by the Chilean Government to promote innovation throughout the Chilean economy (i.e. not confined to the mining sector).[60] The pilot program, started in 2010, brought **22 start-up firms from 14 countries to Chile,** providing them with USD 40 000 of equity-free capital and a one-year visa to develop their projects over a six month period. Of all required criteria for beneficiaries, it was deemed essential that the chosen entrepreneurs work in a global mindset, underscoring the belief that the route to success is via expansion. After a one-year pilot phase, the program's goal in 2011 was to bring 300 start-ups to Chile during the year, with the objective of having 1 000 start-ups participate in the program by its culmination in 2014.

Another area where the government can play a decisive role in helping the industry is by promoting the introduction of common standards. Setting common standards can reduce the transactions costs for providers of equipment and services to the mining sector with underlying benefits for the mining firms. In the case of procurement, for example, aspects like the safety and security requirements defined by different mines could be further standardized and thus reduce the costs of access to the sites by contractors.[61] In the case of information technologies, common standards facilitate software developers' work with different companies. There is a clear role for government in promoting collaboration among mining firms and their local providers in setting standards in order to reduce transaction costs. Approaching these issues collaboratively reduces costs and increases profitability: even if it were possible to take these steps independently by start-up or developing firms, it would be very expensive and slow.

In order to take advantage of current conditions and to accelerate the development of a mining sector cluster, there is a role for the Chilean government to provide public and semi-public goods that facilitate development of these activities. It could start by encouraging the various stakeholders to discuss and create a "sector vision." The vision is a prospective 15 or 20-year exercise in which the sector's challenges and opportunities are under review. Mining producers contribute their investment perspectives and the main challenges they face; the authorities contribute by identifying regulatory problems; the intermediate goods producers contribute their capacities and knowledge of external suppliers; and universities contribute by training qualified professionals and providing technological skills, among others. More important than the predictive aspect of this vision is its preparation and development process. Developing a vision for a sector is common practice in countries that have been successful in developing a mining-related activity industry.[62]

60 CORFO, the Chilean Economic Development Agency, that manages *Start Up Chile* has financed several SME projects with applications for the mining industry. It has also promoted, jointly with the Ministry of Mining, several programs to enhance innovation in the mining industry, including by attracting foreign research centres.

61 The 2011 law of mine security establishes some standards in this area.

62 In order to draw on experience in other countries, see some examples of documents where the sector vision is outlined. In Sweden the 2009 report presents the Swedish strategy and international initiative proposal Mining for Development a preparatory study May 2009. In Australia, Australia 2030, Vision 2020 Project: The Australian Minerals Industry's Infrastructure Path to Prosperity, Prepared for the Minerals Council of Australia May 2009. The most recent is the document Vision 2040, Mining, Minerals and innovation (http://resourcefutures.net.au/sites/default/files/draft_consultation_pre_survey_030511.pdf)

Lessons from Chile: fostering growth from the mining sector

Many mining sector participants agree that Chile does not have a comparative advantage in promoting downstream industries, i.e. increasing its capacity for further refining of copper. In these industries, margins are lower, energy inputs are substantial, and further refining of products is considered to be undertaken more efficiently closer to final markets. Instead, Chile has been introducing a strategy of supporting sectors that service its mining operations, both in terms of equipment and services.

One enabling factor in support of such industries has been change in the organisation of Chile's mining industry. In the last three decades, the mining sector has developed from an industry of vertically-integrated operations that import all necessary inputs to one of a multitude of specialized contractors that contribute a good or service. In this way, contracted firms innovate and compete in their specialized, narrowly defined areas of expertise. This may bring them to a stronger position, encouraging them to become more efficient in their core businesses.

There is some recent evidence of successful partnerships between large mining firms and specialized, contracted firms to develop innovative adaptations of existing technologies to the demands of Chilean mines. One interesting example is that of BHP-Billiton and Codelco who partner with smaller firms that offer goods or services that they need. Partners are chosen for their ability to innovate and find solutions to well-identified problems facing the industry. In this way, the partnerships are expected to develop local providers into world-class suppliers. There is a large, untapped potential for export of these adaptive technologies that build on Chile's comparative advantage of proximity to mining operations.

The demand for new technologies and adaptation of existing ones has grown and will continue to do so. Environmental sustainability requirements, the need to drill deeper to get to new deposits, and exploitation of more complex or lower-grade minerals pose new challenges and open up vast potential for technological development and the provision of specialized, knowledge-intensive services.

A potential public good can be created by cooperation between government and private mining firms and their contractors with an aim to foster common standards. Two areas where common standards could be enhanced are safety and security and information technologies for the mining industry.

A strong need has been identified for internationally competitive, well-trained engineers and technicians. The need for high quality professionals is a known bottleneck in the global mining industry, and Chile is no exception. A large number of new educational programs has been started to train professionals for a career in mining. It remains to consolidate the programs to produce one or two recognized, world-class institutions with international links to other mining programs.

Further development of the mining sector, and the possibility of creating spillovers into the wider economy, will need to be catalysed through a common vision of the sector. In a country such as Chile where the linkages between private, public and regulatory bodies are close and overlapping, such a sector vision should focus energies on medium-term needs and priorities on which each of the market participants can then concentrate. Diagnostic studies have been undertaken which could serve as a backdrop to such a process.

6. Policy lessons from Chile

It has been seen from the policy debate on natural resources that the extent of growth due to development of the mining industry varies widely and depends in large part on the policy balance regulating different aspects of the sector. Some of the areas are touched on in this paper, in particular the taxation of the minerals sector, management of the tax revenue, and policies that are designed to foster spillovers into other sectors of the economy and make the most of Chile's comparative advantage as a long-time global leader in the copper industry.

Naturally, the Chilean experience needs to be regarded in its context, including the complex web of interacting institutions in the public and private sectors. Chile is a small, open economy that has benefitted from dynamic growth over much of the last two decades. It is now at close to full employment. Chile has drawn substantial foreign investment into its mining sector and economy-wide.[63] Chile has had a trade surplus every year for the last ten years, largely due to exports of the mining sector which account for around 60% of exports.

Chile has not resorted to trade instruments such as export restrictions to manage its minerals sector. It has done so through a combination of balanced taxation, stable investment measures, good management of tax revenue, exchange rate policy and initiatives aimed at producing a multiplier effect of economy-wide development. These initiatives are outlined in detail at the end of each section of this paper.

One of the most characteristic features of the mining industry is that it is highly capital intensive and demands necessarily long term investments; once investments are undertaken they are not transportable. Potential investors therefore highly value political and regulatory stability. Chile has been quite exemplary in this area: its trade and investment policies have been open and predictable, encouraging substantial exports of mining products and strong investment in the sector. The tax environment has also been relatively stable. The mining tax, a type of royalty, was introduced in 2006 and revised in 2010. There was consultation in the context of the 2010 revision, and firms could opt in to the new system or retain the previous levels of tax rate for a given time. Only large and some medium-sized firms pay the mining tax.

Another characteristic of the mining sector is that it is made up of large firms with sizable market power, many of which are multinationals based outside the producing country. Their investment decisions are made by weighing all potential costs against the potential benefit of extraction. In this way, governments need to be mindful of tax liabilities facing firms in third countries that they will be paying, but also that they will be considering with respect to future investment. Chile continues to draw significant investment – more than to other countries in the region – including to the mining sector, yet a significant proportion of its tax revenue comes from copper mining.

Chile has implemented a profits-based mining tax that is progressive, calculated on the basis of quantity of output and operating margin. This implies that risk is shared between the government and private firms: when prices are high, firms can afford to pay

63 Investment policy is one area that has not been covered in detail in this study. The reason is so as not to overlap with a recent study released by UNCTAD, *Best Practices in Investment for Development, How to Attract and Benefit from FDI in Mining: Lessons from Canada and Chile*, 2011. There is much good practice in this area in Chile as well, in particular as regards the implementation of Decree-Law 600 for attracting foreign capital, as can be gleaned from UNCTAD 2011.

more tax; when prices are low, government revenue is low but its expenses rise. Implementing this type of tax is beneficial in many ways but demands a high level of institutional quality. It is necessary to be able to ascertain potential operating margins and provide oversight for payment of appropriate amounts of tax. It also implies that the management and investment of tax revenue must be sound and counter-cyclical. The overall Chilean fiscal policy includes a budget policy based on long-term copper revenues and growth forecasts and the tax revenue is invested in sovereign wealth funds. The fact that the counter-cyclical and formula-based approach is embedded in the Fiscal Responsibility Law provides maximum insurance against mismanagement of funds. Spending of the ESSF requires Congressional approval which also ensures against potential spending of the funds for short-term gain, which has been a potential downfall of such funds in some other cases.

The counter-cyclical investment in SWFs and expenditure from them also helps to dampen the adverse effects of changes in the prices of copper and molybdenum on the exchange rate. Tax revenue is invested in dollar, euro or yen-denominated securities thereby offsetting the pressure on the Chilean peso when mineral prices are high. When they are low, the foreign-invested funds are drawn upon, thereby lessening exchange volatility. This is a major issue for countries such as Chile that are heavily dependent on export earnings from their minerals sector and are, at the same time, mindful of "crowding out" other sectors because of a strong or volatile exchange rate.

The Chilean government is aware of the importance of fostering linkages between mining and mining-related sectors that create employment in knowledge-intensive industries with strong future potential. The proximity to mines gives Chilean small and medium-sized firms supplying equipment and services to the mining industry a strong comparative advantage in developing and exporting. The need for technological solutions to challenges posed to the sector by environmental regulations, the need to drill deeper for deposits and increasingly complex mineralogy can potentially be filled by Chilean firms. Partnerships between large mining firms and smaller suppliers are key to responding to these challenges.

Development of the mining and mining-related sectors means appropriate investment in people. Lack of qualified engineers and, in particular skilled technicians, is a bottleneck found in the mining sector in many countries. The Chilean education system provides a labour force of sufficient quality but insufficient supply. Educational programs to prepare students for employment in the mining sector have been expanded although coordination has not been fully adequate to propel such programs to the level of international renown.

In conclusion, there is much to be learned from the Chilean experience in regulating its mining sector. This study started out by indicating that Chile does not resort to using export restrictions to achieve policy objectives that are better served through targeted policies in other areas.[64] Equally, however, some things remain to be done: one example is the management of information on potential deposits which could be consolidated. Another area that warrants reform is the unpublished Ley Reservada del Cobre. The purpose of this paper is to identify best practice in mining regulation, however, and there is much on which to expound in the case of Chile.

64 The policies outlined in this paper respond to some of the objectives outlined in the first paragraph of this paper, in particular: fostering development in other sectors, increasing and managing tax revenue and offsetting exchange rate impacts. Other policies correct for further market failures such as controlling illegal exports, environmental protection and the protection of citizens' health, and managing mineral extraction rates. Policies that address some of these objectives will be covered in additional case studies in future.

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Statistical Annex

Annex Table 1. Population and labour force, Chile

Persons and sectoral share (%)

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Population		15 397 780	15 571 680	15 745 580	15 919 480	16 093 380	16 267 280	16 432 670	16 598 070	16 763 470	16 928 870	17 094 280	1 724 845
Labour force		5 993 550	6 065 835	6 175 813	6 398 813	6 607 653	6 798 408	6 802 753	6 944 385	7 203 000	7 448 358	7 762 630	8 060 948
Employment		5 414 068	5 468 073	5 570 503	5 788 518	5 946 433	6 170 338	6 271 855	6 448 858	6 641 428	6 642 250	7 130 695	7 487 105
in agriculture		764 914	741 705	754 774	792 261	808 314	819 945	789 847	773 942	764 211	698 337	756 229	766 313
Sectoral share	%	14.1	13.6	13.5	13.7	13.6	13.3	12.6	12.0	11.5	10.5	10.6	10.2
in industry *		827 794	830 399	848 671	879 314	895 788	877 731	904 374	932 545	936 745	897 032	998 730	1 075 687
Sectoral share	%	15.3	15.2	15.2	15.2	15.1	14.2	14.4	14.5	14.1	13.5	14.0	14.4
in mining		47 595	47 518	47 304	48 945	48 734	49 569	51 430	58 319	64 268	62 102	66 063	..
Sectoral share	%	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.9	1.0	0.9	0.9	..
in construction		401 841	432 632	453 077	461 695	480 026	511 526	528 083	541 975	586 196	504 377	572 233	608 360
Sectoral share	%	7.4	7.9	8.1	8.0	8.1	8.3	8.4	8.4	8.8	7.6	8.0	8.1
in services		3 371 924	3 415 819	3 466 677	3 606 303	3 713 571	3 911 567	3 998 121	4 142 076	4 290 008	4 480 403	4 737 441	4 970 683
Sectoral share	%	62.3	62.5	62.2	62.3	62.5	63.4	63.7	64.2	64.6	67.5	66.4	66.4
Unemployment level		579 483	597 758	605 310	610 298	661 220	628 068	530 898	495 528	561 573	806 178	632 050	573 843
Unemployment rate	%	9.7	9.9	9.8	9.5	10.0	9.2	7.8	7.1	7.8	10.8	8.2	7.1

Source: OECD.Stat database.

Annex Table 2. GDP and trade, Chile

In billion USD and %

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
GDP*		147.4	155.8	161.7	171.7	188.9	206.4	225.7	242.8	256.9	257.3	276.2	298.9
GDP per capita**		9572.1	10003.9	10271.9	10784.2	11736.5	12689.7	13734.0	14628.5	15327.8	15201.4	16155.9	17311.9
Real GDP growth rate	%	4.5	3.3	2.2	4.0	7.0	6.2	5.7	5.2	3.3	-1.0	6.1	6.0
Share of International imports in goods and services in GDP	%	28.9	30.9	30.7	31.5	30.5	31.8	29.6	31.9	39.5	29.5	31.9	34.7
Share of International exports in goods and services in GDP	%	30.6	32.3	33.0	35.5	39.8	40.3	43.9	45.2	41.5	37.0	38.1	38.1
Goods and services trade balance		1.6	2.6	2.0	2.4	8.3	9.0	20.4	23.5	5.7	12.5	13.1	6.5
Imports of goods		16.6	16.1	15.4	19.3	24.7	32.9	39.0	42.4	60.0	41.1	56.2	74.9
Exports of goods		18.2	18.7	17.4	21.7	33.0	42.0	59.4	66.0	65.7	53.6	69.4	81.4
Services trade balance		-0.7	-0.8	-0.7	-0.6	-0.7	-0.6	-0.6	-1.0	-1.0	-1.4	-1.0	-2.4
Imports of service		4.8	5.0	5.1	5.7	6.8	7.8	8.5	9.9	11.8	10.1	11.8	14.8
Exports of services		4.1	4.1	4.4	5.1	6.0	7.1	7.8	9.0	10.8	8.6	10.8	12.4

* Billion USD current prices and PPPs.

** USD current prices and PPPs.

Source: OECD.Stat database.

Annex Table 3. Global production of copper ore

Thousand metric tonnes of copper content and share (%)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2010 share, %
Chile	4 600	4 740	4 580	4 900	5 410	5 320	5 360	5 560	5 330	5 390	5 420	34.1
Peru	554	722	843	831	1 040	1 010	1 049	1 190	1 270	1 275	1 250	7.9
USA	1 440	1 340	1 140	1 120	1 160	1 140	1 200	1 170	1 310	1 180	1 110	7.0
China	590	590	585	610	620	755	890	946	950	995	1 190	7.5
Indonesia	1 012	1 050	1 160	979	840	1 070	816	797	651	996	872	5.5
Australia	829	869	883	830	675	927	859	870	886	854	870	5.5
Russia	570	620	695	675	427	700	725	740	750	725	703	4.4
Zambia	240	300	330	330	427	436	476	520	546	697	690	4.3
Canada	634	633	600	558	564	567	607	589	607	491	525	3.3
Poland	456	474	503	495	531	523	512	452	430	439	425	2.7
Kazakhstan	430	470	490	485	461	402	457	407	420	390	380	2.4
World total	13 200	13 700	13 600	13 600	14 600	15 000	15 100	15 400	15 400	15 900	15 900	100.0

Source: USGS.

Annex Table 4. Exports of copper by major producers

Billion USD and share (%)

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2010 share, %
Chile	6.27	7.84	14.75	19.06	32.91	37.86	32.99	27.74	40.34	40.6
Peru	1.19	1.26	2.48	3.36	6.06	7.19	7.62	5.91	8.83	8.9
Australia	1.09	1.33	1.89	3.01	5.07	5.26	5.67	4.57	6.68	6.7
Zambia	0.47	0.41	0.52	0.72	1.96	2.51	2.82	2.56	4.73	4.8
Canada	0.91	1.01	1.43	2.12	3.57	4.36	4.5	2.63	3.6	3.6
Russian Federation	0.69	0.64	0.89	1.06	1.59	1.86	1.22	2.47	3.28	3.3
Poland	0.45	0.49	0.79	1.13	1.95	1.71	1.98	1.84	2.4	2.4
United States	0.19	0.31	0.49	0.58	1.21	1.4	2.04	1.47	1.8	1.8
China	0.13	0.12	0.34	0.55	1.49	0.95	0.86	0.44	0.31	0.3
Kazakstan	..	..	1.18	1.56	2.5	2.71	2.79	1.88	..	..
World total	15.31	18.03	32.12	42.69	77.59	88.45	84.8	68.89	99.37	100.0

Source: COMTRADE.

Annex Table 5. Copper exports from Chile by stage of processing

Million USD and sectoral share (%)

		2002	2003	2004	2005	2006	2007	2008	2009	2010
Raw material		1 734	2 714	5 271	7 285	12 381	14 237	10 618	9 414	13 614
sectoral share	%	27.0	33.8	34.9	37.4	36.6	36.3	31.2	33.1	33.1
Semi-processed		4 541	5 126	9 478	11 772	20 531	23 626	22 375	18 323	26 089
sectoral share	%	70.8	63.9	62.8	60.4	60.6	60.3	65.7	64.4	63.5
Waste and scrap		24	39	101	130	351	687	448	358	814
sectoral share	%	0.4	0.5	0.7	0.7	1.0	1.8	1.3	1.3	2.0
Final products		116	140	238	292	601	626	626	364	569
sectoral share	%	1.8	1.7	1.6	1.5	1.8	1.6	1.8	1.3	1.4
Grand total		6 415	8 019	15 088	19 480	33 864	39 176	34 066	28 459	41 086

Source: COMTRADE.

Annex Table 6. Employment in the mining sector, Chile

Persons and sectoral share (%)

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Employment total		5 381 460	5 479 390	5 531 260	5 675 130	6 186 680	6 273 620	6 410 980	6 567 240	6 740 410	6 710 990	6 731 540
in mining, incl. crude oil and carbon		47 595	47 518	47 304	48 945	48 734	49 569	51 430	58 319	64 268	62 102	66 063
in metal mining		39 803	39 909	39 809	40 768	41 256	41 967	44 682	50 743	55 374	53 531	57 128
in industrial minerals mining		5 042	5 042	5 290	5 989	5 383	5 597	5 037	5 526	7 047	7 034	6 918
in fuels		2 750	2 567	2 205	2 188	2 095	2 005	1 711	2 050	1 847	1 537	2 017
Mining	%	0.88	0.87	0.86	0.86	0.79	0.79	0.80	0.89	0.95	0.93	0.98
Mining excluding fuels	%	0.83	0.82	0.82	0.82	0.75	0.76	0.78	0.86	0.93	0.90	0.95
Copper mining	%	0.63	0.63	0.63	0.65	0.60	0.60	0.62	0.70	0.75	0.72	0.76

Source: Yearbook: *Copper and Other Mineral Statistics 1991-2010*, Cochilco, Comision Chilena del Cobre.