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COMPETITION AND COMMODITY PRICE VOLATILITY

Contribution from Mr. Gustavo Lagos

-- Session I --

This contribution is submitted by Mr. Gustavo Lagos (Professor at the Department of Mineral Economics, Catholic University of Chile) under Session I of the Global Forum on Competition to be held on 16 and 17 February 2012.

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-- Contribution from Mr. Gustavo Lagos * --

1. Introduction

1. Iron ore, aluminium, copper and gold make up close to 80% of the economic value produced in mines in 2010 of all the major metals, including additionally, zinc, silver, molybdenum, nickel, and lead.

2. Over the last two decades, the price volatility for copper, iron and aluminium has been greater than prices of goods and services and higher than that of gold prices.

3. The effect of price volatility for countries that produce these commodities has been diverse, depending on their stage of economic development, on the export fraction represented by the commodities in each of the producing countries, on the fiscal income resulting from taxes collected by the state, and on the subsequent investment generated. Volatility of these prices is thought to have negatively affected economic growth of the producing developing countries with significant export of mineral commodities.

4. When a country has a large fraction of its exports dominated by one or more mineral commodities, the price cycles drive the currency valuation up with respect to the US dollar when prices are high, and low when prices fall. When the local currency is stronger this results in the nation's other production more expensive to produce and export, making the manufacturing and other sectors, including agriculture, less competitive. This is denominated the Dutch Disease. This can affect even developed countries, specially large exporters of oil, that have more diversified economies. The Dutch Disease is linked to another theory called the Resource Curse¹.

5. There is enough evidence worldwide that the "Resource Curse" is valid only for some countries over selected periods of time. Canada, Australia, Finland, and other developed countries relied heavily on the export of mineral commodities at the beginning of the twentieth century, yet they could maintain a reasonable rate of economic growth through time. Chile has shown the same capability in the late twentieth century.

6. This paper examines some of the causes and effects of volatility of the prices of copper, iron, aluminium, and gold, on competition and on the economies of producing countries that are dependent on the export of these commodities.

* Note prepared by Mr. Gustavo Lagos, Professor at the Department of Mineral Economics, Catholic University of Chile.

¹ The resource curse theory affirms that those countries with an abundance of non renewable and fuels natural resources have lower economic growth than countries with fewer natural resources. This happens because of a decline in the competitiveness of other economic sectors (caused by the Dutch Disease), volatility of revenues from the natural resource sector, corruption, government mismanagement of resources, or weak, ineffectual, unstable or corrupt institutions (possibly due to the easily diverted actual or anticipated revenue stream from extractive activities).

2. Price volatility of mineral commodities

7. The causes of price volatility of mineral commodities such as iron ore, copper and aluminium, are many, but two of them are the main ones.

8. First is the variation of fundamental forces of the market, namely supply, demand, and stocks of physical metal. It is well known that these drivers can generate short and long term volatility.

9. The determinants of supply for each of the four commodities under the scope are different. Iron and aluminium are two of the four most abundant elements in the earth crust. Therefore discovery and development of new deposits should not be as important as for the case of copper and gold. Long range transport of iron ore, in massive amounts, has been one of the key players in competitiveness due to differing distances from producers and main consumers. From this perspective Brazil is at a disadvantage with respect to Australia and India. For aluminium the key is abundant and cheap energy, since alumina must be refined to aluminium, process that involves passing three electrons for each unit weight of this metal, one of the lightest. For copper and gold the toughest barriers are exploration, extraction and process technologies. A relevant difference between copper and gold is that while about 37% of the latter used is recycled, less than one fifth of the former is recycled.

10. For gold and aluminium, important environmental concerns exist, the first metal linked to cyanide leaching, and the second to the use of huge amounts of energy as well as the emissions of fluorine gases. The use and management of water is an environmental concern linked to the exploitation of all mineral commodities.

11. Construction, the manufacture of industrial goods, and the generation and transmission of electricity, govern demand for iron, aluminium and copper. Industrial production and construction are very good indicators to estimate the consumption or use of these metals. Jewellery annually uses about one half of gold, 38% corresponds to technological uses, and 12% is used in investment, via ETFs (Exchange Traded Funds). A particular feature of this industry is that part of the demand can be readily transformed in supply, i.e., jewellery and reserves held by Central Banks.

12. Some examples of volatility generated by market fundamentals. In recent years, for instance, the uncertainty about unreported Chinese copper stocks is thought to have driven volatility up because the overall consumption of this country cannot be anticipated.

13. Another example of the effect of market fundamentals on price is that shortly after the great Chinese economic boom was globally acknowledged in 2003, the capacity of the copper industry to produce mine copper was exhausted. This happened in 2005. After that time all the predictions of supply for the following year overstated what really happened afterwards. A deficit between 2 and 5% of physical metal with respect to what was thought would be produced in December of the previous year was generated. This trend is likely to continue while industry is at full capacity, adding long term volatility. The reason for this is that giant mines operating now in several parts of the world are subject to large unanticipated disruptions such as land slides (Grasberg, Indonesia), caving (Chuquicamata, Chile), large equipment failure (Collahuasi and Escondida in Chile), and strikes (which should be accounted for in predictions). The fact that Chile has been unable to increase its output of copper in the last 6 years is no coincidence, and certainly is not the result of a concerted action by companies. It is the result of operating giant complex operations which are subject to a larger degree of technical and natural phenomenon production disruptions than was previously thought.

14. A second cause of volatility is the financial market: speculation, hedging, pension funds investment, commodity trading advisors. In traditional cycles inventories are required to fall to low levels

before the price takes off. But since the 1990's funds anticipated fundamentals. The fall and rise of prices in the Global financial crisis of 2008 show the effect of funds, which sold out quickly, generating a fast fall of prices, and shortly afterwards the same funds bought commodity future instruments contributing to a fast recovery of prices. The funds act faster than the forces of supply and demand of physical metal. The fall of prices in 2008 was faster for most commodities than in any crisis recorded before. Interestingly, financial instruments, except the intervention of pension funds, which are mostly long term investments, shorten cycles by anticipating the fundamentals, picking the turning point. These instruments do not have overall impact on the long term price, whereas investment by pension funds elevates the long term price. Arbitrage between the LME and the Shanghai Exchange is understood to increase volatility because the wide differences created must be corrected by transport of metal in either direction.

15. No validated predictive models of the movement of financial markets have been created up to the present time. When stocks are very low, as they were for copper between mid 2005 and 2007, the price no longer responded in a meaningful way to variations of stocks. After the 2008 Global financial crisis, we have seen copper prices increasing with increasing stocks in several occasions, and then, suddenly changing direction to accommodate the traditional dependence of price on stocks. Almost random price walks. The European economic crisis, which lowered all commodity prices considerably in mid 2011, is another example of market guessing. At that time, the price of copper tumbled from more than 4 US/lb to less than 3.5 US/lb in a short time. And there it remained for months, without any evidence that this was caused by a change in stocks. Why has copper not climbed up again to more than 4 US/lb since the European crisis began? Due to lower expectations of China's growth?

16. The weakening of the US dollar is a third cause of volatility because it elevates the value of mineral commodities. This adds to short and long term volatility, in spite of the fact that the changes in value of the US dollar are usually minor in comparison to the other two causes of volatility.

17. Volatility generates numerous effects for mineral commodities. Commodities with greater volatility exhibit slower rates of consumption growth than commodities with smaller volatilities. An example was aluminium consumption growth from 1940 to 1970 which was almost double that of copper. At that time aluminium had stable producer pricing, whereas copper was the first metal traded in the LME in the XIX century.

18. Commodities that are traded in market exchanges or are benchmarked according to the market have, usually, greater price volatility than those commodities where the price is defined by producers (producer price). Such is the example of aluminium, whose volatility was very low prior to being traded on the LME (in the mid seventies). It is also the case for gold, whose price was fixed by the US Government before 1974, and of iron ore, whose recent change of pricing method (2010) generated much greater volatility than existed before, when basically the companies Vale, Rio Tinto and BHP defined annual prices.

19. The production of the four commodities under examination is not thought, generally, of being subsidized. Some of the sub products and processes may receive direct or indirect subsidies nevertheless. Tax advantages for smelters in China and Japan are an example of direct subsidies, whereas ecological dumping is an example of indirect subsidies introduced by governments that apply lower environmental and health standards than what is "acceptable" globally. Subsidies for small mining are general in many developing countries, but the overall contribution of this segment to the total production is negligible.

20. Changes in terms of trade (i.e., value of mineral commodity exports) and profit margins (i.e. fiscal income via taxes) are considered drivers of innovation and productivity. Understanding this is critical to public policy. In many developing countries it is still thought that controlling mineral commodity prices has a long term benefit for the country. The opposite proves right as shown by many experiences of failed cartels, some of which ended dramatically, such as the Tin Agreement in the 1980's. There is abundant

literature regarding the effect of terms of trade change and volatility on the economic growth of countries. This factor governed policies of many countries throughout the world last century. It reveals conflicting views and its discussion is beyond the scope of this paper.

21. Intervention of governments in order to overcome the effects of volatility on economic stability and growth of developing countries has been approached with different solutions.

22. Creation of Social Welfare Funds (SWFs) is the prevailing policy applied in many developing economies, including most of oil exporting countries, and many developed countries.

23. A second policy is the diversification of the economy, policy actively encouraged in Chile and successful until the Great Chinese economic boom began. Before this time mineral exports in Chile were less than 50% of total exports, and some years it reached below 40%. However, recent prices of mineral commodities implied mineral exports surpassing 60% many years.

24. A third policy pursued in many cases was the intervention of Central Banks in order to smooth out and to ameliorate variations of local currency. These policies may have been successful in some cases, but are generally disregarded because of their high cost and ineffectiveness.

25. A fourth policy consists of the intervention of the government clearly defining and controlling externalities, building of public works that facilitate the job of industry and the public, and contribution to the social welfare of the population, specially the populations located close to the mines. The latter has acquired much relevance in the last decade, and many times it is unclear where the border line between the action of governments and of companies is, even understanding that these two sectors may have common ground.

26. As regards the control of competitive behaviour by the mining industry, the “effective” agencies are located in the developed countries, mainly the USA and the European Union. There have been many controls established in the last years by USA and European agencies over competitive behaviour by mining companies, including the merger of Rio Tinto and BHPBilliton, which was delayed by the European Union until the crisis of 2008, and this attempt obviously was extinguished by market reasons. Other examples are the potential collusion of companies to establish prices for smelting and refining of copper which was investigated in the last decade.

3. Estimation of volatilities

27. Table 1 shows the volatility over five year periods for iron ore, aluminium, copper and gold, calculated with average annual nominal prices. We consider the World Bank’s iron ore price data, which is annually based contract data before 2005, and spot prices from 2005.

28. Volatility was calculated using:

$$Vol_t = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (u_i - \bar{u})^2} \quad \text{where}$$

$$\bar{u} = \frac{1}{t} \sum_{i=1}^t u_i \quad \text{and}$$

$$u_i = \ln\left(\frac{P_t}{P_{t-1}}\right), \quad P_t \text{ is the price at time } t.$$

29. It is observed that from 2005 the highest price volatility was that of iron ore, followed by copper, aluminium and gold. For previous years the trend changed quite dramatically, especially for iron ore. Previous to 2010, since the majority of transaction prices were fixed by the main producing companies on annual basis, BHPBilliton, Rio Tinto and Vale.

30. The global financial crisis of 2008, however, changed this, because the spot market price was below the benchmark annual price in that period, and Chinese steelmakers chose to save money by trading on the spot market. Since China had emerged as the main user of iron ore in the early 2000, the annual benchmark pricing system formally collapsed in 2010, and the main producing companies adopted a quarterly pricing system based on the spot market, which provided more transparency and closeness to the supply demand situation.

31. Table 1 also shows that volatility of iron ore, copper and aluminium prices increased steeply since the beginning of the great commodity boom, originated by China's economic boom in 2003. Gold, however remained a low volatility price metal with an increasing trend in its price since the beginning of the boom.

Table 1: Volatility estimated on the basis of annual nominal prices

	Volatility Iron ore	Volatility Aluminium	Volatility Copper	Volatility Gold
1970-1974	11,2	16,2	28,4	21,8
1975-1979	15,1	26,3	32,6	27,1
1980-1984	13,6	27,9	14,4	39,7
1985-1989	7,2	32,7	17,0	15,3
1990-1994	11,8	19,1	14,1	5,6
1995-1999	7,4	16,0	22,0	7,3
2000-2004	7,2	11,4	23,0	8,5
2005-2009	50,4	27,0	33,7	9,1
2010-2011	32,6	11,8	16,0	0,9

32. Aluminium prices were particularly stable before the mid 70's when this metal was incorporated to the London Metal Exchange trading system. From 1975 until the end of the 80's the volatility of aluminium increased dramatically even surpassing that of copper. However, both industries are radically different. The former is the third most abundant crustal element, whereas copper is relatively scarce. Therefore, as stated by Simon Strauss in his book *Trouble in Third Kingdom* (1986, Mining Journal Books Ltd.) the cost of exploration for copper and the difficulty in finding world class deposits made a difference in the number of deposits developed for production. This was shown after 2000 when China decided to develop some high cost bauxite deposits, changing the structure of supply, and reducing volatility. Figure 1 shows constant US\$ 2010 prices for aluminium, copper, iron ore and gold, with base 100 in April 2002, indicating that the price of aluminium fell behind those of copper, iron ore and of gold.

33. The annual volatility of gold prices was comparable to those of the other three commodities before 1985, and it has been very low since then. At times of high economic risk such as 2008-2011 gold provides a shelter for investors and many authors have indicated that the price of gold will continue to increase in the future.

34. A recent study (Shahriar Shaffiee and Erkan Topal, 2010) has shown that the gold price experienced two shocks in the last 50 years, the first with the Iran revolution and the war between Iran and Iraq in 1980, and the second one with wars in Afghanistan and Iraq in 2007. These events also generated price shocks for oil. Eleven barrels of oil were worth one ounce of gold in 1968 and in 2008, and the

correlation between gold and oil prices were around 85% in this period. The first shock lasted seven years while the second one has not ended yet, and between the two shocks, the price of gold was relatively stable, below 250 US nominal/ounce.

35. The price of gold is influenced in the short term by the need for refuge of investors in the face of economic crisis, and by hedging of large conglomerates. In the long term the price of gold is controlled by three factors. First, mine production, whose costs have grown in the last few years and the difficulty to discover new massive deposits. South Africa declined its gold production to one fourth in the last 40 years. Second by “rational” expectations of investors, and third by the ease to buy and sell gold via the Exchange Traded Funds (ETFs).

4. Mineral commodity prices

36. Figures 1 and 2 show constant US\$ 2010 price for aluminium, copper, iron ore and gold, with base 100 in April 2002 and December 2005 respectively. It can be observed that both copper, iron ore and gold prices fared better than the average IMF’s metal price index. The price of iron ore fell as much as twice the price of copper during the 2008 global economic crisis, while the price of gold anticipated the crisis and then the recovery of commodity prices. It is interesting to observe that the gold price also seems to have anticipated the European crisis in 2010. The FMI commodity index considers Copper with a relative weight 2.8, Aluminium 3.9, Iron Ore 1.3, Tin 0.2, Nickel 1.1, Zinc 0.6, Lead 0.2, and Uranium 0.5.

37. Figure 2 shows the prices of these four commodities since 1970. It is observed that aluminium hit its top price in the last 50 years in 1989 signalling that the overcapacity present in today’s industry was non-existent then. This figure also shows the record prices obtained by gold in 1979-1980, exhibiting a much greater volatility than what is observed at present.

Figure 1: Constant US\$ 2010 price for aluminium, copper, iron ore and gold, with base 100 in April 2002

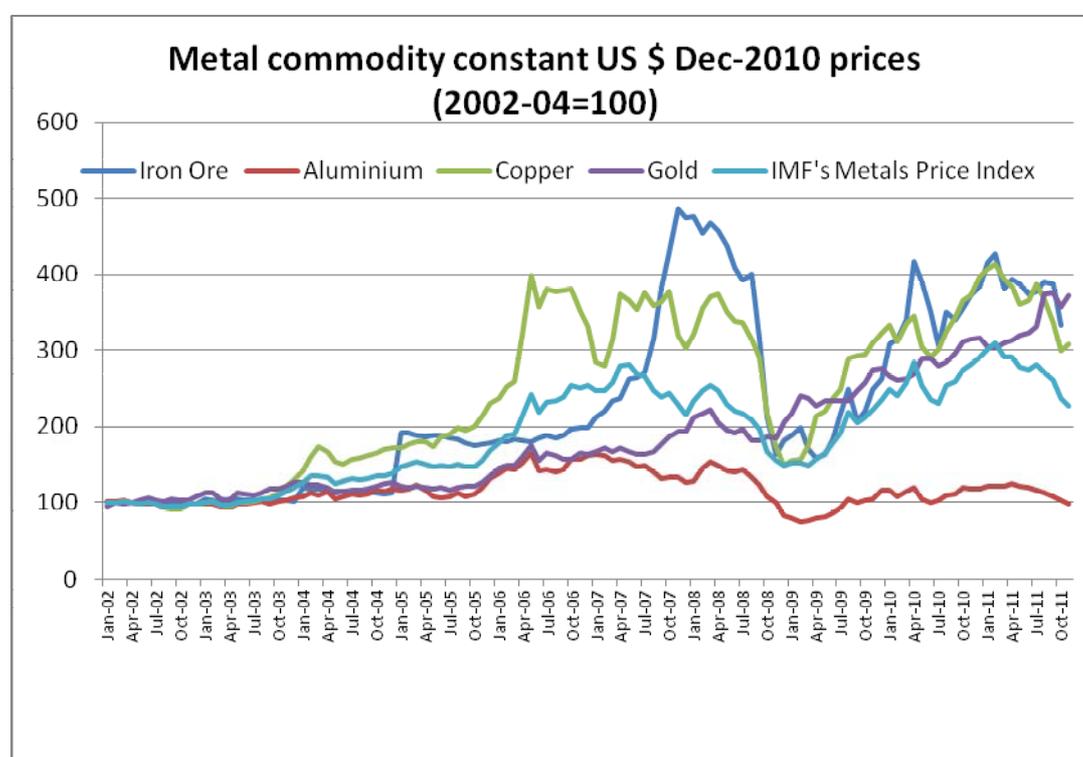
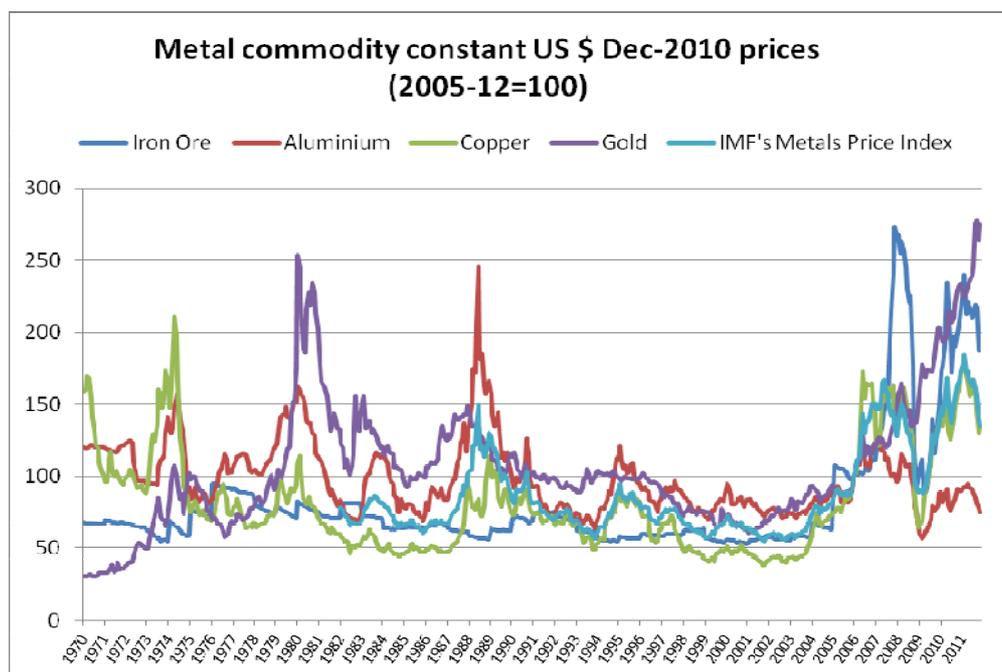


Figure 2: Constant US\$ 2010 price for aluminium, copper, iron ore and gold, with base 100 in December 2005



5. Mineral commodity prices and national economies

38. The volatility of metal commodity prices usually has important effect on those countries where the export of these commodities represents a large fraction, typically more than one third, of their total exports and of their fiscal income. It is relevant to review first which are these countries for aluminium, copper, iron ore and gold.

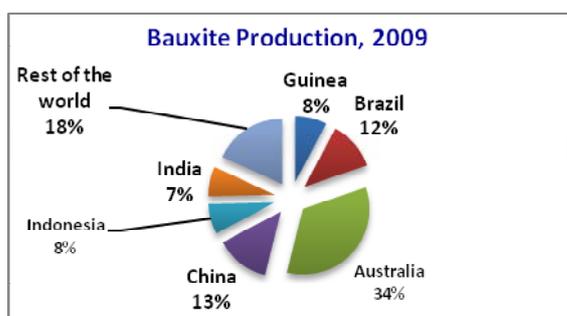
39. Figure 3 shows that the production of bauxite and of iron ore is concentrated in a few countries, whereas the production of copper is more spread out over several countries, and after the decline of gold production of South Africa, the production of this commodity is well disseminated in medium and small producers. China is a large producer of all four metals considered in this paper, Indonesia is a relevant producer of bauxite, copper and gold, whereas the CIS and Australia are relevant producers of two of the four metals considered. Australia's exports of bauxite, aluminium, iron ore and copper represents close to one fourth of total exports. Indonesia's exports of these four commodities represent about 6% of its total exports, while Brazil's exports of bauxite, aluminium, iron ore and copper were less than 15% of its total exports in 2010. In the case of Russia, India, China, and the U.S.A., their exports of these four commodities is less than 2% of their total exports. South Africa's exports of gold were a negligible fraction of their total exports.

40. In Figure 3-a it is observed that 6 countries produce 82% of the world's bauxite. Bauxite is processed into alumina usually in the same location as bauxite mining takes place. Alumina refining requires large amounts of energy, reason for which alumina refining is performed in locations with abundant and cheap energy. This mineral provides close to 80% of exports of Guinea, a country that has about one third of its world reserves.

41. Copper represented more than 50% of the exports of Zambia, Chile and close to this value in the case of Peru. Ghana's gold exports were one third of its total exports in 2010.

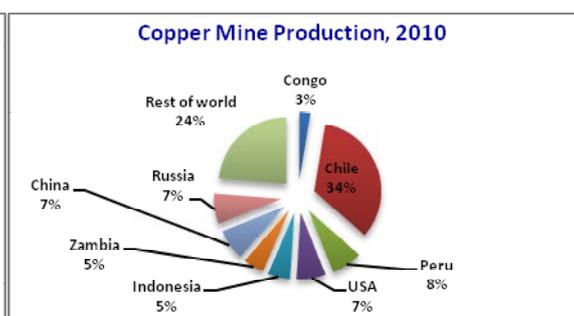
42. In sum, price volatility of these four commodities may affect the total exports, and consequently, availability of foreign currency and fiscal income, of a limited number of countries, namely Zambia, Chile, Peru, Ghana and Guinea. The effect of the price volatility of these commodities would be much less obvious in the case of Australia, Brazil, Indonesia, and negligible in the case of the other main producing countries.

Figure 3-a: Production of Bauxite, 2009



Source: World Bureau of Metal Statistics.

Figure 3-b: Copper Mine Production, 2010



Source: Chilean Copper Commission.

Figure 3-c: Production of Iron Ore

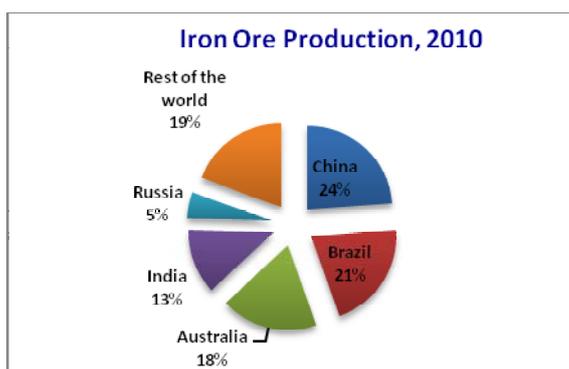
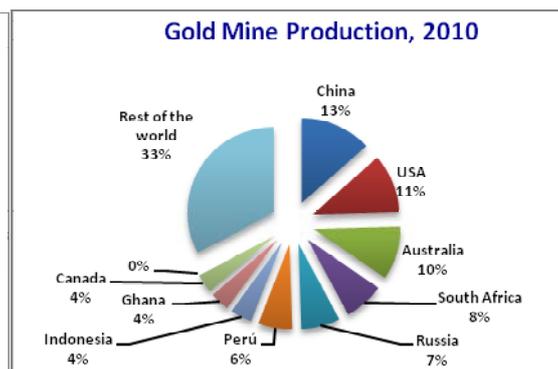


Figure 3-d: Production of Mine Gold



6. Policies and practices for handling price volatility in developing countries.

43. In the case of Chile and over many decades the currency exchange policy maintained an overvalued local currency, thus generating deficits in the export/import balance. The country was always thirsty for hard currency. This led to increasing the import tariffs so as to protect national manufacturing industry, which had important consequences on the competitiveness of this industry. This has also been the case for the other countries considered here, namely, Peru, Ghana, Guinea, and Zambia.

44. This phenomenon started in Chile after the Great Depression, when the economic policy changed from outward driven to inward driven, subsidizing national manufacturing industry. This coincided with the time when the Anaconda and Kennecott, the two US companies that had built the mines of Chuquicamata and El Teniente, respectively, finished paying their investment. The value of the national currency was usually fixed by the government in order to protect the national industry, thus reducing incentives for competitiveness. These type of policies prevailed until after the world recession of 1982, after which the currency was managed more closely linked to international markets.

45. It was not until the 90's that the currency was totally floated on the basis of other international hard currencies. There is much evidence that the copper price has been linked to the value of the Chilean peso throughout the period when floating currency existed, even in recent years, since the great Chinese

economic boom began. However there are periods when this influence is greater, which makes it difficult to predict the variability of the currency. In spite of this economists have stated many times that the “Dutch Effect” was not experienced by Chile since the 90’s.

46. The fiscal income contributed to the State of Chile by the mining industry varied greatly from the 1930’s to the nationalization process in 1971. But the variations of fiscal income derived from copper continued after this time up to 2011. In 1941 the contribution of copper to the fiscal income was 14%, reaching a maximum of 41.5% in 1952. During the last decade fiscal income from copper, this time contributed not only by the State Company but also by private mining companies, varied between 5 and 30%.

47. The changes in fiscal income resulting from the volatility of the price of copper from year to year generated serious problems for the elaboration of the budget. Usually the budget had to be readjusted by Congress when the variations of the copper price were severely downwards.

48. As a result of the influence of copper taxes on fiscal income, in 1986 the Copper Stabilization Fund was created, establishing a reference price for the budget, above which the fund would accumulate income, while if the price was below the reference, there would be a transfer from the stabilization fund to the treasury. In spite of the fact that there is no literature evaluating the effect of this fund it can be generally said that it improved the management of the economy. Also, in 1987 the copper price increased and remained high, except for one year, up to the Asian crisis in 1997. From 1998 to 2003 the price of copper and other mineral commodities was low, and some times, very low. The copper stabilization fund helped at this time since it had built a considerable amount of currency.

49. In 2006 the Chilean Government created the Economic and Social Stabilization Fund (SWF) (Social Welfare Fund) or FEES in Spanish), incorporating the income accrued by the Copper Stabilization Fund (CSF) (2.5 billion US), which reached its end. The aim of this fund was ampler than that of the CSF since it included funding social and economic programs. The same year the Pension Reserve Fund was created, obtaining income from the Government, from the Central Bank to a minimum amount of 0.2% of the GDP, and from the SWF.

50. The SWF obtained 13.1 billion US\$ derived from the old copper Stabilization Fund plus the savings of copper taxes not assigned to previous budgets. Up to November 2011, the FEES had 13.2 billion, and had transferred 9.4 billion to the Government for ameliorating the economic effects of the 2008 Global Economic Crisis. Almost all funds of the SWF were contributed by copper taxes obtained from Codelco and from the private mining companies. The latter contributed 12.3 billion US (nominal) in taxes from 2006 to 2010, which shows that without this contribution the balance of the SWF would have been zero.

51. Peru does not have a mechanism similar to that of Chile for saving surplus originated in mining. This is partly due to the fact that the overall fiscal income obtained from mining has not been as large as that of Chile and has been spent in social welfare and other purposes. With the present growth of the mining sector of Peru, it is likely that such savings may be originated in the future.

52. The case of Zambia is similar to that of Chile before the 1980’s. Mining, mainly copper and cobalt, make up 10% of the GDP and 70% of its exports. A strong Dutch Disease effect is acknowledged historically, which has created aversion to investment in the local currency (Kwacha) in other sectors of the economy. Handling of the exchange rate of the Kwacha varied historically in Zambia. From 1964 to 1976 there was fixed exchange rate, convertible in sterling and later in US dollars. Afterwards degrees of floating currency have been established. But Zambia still does not an SWF. Neither do Guinea and Ghana, but Ghana is considering the creation of a fund to handle revenues of its new oil project which will generate about 2 billion per year income.

53. In fact Chile may be the only non-ferrous mineral producing country without oil that has managed a successful SWF to manage its mineral exports surplus in times of boom.

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