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## THE BRAZILIAN COPPER MARKET

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### ABSTRACT

This paper offers some insights about the affluence of Brazil as a significant player in the world copper market by the end of decade. Its fundamental objective is presenting a prospective evaluation of the expected behavior of the Brazilian supply and demand copper core forces sustaining the envisaged role of the country by 2010.

A summarized scenario is generated by means of a consolidated and cross-sector prospective evaluation of the Brazilian copper market. On the demand side, a quantitative and qualitative analysis of the behavior of selected vectors of concern explaining the expected level of the Brazil's copper consumption is discussed. On the supply side, taking into account the preeminent changes in the *status* of knowledge of the country copper reserves and resources, some fundamental aspects of the copper supply industry are analyzed in order to identify the fundamental forces that should revive and sustain Brazil's long term copper production as well as its share as an exporter and importer.

### INTRODUCTION

Taking into account the relevance of copper as a raw material in the production process of important industrial sectors, it is fundamental to approach this task from a macroeconomic point of view. We present a general and short overview of macroeconomic variables that nowadays

comprise the business investment climate in Brazil. These comments emphasize those aspects that may affect the demand for copper during the time frame of interest.

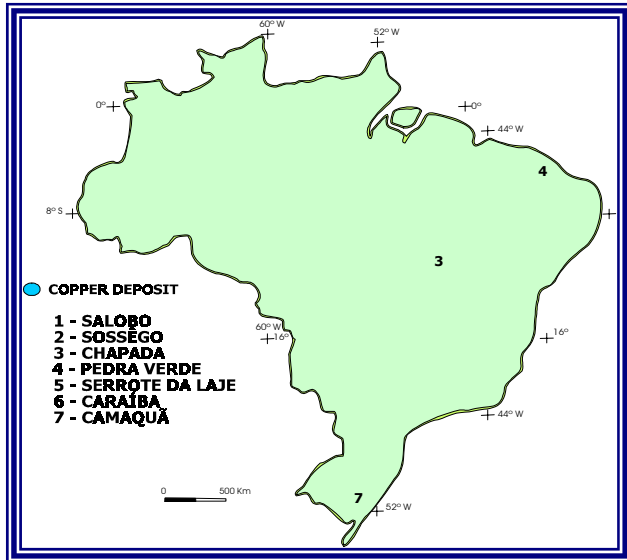
In terms of growth and considering the elected deadline frame of 2010, the potential of the country is to resume an average annual rate of 5.5%, in the neighborhood of the historically observed one for 1955-1999 period. However, in the medium range the authors' expectance points to a lower rate in the range of 3.8% to 4.5% per year as the most probable attainable one. At least by first years of the series. In fact, after a long decade permeated by recession and high annual inflation rates, the Brazilian economy still struggles with some strategic constraints. To return to the historical growth rate and eliminate the gap to potential product, one decisive vector in a matrix of conditions is to increase the annual gross capital investment figure to at least 25% of the GDP.

On the other hand, after 1995 an increasing deficit has been observed in the foreign trade account caused by an expressive growth in the ratio of imports to exports. The comprehensive expansion of imports can be tracked, in a large extension, to investments in modernization, expansion and development of new projects due to the adoption of a more liberal economic policy and the spin off effects from the privatization program. To solve the equation on international front, it is mandatory to increase the competitive position of the domestic industry and the export sectors as well in order to guarantee the expansion of the imports in demand assuring a sustainable balance of payments in the long run.

## BRAZILIAN COPPER SUPPLY

### Resources & Reserves

In 1999, Brazilian official copper resources & reserves were estimated to comprise about 12 million tons of contained metal distributed along six states. Figure 1 presents the geographical situation of principal deposits and respective states: Pará (Salobo e Sossêgo), Goiás (Chapada), Bahia (Caraíba), Alagoas (Serrote do Laje), Ceará (Pedra Verde) e Rio Grande do Sul (Camaquã).



**Figure 1 - Map of Brazilian Copper Reserves**

The major concentration is situated in the Carajás Mineral Province, in Pará state. This province has emerged as the most important one considering the geological endowment, the expressive deposits already discovered and the great number of anomalies waiting further exploration. As a matter of fact the strong association with gold as an economic subordinated metal positioned Carajás as a Cu-Au province of international status.

The ongoing exploration in Carajás has been increasing national resources at a fast pace and unquestionably will bring great surprises. The Salobo deposit embraces an estimated resource of 9 million tonnes of Cu and Sossêgo has already delineated more than 3 million tonnes of Cu, although its potential could surpass 5 million tonnes of Cu. Other areas in the Amazon region are attracting the attention from majors focused on copper. As such deserves mention the Alta Floresta District in Rondônia State that is being targeted by companies with a caliber like CVRD and Phelps Dodge.

### Mine Production

The Mineração Caraíba runs the unique Brazilian copper mine. In 1999, the production of Cu contained in concentrate was 31.000 tonnes, about 10% of the Brazilian apparent consumption. This mine has a useful life limited to 10 years, in an optimistic scenario. So, in fact the fundamental copper projects to be launched in the next few years are being conceived to work the deposits of Salobo and Sossêgo. According to the Investor's Relations Division of CVRD, the Company and its partners are pursuing an investment program of about US\$ 2 billion distributed in 2001-2004 period and encompassing six copper projects. CVRD has the expectation of achieving an equivalent production above 600.000 tonnes of Cu contained in concentrate by 2005.

The first project in the pipeline is Sossêgo. The decision to implement Sossêgo was taken and Mineração Serra do Sossêgo S/A already has submitted the Plan of Economic Development for the deposit to DNPM. The deposit is going to be exploited by a classical open pit, mill, grinding and flotation circuit. The development is scheduled to begin in 2001. At this stage the feasibility study indicates an investment around US\$ 500 million to produce 150.000 t/y of Cu content in the concentrate by year 2004.

The Salobo project was approved at last. The selection of hydrometallurgy route as the most adequate to evade comminution challenge and also a drastic reduction in investments after a comprehensive review of conception support the decision. The mine is expected to come up in 2005 producing 200.000 t/y of Cu and 11 t/y of Au. The investments should be around US\$ 600 million. The remaining production are going to come from Cristalino, Alemão e 118 projects. In this sense, the beginning of Millennium will register the Brazil's debut as an important producer of copper.

Projects	Year <sup>1</sup>	Partnerships	Production <sup>2</sup>
Sossêgo	2001	CVRD/Phelps Dodge	150,000
Cristalino	2002	CVRD/BNDES	150,000
Salobo	2002	CVRD/American	200,000
118	2003	CVRD/BNDES	50,000
Alemão	2004	CVRD/BNDES	50,000

Source: CVRD

**Tabela 1 - Copper Projects in Carajás Province**

Notes: (1) Beginning of development. Start up about 30 months later.  
(2) Copper contained in concentrate.

## Metal Production

Caraíba Metais is responsible for the total production of refined copper, with an installed capacity of 200,000 tons of cathodes and 155,000 tons of wire rod. The company is investing US\$ 30 million to increase its production capacity to 220.000 tons of cathodes per year by 2001. In summary, its program of expansion comprises a level of investments of about US\$ 250 million to achieve a production capacity of about 380.000 t/y in 2003.

A strategic vector inserted in the Brazilian copper supply scenario is associated with the Codelco's decision to increase its level of international exposure reacting to low prices and industry consolidation process. In fact Codelco already has established a business unit with a specific focus on foreign opportunities of investments. After some evaluations in Africa and an exploration agreement formalizing investments in Mexico it is conspicuous its interest in Brazil. The attempt to acquire a stake in Caraíba Metais only is an example. As a matter of fact, in this process, Brazil represents a dual strategic target by means of its importance as an expressive market, although repressed yet, and the impressive copper potential that Carajás's Province embraces.

## BRAZILIAN COPPER DEMAND

The copper processing industry consists of about 200 companies, most of them small in size. The total production capacity is more than 500,000 tons (including the scrap processing activities) and the concentration ratio is high. In the wire and cables segment 9 companies are responsible for 80% of the production. In the bar and tube mills 5 companies control 90%. Five sectors - building, telecom, refrigeration, automotive, and electronics - answer for 67% of the total consumption ( Figure 2).

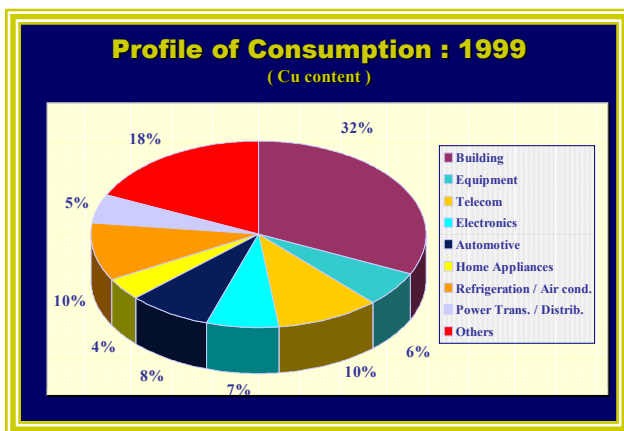


Figure 2 - Profile of Consumption

In 1999, wire and cable and semi-manufactured products had a share, respectively ly of 57% and 39% in apparent copper consumption. In terms of consumption of wire and cables three sectors - building (36%), telecom (13%), and refrigeration (11%) - are responsible for 60%. Consumption of semi-manufactured goods has less concentration with five sectors - building (26%), automotive (12%), refrigeration (8%), equipment (8%), and electronics (7%) - adding up to 61%. Figure 3 shows the evolution of the copper consumption during the period 1976-1999.

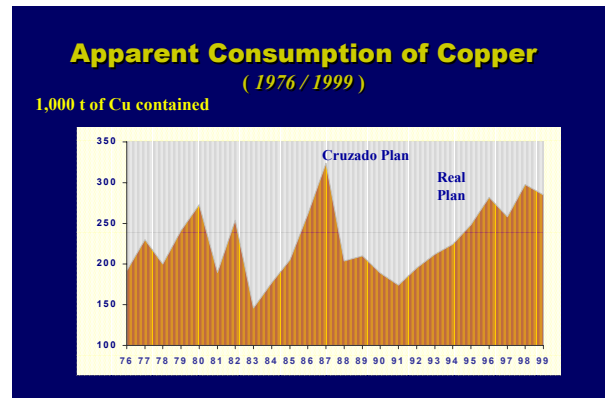


Figure 3 - Evolution of Consumption

The behavior of the consumption points to the relative instability during the 1976-1986 period and the accentuated growth after the implemented measures to stabilize the economy - Cruzado Plan and Real Plan - suggest a strong repressed demand. Figure 4 introduces the observed growth rates of consumption for selected periods. Three important aspects should be noted:

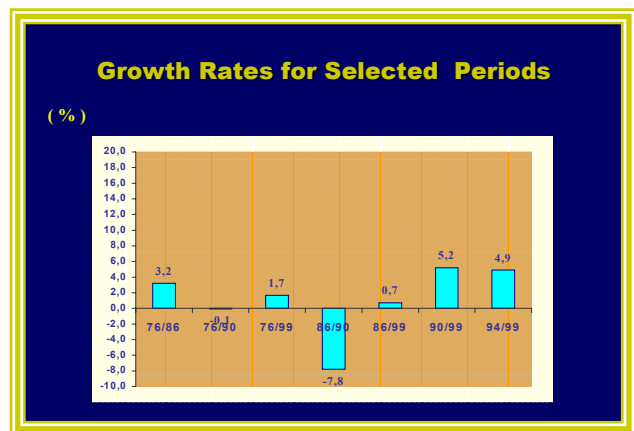


Figure 4 - Consumption Growth Rates

- The average growth in the period 1990-1999 is closer to the historical growth rate of the GDP;
- The growth rate after 1994, reflects the impact resulting from a sharp drop in the inflation rate (Real Plan); and
- In spite of the higher rates observed after 1990 and the relative consistency of growth in the nineties, the average growth rate in the last 23 years was below 2% per year (Figure 5). As a result, the *per capita* copper consumption in 1999 is at the same level as observed in 1976, reinforcing the continuous status of repressed demand for domestic market.

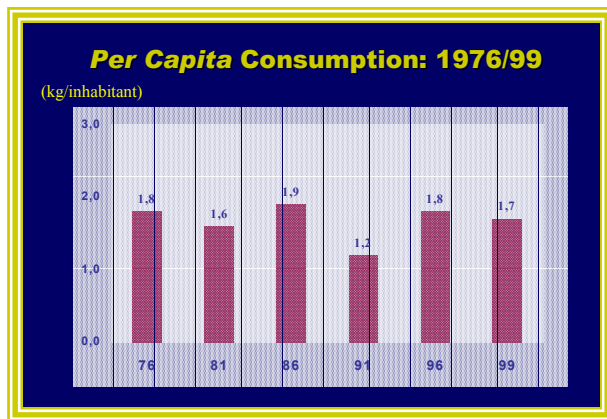


Figure 5 - Brazilian *Per Capita* Consumption

This conclusion can also be inferred by comparing the Brazilian *per capita* copper consumption and *per capita* GDP with similar indicators for selected countries. The Figure 6 presents the *per capita* copper consumption and Figure 7 introduces cross-section ratios of confronting Brazil with these countries.

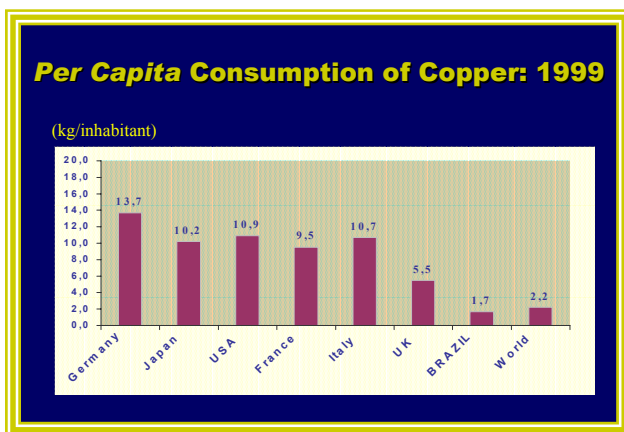


Figure 6 - International *Per Capita* Consumption

It can be observed the relative balance between Brazil, Italy, France, and specially United Kingdom. This yardstick can

be used as a proxy to compare these countries with Brazil in terms of the relative intensities of use of copper.

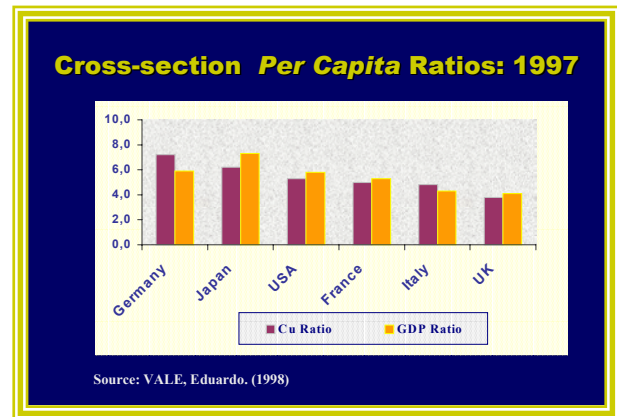


Figure 7 - International Cross-section Ratios

### Focusing on Qualitative Aspects

Taking into consideration the role fulfilled by sectors such as building, infrastructure, automotive and refrigeration it is relevant to present some insights of its interfaces with domestic copper demand.

In the energy front, after the Real Plan, the annual growth rate of energy consumption has been almost twice that of the GDP. However, when we analyze a shorter period the trend points to closer rates. In general the energy income-elasticity has been declining. Anyway, this imbalance has increased the operational risk of the system and the electrical system is operating under an unacceptable level of risk by means of bottle necks in generation & transmission. In generation the risk of deficit is around 15%, three times the normal one. The Ten Year Plan of ELETROBRÁS for the period 1999-2009 covers a portfolio of 129 power plants and has a target of 109 GW to the installed capacity, an increase of 70%. The Plan also addresses the expansion of the transmission as well as distribution systems. The required investments are around US\$ 4 billion per year. The expansion of transmission & distribution grids will have a comprehensive impact in the demand of copper, although susceptible to an increasing competition from aluminum. The transmission side of the equation encompasses constraints that preclude transferring energy between regions. According to government planning the transmission grid (above 230 kV) should increase by 74%, about 48.000 km, encompassing investments of US\$ 15 billion until 2010. With this reference, the energy sector is expected to increase its share in copper consumption from 5% to about 7%, by 2010.

The required investments to recover and expand the telecommunication system to a standard closer to that available in industrialized countries are estimated to sum up to US\$ 115 billion until 2010, representing a capital allocation 233% higher than was recorded in the period 1973-1995. The government plan requires that all cities with more than 100,000 inhabitants be linked by optic cables. Reflecting the international trend, the fast penetration of optic cables is considerable. The expansion program of the optics system considers investments of US\$ 1 billion concerning a network of 20,000 km of optic cables that will permit linking almost all the capital cities and will increase by fifteen-fold the national capacity of data and voice transmission.

The government's intention to substitute copper cables is clear, though there are budget constraints. Priority is given to new lines and urban areas of high traffic, so the complete substitution cycle is a long term project. However, when we analyze the distribution profile of investments the loss of importance of copper cables is unquestionably. In the next few years, the ratio of investment between optic and copper cables will approach 10 to 1 and 9 to 1 between wireless local loop and copper cable. Companies with stakes in electric power are envisaging the opportunity of offering their infrastructure of transmission and distribution lines as a frame to support the expansion of optic cable lines. Brazil is the greater consumer of optical cables in South America with a share of about 70% of the regional demand. The penetration of optical cables is not reversible and will continue at a fast pace. In this sense the share of telecommunications in copper consumption probably is going to stabilize and eventually diminish in the long run.

For a country like Brazil the construction industry is critical to development. We are talking about an activity that represents 19% of the GDP, 70% of total fixed investments and the generation of about 18 million jobs. In this sense all national development plans and programs consider this sector as one of their priorities. Its growth potential can be inferred for example from the higher growth rates observed in the consumption of cement after the Real Plan. During the 1990s the per capita consumption had been increasing at an average annual rate of 3.6%, and after 1994, at 16% by means of the demand emanating from the low income class. As a matter of fact, the Brazilian per capita consumption of several mineral related materials are very low, but with the stabilized economy the effective potential demand is beginning to emerge. This positive trend can be ascertained in several other minerals demanded by the construction industry, such as copper. On the other hand, the government's decision to enforce the technical parameters that should be attained by wire and cables for use by construction will positively affect the demand.

On the time horizon of interest a minimum annual growth rate of 5% should be considered conservative. Finally, it should be noted that according SINDUSCON -

Sindicato da Indústria de Construção Civil de São Paulo the Brazilian residential deficit is estimated to be around 6 million units embracing about 25 million habitants and configuring one of the government priorities to the next years. In this sense, it is expected an increase in the share of building in copper consumption.

The global automotive industry is investing more in Brazil than elsewhere in the world. Investments in expansions and new plants amounted more than US\$ 17 billion when considered the last five years. Composed with other durable consumer goods, the electrical & electronic home appliances sector has greatly profited from the boom triggered by Brazil's macroeconomic stability. For example, in the period 1993-1998, the average annual growth rates for some products were: Microwave ovens : 51%, Refrigerators: 35%, Vertical Freezers: 20%. In general the market saturation for these products (i.e. percentage of households with at least one appliance) is still very low when compared to international parameters. Moreover, the increase in exportation and level of nationalization of the production process should also contribute to a higher share in copper consumption.

## Brazilian Copper Consumption by 2010

Figure 8 presents the authors' most probable range to encompass Brazilian copper consumption in 2010. Demand projections usually are a difficult task. In Brazilian case perhaps, even more challenging and complex, bearing in mind the ever present trade-off between growth and recession periods as a result of the stop and go economic policies adopted in last decades.

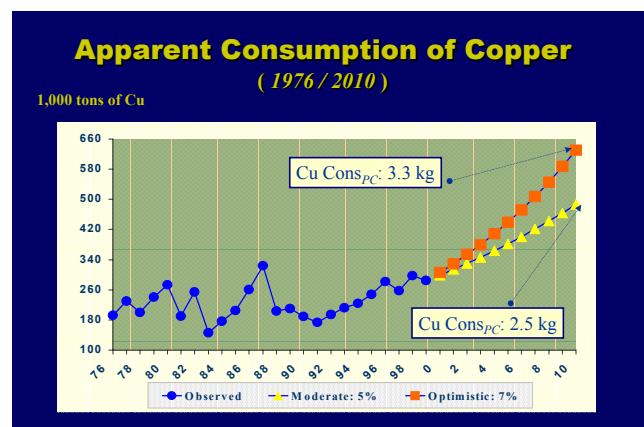


Figure 8 - Brazilian Copper Consumption by 2010

Additionally the absence of adequate statistics, the relatively unknown impact of opening up the economy in terms of the prevalence of past technical coefficients of consumption and productivity not to mention the challenge to infer the standard of consumption flow deriving from the stabilization of the economy and international competition strongly hinders the applicability of pure econometric models. With all these current influential constraints and being adepts of using the dichotomy approach of quantitative versus qualitative methods whenever possible we estimate the Brazilian copper demand by year 2010 based on the conjunction of the following concepts and techniques:

- The intensity of use of copper, defined as the copper consumption by US\$ unit of GDP;
- The *per capita* consumption of copper;
- Selected multiple regressions exercises calibrated by means of combined runs of sensitivity analysis and Monte Carlo simulations to specific and independent variables of concern such as the rates of growth of core consumption sectors.

## CONCLUSIONS & FINAL REMARKS

The Brazilian *per capita* copper consumption is very low yet, but with the stabilization of the economy the effective demand is beginning to appear. Assuming that the Brazilian copper industry begins a new cycle of expansion and development in the first decade of the new millennium we would dare to say that by 2010:

- Brazil will be ranked among the eight principal international producers of concentrated in copper contained;
- Brazilian domestic market will be the ninth in size in terms of copper consumption;
- There is a 90% probability that Brazilian copper demand will be more than 490,000 tons;
- There is a 75% probability that Brazilian copper demand will be more than 490,000 tons and less than 630,000 t of refined copper;
- Taking for granted the government projections for population there is a 75% probability that the Brazilian *per capita* copper consumption is going to pertain to the interval [2.5;3.3] kg/inhabitant;
- The principal consumers would comprise the actual mix of sectors with construction, equipment, telecom,

electronics and automotive having a share of more than 70%; and

- The construction industry will maintain the leadership answering for about 35% of the total consumption.

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