

**ETLA**

**ELINKEINOELÄMÄN TUTKIMUSLAITOS**  
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY  
Lönnrotinkatu 4 B 00120 Helsinki Finland Tel. 609 900 Telefax 601 753

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Tomi Torri

**THE WORLD ECONOMY OF METALS;  
A FINNISH PERSPECTIVE**

Kansallinen kilpailukyky ja teollinen tulevaisuus -projektissa tutkitaan, millaista teollista toimintaa voidaan harjoittaa Suomessa menestyksekkäimmin. Siinä tutkitaan menestyneitä vientiyrityksiämme ja pohditaan, miten niiden toimintaympäristöä tulisi kehittää, jotta ne pystyisivät saavuttamaan kilpailuetuja kansainvälisiin kilpailijoihin verrattuna.

Projektin päärahoittajina ovat Suomen itsenäisyyden juhlarahasto (SITRA), Elinkeinoelämän Tutkimuslaitos (ETLA), kauppa- ja teollisuusministeriö (KTM) sekä eri alojen tärkeimmät yritykset.

"The Competitive Advantage of Finland" research project evaluates the competitiveness of Finnish export industries and crucial elements behind their performance. The project focuses on what kind of industrial activities have the best possibilities for success in Finland.

The project is organised by Etlatieto Ltd and financed mainly by the Finnish national Fund for Research and Development (SITRA), The Research Institute of the Finnish Economy (ETLA), Ministry of Trade and Industry (KTM) as well as major companies in various fields.



(ETLAn projektitutkimus- ja tietopalveluyksikkö)  
Lönnrotinkatu 4 b 00120 Helsinki Finland  
90 - 600 901 fax: 90 - 601 753

# Tomi Torri

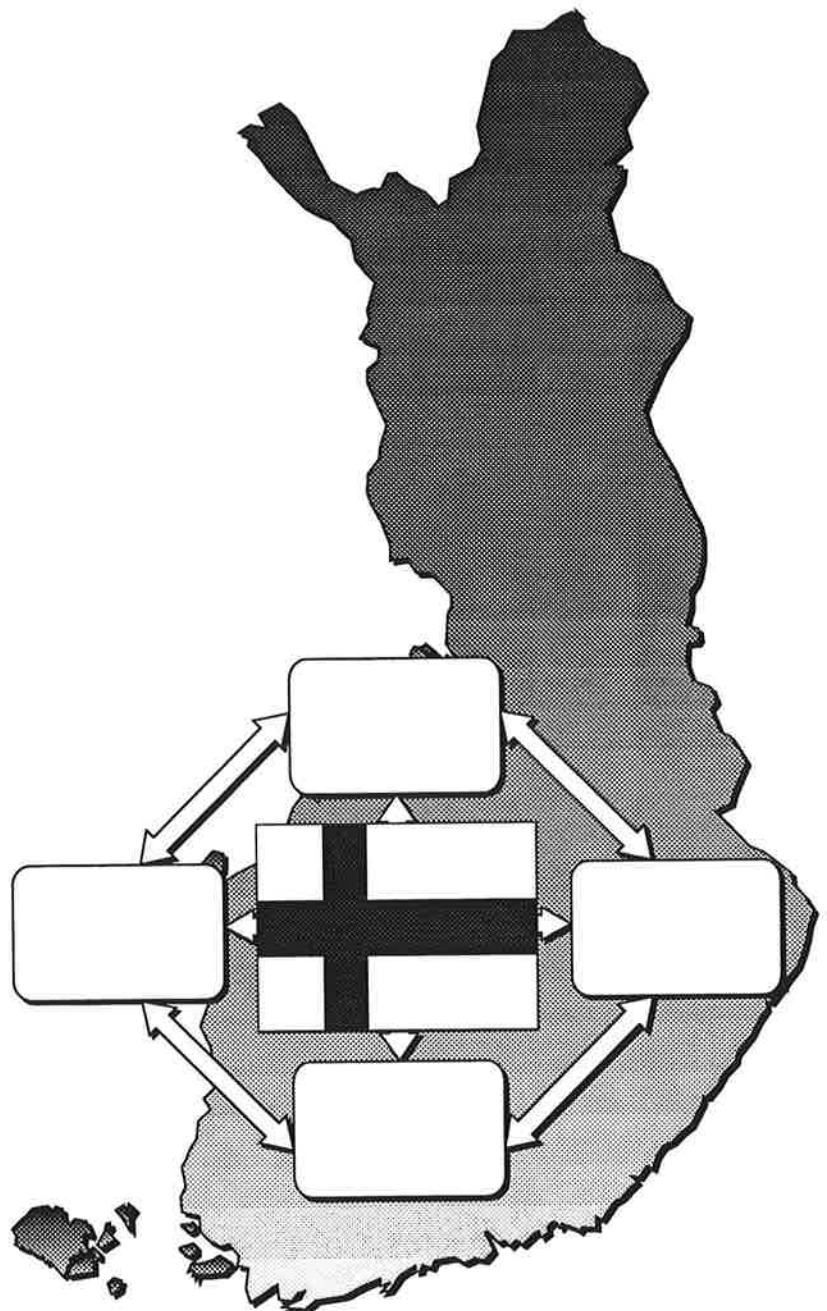
Kansallinen kilpailukyky ja teollinen tulevaisuus

The Competitive Advantage of Finland

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## THE WORLD ECONOMY OF METALS; A FINNISH PERSPECTIVE

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Helsinki, ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 1994, 49 p. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847, No. 492)

**ABSTRACT:** This research is a part of The Competitive Advantage of Finland -research project, which is organised by Etlatieto Ltd. The research describes and analyses the phenomena in the world economy of metals and presents historical and future trends and prospects. After a long period of growth the metal markets are now in a deep depression and the recovery is forecast to take place at the end of the 1990s. The theoretical framework of the research is based on theories of Michael Porter. Competition within the industry is fierce and success is primarily based on low production costs. The world steel production is facing a major problem in decreasing the overproduction.

**KEY WORDS:** world economy, world market, metals, prospects

**Torri, Tomi, METALLIEN MAAILMANTALOUS; SUOMALAINEN NÄKÖKULMA.**  
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**TIIVISTELMÄ:** Tämä tutkimus on osa Etlatieto Oy:n koordinoimaa Kansallinen kilpailukyky ja teollinen tulevaisuus -tutkimusprojektia. Tutkimus antaa yleiskuvan metallien maailmantalouteen liittyvistä ilmiöistä sekä esittää markkinoiden historiaa ja tulevaisuuden trendejä. Pitkän kasvusuhdanteen jälkeen metallien markkinat ovat nyt syvässä lamassa, josta toipuminen tapahtuu arvioiden mukaan 1990-luvun loppupuoliskolla. Tutkimuksen teoreettinen viitekehys muodostuu Michael Porterin teorioista. Kilpailu toimialalla on ankaraa ja menestyminen perustuu paljolti alhaisiin tuotantokustannuksiin. Maailman teräksen-tuotannon tämänhetkinen suuri ongelma on ylikapasiteetista luopuminen.

**AVAINSANAT:** maailmantalous, maailmanmarkkinat, metallit, ennuste

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# YHTEENVETO

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Tämän tutkimuksen perushypoteesin mukaan metallimarkkinat ovat luonteeltaan globaaleja. Tutkimuksen tarkoituksena on kuvailla ja analysoida metallimarkkinoiden ilmiöitä ja esittää niiden tueksi tunnuslukuja ja trendejä. Tutkimus käsittelee terästä, kuparia, sinkkiä, nikkeliä ja alumiinia. Tutkimus on perustaltaan kirjallisuustutkimus, mutta aineistoa on tuettu haastatteluilla.

Toisen maailmansodan jälkeinen kasvu sai metallien kysynnän kasvamaan eri puolilla maailmaa. Monissa maissa, joista esimerkkinä voidaan mainita Ranska ja Italia, terästeollisuus organisoitiin valtion omistukseen. Monissa kehitysmaissa puolestaan läntisten yhtiöiden omistamat kaivokset kansallistettiin. Kaupan sopimukset suosivat raaka-aineiden kauppaa verrattuna jalosteiden kauppaan. Metallituotannon aiheuttama ympäristön saastuminen tuli merkittäväksi tekijäksi länsimaissa 1960-luvun lopulla.

Ensimmäinen öljykriisi vuonna 1973 aiheutti kaivostuotteiden hintojen romahtamisen ja koko teollisuus kärsi heikosta kannattavuudesta. Siitä lähtien metalleja tuottava teollisuus on ollut rakenteellisten uudistusten kourissa ja uusia kilpailijoita on perustettu NIC - maihin. Vuonna 1982 metallien hinnat putosivat alimmalle tasolle kolmeen vuosikymmeneen. Monistakin syistä johtuen varsinainen kaivostoiminta on yhä enemmän siirtynyt länsimaiden ulkopuolelle. Suuret länsiyritykset yrittävät kuitenkin ylläpitää paikallista sulattokapasiteettiaan kaivostoiminnan laantumisesta huolimatta.

Perustuen 'Rooman klubin' katastrofaalisiin ennusteisiin käytiin 1970-luvun alussa kiivasta keskustelua maailman luonnonvarojen riittävydestä. Myöhemmin on kuitenkin huomattu, että lähes kaikki tähänastiset ennusteet ovat osoittautuneet turhan pessimistisiksi. Oikeastaan on niin, että luonnonvarat eivät koskaan lopu - raaka-aineiden hinta vaan nousee. Metallien saatavuus on käytännössä riippuvainen kolmesta tekijästä: metallireservit, esiintymien hyödyntäminen ja tekninen kehitys. Merenpohjan esiintymien hyödyntämisellä saattaa tulevaisuudessa olla suuri merkitys.

Yleisesti ottaen metalleja tuotetaan niissä maissa, joissa on rikkaita esiintymiä. Suurin osa metallien kulutuksesta tapahtuu korkean elintason ja elintason kasvun maissa. Kierrätyksestä johtuen metallien kulutus on suurempaa kuin niiden perustuotanto. Romun osuus metalliraaka-aineista on 50% kuparilla, 33% sinkillä ja teräksellä ja 25% alumiinilla. Perusmetallien reaali hinnat ovat viimeisinä vuosikymmeninä pysyneet lähes

vakaina, mutta raudanmalmin hinta on puolittunut 35 vuodessa. Hintojen vaihtelut seuraavat länsimailman talouskehitystä.

Metallien tuotannon osuus BKT:stä on jatkuvasti pienentynyt länsimaissa. Metallien käyttö sinänsä on kuitenkin tärkeä edellytys muiden teollisuudenalojen toiminnalle. Kansallisista turvallisuussyistä johtuen monien metallien kauppa on edelleenkin sidottu supervaltojen tarpeiden mukaiseksi. Tullimaksut ovat yleisesti ottaen ovat pienempiä halvoilla raaka-aineilla, kuten bauksiitilla, ja korkeampia maksuja sovelletaan pidemmälle jalostetuihin metalleihin, kuten kuparin puolivalmisteisiin. Tullit saattavat kuitenkin poistua tulevaisuudessa riippuen kansainvälisistä MSA -neuvotteluista.

Metallien pitkántähtäimen hinnan määräävät kysynnän kasvu, kaivos- ja metallurgisen teknologian kehittyminen, uusien esiintymien löytyminen ja rikkaiden esiintymien hyväksikäyttö. Hinnat pyrkivät asettumaan tasolle, joka kattaa tuotannon pääomakustannukset. Ylituotannosta ja rakenteellisista muutoksista johtuen monet kaivokset joutuvat kuitenkin toimimaan kannattamattomina ja toiminnan lopettaminen on vaikeaa. Lontoon metallipörssi ja COMEX Yhdysvalloissa antavat tärkeimmille metalleille päivittäiset hinnat, suojastamis- ja sijoitusmahdollisuuksia, sekä myös fyysisen jakelutien. Kuitenkaan esimerkiksi terästä ei noteerata pörsseissä. Suojastamisen tarkoituksena on välttää hintaheilahtelujen aiheuttamia riskejä. Spekuloinnin tarkoitus on päinvastainen, eli riskien avulla saavuttaa voittoa. Metallien pörssikauppa tapahtuu pääasiassa futuurisopimusten avulla.

Viimeisten 20 vuoden aikana metallien tuottajilla on ollut kaksi yritystä kartellisoida maailmankauppaa (bauksiitti ja tina), joista molemmat ovat epäonnistuneet. Kaupan yhdistykset keskittyvät nykyisin lähinnä kehittävään yhteistyöhön. Tunnetuin yhdistyksistä on the International Iron and Steel Institute (IISI).

Metallintuotannon sijoittuminen maailmankartalle perustuu esiintymien sijaintiin ja tärkein asiakas metallituotteille on luonnollisesti metalliteollisuus. Luonnonsuojelun merkityksen tuotantoon ja kysyntään arvioidaan kasvavan tulevaisuudessa. Yritykset saattavat tulevaisuudessa olla halukkaita siirtämään tuotantoaan maihin, joissa ympäristöä koskevat säädökset ovat löyhempiä. Vertaamalla sellu- ja paperiteollisuuden kehitystä metalleja tuottavaan teollisuuteen voidaan arvioida ympäristötekijöiden merkityksen kasvavan myös metallien tuotannossa.

Kilpailu metallituottajien välillä on kova: yritykset ovat suurinpiirtein samankokoisia ja kasvuprosentit ovat tyypillisesti alle 5%. Toimialalta poistuminen ja sinne pääseminen on vaikeaa, mikä pääasiassa johtuu toimialan pääomavaltaisuudesta ja suuruuden ekonomiasta. Tuotedifferentointi on monasti mahdotonta, sillä kyseessä on

pääomavaltainen prosessiteollisuuden toimiala, jonka tuotteet ovat suuressa määrin bulkkia. Kannattavuus alalla perustuu suuressa määrin kustannustehokkuuteen.

Läntisen maailman 20 suurinta kaivosyhtiötä tuottavat lähes 40% koko tuotannon arvosta. Suurin suomalainen alan yritys on Outokumpu Oy, joka on maailman 38. suurin ja muodostaa 0,5% alan tuotannon arvosta.

Metallien kulutus maailmanlaajuisesti on nyt heikko (joulukuu 1993), mutta tuotantomäärät ovat lievässä kasvussa. Markkinoilla on jonkin verran ylituotantoa ja varastojen täyttöaste on suuri. Markkinoiden kehittymiseen on viime vuosina erityisesti vaikuttanut Itä-Euroopassa tapahtuneet muutokset. Monet näistä maista ovat muuttuneet nettotuojista nettoviejiksi. Arvioiden mukaan vuosi 1993 oli kuitenkin huippuvuosi itäviennin suhteen ja markkinat tasaantuvat tältä osin lähitulevaisuudessa. Kysyntä Kaukoidän maissa on jatkanut kasvuaan jo pidemmän aikaa ja kehitysmaiden kysynnän merkitys on kasvanut Kiinan nopean talouskasvun mukana.

Merkittävää hintojen nousua ei ole odotettavissa ennen vuosikymmenen loppupuolta ja useimpien metallien markkinoilla on nyt ylitarjontaa. Kaivos-, sulatto- ja jalostustoiminnan arvioidaan siirtyvän enenevässä määrin kehitysmaihin. Samalla metallien tuotannon osuus BKT:stä kuitenkin tyypillisesti pienenee.



# 1 INTRODUCTION

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## 1.1 BACKGROUND

Metals are used in all of the countries in the world and they form a significant part of the whole world economy. Metals are one of the major articles in the world trade too. The term 'metal' consists of metal raw materials, refined pure metals and some metallic semi-products. In absolute terms Finland represents only a small part in the metal production in the world. For the Finnish economy, however, Finnish metal production is important.

This research is a part of 'the Competitive Advantage of Finland' research, the purpose of which is to analyse Finnish industry and competitiveness according to theories presented by Michael Porter. This paper is one of the six partial researches made for the Finnish metal cluster.

The 'diamond model' theory presented by Porter supposes that primarily domestic markets form the basis for the competitiveness of companies in international markets. A hypothesis in this research is that the markets of metals are so global in their nature that the primary base for competition is the international market. The research problem of this study is how the international aspects are related to Porter model. It is essential to understand the importance of the world market compared to domestic. In case of disregarding the possible importance of the international market the importance of domestic phenomena are in danger to be exaggerated.

## 1.2 OBJECTIVES OF THE RESEARCH

The main objective of the research is to give adequate background information concerning the world economy of metals for the basis of the cluster report. This objective is subdivided to two following partial objectives.

First partial objective of the research is to describe and analyse the phenomena in the world economy of metals. The reader should get a picture of subjects concerning the topic and their importance. Another partial objective is to present historical facts and future trends of the world metal market. In addition, a future market forecast is to be presented.

## 1.3 SCOPE OF THE RESEARCH

The research is dealing with a wide topic the parts of which are deeply studied in many researches. The purpose of this research is to draw an overview of the whole topic and not

to go deep in any of the parts. The subject of the research is limited to cover only those metals with interest to Finnish producers: steel, copper, zinc, nickel and aluminium. In some occasions some other metals are also mentioned.

The research presents some statistical data of the markets. The purpose of figures is to clarify and deepen the written text. The time scale used in historical and future analysis is between 1945 and 2005.

## **1.4 METHODS**

The research is primarily a literature study. The written sources are mostly researches but there are also some theoretical books. The secondary source of information is interviews. The six interviewed persons were researchers and managers. Some of the statistical data are based on secondary written sources and interviews. In these occasions, if possible, the primary source is mentioned also.

Theoretical approach is based on the models of Porter. The analysis based on the 'diamond model' -terms is presented in chapter 4. Applying parts of this model in this type of research is not advised by Porter but in this case it can give some additional information. Porter's theory of 'five competitive forces' is applied to metals producing industry in chapter 5.

## 2 METALS IN GENERAL

### 2.1 PRIMARY COMMODITIES, MINERALS AND METALS

Primary commodities consist of

- Agricultural products*
- Minerals*

Minerals are classified in three categories which are

- Metals*
- Industrial minerals*
- Fuels*

Different metals are categorised in the table 1. The list covers all the most common metals. Metals discussed in this research are printed in italic.

*Table 1: Classification of metals<sup>1</sup>*

Ferrous metals		Nonferrous metals	
<b>Iron:</b>	<i>iron ore</i>	<b>Base metals:</b>	<i>copper</i>
<b>Iron alloy:</b>	chromite		lead
	cobalt		<i>nickel</i>
	manganese ore		tin
	molybdenum		<i>zinc</i>
	<i>nickel</i>	<b>Precious</b>	gold
	vanadium	<b>metals:</b>	platinum group
			silver
		<b>Light metals:</b>	<i>aluminium</i>
			magnesium
			titanium
		<b>Rare metals:</b>	beryllium
			rare earths
			rhenium
			uranium

<sup>1</sup>Ala-Härkönen, Martti, 1993, p. 3.

## **2.2 HISTORY OF THE WORLD ECONOMY OF METALS**

### **2.2.1 The Post World War II Growth**

High economic growth of the post World War II era accelerated the demand for metals all around the world. Previously self-sufficient USA became dependent on exports from the third world. In Europe ESCC was formed to support economical integration especially in the field of primary commodities. In many countries like in France and Italy the steel industry was reorganised under state ownership. Development of new technologies also empowered the growth.

New world scale metal industry centers were built in Japan and in the Soviet Union. It was not any more only Europe and USA dominating the world economy. The colonies began to gain independence and the newly independent countries strove for industrialisation. Many of the mines owned by western corporations were nationalised in these countries .

The state of the metal market was positive in the 1950s and 1960s. The Korean war and the high economic growth in the 1960s enforced the demand for metals. However, the economical fluctuations impeded the economic growth of the countries that produced mining products. The discussion concerning free-trade and stabilising the metal market was opened. However, the industrialised countries showed very little interest on this. In addition, the trade arrangements favored the import of raw-materials and semi-products instead of refined products.

The major US and European mining corporations corresponded to the nationalisation by establishing vertical integration in downstream industries. The control over distribution and marketing channels discouraged new entrants to enter the markets.

The question of environmental pollution became an important social and political problem for western countries at the end of the 1960s. The environmental legislature was tightened. It became more competitive to do mining outside the western world.<sup>2</sup>

### **2.2.2 The Depression and Structural Changes after 1974**

The first oil crisis in 1973 turned the world economy into a depression, which went on for the entire 1970s. The prices of the mining products decreased tremendously and the whole industry suffered from inprofitability. New competitors appeared from among the newly industrialized countries (NICs). Western steel industry was strongly reorganised at the end of 1970s. The average company size grew and special interest was called in new production technologies, saving energy and process control.

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<sup>2</sup>Raumolin, Jussi, 1986, pp. 17-27.

The new economic policy adapted by the USA, revaluated dollar and increased interest rates, hindered the profitability of new mining projects. In 1982 the prices of non-ferrous metals fell to the lowest point in three decades. Old ore deposits were not any more profitable and mines were closed all over the western world. The social problems in mining areas caused a lot of trouble for politicians, especially in Europe.

The increasing price of energy weakened the profitability of mining and metal industries. Especially aluminium production – which is extremely energy consuming – moved to a great extent to low energy cost countries. Together with the reorganisation, many mergers, closures and rationalisation were done. Countries dependent on exports of mining products suffered from a deep indebtedness. Countries that had low production costs – like Chile – were able to increase the exports and pay back their debts.

Foreign-owned mines in developing countries were increasingly nationalised. Especially in copper production the big American corporations were displaced. Encouraged by OPEC the metal producing countries tried to establish producers' organisations for metals in 1970. However, their importance has remained small. For example the attempt by Malaysian government to control prices of tin ended up in a bankruptcy.

The attempts of producing countries for national control over natural resources have turned the western countries increasingly back to so called 'security zone', Canada, Australia, etc., rather than developing countries. The political risks are said to be too big in developing countries. On the other hand, many developing countries have restricted foreign investments in mines. Due to many reasons the actual mining industry is moving increasingly outside USA, Europe and Japan – to countries of rich deposits.

Big western corporations are still trying to maintain their smelting capacity even though their role in mining industry itself is decreasing. On the other hand, ore producing countries are increasing their degree of working up. The argument has culminated in the question of location and sizing of the melting capacity in the world. In USA the oil companies have gained control over mining companies. The big enterprises try to secure their raw material supply by making long term agreements with producing countries.<sup>3</sup>

## **2.3 TREATED METALS**

### **2.3.1 Iron and Steel**

The ferrous metals iron and steel account, in tonnage terms, for more than 90% of all metal produced, although as the cheapest of metals they account for much smaller proportion in value terms. Iron ore is found in mineable quantities all over the world but from the late

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<sup>3</sup>Raumolin, Jussi, 1986, pp. 28-35.

1960s onward, as the very rich deposits of Western Australia and the Amazon basin came to be exploited, many mines with less deposits were closed down.<sup>4</sup>

Steel production in the world is located in most countries. Steel is mainly used for car, mechanical and construction industries.

### 2.3.2 Copper

The world production of copper is primarily located in the countries where the copper mines are. Almost 60 countries in the world produce copper.

The production of copper ore increased rapidly after World War II. During 1950 - 1965 the growth rate was approximately 6,5 percent a year. Between 1970 -1988 the growth rate has been significantly lower – only 1,7 percent annually.<sup>5</sup>

Until the mid-1970s, the industry was dominated by perhaps a dozen major fully integrated producers with mines in North and South America and Africa. Many of them were US based and the others were British and African. Nationalisation by the Third World governments and entry by the Third World suppliers in new areas as the Philippines and New Guinea, however, has resulted in an industry that is much more fragmented. The net result is that copper industry has become fairly competitive.

Traditionally, many copper firms were integrated from mining through metal production. Many new world producers, however, are much less integrated. Much of the concentrate is sold to smelters in countries and companies other than that of origin.<sup>6</sup>

### 2.3.3 Zinc, Nickel and Aluminium

The annual increase in demand for zinc was 5,1 percent in the 1960s, rising in the beginning of the 1970s to 7,3 percent. During 1980 - 1988 the increase was only 1,8 percent.<sup>7</sup>

The top ten mining companies control over forty percent of the Western world's zinc mining capacity and worldwide concentration is even higher. Increases in concentration have occurred both through mergers and smelter closings due to an inability to meet environmental standards. The market is a tight oligopoly and the trend in the industry is concentration.<sup>8</sup>

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<sup>4</sup>Metal Bulletin Monthly, April 1993, pp. 88.

<sup>5</sup>Oroza, Gonzalo, 1990, p. 19.

<sup>6</sup>Slade, Margaret, 1988, pp. 55-56.

<sup>7</sup>Oroza, Gonzalo, 1990, p. 22.

<sup>8</sup>Slade, Margaret, 1988, p. 79.

Nickel's greatest value is in alloys with other elements, where it adds strength and corrosion resistance. Stainless steel accounts for just over half of nickel consumption.<sup>9</sup>

Aluminium is the most important non-ferrous metal in terms of the volume of consumption. The container and food-packaging sector is the largest of aluminium's markets. The most common and inexpensive raw material for aluminium production is bauxite.

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<sup>9</sup>Slade, Margaret, 1988, p. 70.

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## 3 MARKET SITUATION

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### 3.1 RESOURCES

In the early seventies there was a lot of discussion concerning sufficiency of ore resources in the world – for example based on the catastrophic future scenarios of the 'Club of Rome'. The economic depression and the new scenario of turning to "non-material growth" have paralysed this conversation during the later years.<sup>10</sup>

Resources consist of all known and unknown deposits that can be exploited at present economic conditions. Resource base, however, means all existing crustal abundance of the earth. Reserves are those quantities of metals that are known and proven to exist and are economically exploitable under given technological conditions. Resources and reserves are quite often mixed in spoken language.

Availability of metals depends on three things: metal reserves, deposit exploitation and technological progress. In any future scenario attention has to be paid to all three. The most important among them is technological progress. In every single case of serious material scarcities in the course of history, it was scientific and technological advantage that provided the solution.

The thing that is mostly concerned in resources is the lifetime of reserves – in other words – their adequacy. This depends on two determinants: the magnitude of reserves and the quantity of requirements. They are both changing dynamically which makes forecasting difficult. Almost every time so far the estimates have turned out to be too pessimistic. Actually, the reserves never finish – the price just increases. In table 2 there are two approaches to foresee the future sufficiency of discussed metals. 'Adequacy' describes the static adequacy of identified reserves assuming that their exploitation remains the same. 'Reserves/demand' is balanced with the foreseeable primary demand to the year 2010, based mainly on historical growth rates projected forward.<sup>11</sup>

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<sup>10</sup>Raumolin, Jussi, 1986, pp. 28-33.

<sup>11</sup>Ray, George, 1991, pp. 1-27.



*Table 2: Reserves and Their Adequacy.*<sup>12,13</sup>

	<b>reserves (milj. tons)</b>	<b>consumption (p.a.)<sup>a</sup></b>	<b>adequacy (years)</b>	<b>reserves/ demand<sup>b</sup></b>
<b>zinc</b>	170	8	21	1,6
<b>copper</b>	525	11	40	1,9
<b>nickel</b>	53	1	57	4,9
<b>iron ore</b>	93000	556	122	8,2
<b>aluminium</b>	21100	18	1000	12

(a) Year 1988.  
(b) Ratio of identified reserve base to foreseeable cumulative primary demand 1989-2010.

In 1970s there was also a strive for mapping and utilising the ore resources of the sea bottom and sea-bed. However, quarrying has not gone further than beginning. At the moment it may sound like science fiction but on a 25-year horizon the mining from the sea-bed may be nearer to reality. If the first pioneering enterprise succeeds, it may be followed by others and seabed mining could become a source of supplies of some importance.<sup>14</sup>

### **3.2 PRODUCTION, CONSUMPTION AND PRICES**

One of the basic features in metal markets is that (mine) production and consumption are usually not in the same country. Production is located in countries with rich deposits, and consumption in countries of high GNP or growth rate of GNP. Due to recycling, consumption of metals is greater than primary production. The following figure pictures the quantity of metal trade between industrialized, developing and socialist countries in the period of 1983-85. However, the former socialist economies are not any more separated from the western economy and the prevailing demand and supply has significantly changed. The changes in East-West trade are discussed more thoroughly in chapter 6.

<sup>12</sup>Oroza, Gonzalo, 1990, p. 5.

<sup>13</sup>Ray, George, 1991, p. 20.

<sup>14</sup>Ray, George, 1991, p. 27.

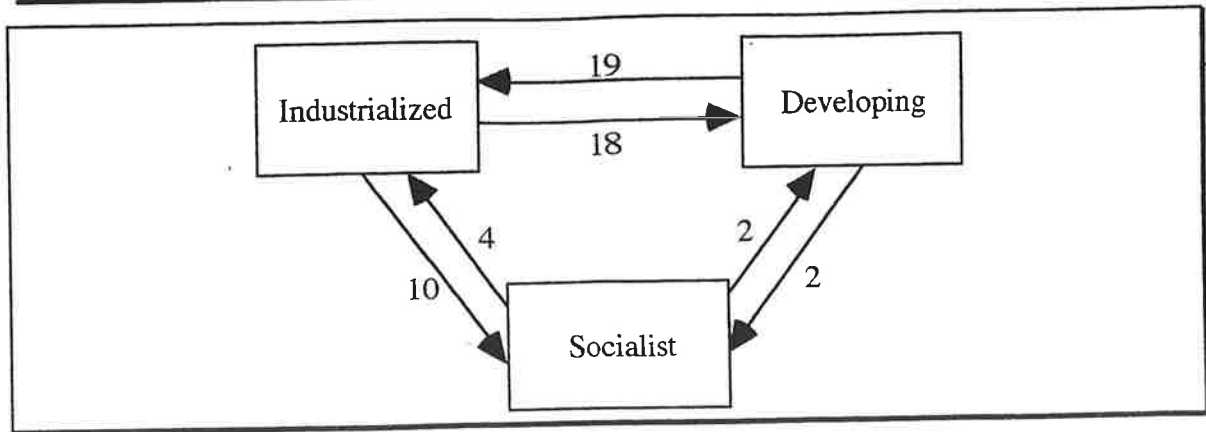


Figure 1: Inter-regional Trade of Metals and Minerals, 1983-85 averages (mrd USD).<sup>15</sup>

The rapid long-run growth in consumption following World War II stalled in the early 1970s for all of the major metals. This abrupt slowdown was unanticipated, and first was assumed to be simply another temporary downturn associated with decline in the business cycle. Later, however, it was realised that there was a long term change happening in the structure of demand. The following figures point out the quantity of structural change in metal industry.

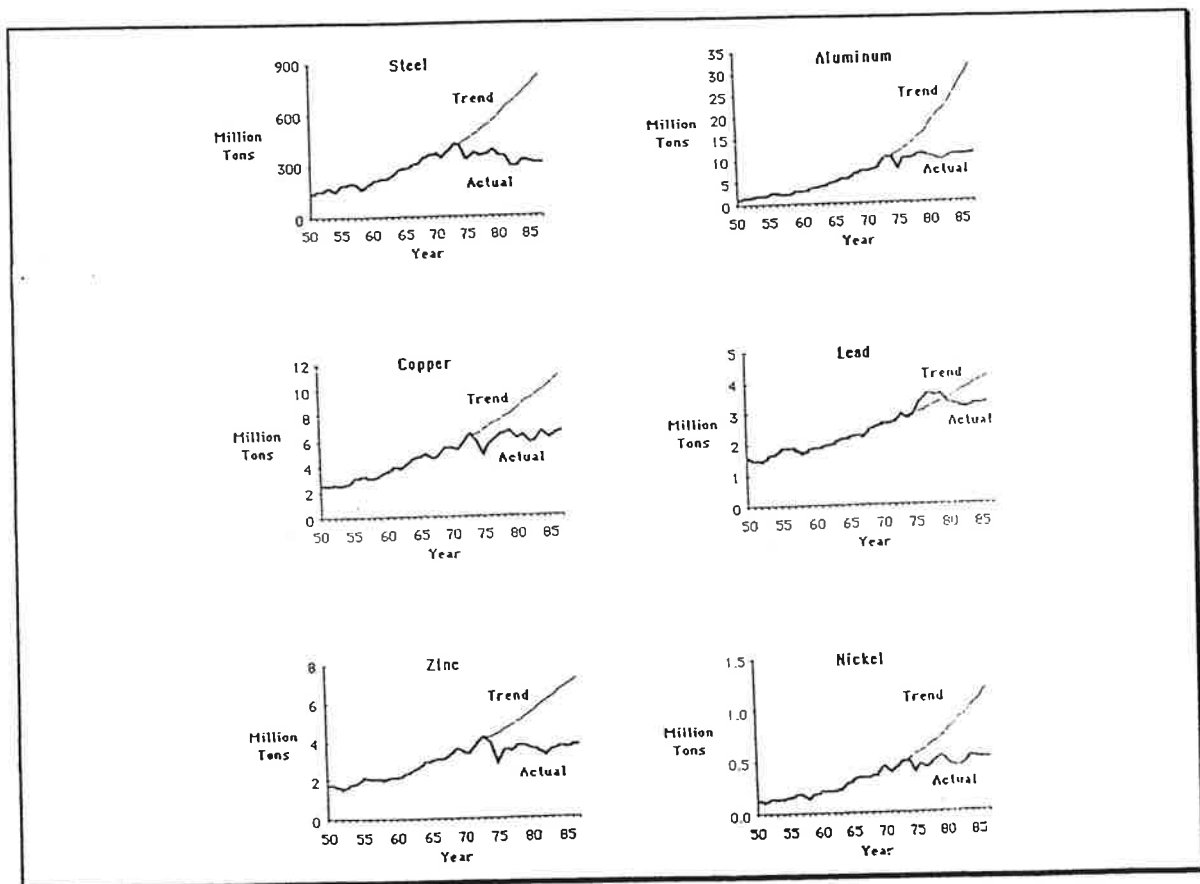


Figure 2: OECD Consumption of Steel, Aluminium, Copper, Lead, Zinc, and Nickel, Actual and Trends.<sup>16</sup>

<sup>15</sup>Radetzki, Marian, 1990, p. 11.

<sup>16</sup>Tilton, John, 1989. at Jackson, Moira & Richardson, Peter (editors), p. 17

The following figure represents the development of metal prices starting from the 1950s. The real price of iron ore has clearly halved in 35 years. The trend in non-ferrous metals prices has been quite steady and the real prices have decreased only slightly. The price variances have followed the economical situation in the western world. The price figures for discussed metals can be found in chapter 6.

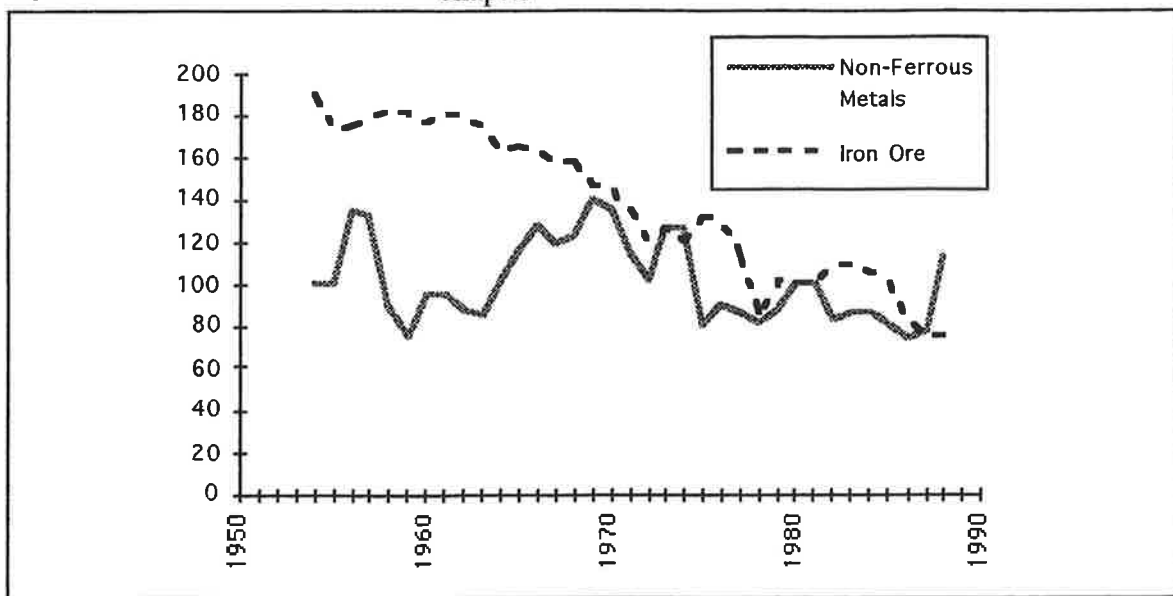


Figure 3: Real Prices of Metal Raw Materials 1953-1988 (Ind. 1980=100)<sup>17</sup>

The following diagrams point out the quantity difference of mine production and consumption between different continents.

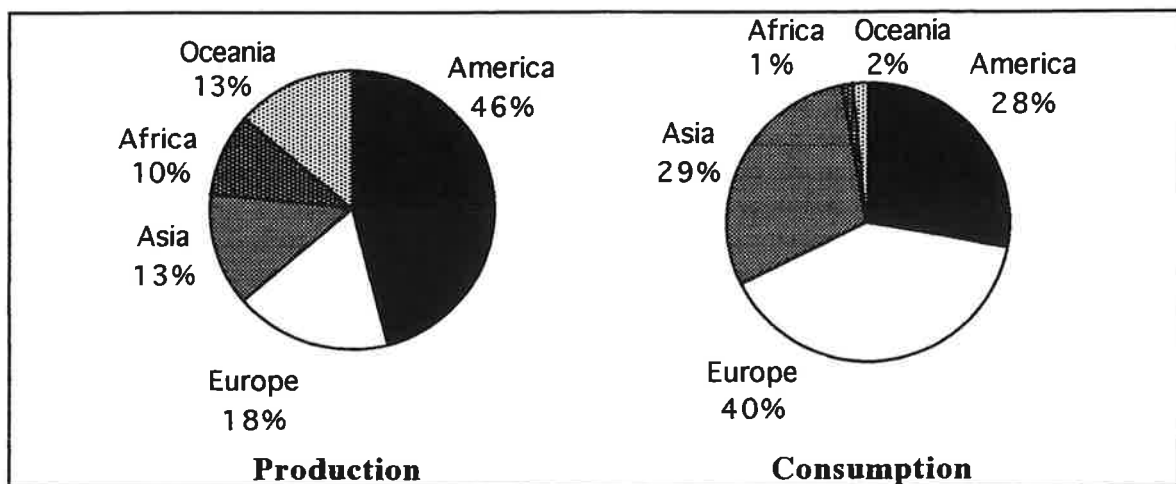


Figure 4: Value of Consumption and Production of Selected Metals (Aluminium, Copper, Zinc) by Continents, 1992.<sup>18</sup>

<sup>17</sup>UN International Trade Price Indexes at Oroza, Gonzalo, 1990, p. 9.

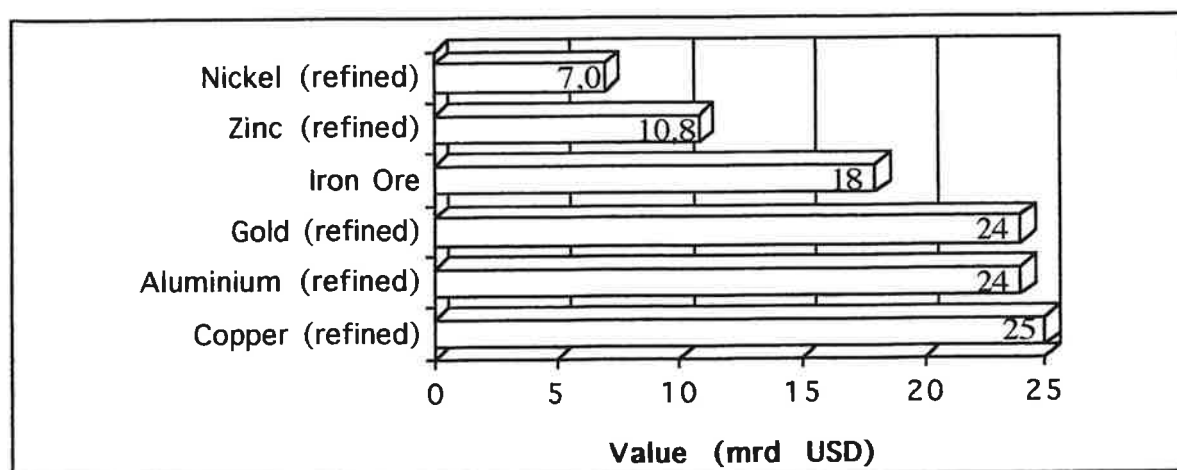
<sup>18</sup>American Bureau of Metal Statistics Inc, Non-Ferrous Metal Data, 1992.

## 4 NATURE OF THE MARKETS

### 4.1 IMPORTANCE OF METALS IN INTERNATIONAL ECONOMY

Steel industry and other primary commodities have traditionally been considered a generating force for industrialisation. In many cases steel has created the basis for a wealthy society. However, the portion of traditional steel industry of GNP is declining in most of the industrialised countries. The reasons for this are: reduction in the intensity of metal use and increase in degree of working up. In other words production and people's needs are more sophisticated than earlier and they can not be fully satisfied with primary and secondary commodities. However, metals are an absolute prerequisite for functioning of other industries.

In the following picture there are the values of annual production of different metals. Value of steel (which is not presented in the picture) is approximately 300 mrd USD.



*Figure 5: Value of Contained Metal Annual Worldwide Production, USD Billiards, Average 1991 Prices and 1990 Production Level.<sup>19</sup>*

In order to maintain industrial production all countries have to secure their metal supplies in normal times and in extraordinary cases such as wartime. This is a problem especially in cases when the production of a certain metal is concentrated in one or few countries. Concentration of iron alloy resources in few countries causes a lot of trouble for western strategists. South-Africa and Russia, for example, are major resources for many strategic rare metals. The world economy of metals is still tightly bound to security needs of the superpowers.<sup>20</sup>

<sup>19</sup>Ala-Härkönen, Martti, 1993, p. 5.

<sup>20</sup>Raumolin, Jussi, 1986, p. 35.

## 4.2 SOME FEATURES

### 4.2.1 Business Cycles

Perhaps the most important feature in the nature of the metal markets are the business cycles of the markets. There used to be a clear cycle for metal demand and prices. Nowadays the cycle is more or less following the economic situation within the producer countries. An estimation of the delay between the status of the world metal industry and metal producing industry is two years.<sup>21</sup>

### 4.2.2 Secondary Material (Scrap) and Recycling

Scrap consist of new scrap, which is produced during fabrication, and old scrap, which consists of old metal products. The quantity of recycled metal varies somewhat, influenced by the current price of primary metal. Scrap recovery yielded, in the past 20-25 years, quantities equivalent to significant shares of the consumption in the western world: 50% of copper, 33% of zinc and steel, 25% of aluminium. Popularity of recycling is increasing nowadays.<sup>22</sup>

### 4.2.3 Restrictions of Trade

The common restrictions of international trade are:<sup>23</sup>

- *import tariffs*
- *variable import levy*
- *import quotas*
- *import licenses*
- *voluntary export restraints*
- *national standards*
- *subsidies*
- *tax concessions*
- *public procurement*

All countries have some kind of restrictions for metal trade. For example USA does not buy nickel from Cuba. The normal method, however, is to use import tariffs. Tariff percentages vary a lot depending on the country, metal and level of refining. The smallest tariffs are with common raw material like bauxite and the biggest with highly refined metals like copper semi-products.<sup>24</sup>

The GATT negotiations dealing with commodity tariffs in the world trade dealt with metal tariffs also. The GATT agreement made in December, 1993, however, did not change metal

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<sup>21</sup>Oroza, Gonzalo, 24.11.1993.

<sup>22</sup>Ray, George, 1991, pp. 8.

<sup>23</sup>Radetzki, Marian, 1990, pp. 22-23.

<sup>24</sup>Oroza, Gonzalo, 24.11.1993.

tariffs. Metal tariff negotiations are made further in a different body called MSA. It is possible that all the tariffs in metal trade will be removed in the future<sup>25</sup>.

## 4.3 METAL PRICES

The price formation in steel and base metals is basically the same. Unlike base metals the price of steel, however, is not quoted in an exchange. This is probably due to multiple different qualities of steel.

### 4.3.1 General Theory

Price formation in a short term is based on supply and demand factors. According to the economic theory the price will increase if demand exceeds supply and vice versa.

In some occasions, however, there are monopolistic features in the metal markets. Nowadays the imbalance is rarely permanent but in the history the prices used to be fixed by producers and merchants. In general there are three possible ways of price formation: commodity exchanges, producer dictated prices and transfer prices. Many metals are found combined in deposits. The result is that production numbers of certain metals vary together. For example copper/nickel, lead/zinc, and gold/copper are quite commonly found in same deposits. This creates imbalance, too.

Each metal has unique price path. Certain tendencies, however, emerge from the diverse behavior patterns. The most important factors that affect long-run trends in metal prices are:<sup>26</sup>

- *growth of metal demand*
- *changes in mining and metallurgical techniques*
- *discovery of new deposits*
- *depletion of high-grade orebodies*

In the long run the price will tend to settle at a level that will cover the cost of capital, including profits, in those new production facilities that will be needed to replace worn-out installations, or to expand capacity in line with the trend growth of demand. However, subsidies and taxes also affect the long-term prices.<sup>27</sup>

According to the theory, supply tends to increase if the price increases. This is due to sudden potential profitability of poor closed deposits and they will be opened. In practice,

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<sup>25</sup>Oroza, Gonzalo, 24.11.1993.

<sup>26</sup>Slade, Margaret, 1988, p. 4.

<sup>27</sup>Radetzki, Marian, 1990, p. 43.

however, these mines are quite often already functioning even though they are under the break-even point. This causes overproduction which tends to decrease the prices.

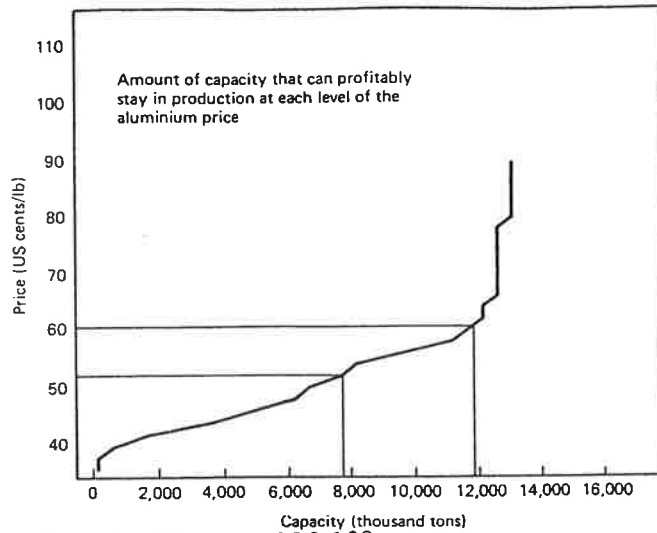


Figure 6: Aluminium Supply Curve, 1986.<sup>28</sup>

The reason for overproduction is the fear of closing the production: avoiding switching costs, losing investments, political reasons and fear of social problems, to mention few of them. In other words: the exit barriers are high.

Another feature in metal markets (and other commodity markets, too) is the instability of prices. There are many reasons for fluctuations, for example:

- *inflation*
- *aggregations*
- *hog cycle*
- *price elasticity*
- *strikes*
- *political disturbances*
- *business cycles*
- *inventory fluctuations*
- *technological shifts*
- *ratchet effect*

The price instability is critical for metal users. In order to price their own products they have to know the price of their raw material in advance. Hence, the metal exchanges – like the London Metal Exchange – offer price dealing instruments. Metal exchanges and these instruments are discussed in the following two chapters.<sup>29</sup>

<sup>28</sup>Radetzki, Marian, 1990, p. 44.

<sup>29</sup>Radetzki, Marian, 1990, pp. 40-59.

### 4.3.2 Metal Exchanges

There are two major commodity exchanges for metals in the world. The less important of them is COMEX which is the largest metal exchange in the USA. It is located in New York. The four goods they are hedging are copper, aluminium, gold and silver. However, only copper trade has some significant importance compared the London Metal Exchange. Traditionally there has been a high degree of speculative participation in COMEX.

The London Metal Exchange was established in 1877. It is the major metal exchange in the world. The LME acts now as a barometer of supply and demand for metals world wide and its official prices are used by producers and consumers for their long-term contracts. The LME is hedging the following metals: copper, aluminium, lead, zinc, nickel, tin and silver.

The services given by the LME and COMEX are in table 3:

**Table 3: The Functions of Commodity Exchanges.**<sup>30,31</sup>

- 1. Daily Prices. To constitute authoritative mechanism for price determination.**
- 2. Hedging. To provide an opportunity for hedging through which producers and users of a commodity can obtain a kind of price insurance.**
- 3. Commodity investments. To greatly facilitate both very safe and highly speculative investments in commodity inventories and commodity-related trade instruments.**
- 4. Delivery. To establish a physical trade outlet through spot transactions and through futures contracts at their termination.**

By registering daily price quotations, metal exchanges reflect changes both in the supply of and demand for metals worldwide. These prices are used as the basis of most of the contracts in the metal trade. Exchange prices can be used the way they are or, as quite often, prices can be relative to the official settlement price. For example, the price of copper ore is usually related to the LME official settlement price of 'Grade A - Electrolytic Copper'.

A dominant proportion of commodity exchange trade on the exchanges is in "pure paper" with no physical products changing hands. Although the exchanges do provide a facility for physical trade, most such trade is in fact transacted elsewhere. Nevertheless, the exchanges do offer a convenient facility for the buyer or seller without standing trading connections.

<sup>30</sup>Radetzki, Marian, 1990, p. 77.

<sup>31</sup>Booklet of the London Metal Exchange Limited.



Exchanges have their own warehouses that are ready to absorb and release the metal on a 'spot basis', at the going prices.

It is important to notice that metal exchanges are not hedging all the common metals. They disregard many significant ones, for example hedging of iron and steel is not included in their services. Hedging of the following, if less important, metals is disregarded, too: magnesium, chromite, cobalt, manganese, molybdenum and vanadium. For these metals the above mentioned exchange services of metals are not available. Based on mutual agreements and markets, the price settlement for these metals is unambiguous too.<sup>32,33</sup>

#### **4.3.3 Hedging and Speculation**

Unnecessary risk taking (speculation) is not a part of industrial business, especially in the markets where experience is limited. Avoiding risk of price fluctuation is called hedging and instruments used for hedging are provided by commodity exchanges. Most of the business in commodity exchanges is actually hedging. If a company is carrying a price risk that it could be prevented by hedging it is speculating. The two types of customers in exchanges are hedgers and speculators.

Hedging is done by metal buyers and sellers. All companies that produce ore or metals hedge too. However, only some of the companies purchasing metals are involved in hedging. These companies are usually middle sized and big companies that want to prevent effects of price fluctuations in their business. The advantages for a company if they do hedging, are:<sup>34</sup>

- *Eliminating possible losses*
- *Improving purchases and sales*
- *Minimising inventory*
- *Lesser investments*
- *Accuracy in budgeting*
- *Readiness for immediate sales*
- *Better financial situation*
- *Improvement in information collection*

A futures contract is an agreement to buy or to sell a specified quantity of a metal (commodity) for the agreed price at a particular future time. A normal period of a futures contract is three months in the LME. A futures agreement has to be fulfilled, unless it is sold forward for a third party. Actually, only 5% of all futures agreements end in a purchase – the rest 95% is hedging and speculating.

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<sup>32</sup>Radetzki, Marian, 1990, pp. 71-90.

<sup>33</sup>Kranck, Gustaf, 1989, pp. 37-40.

<sup>34</sup>Kranck, Gustaf, 1989, pp. 15-20.

Another instrument for hedging is called option. Options are also used for heading but they function in a different way. The use of options is far more rare than futures agreements. A deeper analysis of trading instruments, however, is beyond the scope of this research.<sup>35</sup>

#### 4.3.4 Producer Cartels and Trade Associations

A successful cartel is hard to create and maintain. The purpose of a cartel is to maximise profits for all participants by decreasing the production or increasing the prices. Encouraged by the success of oil production cartel, OPEC, in the 1970s some metal producers have wanted to establish cartels in metals trade.

In metal markets there are four examples of cartels in history: bauxite, phosphate, uranium and tin. Bauxite producing countries founded the International Bauxite Association (IBA) in 1974. They produced 85% of world bauxite and they were led by Jamaica. They were able to double the price of bauxite in a few years. The weak development of aluminium demand after the second oil price rise added to the cartel members' problems eroded the cartel. As a result of that period, some new aggressive bauxite producing countries gained share of the market.<sup>36</sup>

The new form of co-operation between metal producers are trade associations. They are legal entities which enable competitors to legally and collectively accomplish a purpose which is for the general good of the industry. The general difference to cartels is that trade associations do not use restrictive methods in trade. Their purpose is to support their member companies by improving information flow, contacting governments, forecasting the markets, etc. The most well known of them is the International Iron and Steel Institute (IISI)<sup>37,38</sup>

## 4.4 FACTORS OF LOCATION, PRODUCTION AND DEMAND

Location of mining industry in the world is based on the location of the ore deposits. Location of refining industry, however, is a bit more complicated; it depends not only on the ore availability and price, but also on infrastructure, interest rates, loan availability, labor, and other factors of production. A good example is aluminium refining industry which is located in countries of low energy prices.<sup>39</sup>

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<sup>35</sup>Kranck, Gustaf, 1989.

<sup>36</sup>Radetzki, Marian, 1990, pp. 107-128.

<sup>37</sup>Smolsky, Sirpa, 18.11.1993.

<sup>38</sup>Dresher, William, at Jackson, Moira & Richardson, Peter (editors), pp. 58-60.

<sup>39</sup>Radetzki, Marian, 1990, pp. 8-16.

The natural customer base for the metal producing industry is the metal industry, the parts of which are: metals products, machinery, transportation and electronic industry.<sup>40</sup> The relations between producers and customers are handled in two ways. First of all buyers and sellers are in contact via metal exchanges. Second, and the more important way, is direct interaction primarily through purchases but also through joint development and other sophisticated forms of co-operation.

The quality standards for metals are very simple but absolute. However, for some special products, like stainless steel and copper semi-products, the chances for product differentiation are much bigger. In these cases, the role of normal standards of the processing industry is essential. Standards in general are not considered very critical in metal production industry.

The main uses and factors of production are presented in the table 4.

**Table 4: Main Usage and Factors of Production (Refining) for Some Metals.**<sup>41</sup>

<b>Metal</b>	<b>Main Usage</b>	<b>Main Factors of Production</b>
Aluminium	Construction Cars Electronics	Energy
Copper	Electronics Construction	Concentration of ore deposit Mine + Smelter
Lead	Accumulators (Gasoline)	Concentration of ore deposit
Nickel	Stainless steel Transportation equipment	Only few deposits in the world Mine + Smelter
Steel	Transportation equipment Machinery Construction	Technology Know-how Access to cheap alloys
Tin	Groceries Soft drinks	Concentration of ore deposit
Zinc	Transportation equipment Construction	Concentration of ore deposit

An interesting new factor affecting the production of and demand for metals is environmental protection. Metal producing industry is one of the major polluters in the world, for example in the case of carbon dioxide. International and national treaties enforce

<sup>40</sup>Metalliteollisuus 1993, p.33.

<sup>41</sup>Oroza, Gonzalo, 24.11.1993.

metal producers to spend a lot of money in environmental protection in their plants. Hence, the companies are willing to move to countries of less regulations and control. Availability of protection technology may also affect the choosing of location. Environmental aspects have not affected the marketing of metals so far. Analogous to pulp and paper industry it is possible that the customers in the future will demand 'environmental features' in production of metals too.

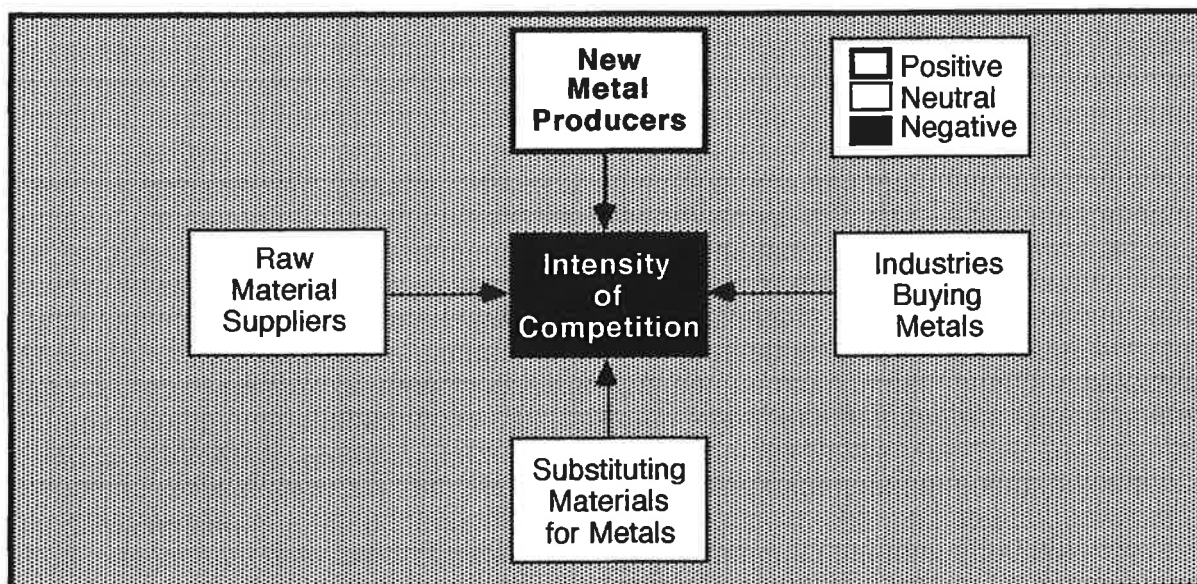
## 5 COMPETITION

### 5.1 COMPETITIVE RIVALRY IN REFINING

This chapter analyses the competition within the steel and base metals refining industries. The theory of competitive rivalry used here is by Michael Porter<sup>42</sup>. The theory describes competitive situation of a company within the framework of: raw material suppliers, end-product buyers, new entrants, substitutes, and companies in the same industry. The idea of the theory is to analyse these aspects in order to realise their importance for the discussed company.

Here we analyse the competition within refining industry of metals. It covers the trade of both raw materials and refined metals. It is good to notice at this point that competition with price is almost impossible because the price level is basically the same everywhere.

In the following figure the black box represents more rivalry for refining industry and white box printed in bold represents less rivalry for refining industry. The outlooks are based on the sum of different opinions absorbed during interviews. Effects of prevailing economical depression are disregarded as much as possible so that the analysis could represent the long term situation.



*Figure 7: Competitive Rivalry within Steel and Base Metals Industries.*

The entry barriers to metal refining industry are high. This is mostly due to high capital requirements and economics of scale that occur in a processing industries like this. Product

<sup>42</sup>Porter, Michael, 1979.

differentiation is also generally impossible because products are mostly bulk. However, in steel and copper semi-products there are even significant product differentiation and some differentiation can also occur in transport and customer service. There are some cost advantages independent of size too, like technological know-how. Distribution channels are usually direct and new access to distribution channels may sometimes turn out to be complicated due to old producer-customer relations. Government policy towards new steel mills may be quite negative due to international overproduction.

The threat of substitutes is somewhat tolerable. Steel, base metals and aluminium are relatively more and more substituted with plastic and other materials. Copper in telecommunications is quite often replaced by optical fiber. The quantity of substitution is, however, rather small and it will probably not harm the growth of metal consumption.

Supplier (raw material producer) power is basically small in iron, copper, zinc and nickel ores and bauxite. There are many producers in the world and ore is not differentiable in any way. Suppliers have, at least, the 'power' to sell their product in the world market price.

Buyer power in discussed metals is somewhat small. The lot sizes are not big, the sold metal is rather standard, metals are (usually) unimportant to the quality of the buyers' products, metal does not save buyers money but the cost of metal may cause a significant fraction of buyers costs. In stainless steel some of these assumptions are not correct and there can be some more buyer power.

The rivalry within the producers is hard. There are many competitors almost equal to size. The industry is mature and the growth rates are typically less than 5%. The exit barriers as well as the entry barriers are high. Capacity increases causing price instability. The industry described here is capital intensive process industry, that produces mostly bulk products. The most important factor is cost efficiency and differentiation is hardly possible.<sup>43</sup>

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<sup>43</sup>Erling, Tapani. 30.11.1993.

## 5.2 MAJOR CORPORATIONS IN MINING

*Table 5: Western World's 20 Largest Mining Companies Ranked by Approximate Share of Total Value of Western World Mine Production of All Non-Fuel Minerals.<sup>44</sup>*

	Name of the Company	Home Country	%	% cum.
1	Anglo American Corporation of South Africa Limited	South Africa	8,5	8,5
3	Codelco-Chile (State of Chile)	Chile	2,9	15,6
4	State of Brazil (mainly CVRD)	Brazil	2,6	18,2
5	Noranda Inc.	Canada	1,8	20,0
6	Inco Ltd.	Canada	1,8	21,8
7	Broken Hill Pty Co. Ltd.	Australia	1,5	23,3
8	State of Zaire (mainly Gecamines)	Zaire	1,5	24,8
9	Phelps Dodge Corporation	USA	1,4	26,2
10	Hanson PLC	UK	1,4	27,6
11	Gencor Ltd.	South Africa	1,3	29,0
12	Asarco Inc.	USA	1,3	30,3
13	Western Mininig Corp. Holdings	Australia	1,2	31,5
14	Holdings Ltd.	Australia	1,2	32,7
15	Placer Dome Inc.	Canada	1,0	33,7
16	State of Morocco (OCP and BRPM)	Morocco	1,0	34,7
17	Trelleborg	Sweden	1,0	35,7
18	State of Malaysia (mainly Malaysia Mining)	Malaysia	1,0	36,7
19	Cyprus Minerals Co.	USA	0,9	37,6
20	Freeport McMoran Co	USA	0,8	38,5
<b>38</b>	<b>Outokumpu Oy</b>	<b>Finland</b>	<b>0,5</b>	

<sup>44</sup>Who Owns Who In Mining 1992 by the Raw Materials Group, 1992, p. 13, at Ala-Härkönen, Martti, 1993.

## 6 TRENDS AND PROSPECTS

### 6.1 SHORT-TERM PROSPECTS

The economic situation in the world has changed tremendously since the boom of the end of the 1980s. Having faced a serious depression the economy is now in a very slow recovery. The growth of industrial production in OECD countries in 1993 was 1-2%. The prices of metals in 1994 are estimated to be low. This is a result of weak consumption and firm growth of production of metals. Hence, there is over supply and the metals stocks are high.<sup>45</sup> (see appendix)

The metal markets are influenced in particular by changes taking place in the Eastern European countries. Many Eastern countries have changed from net importers to net exporters. It is generally expected that in most cases 1993 would be the peak export year and the effect of Eastern countries on the metal markets is expected to diminish at least in a couple of years.

The demand from the developing countries in the Far East has continued to expand already for quite a long time. The importance of the demand from developing countries is reinforced by the high economic growth in China.<sup>46</sup>

*Table 6: Demand, Supply and Price Growth Percentages in 1993 and 1994.*<sup>47,48,49</sup>

	Demand 1993	Demand 1994	Supply 1993	Supply 1994	Price 1993	Price 1994
<b>Steel</b>	-0,5	1	-1	1,5	9	5
<b>Copper</b>	neg.	2-3	<1	<3,0	-13	-6
<b>Zinc</b>	neg.	2	neg.	neg.	-23	3
<b>Nickel</b>	2,5	3	neg.	pos.	-24	-1
<b>Aluminium</b>	1-2	3	1	0	-8	14

<sup>45</sup>Cook, Michael, 1993.

<sup>46</sup>ETLA, 1993, p. 9.

<sup>47</sup>Cook, Michael, 1993.

<sup>48</sup>IISI, 1993.

<sup>49</sup>AIECE, 1993.



## 6.2 FORECASTS TO 2005

Metal prices are expected to fall even further in real terms from the 1991 record low. No significant increase is foreseen until the latter half of this decade. Recent developments in Eastern Europe, and particularly in CIS, have increased the uncertainty in the outlook for most commodities. Because of their reductions in consumption they will increase their metals exports.

Most metals markets are now in surplus and prices should increase over the next few years as balance is restored. Mining, smelting, and refining are expected to continue shifting towards the developing countries. The metal intensity of GNP in western countries tends to decrease through the period.<sup>50</sup>

### 6.2.1 Steel

Steel consumption in high-income countries has declined in the early 1990's because of the economic slowdown in the world. Full recovery is not expected until the mid-1990s. The average annual growth rate for the 1991-2005 period is forecast at only 0,7%.

Steel consumption in the low and middle income countries (LMIC) fell 8% in the past two years, mainly because of the sharp decline in the Eastern European countries and the CIS. LMIC growth of steel consumption over the 1991-2005 period is projected at 2,1% p.a..

The steel industry worldwide has entered an era of restructuring. The total capacity in high-income countries declined by 120 million tons during the 1980-91 period and a further 20 million tons reduction is expected before the year 2000. In contrast, steel producing capacity increased by 110 million tons in LMICs during this period, and a further 30 million tons increase is expected by 2000.

The average growth rate of steel production in high-income countries is projected to be 0,7% p.a. over the 1991-2005 period, identical to the consumption growth of this group. For LMICs, steel production should grow at a much faster pace (2% p.a.). The traditional net-trade pattern in steel is expected to hold where by high-income countries are basically net exporters and LMICs are net importers.

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<sup>50</sup>World Bank, 1993, p. 1.

Steel price index in real terms is expected to decline in 1992 and to hold relatively constant till 2005, with slight upswings in the mid-1990s and around the year 2000.<sup>51</sup>

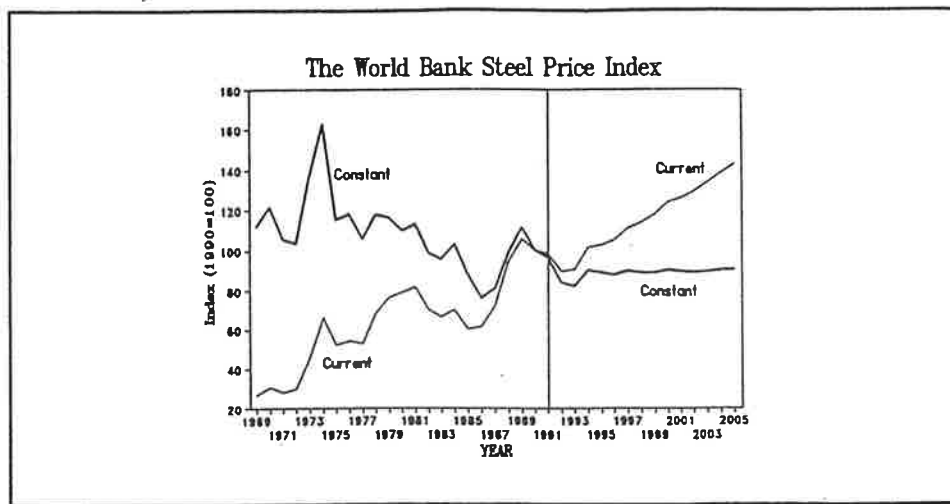


Figure 8: Steel Prices Forecast 1969-2005.

### 6.2.2 Copper

Among base metals, copper has continued to enjoy relatively high prices over the several years, supported by a series of supply disruptions at a time of sustained and substantial growth. Copper prices rarely fell below \$1/lb over the 1988-92 period and lately rose to \$1,1/lb on fears of supply disruptions and a demand surge.

Over the period to 1996, the market balance is expected to turn to a moderate surplus as supplies increase. Prices are likely to decline. The constraints of smelter capacity should continue to be binding through early 1995, limiting the size of the surplus, which in any case is likely to be fragile and easily wiped out if industrial economies recover strongly.

If historical pattern of the investment cycle is repeated, copper prices are likely to trend upwards in the latter part of the 1990s, followed by declines over 2000-2005 period. Long term copper prices are forecast to be roughly at a level sufficient to create new projects currently envisaged for the 1990s and beyond.

World consumption of refined copper is forecast to be relatively robust with an average growth rate of 2% p.a. over 1991-2005. As before, industrialising countries are expected to be the main growth market for copper. The copper intensity of industrial production in industrial countries should decline at a slower rate than over the past two decades owing to lower energy prices and faster expansion of capital goods sector. Demand in the CIS and Eastern Europe is expected to remain depressed in the near term but it should grow quickly

<sup>51</sup>World Bank, 1993, p. 140.

from the mid-1990s as these economies require huge investments in infrastructure and equipment.

A tally of announced projects indicates that over the 1992-1995 period, world mine and refined copper capacities will expand by as much as one million tons each. Most of these increases will take place in Latin America, North America, and Asia. For the 1995-2005 period, probable and potential new projects amounting to 2,3 million tons of copper are envisaged, mostly in developing countries whose investment climate should improve as they move away from state monopoly of mineral resource exploitation.<sup>52</sup>

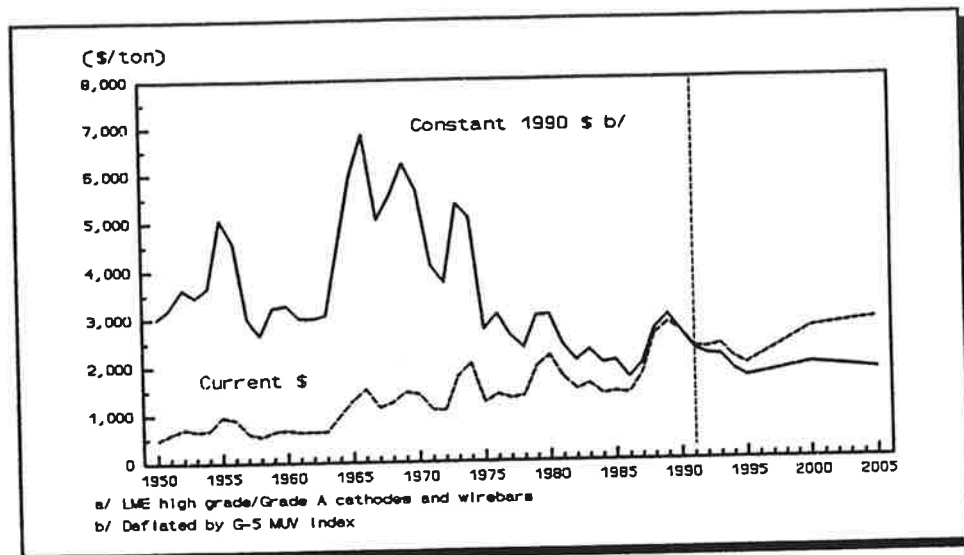


Figure 9: Copper Price Forecast 1950-2005.

<sup>52</sup>World Bank, 1993, pp. 56-57.

### 6.2.3 Zinc

Zinc prices in the early 1990's have been affected by speculative activities. The short-term outlook of zinc is flat.

Demand growth is likely to be constrained by the sluggish US economic recovery and recessions in Japan and Germany. Prices, however, are not likely to decline much from the current low levels.

Over the longer term, the price forecasts are set at approximately the expected total production costs of new projects likely to come on-stream in the 1990s.<sup>53</sup>

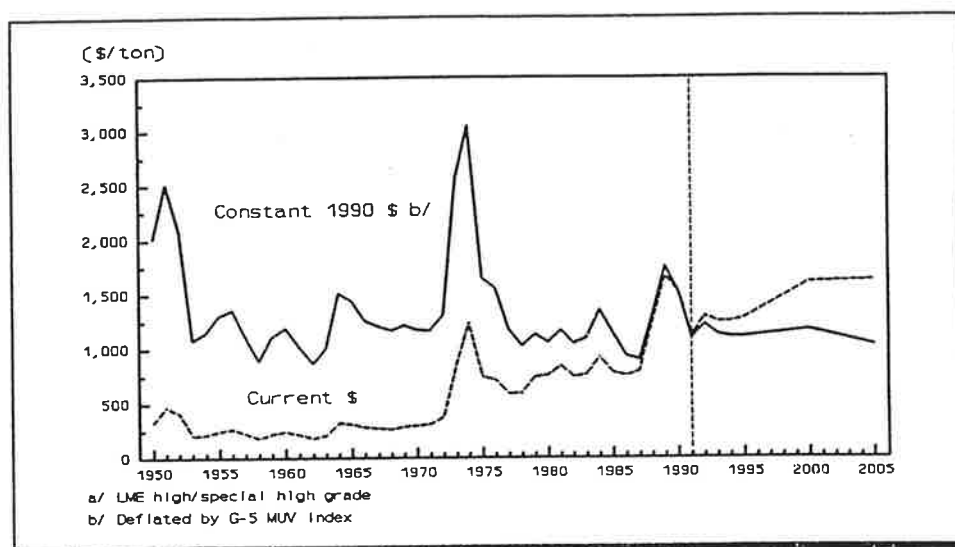


Figure 10: Zinc Price Forecast 1950-2005.

### 6.2.4 Nickel

The outlook for nickel can be described as fundamentally optimistic compared with other base metals because of the demand for its indispensable properties in products such as stainless steel.

Nickel production capacity worldwide is expected to increase by at least 100 000 tons over the next five years. The major expansions are in Australia, Brazil, China, Cuba, and Colombia. Such capacity expansion would allow a 2,1% p.a. production growth over this period.

<sup>53</sup>World Bank, 1993, p. 155.

The nickel price is expected to rise in constant terms during the 1996-2000 period (by 2% p.a.). The forecast to 2000-2005 period for nickel price is for it to be essentially flat in constant terms.<sup>54</sup>

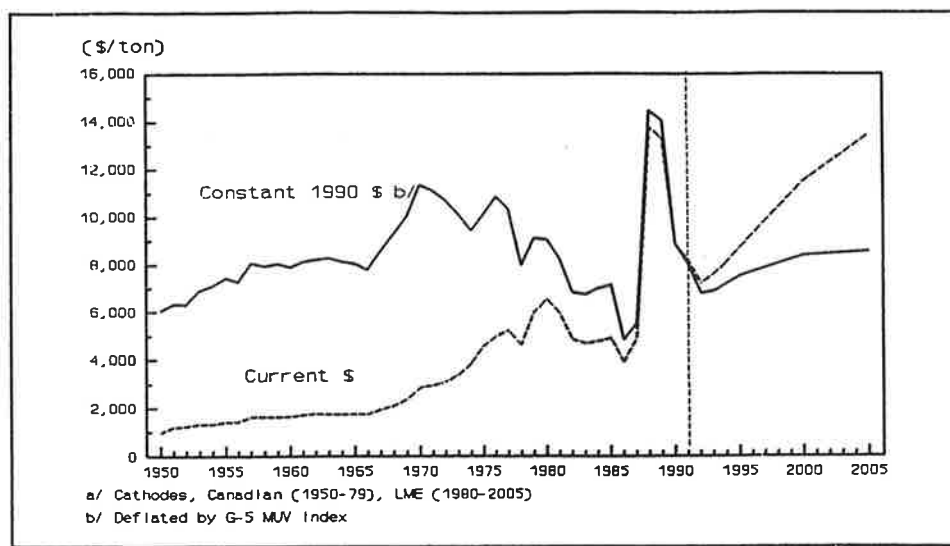


Figure 11: Nickel Price Forecast 1950-2005.

### 6.2.5 Aluminium

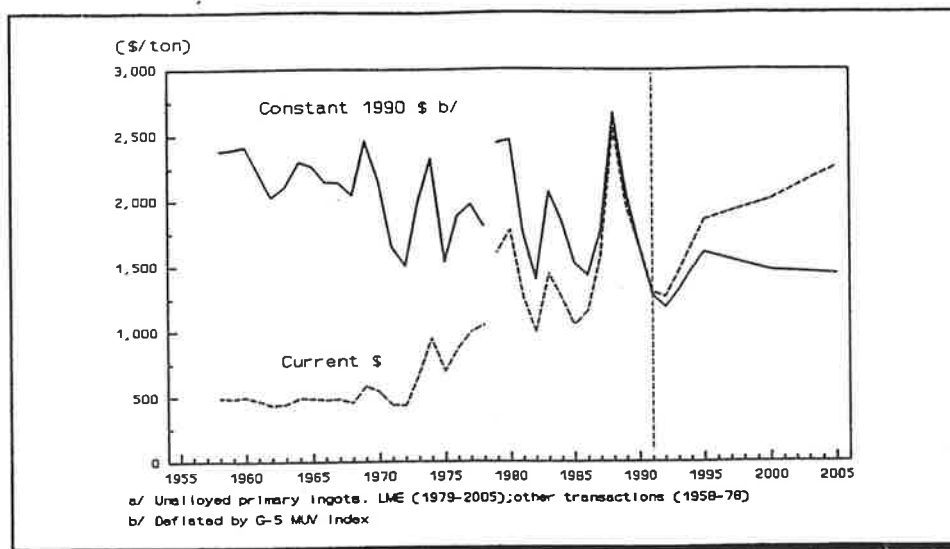
Aluminium consumption growth has slowed over the past three decades from an annual growth rate of 9,1% to the 1960s, to 4,8% in the 1970s, and to mere 1,6% in the 1980s. However, in the period 1992 to 2005, world consumption is expected to increase at a slightly faster annual rate of 2,2%. The share of low and middle income countries is rising from 31% in 1991 to 36% in 2005.

Aluminium prices and consumption growth are expected to remain relatively low (by historical standards) in the 1992-2005 period. Thereby the growth of aluminium smelting capacity should be slow. Most investments in new smelting capacity are likely to take place in Australia, Canada, the Middle East, South America, and southern Africa where both bauxite and low-cost energy are available.

Prices of aluminium and bauxite are expected to increase in 1994, as the market balance adjusts from the gross surplus. Then there is a peak around 1995 at relatively low real prices. The greatest source of uncertainty regarding the course of aluminium prices in the medium term is the level of the CIS exports to international markets. This will depend on the pace of the domestic demand recovery and the renovation of antiquated smelting facilities. Over the long term (2000-2005), aluminium prices are projected at levels that

<sup>54</sup>World Bank, 1993, p. 88.

cover the costs of production of new capacities, estimated at about \$1400/ton in constant 1990 dollars.<sup>55</sup>



*Figure 12: Aluminium Price Forecast 1950-2005.*

<sup>55</sup>World Bank, 1993, p. 99.

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## 7 SUMMARY

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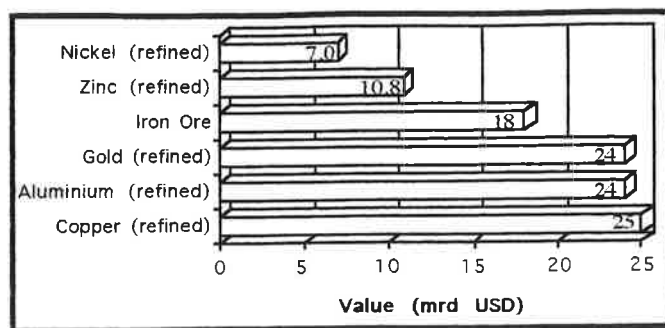
A basic hypothesis in this research is that the markets of metals are global in their nature. The objectives of the research are to describe and analyse the phenomena in the world economy of metals and to present facts and trends of the world metal market. The research is dealing with steel, copper, zinc, nickel and aluminium. The research is primarily a literature study. The secondary source of information are interviews.

High economic growth of the post World War II era accelerated the demand for metals all around the world. In many countries like France and Italy the steel industry was reorganised under state ownership. In developing countries many of the mines owned by western corporations were nationalised. The trade arrangements favored the import of raw-materials and semi-products in stead of refined products. The question of environmental pollution become an important social and political problem for western countries at the end of the 1960s

The so called oil crisis in 1973 caused the decrease of prices of mining products and the whole industry suffered from unprofitability. Since then there has been a structural change in the metal industry and new competitors have started to appear from among the NICs. In 1982 the prices of non-ferrous metals fell into the lowest point in three decades. Due to many reasons, the actual mining industry is moving increasingly outside USA, Europe and Japan. Big western corporations are still trying to maintain their smelting capacity even though their role in mining industry itself is decreasing.

In the early seventies there was a lot of discussion concerning the sufficiency of ore resources in the world based on the catastrophic future scenarios of the 'Club of Rome'. Almost every time so far the estimates have turned out to be too pessimistic. Actually, the reserves never finish – the price just increases. Availability of metals is dependent on three things: metal reserves, deposit exploitation and technological progress. New ore resources will perhaps be exploited from sea bottom and sea-bed.

Metal production, in general, is located in countries with rich deposits and consumption in countries of high GNP or growth rate of GNP. Consumption of metals exceeds primary production due to recycling. The share of scrap in metal production is: 50% of copper, 33% zinc and steel, 25% of aluminium. The price of iron ore has decreased to half in 35 years. The trend in non-ferrous metals prices has been steady and the real prices have remained quite the same. The price variances have followed the economic situation in the western world.



*Figure 13: Value of Contained Metal Annual Worldwide Production.*

The portion of traditional metal producing industry in GNP has been declining. However, metals are still an absolute prerequisite for functioning of other industries. Due to supply security reasons, the world economy of metals is still tightly bound to the security needs of the superpowers. The business cycle in metal production follows more or less the economic situation within producer countries.

Export tariffs are low for common raw materials like bauxite and higher for highly refined metal like copper semi-product. It is possible that all the tariffs in metal trade will be removed in the future if negotiations succeed in MSA.

The factors that affect long-run trends in metal prices are the growth of metal demand, changes in mining and metallurgical techniques, discovery of new deposits and depletion of high-grade orebodies. In the long run the prices will tend to settle at a level that will cover the cost of capital. Quite many mines function under their break-even point because the exit barriers are high.

London Metal Exchange and COMEX provide daily prices, hedging, commodity investments and delivery. Their prices are used as the basis of most of the contracts in the metal trade. They do not hedge all metals, for example steel. The purpose of hedging is to avoid risk in metal trade and purpose of speculation is to earn money by taking risk. The trade is mostly done by futures contracts that are agreements to buy or to sell a specified quantity of a metal for the agreed price at a particular future time.

During the last 20 years of metal production there has been two producer cartels – tin and bauxite, both not successful. Trade associations are nowadays the form of producer co-operation. The best known of them is the International Iron and Steel Institute (IISI).

Location of mining industry in the world is based on the location of ore deposits. The natural customer base for the metal producing industry is the metal industry. An interesting new factor of production, location and demand is environmental protection. In the future companies may be willing to move to countries of less regulations and control. Analogous



to pulp and paper industry it is possible that the customers would start demanding 'environmental features' of production of metals too.

The rivalry among the producers of steel and base metals is hard: the competitors are almost equal to size and growth rates are typically less than 5%. The exit barriers are high. On the other hand the entry barriers to metal refining industry are high. This is mostly due to high capital requirements and economies of scale. Product differentiation is also hardly possible because the industry is capital intensive processing industry, that produces bulk products. Profitability comes from cost efficiency.

Western world's 20 largest mining companies produce almost 40% of the value of production. The largest Finnish company is Outokumpu Oy, 38th biggest in the world and 0,5% of the total value.

The consumption of metals is now weak (December 1993), and in production there is a firm growth. There is some over-supply in the metal markets and the metals stocks are high. The metal markets are influenced in particular by changes taking place in the Eastern European countries. Many Eastern countries have changed from net importers to net exporters. It is generally expected that in most cases this year will be the peak export year and the effect of Eastern countries on the metal markets is expected to diminish at least in a couple of years. The demand from the developing countries in the Far East has continued to expand already for quite a long time. The importance of the demand from developing countries is reinforced by the rapid economic growth in China.

No significant price increase is foreseen until the latter half of this decade. Most metal markets are now in surplus and prices should increase over the next few years as balance is restored. Mining, smelting, and refining are expected to continue to shift towards the developing countries. The metal intensity of GNP tends to decrease through the period.

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# APPENDIX: STATISTICS

## 1 STEEL

*Table 7: The Major Steel-Producing Countries, 1991 and 1992 (Millions of Metric Tons)<sup>56</sup>*

Country	1992	1991	Country	1992	1991
Japan	98,1	109,6	Poland	9,8	10,4
United States	84,3	79,7	South Africa	9,1	9,4
PR China	80,0	71,0	Mexico	8,4	8,0
Russia	67,0	77,1	Korea	7,0	7,0
Ukraine	41,8	45,0	Australia	6,9	6,2
Germany	39,7	42,2	Netherlands	5,4	5,2
Republic of Korea	28,1	26,0	Romania	5,4	7,1
Italy	24,9	25,1	Sweden	4,4	4,3
Brazil	23,9	22,6	Kazakhstan	4,0	5,9
India	18,1	17,1	Austria	4,0	4,2
France	18,0	18,4	Venezuela	3,4	3,1
United Kingdom	16,1	16,5	Indonesia	3,1	3,0
Canada	13,9	13,0	Finland	3,1	2,9
Spain	12,3	12,9	Luxembourg	3,1	3,4
Czechoslovakia	11,1	12,1	Iran	2,9	2,2
Taiwan	10,7	11,0	Argentina	2,7	3,0
Belgium	10,3	11,3	Egypt	2,5	2,6
Turkey	10,3	9,3	Other Countries	28,0	28,7
			<b>World Total</b>	<b>721,2</b>	<b>736,5</b>

<sup>56</sup>World Steel in Figures, 1992.

Table 8: Apparent Steel Consumption 1985 to 1991.<sup>57</sup>

	1985	1986	1987	1988	1989	1990	1991
Japan	74.0	71.0	76.7	86.6	93.7	98.9	99.1
EC(12)(a)	102.3	104.0	104.5	120.0	123.4	123.5	118.2
Other W. Europe	22.7	23.0	24.3	22.7	25.2	23.1	20.9
United States	106.9	96.2	102.7	108.6	101.8	100.4	88.0
Canada	13.4	12.5	13.7	15.4	14.1	11.7	10.6
South Africa	5.0	5.1	5.2	5.8	6.0	5.5	5.0
Oceania	6.7	6.7	6.6	6.7	7.1	5.9	4.7
<b>Total industrialised countries</b>	<b>331.0</b>	<b>318.4</b>	<b>333.7</b>	<b>365.8</b>	<b>371.3</b>	<b>369.0</b>	<b>346.5</b>
Latin America	27.5	29.6	31.9	30.2	30.1	27.1	29.5
Africa except South Africa	10.8	12.2	10.4	10.1	10.3	10.3	10.1
Middle East	16.9	11.3	12.2	12.3	12.6	12.9	13.5
Asia except Japan, PR China, DPR Korea	47.3	50.6	57.9	68.5	72.4	80.1	88.2
<b>Total developing countries</b>	<b>102.5</b>	<b>103.7</b>	<b>112.4</b>	<b>121.0</b>	<b>125.4</b>	<b>136.4</b>	<b>141.3</b>
<b>Total Western World</b>	<b>433.5</b>	<b>422.1</b>	<b>446.1</b>	<b>486.8</b>	<b>496.8</b>	<b>499.4</b>	<b>487.8</b>
USSR and Eastern Europe (b)	211.6	217.3	219.2	219.3	213.5	192.0	160.0
PR China and DPR Korea	78.7	83.9	79.2	77.5	79.4	77.2	81.0
<b>Total centrally-planned economies</b>	<b>290.3</b>	<b>301.2</b>	<b>298.4</b>	<b>296.8</b>	<b>292.9</b>	<b>269.2</b>	<b>241.0</b>
<b>Total World</b>	<b>723.8</b>	<b>723.3</b>	<b>744.4</b>	<b>783.6</b>	<b>789.7</b>	<b>768.6</b>	<b>728.8</b>
Unallocated	-4.9	-9.8	-8.0	-3.5	-3.5	1.3	7.4
<b>World crude steel production</b>	<b>718.9</b>	<b>713.5</b>	<b>736.4</b>	<b>780.1</b>	<b>786.2</b>	<b>769.8</b>	<b>736.2</b>

(a) -not including the former G.D.R.

(b) -including the former G.D.R.

<sup>57</sup>World Steel in Figures, 1992.

## 2 COPPER MARKET INDICATORS

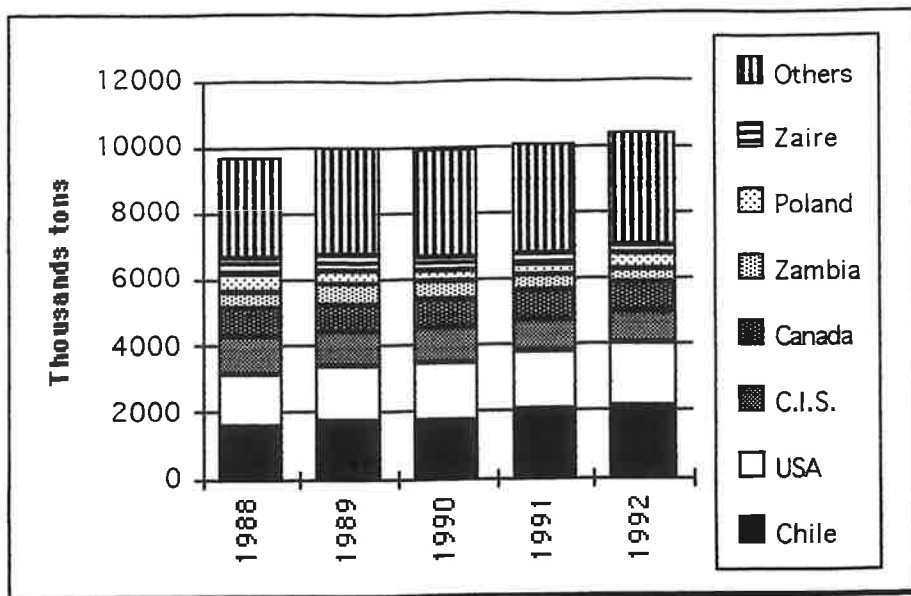


Figure 14: Mine Production in Major Copper-Producing Countries.<sup>58</sup>

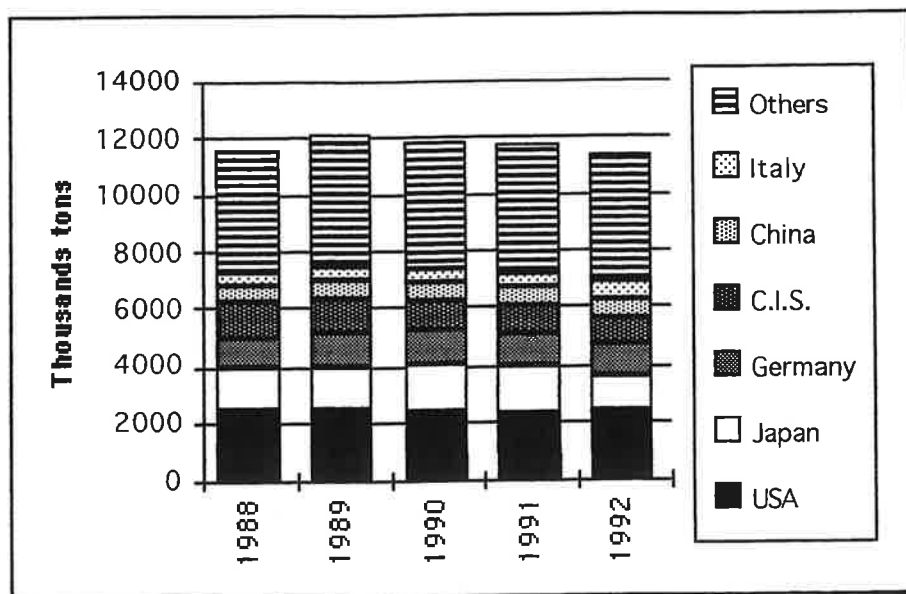


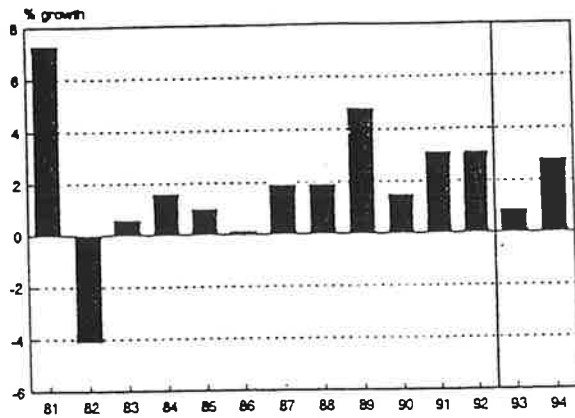
Figure 15: The Major Copper-Consuming Countries.<sup>59</sup>

<sup>58</sup>Americal Bureau of Metal Statistics Inc, Non-Ferrous Metal Data, 1992

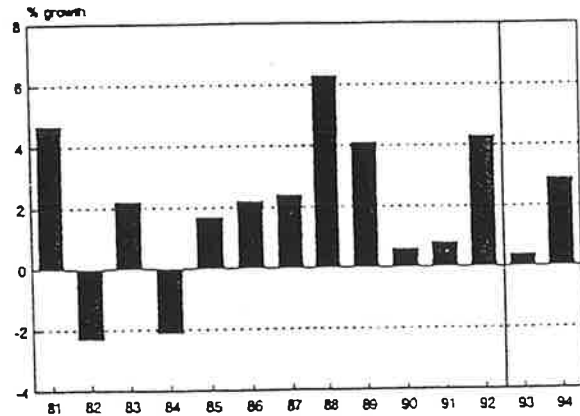
<sup>59</sup>Americal Bureau of Metal Statistics Inc, Non-Ferrous Metal Data, 1992.

# COPPER MARKET INDICATORS

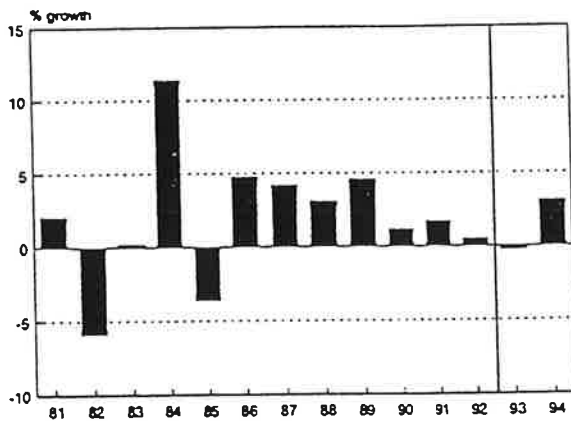
Mine Production



Refined Production

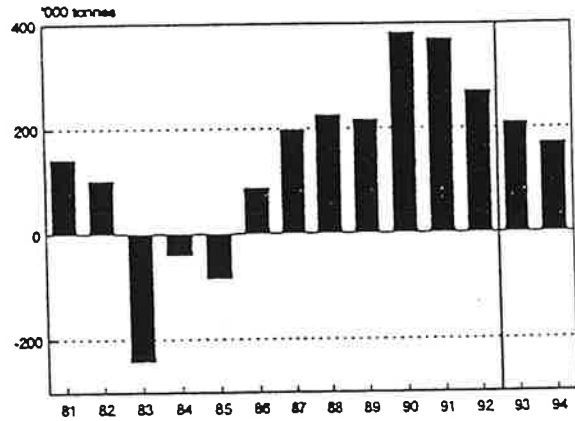


Refined Consumption

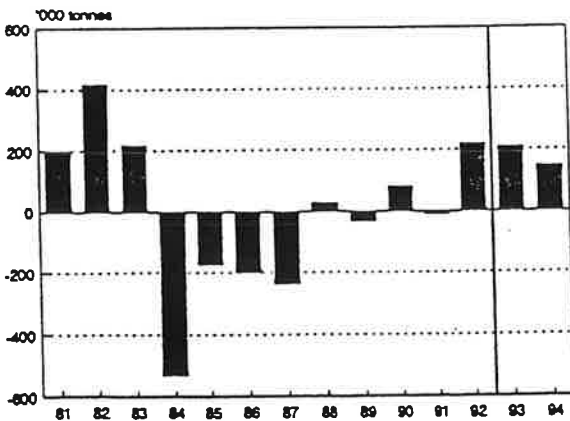


East-West Net Trade

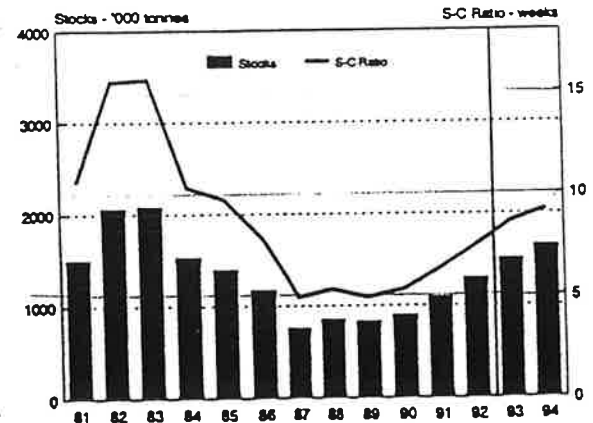
Positive balance means net exports to West



Supply-Demand Balance



Stocks/Stock-Consumption Ratio



### 3 ZINC MARKET INDICATORS

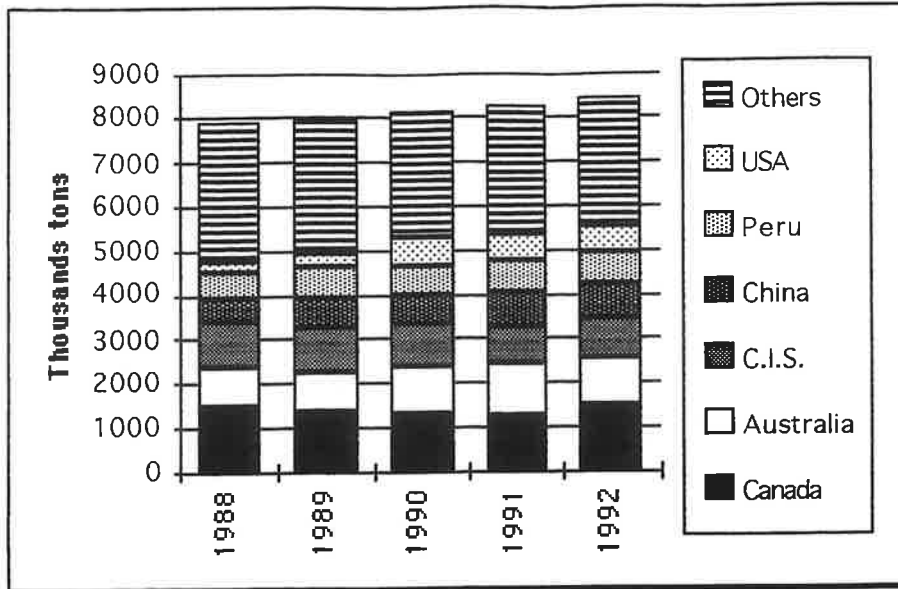


Figure 16: Mine Production in Major Zinc-Producing Countries.<sup>60</sup>

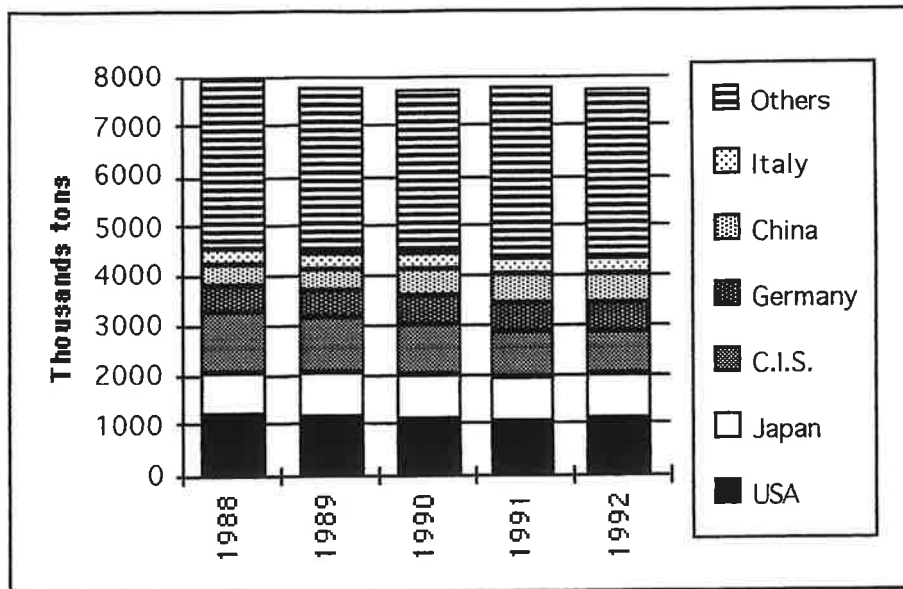


Figure 17: The Major Zinc-Producing Countries.<sup>61</sup>

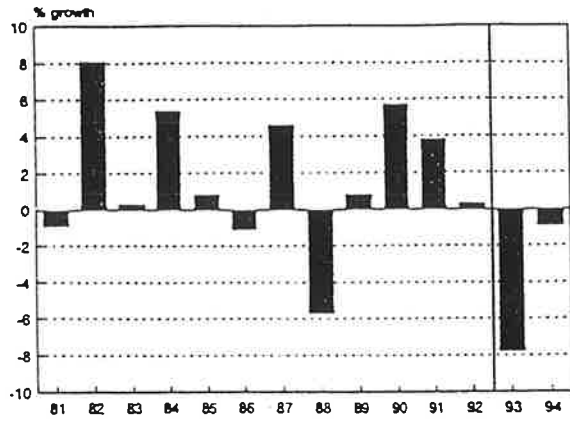
<sup>60</sup>American Bureau of Metal Statistics Inc, Non-Ferrous Metal Data, 1992.

<sup>61</sup>American Bureau of Metal Statistics Inc, Non-Ferrous Metal Data, 1992.

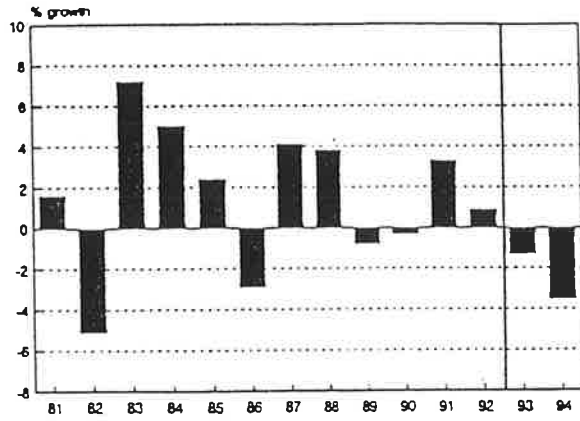


# ZINC MARKET INDICATORS

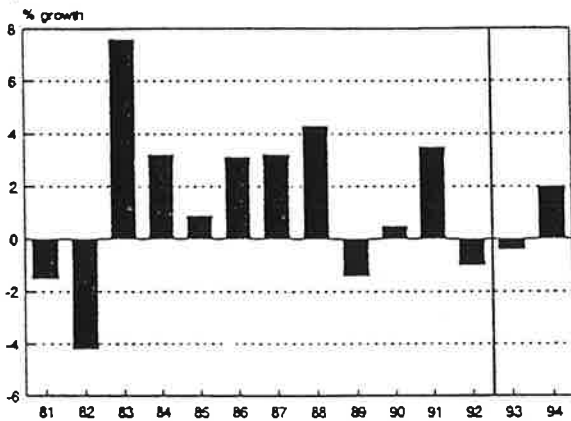
Mine Production



Slab Production

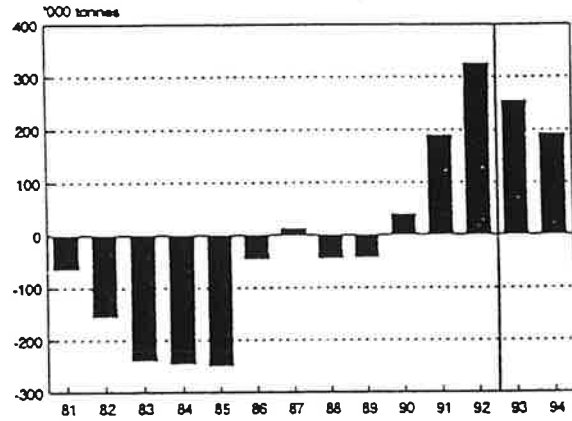


Consumption

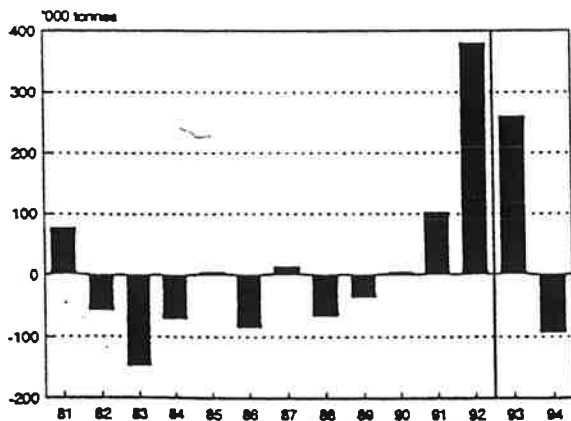


East-West Net Trade

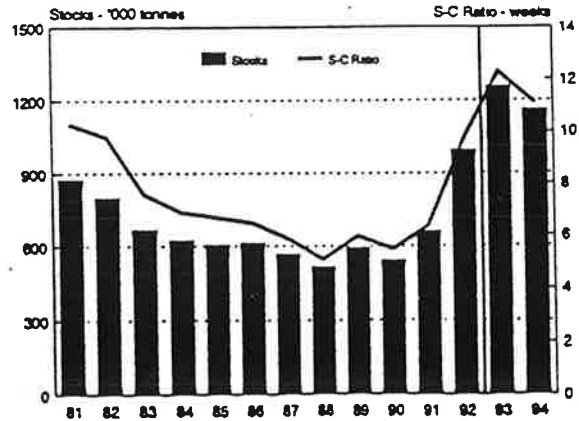
Positive balance means net exports to West



Supply-Demand Balance



Stocks/Stock-Consumption Ratio



### 4 NICKEL MARKET INDICATORS

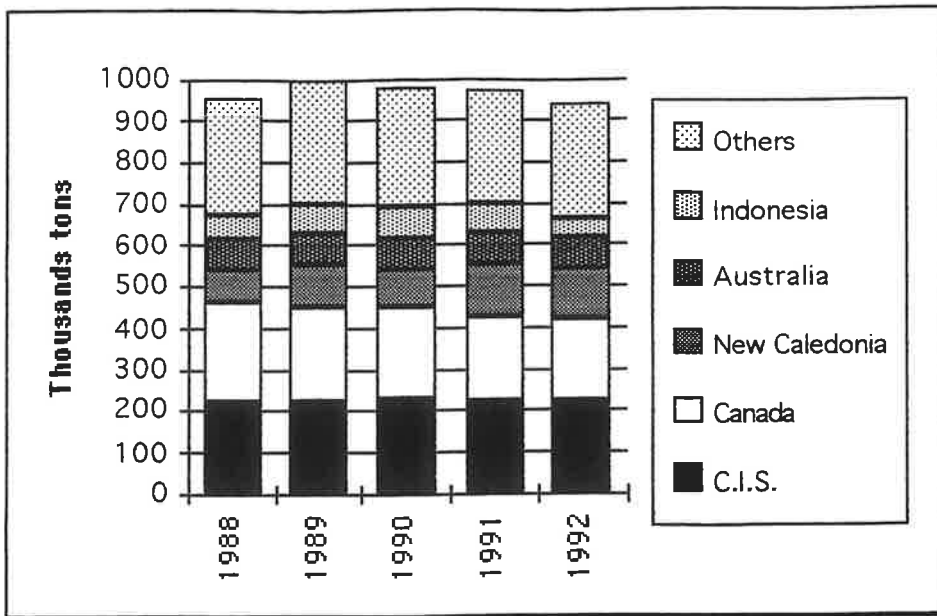
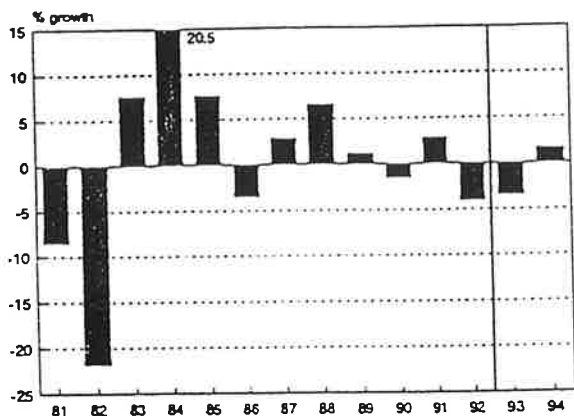


Figure 18: Mine Production in Major Nickel-Producing Countries.<sup>62</sup>

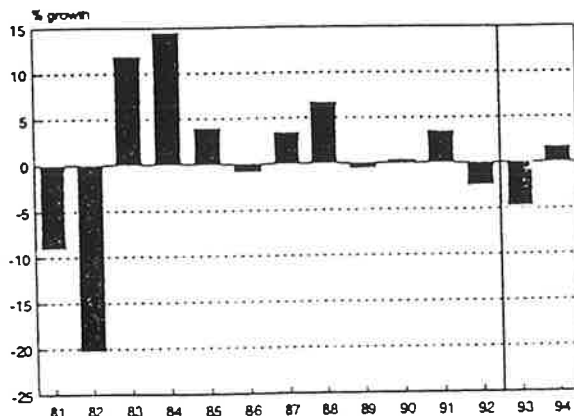
<sup>62</sup>American Bureau of Metal Statistics Inc, Non-Ferrous Metal Data, 1992.

# NICKEL MARKET INDICATORS

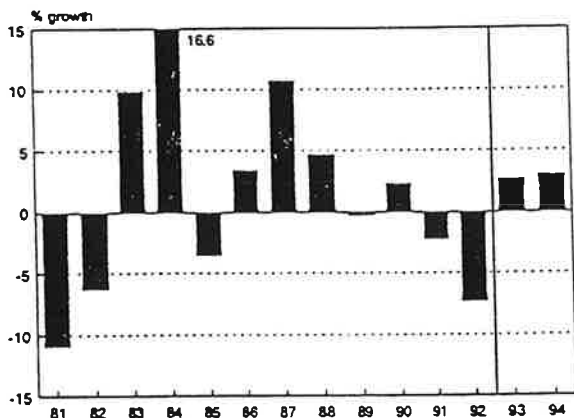
Mine Production



Metal Production

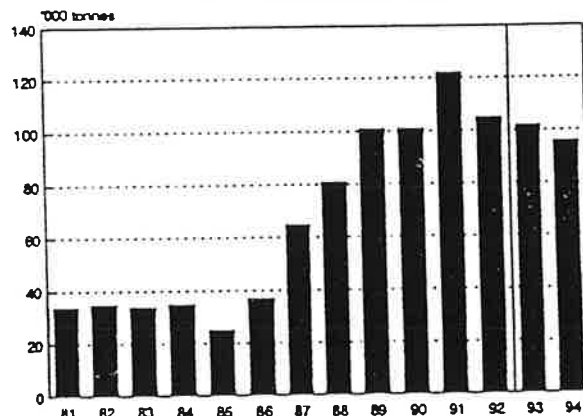


Consumption

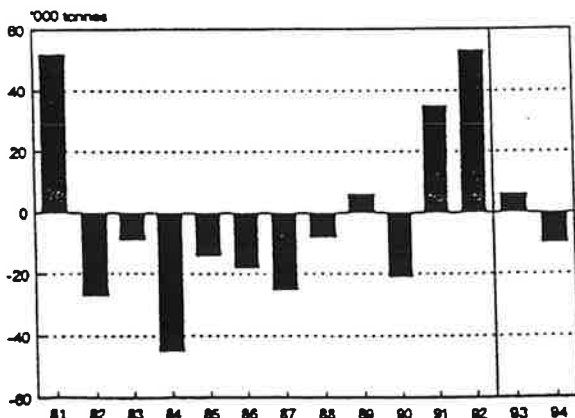


East-West Net Trade

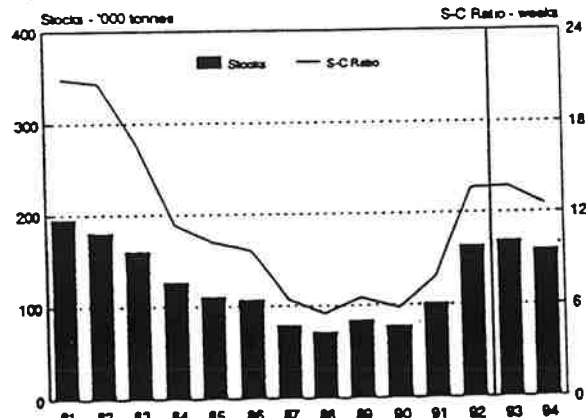
Positive balance means net exports to West



Supply-Demand Balance



Stocks/Stock-Consumption Ratio



## 5 ALUMINIUM MARKET INDICATORS

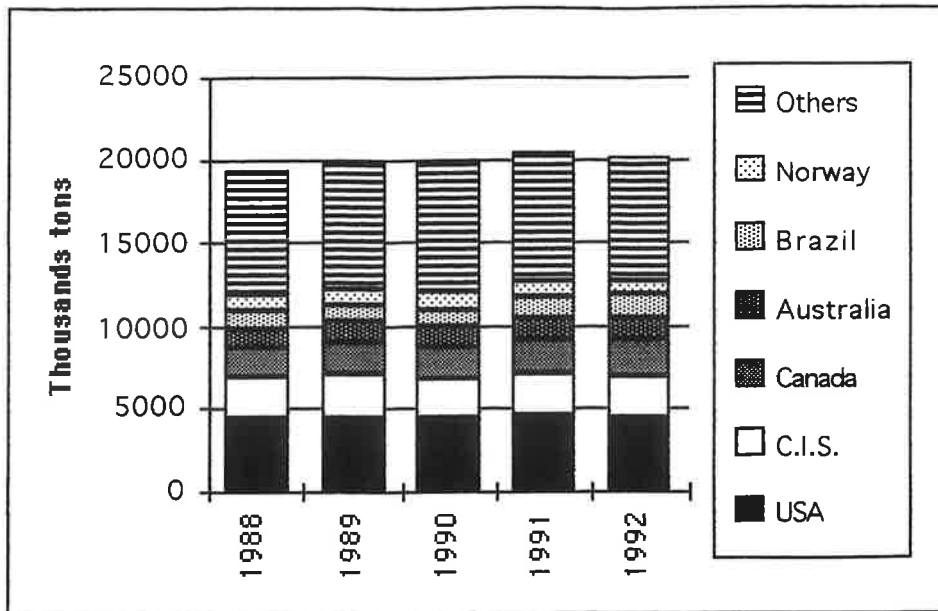


Figure 19: The Major Primary Aluminium-Producing Countries.<sup>63</sup>

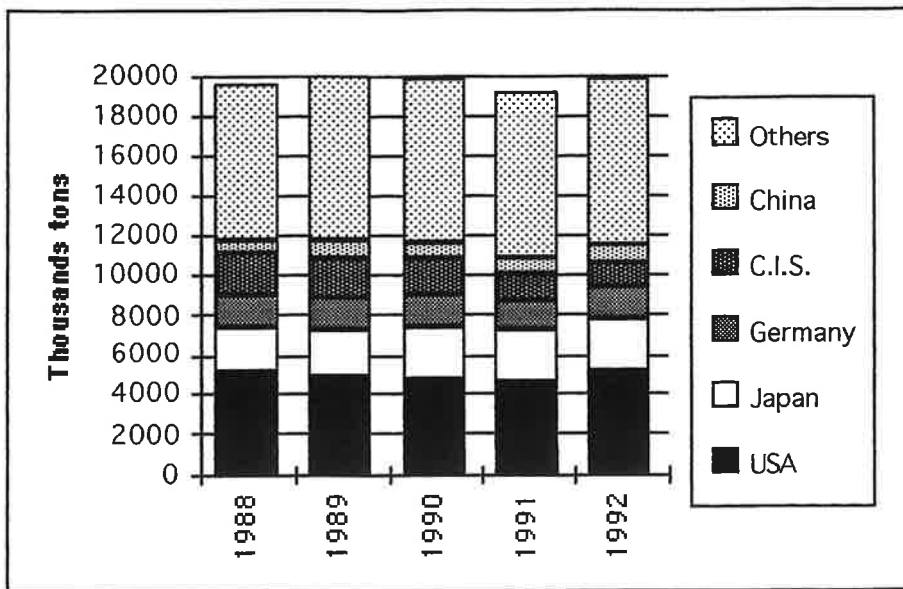


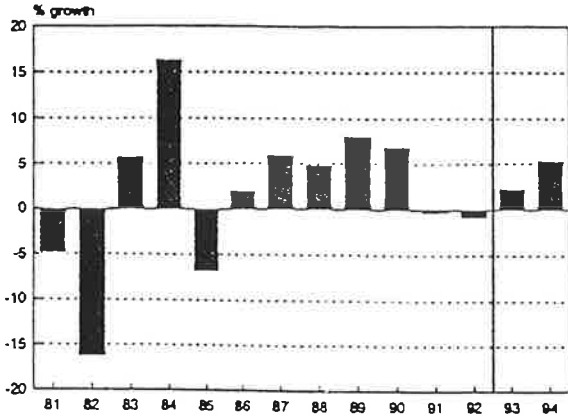
Figure 20: The Major Primary Aluminium-Consuming Countries.<sup>64</sup>

<sup>63</sup>American Bureau of Metal Statistics Inc, Non-Ferrous Metal Data, 1992.

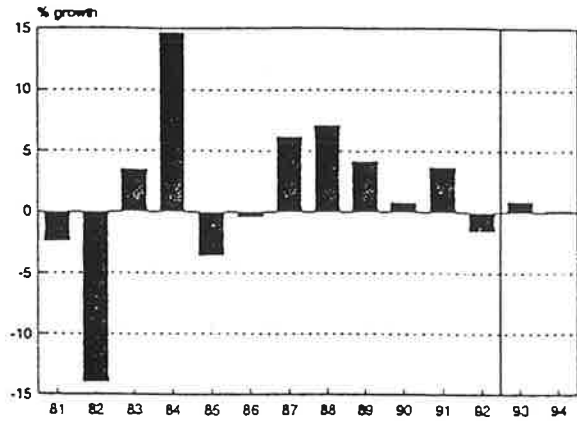
<sup>64</sup>American Bureau of Metal Statistics Inc, Non-Ferrous Metal Data, 1992.

# ALUMINIUM MARKET INDICATORS

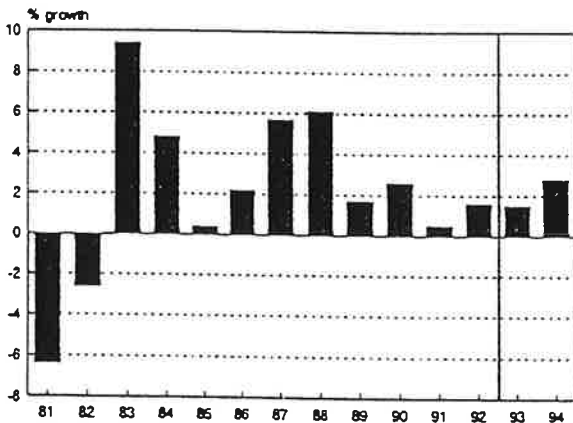
Alumina Production



Primary Production

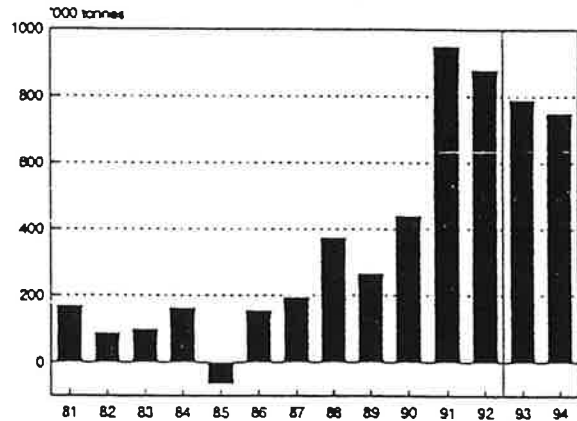


Primary Consumption

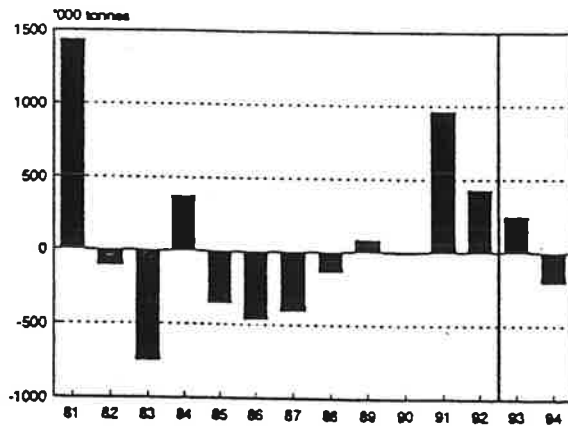


East-West Net Trade

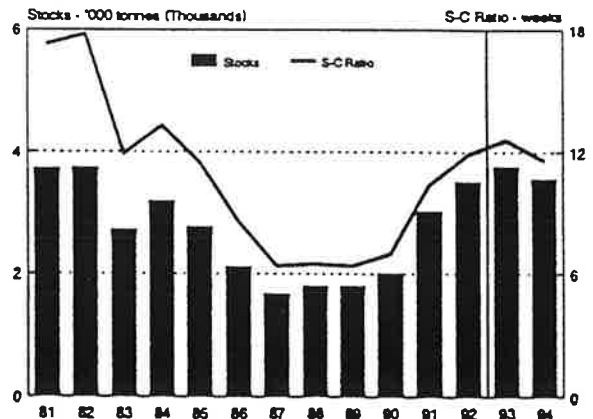
Positive balance means net exports to West



Supply-Demand Balance



Stocks/Stock-Consumption Ratio



**ELINKEINOELÄMÄN TUTKIMUSLAITOS (ETLA)**  
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY  
LÖNNROTINKATU 4 B, SF-00120 HELSINKI

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