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Market Outlook for Major Primary Commodities

(In Two Volumes) Volume I: Summary, Energy, and Metals and Minerals

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Market Outlook For Major Primary Commodities

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Volume I: Summary, Energy, and Metals and Minerals

Contributors to this volume were:

Boum-Jong Choe (coal, copper, lead and zinc); CPM Group (gold, silver); Mudassar Imran (petroleum); Ying Qian (iron ore, nickel, steel), Kenji Takeuchi (aluminum and bauxite, tin).

Contents

Preface v

Notes and Definitions vi

Commodity Description vii

Summary viii
Highlights of Forecasts to 2005 viii
Commodity Price Forecasts ix
Commodity Market Outlook--Agriculture ix
Commodity Market Outlook--Metals and Minerals xiii
Commodity Market Outlook--Energy xv

Energy

Petroleum 1
Summary 1
Demand Outlook 6
Supply Outlook 13
Petroleum Price Outlook 22
Uncertainties in the Petroleum Market Outlook 26
Annex I: Investment Needs of the International Oil Industry 31
Annex II: World Refining Outlook 33

Coal 42
Summary 42
Demand Outlook 43
Supply Outlook 46
Price Outlook 49
Coal and the Environment 50

Metals and Minerals

Copper
Summary 56
Demand Outlook 57
Supply Outlook 60
Price Outlook 66

Tin 80
Summary 80
Demand Outlook 81
Supply Outlook 83
Price Outlook 85

Nickel 88
Summary 88
Demand Outlook 89
Supply Prospects 91
Price Prospects 96

Aluminum and Bauxite 99
Summary 99
Demand Outlook 100
Supply Outlook 103
Trade Outlook 107
Price Outlook 110

Iron Ore 124
Summary 124
Demand Outlook 125
Supply Outlook 126
Trade Outlook 129
Price Prospects 132

Steel 140
Summary 140
Demand Outlook 141
Supply Outlook 143
Trade Prospects 149
Price Outlook 149

Lead and Zinc 155
Summary 155
Demand Outlook 156
Supply Outlook 157
Price Outlook 159

Gold 163
Summary 163
Price Outlook 164
Supply Outlook 165
Demand Outlook 167

Silver 174
Summary 174
Price Outlook 175
Demand Outlook 175
Supply Outlook 177

Preface

This report is a compilation of studies which review the market prospects for major primary commodities exported by developing countries.

The forecasts are mainly used in forecasting the balance of payments of countries that borrow from the World Bank and in appraising investment projects that include these commodities as inputs or outputs. Because of the multiple purposes they are intended to serve, the price forecasts are presented in current (nominal) as well as 1990 constant dollar (real) terms.[1] For the period 1992-95, the price forecasts are in terms of prices expected for the individual years. For 2000 and 2005, the price forecasts are forecasts of the average price levels expected during that period.

The forecasts are conditional on the various macroeconomic and commodity-specific assumptions used--all of which are subject to uncertainty. The macroeconomic assumptions forming the basis for the forecasts are available in the World Bank's report Global Economic Prospects and the Developing Countries, 1992. Because of the uncertainty which is inherent in commodity price forecasts, the International Trade Division periodically prepares probability distributions of its price forecasts. These are available upon request.

The primary commodity market outlooks are discussed by commodity. For most commodities or group of commodities, there is a standardized set of tables giving historical and forecast values for production, consumption, exports, and imports; these tables give details in terms of major economic regions as well as for countries which are major participants in these markets. For most commodities, the forecasts have been based on simulation runs of global commodity models maintained within the International Trade Division of the World Bank's International Economics Department. Details of these models can be obtained directly from the Division.

The assistance given to the Division in preparing this report is gratefully acknowledged. People in both public and private organizations have been most forthcoming in providing data and in discussing the outlook for the various commodity markets. Their cooperation has added greatly to the usefulness of the report.

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[1] Commodity prices have been deflated by the World Bank's Manufacturing Unit Value (MUV) index and the G-7 CPI. The MUV index is the c.i.f. index of US dollar prices of industrial countries' manufactured exports (SITC 5-8) to the developing countries and may be regarded as a useful deflator to measure changes in the net barter terms of trade of developing countries highly dependent on exports of primary commodities. The G-7 CPI may be a useful deflator to use in circumstances where the major countries' inflation rate is believed to be an appropriate measure of changes in the overall price or cost level.

Notes and Definitions

- Commodity market-price descriptions are shown on the next page.
- Dollars are United States dollars unless otherwise specified.
- All tons refer to metric tons (1,000 kilograms) unless otherwise noted.

Abbreviations and Symbols

tons	= metric tons	lb	= pounds
cum	= cubic meters	bbl	= barrels
kg	= kilograms	mb/d	= million barrels per day
ha	= hectares	N.A.	= not available
MTOE	= million tons of oil equivalent	../--/	= no data

Country Classifications

High-Income Countries

OECD

Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, United States, United Kingdom.

Non-OECD

Andorra, Aruba, Bahamas, Bermuda, Brunei, Channel Islands, Cyprus, Faeroe Islands, French Polynesia, Greenland, Hong Kong, Israel, Kuwait, Mayotte, OAE [a], Qatar, Singapore, United Arab Emirates, Virgin Islands (US).

Low- and Middle-Income Countries (LMICs)

Africa

Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Rep., Chad, Comoros, Congo, Rep., Côte d'Ivoire, Djibouti, Equatorial Guinea, Ethiopia, Gabon, the Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Reunion, Rwanda, São Tomé and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zaire, Zambia, Zimbabwe.

America

Antigua and Barbuda, Argentina, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Rep., Ecuador, El Salvador, French Guiana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Mexico, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, St. Kitts and Nevis, St. Vincent, St. Lucia, Suriname, Trinidad and Tobago, Uruguay, Venezuela.

Asia and Pacific

American Samoa, Bangladesh, Bhutan, Cambodia, Fiji, Guam, Indonesia, Kiribati, Korea, Dem. Rep., Korea, Rep., Lao PDR, Macao, Malaysia, Maldives, Mongolia, Myanmar, Nepal, New Caledonia, Pacific Islands, Trust Territory, Pakistan, Papua New Guinea, Philippines, Solomon Islands, Sri Lanka, Thailand, Tonga, Vanuatu, Viet Nam, Western Samoa.

Europe

Albania, Bulgaria, Czechoslovakia, Former Soviet Union (FSU)[b], Gibraltar, Greece, Hungary, Isle of Man, Malta, Poland, Portugal, Romania, Turkey, Yugoslavia.

Middle East and North Africa

Afghanistan, Algeria, Bahrain, Egypt, Arab Rep., Iran, Islamic Rep., Iraq, Jordan, Lebanon, Libya, Morocco, Oman, Saudi Arabia, Syrian Arab Rep., Tunisia, Yemen, Rep.

a/ Other Asian economies–Taiwan, China.
b/ Data are not available for individual republics.

Commodity Description

Energy

Petroleum, average OPEC price: OPEC government sales weighted by export volumes through 1981; beginning 1982 OPEC spot prices weighted by OPEC export volumes.
Thermal Coal, (12,000 BTU/lb, less than 1.0% sulfur, 12% ash), f.o.b. Piers, Hampton Roads, Norfolk.

Food

Coffee (ICO), indicator price, other mild Arabicas, average New York and Bremen/Hamburg markets, ex-dock for prompt shipment.
Cocoa (ICCO), daily average price, New York and London, nearest three future trading months.
Tea (London Auction), average price received for all teas.
Sugar (World), ISA daily price, f.o.b. and stowed at greater Caribbean ports.
Beef (Australian/New Zealand), cow forequarters, frozen boneless, 85% chemical lean, c.i.f. US port (East Coast), ex-dock.
Bananas (Central and South American), first-class quality tropical pack, importer's price to jobber or processor, f.o.r. U.S. ports.
Oranges (Mediterranean Exporters), navel, EEC indicative import price, c.i.f. Paris.

Cereals

Rice (Thai), white, milled, 5% broken, government standard, Board of Trade posted export price, f.o.b. Bangkok.
Wheat (Canadian), No. 1 Western Red Spring (CWRS) 13.5%, basis in store Thunder Bay, domestic through March 1985; subsequently St. Lawrence, export.
Maize (US), No. 2, yellow, f.o.b. Gulf ports.
Grain Sorghum (US), No. 2, Milo yellow, f.o.b. Gulf ports.

Fats and Oils

Palm Oil (Malaysian), 5% bulk, c.i.f. N.W. Europe.
Coconut Oil (Philippines/Indonesian), bulk, c.i.f. Rotterdam.
Groundnut Oil (Nigerian/West African), bulk c.i.f. UK, through January 1977; subsequently (any origin), c.i.f. Rotterdam.
Soybean Oil (Dutch), crude, f.o.b. ex-mill.
Soybeans (US), c.i.f. Rotterdam.
Copra (Philippines/Indonesian), bulk, c.i.f. N.W. Europe.
Palm Kernels (Nigerian), c.i.f. UK.
Groundnut Meal (Indian), 48%, c.i.f. Rotterdam through 1981; thereafter Argentine, 48/50%.
Soybean Meal (US), 44% extraction, c.i.f. Rotterdam.

Non-Food

Cotton (Outlook "A" Index), Middling (1-3/32"), c.i.f. Europe.
Jute (Bangladesh), white D, f.o.b. Chittagong/Chalna.
Rubber (RSS No. 1), in bales, spot New York.
Tobacco (Indian), flue-cured, average export unit value.

Timber

Logs (Southeast Asian), Philippines, Lauan for plywood and veneer, length over 6.0 M, diameter over 60 CM, average wholesale price in Japan through 1976, beginning 1977, Malaysian, Meranti, Sabah SQ Best Quality, sale price charged by importers, Japan.
Logs (West African), Sapelli, high quality, loyal and marchand, f.o.b. Cameroon.
Sawnwood (Malaysian), Dark Red Meranti, select and better quality, standard density, c.i.f. French ports.

Metals and Minerals

Copper (LME), cash wirebars through November 1981; from December 1981 through June 1986, high grade cathodes, settlement price; subsequently, grade A.
Tin (Malaysian), Straits quality, ex-smelter, Penang, official settlement price.
Nickel (Canadian), electrolytic cathodes, Ni 99.9% shipping point through 1979; subsequently cathodes, minimum 99.8% purity, official morning session weekly average bid/asked price.
Aluminum, indicative price of U.S. unalloyed primary ingot in the European Market through 1978; subsequently LME standard grade, minimum 99.5% purity, cash price.
Lead (LME), settlement price, refined lead, purity 99.97%.
Zinc (LME), settlement price, good ordinary brand through August 1984; thereafter High Grade brand.
Iron Ore (Brazilian), CVRD Itabira sinter feed produced from 64.2 purity ore, metal content weight, contract to Germany, Federal Republic, f.o.b. reference price through 1974; from 1975 through 1985, standard sinter feed from 64% purity ore; starting 1986 Southern System (Itabira and other southern mines) 64%; during 1988 and 1989, 64.2%; beginning 1990 64.3% purity ores.
Bauxite, crude and dried, US import reference price based on imports from Jamaica through 1974; from 1975 US import price, c.i.f. US port.
Gold (UK), 99.5% fine, London afternoon fixing, average of daily rates.
Silver (Handy & Harman), 99.9% grade refined, New York.

Fertilizers

Phosphate Rock (Moroccan), 72% BPL, FAS Casablanca through 1980; from 1981, 70% TPL contract.
Urea (any origin), bagged, f.o.b. N.W. Europe.
TSP (Triple Superphosphate), bulk, f.o.b. US Gulf.
DAP (Diammonium Phosphate), bulk, f.o.b. US Gulf.
Potassium Chloride (Muriate of Potash), bulk, f.o.b. Vancouver.

World Bank, International Economics Department.
November 5, 1992

Summary

HIGHLIGHTS OF FORECASTS TO 2005

Prices

- *Non-fuel commodity 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.*

- *Real price declines over the next few years are expected in all commodity groups with the exception of beverages (the price index for this group has declined an extraordinary 68% in real terms since 1986) timber (which is expected to continue increasing in real terms), and vegetable oils.*

- *Over the longer term, it is mainly the expected recovery in beverage prices which supports the upturn in non-fuel prices.*

- *Petroleum prices are expected to average near present levels in current dollar terms for several years before increasing due to tightening supplies.*

Production, Consumption, and Trade

- *Recent developments in Eastern Europe, and particularly in the FSU, have increased the uncertainty in the outlook for most commodities. Because of their reductions in consumption, reverberations will be felt for many years in the form of reductions in imports (e.g., cocoa, coffee, tea, sugar, grains) or increases in exports (e.g., metals).*

- *Production growth in the beverages should slow rapidly as a result of reduced new plantings and replantings and reduced inputs, setting the stage for a recovery in prices.*

- *The main growth markets for grains imports will be the developing countries, particularly those in the Asia-Pacific region. Industrial country exporters will supply the bulk of these imports.*

- *Most metals markets are 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.*

- *Petroleum consumption is expected to grow at 1.3% p.a. on average but with growth being increasingly concentrated in the LMICs.*

- *Petroleum supplies will be more concentrated in the Middle East.*

COMMODITY PRICE FORECASTS

The historical prices and the price forecasts made in this report are brought together in constant 1990 dollars in the Summary Table 1 and in current dollars in Table 2. The various commodity price indices maintained by the World Bank are shown in Table 3 (constant dollars) and Table 4 (current dollars), with the indices based on weights for the period 1979-81. The deflator used to derive the constant dollar values in Tables 1 and 3 is the Manufacturing Unit Value (MUV) Index. This and other price indices are presented in Table 5 for the period 1948-2005. The price indices for the major commodity groups, in current and constant dollars, are graphed in the two figures below.

The constant dollar, non-fuel commodity price index is expected to fall six percentage points in 1992, matching the fall in 1991, and to remain at that level over the following two years. The main reason for the decline in 1992 is the 20% decline in the beverage index. The constant dollar beverage price index has now fallen 68% since 1986. With beverage prices expected to recover somewhat in 1993, offsetting declines in the aggregate index are expected mainly to come from cereals and other foods.

The turnaround in the aggregate non-fuel index after 1994 is supported by all commodity groups with the exception of vegetable fats and oils. This turnaround is conditional mainly on two assumptions: that there will be an upturn in economic activity in the industrial countries and that production growth in the perennial crops will slow fairly rapidly.

A brief summary of the market outlook for the major primary commodities is provided below. For more details, readers are referred to the chapters reporting on the market outlook for each commodity.

COMMODITY MARKET OUTLOOK--AGRICULTURE

(i) BEVERAGES

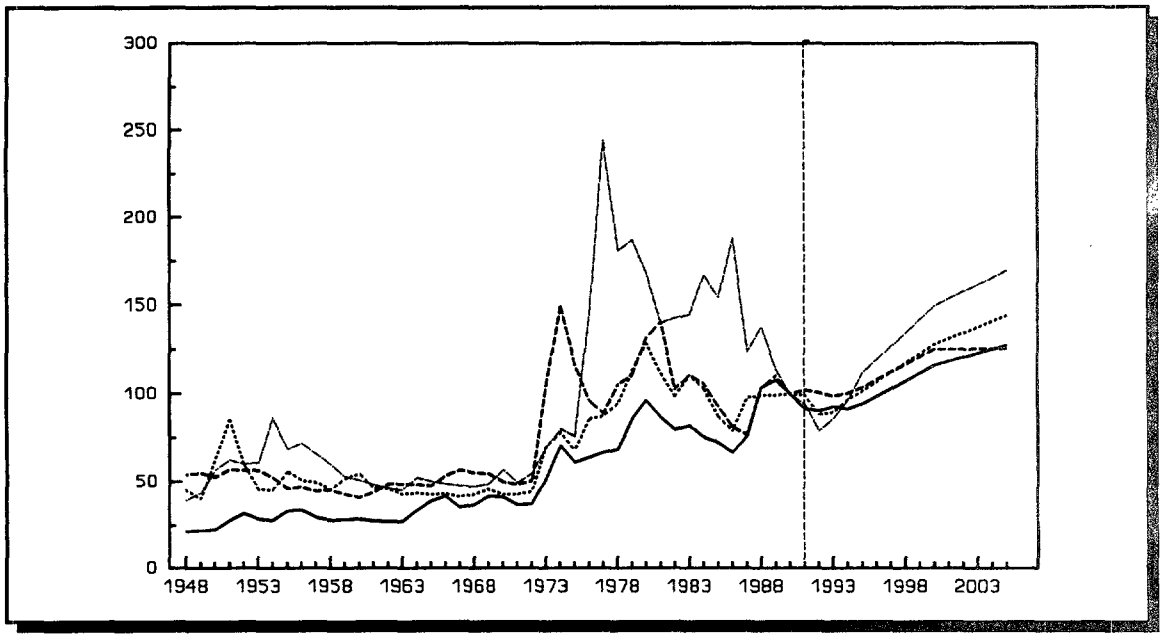
Cocoa prices to increase eventually, as production growth slows. In real terms, the market outlook for the 1992-95 period is for cocoa prices to remain near present levels, given the large stocks and the continuing increases in production.

After the mid-1990s, the low level of new plantings and replantings in recent years should result in a production decline in some of the major producers (Brazil, Cameroon, Côte d'Ivoire, and Malaysia) and a slowdown in most other. Only Indonesia is expected to have significant growth in production over the forecast period.

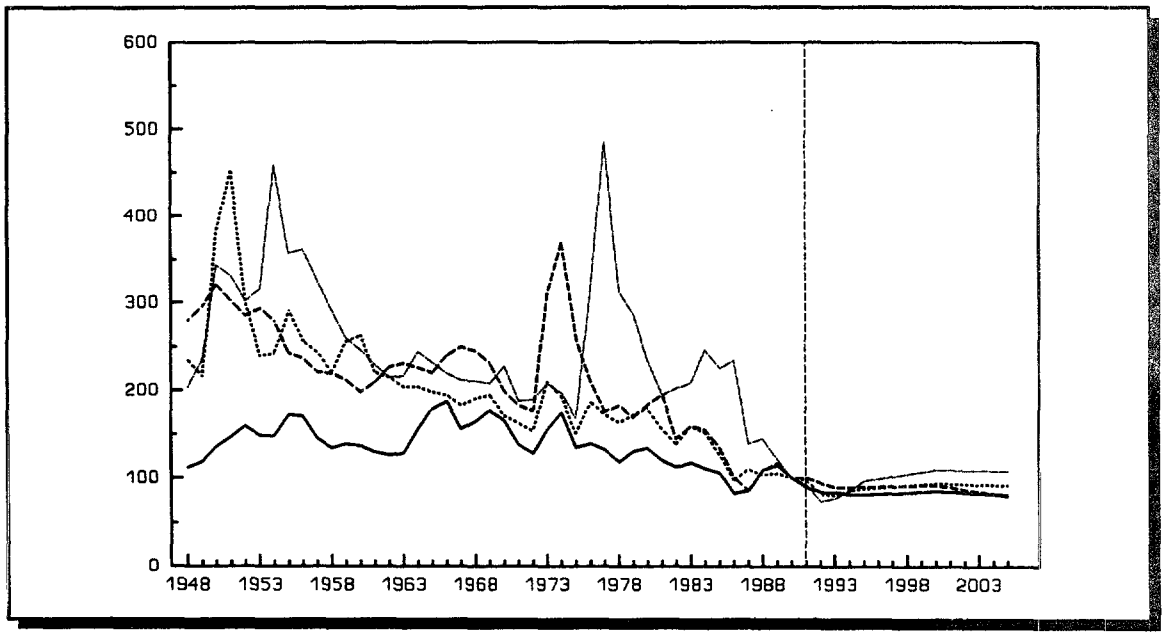
Long-term prices should increase somewhat in real terms with the slowing of production growth.

Consumption growth will be likely slow, averaging less than 2% p.a. Recent developments in the FSU and Eastern Europe, which have been substantial cocoa importers, increase the range of uncertainty about this market. Growth in consumption is expected from some nontraditional markets such as China, Japan, and the Republic of Korea.

Index of Non-Fuel Primary Commodity Prices (Current), 1948-2005
(1990=100)



Index of Non-Fuel Primary Commodity Prices (Constant), 1948-2005
(Deflated by MUV, 1990=100)



Beverages — Cereals — Non-Food — Metals & Minerals

Source: World Bank, International Economics Department.

Coffee price outlook is also dependent on production growth; demand growth expected to be only 1%. The current low international prices are below variable production costs for many producers, dampening new plantings and replantings. Production growth should slow; with output growth projected to average only 0.6% p.a. over the forecast period.

Supply prospects differ significantly between countries; output in Brazil, Colombia, and Côte d'Ivoire is expected to fall. Indonesia is expected to increase production during the forecast period because of its abundance of land and low-cost labor.

World coffee demand is expected to average about 1% p.a. growth for the 1991-2005 period. Very slow population growth and already high consumption levels in the high-income countries mean faster consumption growth is unlikely. Japan and LMIC Asia and Europe are the main prospective growth areas.

International coffee price prospects point to some recovery in 1993. But any possibility of a significant increase during the 1990s, absent some supply shock or re-introduction of an international coffee agreement, has been made less likely by the large stocks now held in the importing countries.

The demand for robusta coffees is projected to grow more slowly than the demand for arabica coffees. The switch from robustas to arabicas in the OECD countries is expected to continue. This, together with the expected increase in robusta production in Brazil, Indonesia, and Viet Nam should lead to an increasing price differential between arabicas and robustas, which is bad news for African producers of robustas such as Cameroon, Côte d'Ivoire, and Uganda.

Tea price increase expected with Kenyan production growth slowing; recovery of FSU and Middle East demand would assist. World tea prices at London auctions were at their lowest level ever in real terms in 1991. The main cause has been continuing output increases while world import demand has been stagnant.

One of the key reasons for the continued growth in output in major producing countries has been depreciations in their real exchange rates.

Tea prices are recovering somewhat at the end of 1992 and this should continue into 1993 as a result of reduced output in South India, Sri Lanka, and southern Africa due to drought. In the second half of the 1990s, real tea prices should increase as production growth slows in Kenya and demand increases in the FSU and the Middle East.

World tea output is projected at 2% p.a. over the forecast period--a considerably slower rate than for the 1970-90 period when it averaged 4.8% p.a.

(ii) GRAINS, OILSEEDS, AND SUGAR

Grain import gap in developing countries will continue to widen; to be filled by high-income exporters. The LMICs other than Eastern Europe and the FSU are expected to continue expanding their net grain imports to satisfy the increased demand generated by increasing incomes and populations. They are projected to double their grain imports over the period to 2005. The industrial countries will be the main sources of exports--increasing exports by about 40% over the forecast period. Wheat is projected to be the fastest growing export crop.

Forecasts for Eastern Europe and the FSU are highly uncertain but our best guess is that grain consumption will be depressed for several years, production will begin to grow more quickly than over the past two decades, and thus imports will decline--probably halving over the forecast period.

Grain prices are expected to remain nearly constant in nominal dollars for the next several years with grains markets in relative surplus. However, prices are expected to rise slightly in real terms in the latter half of the 1990s given the continued fast growth projected for the developing countries.

Vegetable oils/meals markets to have robust growth, but declining real prices. Over the long term, vegetable oil prices are expected to be constant to downward trending in real terms, despite vigorous growth in demand. The recent fast pace of production increases in the low-cost producing countries, especially Argentina, Brazil, Indonesia, and Malaysia, is expected to continue. Because of earlier plantings, Indonesia and Malaysia are locked onto a path of rapid expansion of palm oil output throughout this decade.

In an environment of falling real prices and substantial income growth, especially in the many populous countries in Asia, vegetable oil demand should grow strongly. Demand for oilseed meals should also grow rapidly in developing countries, especially in the Asia-Pacific region, as their demand for meats rises.

Sugar consumption growth expected to return to 2% p.a. after China and FSU shocks; long-term real price about ¢13/lb. Since 1988-89, political developments in China, Eastern Europe, and the FSU have resulted in a halving of the usually steady 2-2.5% p.a. growth in sugar consumption. Prices fell from around ¢15/lb in 1989 to around ¢10/lb in mid-1992.

Long-term world sugar consumption growth is expected to average 2% p.a. with strongest growth in Asia (3.1%), Africa (2.5%), and Latin America (2.1%). Sugar production is expected to decline in Cuba, the FSU, and the United States; growth in production should slow in China and India; while growth should increase in Australia, Brazil, the EC, and Thailand.

The long-term average price forecast is ¢12-13/lb (1990 dollars). However, price volatility is expected to remain very high.

(iii) AGRICULTURAL RAW MATERIALS

Cotton market to be dominated by Asia region. Cotton consumption declined in the 1990-92 period due to the poor global economic performance, particularly in the Eastern European countries and the FSU.

Over the long term, the declining trend in population growth is expected to reduce the growth rate of cotton consumption below the 2% p.a. rate of the 1964-90 period. The region with the largest population and fastest expected economic growth--LMIC Asia-Pacific--is expected to see the fastest increase in cotton consumption. A large part of this increase should be in China, although China's cotton demand growth should be at a slower pace than in recent years due to competition from domestically produced synthetic fibers.

The Asia region (major producers China, India, and Pakistan) is expected to continue to be the largest cotton-producing area. LMIC Europe is likely to see production declining.

Some recovery in prices is expected in 1993/94 as producers reduce planted area and yields fall from the record levels of 1991/92. Long term, the declining trend in real prices is expected to continue.

Rubber markets' main growth to be in Asia-Pacific region; Indonesia to become leading producer. Natural rubber consumption is expected to grow fastest in the LMICs of the Asia-Pacific region. The impact of rapid income growth on rubber consumption in these countries is illustrated by the 50% increase in China's consumption from 450,000 tons to 660,000 tons during the 1986-88 period and by the 30% increase in India's consumption from 278,000 tons to 358,000 tons in the 1987-90 period. Rubber consumption in the Asia-Pacific region is expected to increase from 1.9 million tons to 3.1 million tons over the forecast period.

World rubber consumption is expected to increase at 2.6% p.a. to reach 7.6 million tons in 2005. The fastest growth in the OECD countries should be in Japan with 1.7% p.a. increase.

The economic reforms in Eastern Europe and the FSU should reduce demand for synthetic rubber and increase natural rubber consumption. However, the time path of this shift is highly uncertain.

Of the three major producers, Indonesia is projected to become the leading producer with output growth of 3.5% p.a.--going from 1.1 million tons in 1992 to 1.9 million tons in 2005. Higher investment than previously expected in Malaysia should lead to 2.4% growth, with output increasing from 1.2 million tons in 1992 to 1.8 million tons in 2005. Because of its land constraint, growth in Thailand is expected to slow to 1.3% p.a. Fast growth is expected in the upcoming producers China, India, and Viet Nam.

An upturn in real prices is expected over the 1995-2000 period, given the economic growth assumptions. But over the long run, major improvements in productivity--including shifts to lower-cost producers--are expected to cause real prices to decline.

Commodity Market Outlook--Metals and Minerals

Copper market outlook reasonably optimistic for producers. World consumption of refined copper is forecast to be relatively robust, with an average growth rate of 2% p.a. over the 1991-2005 period. The newly industrializing countries are expected to continue to be the main growth point.

Demand in the FSU and Eastern Europe is expected to remain depressed, at least in the near term, but could grow rapidly from the mid-1990s as these economies require large investments in infrastructure and equipment.

In the industrial countries, the copper intensity of industrial production should decline at a slower rate than over the past two decades owing to lower energy prices and faster expansion of the capital goods sector.

A tally of announced projects indicates that over the 1992-95 period world mine and refined copper capacities will each expand by as much as one million tons. Most of these increases will take place in Latin America, North America, and Asia.

Over the period to 1996, the market balance is expected to turn to a moderate surplus as supplies increase. Prices are likely to decline. However, the constraints of smelter capacity should persist through 1995.

If the historical pattern of the investment cycle is repeated, copper prices are likely to trend upwards again in the latter part of this decade.

Aluminum market should continue its recent slow growth. Aluminum consumption growth in the 1980s was a mere 1.6% p.a. Some increase in the growth rate is expected in the forecast period (to 2.2% p.a.), with the share of LMICs rising from 31% in 1991 to 36% in 2005.

As aluminum prices are also expected to remain low by historical standards, smelting capacity growth should be slow. Most new smelting capacity is likely to be in Australia, Canada, the Middle East, South America, and southern Africa where bauxite and low-cost energy are in good supply.

Prices of aluminum and bauxite are expected to increase in the 1992-94 period as the market balance adjusts from the surplus in 1991. After that, with declining average costs of production, aluminum prices should fall in real terms.

The greatest source of uncertainty in the medium term for aluminum prices is the level of FSU exports to international markets. These will depend on the pace of domestic demand recovery, the changes in energy prices, and the renovation of antiquated smelting facilities.

Steel consumption in high-income countries fell 7% in 1991 due to the global economic slowdown. Consumption in the LMICs fell 8% in the 1989-91 period--mainly because of the sharp declines in Eastern Europe and the FSU. High-income country consumption is expected to grow at only 0.7% p.a. over the period to 2005. LMIC steel consumption growth is forecast at 2.1% p.a.

Steel production to continue its shifts to LMICs. World steel production is undergoing a substantial change with capacity shifting from the high-income countries to the LMICs. In 1980-91, steelmaking capacity in the high-income countries fell 120 million tons while LMIC capacity grew by 110 million tons. A further 20 million tons decline is expected in the high-income countries by 2000, which should be more than offset by a 30 million tons increase anticipated in the LMICs.

Low-cost iron ore producers will increase domination. Iron ore consumption will track steel production, increasing at about 1.3% p.a. over the 1991-2005 period. About 30 million tons of additional iron ore production capacity is expected to come on-line around the mid-1990s, mainly from upgrading existing operations in major producing countries. Australia and Brazil should strengthen their dominant positions as producers.

With the increasing dominance of the large low-cost producers, iron ore prices are expected to decline at an average rate of 0.7% p.a. in real terms over the forecast period.

Nickel market is one of the brighter spots for producers. Long-term growth in nickel consumption should be sustained at around 2% p.a. The outlook for nickel is generally upbeat because of its use in products that have strong growth potential. Environmental protection pressures should boost

nickel demand in the form of stainless steel and high nickel alloys used in the flue gas desulphurization in power plants.

Nickel production capacity is expected to increase by at least 100,000 tons over the next five years, with major expansions in Australia, Brazil, China, Cuba, and Colombia.

Some increase in real prices is expected in the latter half of the 1990s, with capacity expansions lagging demand increases because of current low prices.

Lead and zinc markets to remain in excess supply for several years. New mines will lower production costs. Lead and zinc prices have been at record lows in real terms in the past year due to weak demand--particularly in the automobile sector--and to increased supplies. The excess supply situation was exacerbated by exports from the FSU and Eastern Europe. Prior to 1990, these countries had been net importers of these metals.

Over the short term, lead and zinc prices are not expected to increase much, if at all, as the excess supply situation is expected to continue for the next two to three years.

The market balance is expected to improve by the mid-1990s as demand catches up with production capacity. Although greenfield lead and zinc projects have moved to more unfriendly environments in recent years (e.g., Red Dog mine in Alaska), costs of production have tended to fall. New mines projected to come on-stream in the latter half of the 1990s are expected to have even lower costs. So prices over the long term are expected to average at near the currrent low levels in real terms.

COMMODITY MARKET OUTLOOK--ENERGY

Petroleum consumption will grow most rapidly in LMICs. Petroleum consumption is expected to increase, on average, by 1.3% p.a. during the forecast period. Fastest growth should be seen in the LMICs (excluding Eastern Europe and the FSU), with their share growing from 16% in 1991 to 36% by 2005. Increased use of motor transport will be the main reason for this growth.

Supplies from non-OPEC producers (excluding the FSU) will contribute about one half of the incremental global output up to the mid-1990s. But beyond that time, dependence on OPEC will increase as several producing regions reach maturity.

OPEC's share to increase. OPEC's share of global output is expected to increase from 38% in 1991 to around 46% in 2005. The share of Middle East producers is expected to grow from 28% to 37%.

Which could mean higher prices for a period. The market outlook is for prices to decline slightly in real terms in the near term. Although industrial activity is expected to pick up after 1994, supplies should be ample to forestall price increases for some time. However, in the latter half of the decade, we expect prices to increase in real terms as production begins to decline in several OPEC and non-OPEC producers.

Coal prices expected to rise in long term with increased consumption and higher production costs. World coal consumption is expected to increase at 1.8% p.a. over the 1991-2005 period. Thermal coal consumption growth is forecast at 2.5% p.a.

Future production increases should come mostly from Australia, China, India, South Africa, and the United States. Most European countries and Japan can be expected to phase down their coal industries due to high costs, while Colombia, Indonesia, and Venezuela are likely to become more important exporters.

No increase is expected in coal prices in real terms up to 1995. Beyond that time, prices are expected to rise somewhat in real terms in line with increases in petroleum prices and with expected increases in production costs.

Table 1: Commodity Prices and Price Projections in 1990 Constant Dollars a/

		Actual							Projections					
									Short-Term				Long-Term	
		1970	1980	1985	1988	1989	1990	1991	1992	1993	1994	1995	2000	2005
ENERGY														
Petroleum	$/BBL	5.2	42.4	38.9	14.3	17.2	21.2	17.0	16.5	15.7	15.5	15.6	18.0	17.0
Coal	$/MT	N.A.	60	68	39	43	42	41	38	38	38	39	44	43
FOOD														
Coffee	c/KG	457	478	468	318	252	197	183	130	142	164	195	226	216
Cocoa	c/KG	269	362	329	166	131	127	117	106	108	111	113	124	136
Tea	c/KG	437	310	289	188	213	203	181	193	188	182	190	198	204
Sugar	$/MT	323	878	130	236	298	277	194	188	185	195	220	255	280
Beef	c/KG	520	384	314	264	271	256	261	229	228	227	228	274	253
Bananas	$/MT	659	527	551	502	578	541	548	471	443	439	434	422	414
Oranges	$/MT	670	543	581	476	471	531	510	488	473	471	470	453	436
Rice	$/MT	574	603	315	316	338	287	308	272	261	258	260	245	237
Wheat	$/MT	250	265	253	188	213	156	140	161	147	146	148	159	129
Maize	$/MT	233	174	164	112	118	109	105	99	94	95	95	101	82
Grain Sorghum	$/MT	207	179	150	103	112	104	103	97	92	91	91	98	79
FATS & OILS														
Palm Oil	$/MT	1,037	811	730	459	370	290	332	371	380	353	343	303	266
Coconut Oil	$/MT	1,584	936	860	593	546	337	424	554	498	509	535	564	457
Groundnut Oil	$/MT	1,510	1,194	1,319	619	819	964	875	568	584	583	617	554	421
Soybean Oil	$/MT	1,224	829	834	486	456	447	444	404	416	443	433	409	374
Soybeans	$/MT	466	412	327	318	291	247	235	221	224	234	234	219	233
Copra	$/MT	897	629	563	417	368	231	280	357	326	335	350	396	322
Palm Kernels	$/MT	670	480	424	280	265	185	215	216	214	219	234	243	227
Groundnut Meal	$/MT	407	334	208	220	211	185	147	147	149	163	172	157	175
Soybean Meal	$/MT	411	364	229	281	260	209	195	195	199	204	209	185	210
NON-FOOD														
Cotton	c/KG	252	284	192	147	177	182	164	122	117	136	140	150	145
Jute	$/MT	1,092	428	850	388	394	408	370	300	308	311	308	321	313
Rubber	c/KG	185	226	135	135	118	102	99	96	96	99	103	114	112
Tobacco	$/MT	3,938	3,196	2,843	2,037	1,998	1,964	2,182	1,849	1,787	1,742	1,733	1,712	1,690
TIMBER														
Logs (Meranti)	$/CM	148	271	199	245	237	210	217	236	238	241	243	258	276
Logs (Sapelli)	$/CM	171	350	253	285	289	344	309	316	322	324	327	346	368
Sawnwood	$/CM	370	507	403	322	446	524	462	483	484	489	493	517	543
METALS & MINERALS														
Copper	$/MT	5,634	3,032	2,066	2,730	3,009	2,662	2,291	2,173	2,153	1,865	1,704	1,974	1,840
Tin	c/KG	1,432	2,284	1,682	740	902	609	536	577	597	640	675	620	610
Nickel	$/MT	11,348	9,058	7,142	14,457	14,061	8,864	7,987	6,759	6,876	7,195	7,527	8,377	8,566
Aluminum	$/MT	2,153	2,466	1,517	2,676	2,062	1,639	1,275	1,183	1,312	1,466	1,601	1,465	1,435
Lead	$/MT	1,212	1,259	570	688	711	811	546	530	543	551	597	656	539
Zinc	$/MT	1,176	1,057	1,141	1,303	1,753	1,513	1,094	1,220	1,131	1,110	1,107	1,173	1,034
Iron Ore	$/MT	39.2	39.0	38.7	24.7	28.0	30.8	32.6	29.7	27.4	26.4	27.8	27.9	27.1
Bauxite	$/MT	47.8	44.5	52.0	31.8	36.3	34.4	33.1	30.0	29.9	30.2	31.1	30.0	30.0
Gold	$/TOZ	143	845	463	459	403	384	355	324	317	335	340	360	360
Silver	c/TOZ	706	2,867	895	686	581	482	396	375	353	380	389	450	450
FERTILIZERS														
Phosphate Rock	$/MT	44	65	49	38	43	41	42	40	40	41	42	42	41
Urea	$/MT	193	309	199	163	140	157	168	134	141	148	153	169	159
TSP	$/MT	169	251	177	166	152	132	130	114	110	115	120	125	123
DAP	$/MT	215	309	246	206	183	171	169	136	127	135	140	148	145
Potassium Chlor b/	$/MT	126	161	122	92	104	98	107	105	104	108	108	107	105

N.A. = Not Available.
a/ Computed from unrounded data and deflated by MUV (1990=100).
b/ Potassium Chloride, also known as Muriate of Potash.

Source: World Bank, International Economics Department.
November 9, 1992

Table 2: Commodity Prices and Price Projections in Current Dollars a/

		Actual							Projections					
									Short-Term				Long-Term	
		1970	1980	1985	1988	1989	1990	1991	1992	1993	1994	1995	2000	2005
ENERGY														
Petroleum	$/BBL	1.3	30.5	26.7	13.6	16.3	21.2	17.3	17.6	17.3	17.4	18.0	24.7	26.8
Coal	$/MT	N.A.	43	47	37	41	42	42	40	42	43	45	60	68
FOOD														
Coffee	¢/KG	115	344	321	303	239	197	187	139	157	185	225	310	340
Cocoa	¢/KG	68	260	225	159	124	127	120	113	119	125	131	170	215
Tea	¢/KG	110	223	198	179	202	203	184	206	208	205	220	272	322
Sugar	$/MT	81	632	90	225	282	277	198	200	205	220	254	350	441
Beef	¢/KG	130	276	215	252	257	256	266	244	252	256	264	376	399
Bananas	$/MT	165	379	378	478	547	541	560	502	490	494	502	579	652
Oranges	$/MT	168	391	398	453	445	531	521	520	523	530	543	622	687
Rice	$/MT	144	434	216	301	320	287	314	290	288	290	300	336	374
Wheat	$/MT	63	191	173	180	201	156	143	172	162	164	171	218	204
Maize	$/MT	58	125	112	107	112	109	107	105	104	107	110	139	130
Grain Sorghum	$/MT	52	129	103	99	106	104	105	103	102	103	105	134	125
FATS & OILS														
Palm Oil	$/MT	260	584	501	437	350	290	339	395	420	397	396	416	420
Coconut Oil	$/MT	397	674	590	565	517	337	433	590	550	573	618	774	721
Groundnut Oil	$/MT	379	859	905	590	775	964	894	605	645	656	713	760	664
Soybean Oil	$/MT	307	597	572	463	432	447	454	430	460	499	500	562	590
Soybeans	$/MT	117	296	224	304	275	247	240	235	248	263	270	300	368
Copra	$/MT	225	453	386	398	348	231	286	380	360	377	404	544	508
Palm Kernels	$/MT	168	345	291	267	251	185	220	230	237	246	270	334	358
Groundnut Meal	$/MT	102	240	143	210	200	185	150	157	165	184	199	216	276
Soybean Meal	$/MT	103	262	157	268	246	209	199	208	220	230	241	254	331
NON-FOOD														
Cotton	¢/KG	63	205	132	140	167	182	168	130	129	153	162	206	229
Jute	$/MT	274	308	583	370	373	408	378	320	340	350	356	441	493
Rubber	¢/KG	46	162	92	129	112	102	101	102	106	112	119	156	177
Tobacco	$/MT	988	2,300	1,950	1,941	1,891	1,964	2,228	1,970	1,975	1,961	2,003	2,350	2,663
TIMBER														
Logs (Meranti)	$/CM	37	195	136	233	225	210	222	251	263	271	281	354	435
Logs (Sapelli)	$/CM	43	252	174	271	274	344	316	337	356	365	378	475	580
Sawnwood	$/CM	93	365	276	307	422	524	472	514	535	550	570	710	855
METALS & MINERALS														
Copper	$/MT	1,413	2,182	1,417	2,602	2,848	2,662	2,339	2,315	2,380	2,100	1,970	2,710	2,900
Tin	¢/KG	359	1,644	1,154	705	853	609	548	615	660	720	780	851	961
Nickel	$/MT	2,846	6,519	4,899	13,778	13,308	8,864	8,156	7,200	7,600	8,100	8,700	11,500	13,500
Aluminum	$/MT	540	1,775	1,041	2,551	1,951	1,639	1,302	1,260	1,450	1,650	1,850	2,011	2,261
Lead	$/MT	304	906	391	656	673	811	558	565	600	620	690	900	850
Zinc	$/MT	295	761	783	1,242	1,659	1,513	1,117	1,300	1,250	1,250	1,280	1,610	1,630
Iron Ore	$/MT	9.8	28.1	26.6	23.5	26.5	30.8	33.3	31.6	30.3	29.7	32.1	38.3	42.7
Bauxite	$/MT	12	32	35.7	30.3	34.4	34.4	33.8	32	33	34	36	41.2	47.3
Gold	$/TOZ	36	608	318	437	381	384	362	345	350	377	393	494	567
Silver	¢/TOZ	177	2,064	614	654	550	482	404	400	390	428	450	618	709
FERTILIZERS														
Phosphate Rock	$/MT	11	47	34	36	41	41	43	43	44	46	48	58	65
Urea	$/MT	48	222	136	155	132	157	172	143	156	167	177	232	251
TSP	$/MT	43	180	121	158	144	132	133	121	122	129	139	172	194
DAP	$/MT	54	222	169	197	173	171	173	145	140	152	162	203	229
Potassium Chlor b/	$/MT	32	116	84	88	99	98	109	112	115	122	125	147	165

N.A. = Not Available.
a/ Data have been unrounded.
b/ Potassium Chloride, also known as Muriate of Potash.

Source: World Bank, International Economics Department.
November 9, 1992

Table 3: Weighted Index of Commodity Prices
(Constant US Dollars)
(1990=100)

(Weights-%Share) a/	Petroleum	33 Commodities (Excluding Energy) (100.0)	Agriculture: Total (67.7)	Food: Total (53.2)	Beverages (22.3)	Cereal (9.4)	Fats & Oil (9.3)	Other (12.3)	Non-Food (14.4)	Timber (5.2)	Metals & Minerals (27.1)
1948	55.9	176.2	228.7	226.8	203.4	280.0	396.7	137.6	235.0	50.7	111.9
1949	48.1	175.7	223.8	226.1	234.8	295.5	309.7	136.1	216.2	55.7	118.1
1950	48.8	232.3	308.4	286.4	343.7	320.6	370.2	165.4	380.0	66.5	136.1
1951	42.4	242.9	317.8	276.3	331.3	301.3	383.5	151.5	453.2	84.9	147.1
1952	40.5	210.5	258.3	245.5	301.5	285.1	308.1	133.1	300.3	60.7	159.5
1953	44.1	202.3	251.2	254.8	316.4	293.9	317.0	137.1	239.2	57.1	148.6
1954	47.6	224.0	285.5	299.0	458.6	279.1	300.8	141.6	241.5	80.1	148.1
1955	46.7	217.3	262.3	253.6	357.6	242.1	274.5	140.5	290.6	63.0	172.1
1956	45.1	211.5	254.1	253.5	362.0	236.4	271.6	140.3	256.1	58.6	170.1
1957	44.1	195.7	242.1	241.8	324.1	220.5	267.8	154.6	243.3	55.3	145.1
1958	41.1	179.3	220.7	220.9	290.3	219.6	247.8	135.4	220.3	51.8	134.5
1959	37.0	181.5	220.8	210.2	258.9	211.8	268.0	129.6	255.5	61.9	138.7
1960	34.0	177.9	215.2	200.7	246.1	197.6	249.5	130.7	262.6	66.6	137.0
1961	33.5	166.4	199.9	193.7	229.2	208.9	248.2	120.9	220.3	67.7	129.3
1962	30.6	163.4	196.4	190.8	214.1	226.2	238.3	122.8	214.6	72.8	125.5
1963	31.2	170.9	207.7	209.1	215.7	230.6	256.2	166.7	203.1	72.5	128.2
1964	28.5	181.4	210.9	213.3	243.6	225.9	259.6	151.3	203.3	60.9	155.7
1965	28.2	184.4	201.7	203.1	231.7	219.3	283.3	124.3	197.4	69.7	178.6
1966	27.4	184.8	197.7	198.9	218.9	239.5	265.8	121.7	193.7	70.9	186.4
1967	27.0	172.1	193.3	196.7	210.7	249.2	251.7	125.0	182.0	74.9	156.0
1968	27.3	175.3	193.9	195.0	210.3	244.8	242.9	126.8	190.3	77.5	163.7
1969	25.9	177.9	191.9	191.4	207.2	230.5	228.2	134.3	193.7	71.0	176.1
1970	24.4	172.9	189.7	195.6	226.6	198.4	253.9	132.7	170.5	70.6	165.5
1971	30.2	153.4	172.4	175.5	187.2	181.8	240.9	127.5	162.2	68.3	138.6
1972	31.0	148.0	170.3	175.6	189.0	175.7	218.1	140.7	153.1	62.0	127.6
1973	38.0	194.1	229.2	235.4	207.5	310.0	389.3	146.3	209.1	93.5	154.6
1974	129.4	212.3	249.2	266.8	196.2	368.8	361.4	236.2	191.7	91.9	173.9
1975	113.3	158.9	184.7	195.3	167.5	259.3	218.3	176.5	150.0	62.4	134.6
1976	119.9	179.3	214.4	223.1	316.2	209.1	230.5	129.4	186.2	82.6	139.0
1977	119.4	197.0	247.8	271.0	484.8	174.8	260.1	106.5	172.2	87.4	132.5
1978	104.6	163.2	199.6	210.9	312.3	182.3	236.4	108.1	162.9	80.0	117.9
1979	133.1	167.9	195.2	202.5	285.6	168.0	238.9	116.9	171.4	123.2	130.2
1980	199.0	168.2	193.0	197.4	233.6	182.8	201.7	165.4	178.7	129.1	133.8
1981	222.9	146.6	167.9	172.0	193.6	194.4	193.7	125.8	154.7	102.4	119.2
1982	204.6	134.0	150.6	154.3	200.9	143.8	160.2	108.4	138.4	104.2	111.8
1983	189.8	144.2	165.3	167.3	207.8	159.1	193.3	116.6	159.0	99.3	117.1
1984	189.7	148.8	174.8	182.0	245.5	155.3	232.3	105.9	151.3	116.8	110.6
1985	182.7	131.3	151.0	158.7	224.4	134.7	161.4	101.8	126.1	94.4	105.1
1986	78.4	112.1	132.1	142.8	232.8	100.0	105.6	91.1	97.2	89.0	82.4
1987	90.9	102.0	109.6	109.6	139.2	85.9	111.9	90.8	109.9	118.5	85.4
1988	67.0	114.0	116.8	120.8	144.9	108.1	136.9	94.8	103.9	116.4	108.7
1989	80.9	112.8	112.2	114.5	120.4	116.3	124.3	102.3	104.6	112.9	113.8
1990	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	79.6	93.9	95.5	95.1	92.2	100.0	100.8	92.5	97.0	103.2	89.2
1992	77.6	87.2	85.8	86.8	73.8	94.4	104.0	87.7	82.4	112.0	84.4
1993	73.5	86.6	84.9	86.3	77.5	89.5	104.1	84.9	80.6	113.1	83.8
1994	72.6	87.5	88.1	88.9	85.0	89.2	104.5	85.2	85.6	114.4	80.9
1995	73.2	90.1	92.2	93.5	96.6	89.7	105.8	86.5	87.7	115.6	81.3
2000	84.5	94.2	96.4	97.4	109.1	91.2	98.0	88.2	93.4	122.6	84.6
2005	79.9	92.2	94.1	94.9	107.6	79.6	96.9	89.1	91.6	131.2	80.9

a/ Weighted by 1979-1981 Developing Countries Export Values.

Source: World Bank, International Economics Department.
November 9, 1992

Table 4: Weighted Index of Commodity Prices
(Current US Dollars)
(1990=100)

(Weights-%Share) a/	Petroleum	33 Commodities (Excluding Energy) (100.0)	Agriculture: Total (67.7)	Food: Total (53.2)	Beverages (22.3)	Cereal (9.4)	Fats & Oil (9.3)	Other (12.3)	Non-Food (14.4)	Timber (5.2)	Metals & Minerals (27.1)
1948	10.8	34.0	44.1	43.8	39.3	54.1	76.6	26.6	45.4	9.8	21.6
1949	8.9	32.6	41.5	41.9	43.5	54.8	57.4	25.2	40.1	10.3	21.9
1950	8.0	38.0	50.5	46.9	56.2	52.5	60.6	27.1	62.2	10.9	22.3
1951	8.0	45.7	59.8	52.0	62.3	56.7	72.1	28.5	85.3	16.0	27.7
1952	8.0	41.5	50.9	48.4	59.5	56.2	60.8	26.2	59.2	12.0	31.5
1953	8.5	38.8	48.1	48.8	60.6	56.3	60.7	26.3	45.8	10.9	28.5
1954	8.9	42.0	53.5	56.0	86.0	52.3	56.4	26.5	45.3	15.0	27.8
1955	8.9	41.5	50.1	48.4	68.3	46.2	52.4	26.8	55.5	12.0	32.9
1956	8.9	41.9	50.3	50.2	71.6	46.8	53.7	27.8	50.7	11.6	33.7
1957	8.9	39.6	48.9	48.9	65.5	44.6	54.1	31.2	49.2	11.2	29.3
1958	8.5	36.9	45.4	45.4	59.7	45.2	50.9	27.8	45.3	10.6	27.7
1959	7.5	36.8	44.8	42.6	52.5	42.9	54.4	26.3	51.8	12.5	28.1
1960	7.0	36.8	44.5	41.5	50.9	40.9	51.6	27.1	54.4	13.8	28.3
1961	7.0	35.0	42.1	40.8	48.2	44.0	52.2	25.4	46.4	14.3	27.2
1962	6.6	35.1	42.2	41.0	46.0	48.6	51.2	26.4	46.1	15.6	27.0
1963	6.6	36.0	43.7	44.0	45.4	48.5	53.9	35.1	42.7	15.3	27.0
1964	6.1	38.8	45.1	45.6	52.1	48.3	55.6	32.4	43.5	13.0	33.3
1965	6.1	39.9	43.6	43.9	50.1	47.4	61.2	26.9	42.6	15.1	38.6
1966	6.1	41.2	44.1	44.4	48.8	53.4	59.3	27.1	43.2	15.8	41.6
1967	6.1	38.9	43.7	44.4	47.6	56.3	56.8	28.2	41.1	16.9	35.2
1968	6.1	39.2	43.4	43.6	47.1	54.8	54.4	28.4	42.6	17.3	36.6
1969	6.1	41.9	45.2	45.1	48.8	54.3	53.8	31.7	45.6	16.7	41.5
1970	6.1	43.3	47.5	49.0	56.7	49.7	63.6	33.2	42.7	17.7	41.4
1971	8.0	40.6	45.6	46.4	49.5	48.1	63.7	33.7	42.9	18.1	36.6
1972	8.9	42.7	49.1	50.6	54.4	50.6	62.8	40.5	44.1	17.9	36.8
1973	12.7	64.7	76.5	78.5	69.2	103.4	129.9	48.8	69.7	31.2	51.6
1974	52.6	86.3	101.2	108.4	79.7	149.8	146.9	96.0	77.9	37.4	70.7
1975	51.2	71.8	83.4	88.2	75.7	117.2	98.6	79.7	67.8	28.2	60.8
1976	54.9	82.1	98.2	102.2	144.9	95.8	105.6	59.3	85.3	37.8	63.7
1977	60.1	99.2	124.8	136.4	244.1	88.0	131.0	53.6	86.7	44.0	66.7
1978	60.6	94.5	115.6	122.1	180.8	105.5	136.9	62.6	94.3	46.3	68.3
1979	87.3	110.1	128.0	132.8	187.3	110.2	156.7	76.7	112.4	80.8	85.4
1980	143.2	121.1	138.9	142.0	168.1	131.6	145.1	119.0	128.6	92.9	96.2
1981	161.0	105.9	121.3	124.3	139.8	140.4	140.0	90.9	111.8	74.0	86.1
1982	145.5	95.3	107.1	109.7	142.9	102.3	113.9	77.1	98.4	74.1	79.5
1983	131.9	100.2	114.9	116.3	144.5	110.6	134.4	81.0	110.5	69.0	81.4
1984	129.1	101.2	118.9	123.8	167.0	105.6	158.0	72.1	102.9	79.5	75.3
1985	125.4	90.1	103.6	108.8	154.0	92.4	110.7	69.8	86.5	64.7	72.1
1986	63.4	90.6	106.8	115.5	188.2	80.8	85.4	73.6	78.6	71.9	66.6
1987	80.8	90.6	97.4	97.3	123.6	76.3	99.4	80.7	97.6	105.2	75.8
1988	63.8	108.7	111.4	115.1	138.1	103.0	130.5	90.3	99.1	110.9	103.7
1989	76.5	106.7	106.1	108.3	113.9	110.0	117.6	96.8	99.0	106.8	107.7
1990	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	81.2	95.9	97.5	97.1	94.1	102.1	102.9	94.4	99.1	105.4	91.0
1992	82.6	92.9	91.4	92.5	78.6	100.6	110.8	93.4	87.7	119.3	89.9
1993	81.2	95.6	93.9	95.3	85.7	98.9	115.0	93.8	89.1	125.0	92.6
1994	81.7	98.5	99.2	100.1	95.8	100.4	117.6	95.9	96.4	128.8	91.1
1995	84.5	104.1	106.5	108.0	111.6	103.6	122.2	99.9	101.3	133.6	94.0
2000	116.0	129.4	132.4	133.7	149.8	125.2	134.5	121.1	128.2	168.3	116.1
2005	125.8	145.3	148.2	149.4	169.5	125.5	152.7	140.4	144.3	206.7	127.5

a/ Weighted by 1979-1981 Developing Countries Export Values.

Source: World Bank, International Economics Department.
November 9, 1992

Table 5: Inflation Indices: 1948-2005 a/

Year	G-5 MUV Index b/ 1990=100	G-5 MUV Index b/ % Change	US GNP Deflator 1990=100	US GNP Deflator % Change	G-5 GNP Deflator c/ 1990=100	G-5 GNP Deflator c/ % Change	G-7 CPI d/ 1990=100	G-7 CPI d/ % Change
1948	19.29		17.89	7.01				
1949	18.54	-3.90	17.80	-0.52			13.25	
1950	16.33	-11.90	18.15	2.01			12.40	-6.46
1951	18.83	15.30	19.03	4.82			13.74	10.84
1952	19.73	4.80	19.32	1.51			14.33	4.29
1953	19.18	-2.80	19.63	1.61	14.38		14.45	0.87
1954	18.76	-2.20	19.94	1.60	14.63	1.75	14.67	1.48
1955	19.11	1.90	20.58	3.24	14.94	2.16	14.72	0.38
1956	19.80	3.60	21.28	3.36	15.57	4.22	15.04	2.13
1957	20.22	2.10	22.04	3.60	16.08	3.24	15.37	2.24
1958	20.56	1.70	22.49	2.05	16.27	1.18	15.66	1.86
1959	20.27	-1.40	23.07	2.57	16.27	0.00	15.63	-0.21
1960	20.70	2.10	23.46	1.68	16.65	2.33	15.93	1.91
1961	21.05	1.70	23.68	0.96	17.21	3.41	16.30	2.36
1962	21.47	2.00	24.21	2.22	17.84	3.66	16.76	2.84
1963	21.06	-1.90	24.56	1.44	18.35	2.83	17.30	3.21
1964	21.43	1.75	24.96	1.64	18.85	2.75	17.75	2.60
1965	21.59	0.74	25.60	2.57	19.42	3.01	18.32	3.18
1966	22.35	3.50	26.50	3.50	20.05	3.25	18.94	3.39
1967	22.61	1.16	27.25	2.82	20.68	3.14	19.43	2.58
1968	22.39	-0.96	28.61	4.98	21.44	3.66	19.97	2.78
1969	23.60	5.40	30.16	5.42	22.07	2.94	20.84	4.38
1970	25.08	6.27	31.86	5.65	23.55	6.71	22.11	6.10
1971	26.44	5.42	33.64	5.59	25.44	8.03	23.60	6.71
1972	28.81	8.97	35.24	4.77	28.05	10.26	26.04	10.38
1973	33.37	15.84	37.55	6.55	31.82	13.44	29.76	14.27
1974	40.66	21.84	40.91	8.93	34.73	9.11	32.96	10.74
1975	45.21	11.18	44.96	9.91	39.28	13.11	37.03	12.36
1976	45.83	1.38	47.81	6.34	40.39	2.83	38.26	3.30
1977	50.34	9.85	51.00	6.67	44.03	9.02	42.29	10.54
1978	57.94	15.08	54.75	7.34	51.23	16.35	51.82	22.54
1979	65.62	13.26	59.56	8.79	57.10	11.46	54.84	5.82
1980	71.97	9.68	64.98	9.10	63.06	10.42	61.32	11.82
1981	72.26	0.41	71.23	9.62	62.65	-0.65	61.82	0.82
1982	71.15	-1.53	75.81	6.43	62.20	-0.72	61.04	-1.27
1983	69.53	-2.28	78.73	3.86	62.49	0.48	62.01	1.58
1984	68.05	-2.14	81.67	3.73	61.74	-1.20	61.84	-0.26
1985	68.60	0.81	84.11	2.98	63.11	2.21	63.10	2.02
1986	80.89	17.91	86.37	2.69	76.53	21.27	76.14	20.67
1987	88.84	9.84	89.20	3.28	86.32	12.78	86.01	12.97
1988	95.31	7.28	92.28	3.45	92.11	6.71	92.60	7.65
1989	94.65	-0.70	96.08	4.12	91.25	-0.94	92.18	-0.45
1990	100.00	5.66	100.00	4.08	100.00	9.59	100.00	8.49
1991	102.11	2.11	103.63	3.63	104.01	4.01	105.11	5.11
1992	106.53	4.33					111.65	6.22
1993	110.53	3.75					115.65	3.58
1994	112.58	1.86					118.37	2.35
1995	115.59	2.67					121.78	2.88
1996	119.63	3.50					126.40	3.80
1997	123.82	3.50					131.21	3.80
1998	128.15	3.50					136.19	3.80
1999	132.64	3.50					141.37	3.80
2000	137.28	3.50					146.74	3.80
2005	157.60	2.80					175.55	3.65

a/ Figures for 1992-2005 are projections.
b/ Unit value index in US dollar terms of manufactures exported from the G-5 countries (France, Germany, Japan, UK, and US) weighted proportionally to the countries' exports to the developing countries.
c/ Aggregate index of GNP deflators in US dollar terms for the G-5 countries, using SDR-based moving weights.
d/ Aggregate consumer price index in US dollar terms for the G-7 countries (Canada, France, Germany, Italy, Japan, UK and US) weighted by the countries' 1988-90 average GNP in current US dollars.

Sources: G-5 MUV Index, G-5 GNP Deflator, and G-7 CPI -- World Bank.
US GNP Deflator -- International Monetary Fund.

World Bank, International Economics Department, International Trade Division.
October 26, 1992

Petroleum

Summary

- Petroleum consumption is expected to grow at an average 1.3% p.a. throughout the 1992-2005 period.

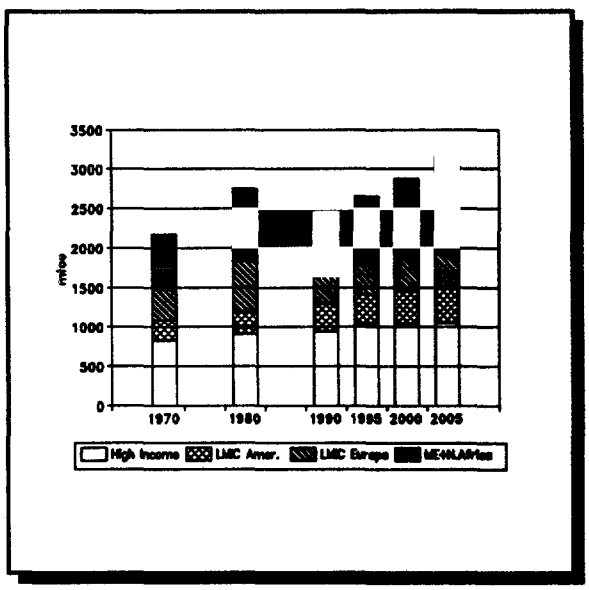
- Fastest consumption growth should be seen in the LMICs (excluding Eastern Europe and the FSU), with their share of global consumption growing from 16% in 1991 to 36% by 2005. Increased use of motor transport will be the main reason for this growth.

- Supplies from non-OPEC producers (excluding the FSU) will contribute about one half of incremental global output up to the mid-1990s. But beyond that time, the world will depend increasingly on OPEC as many producing regions reach maturity.

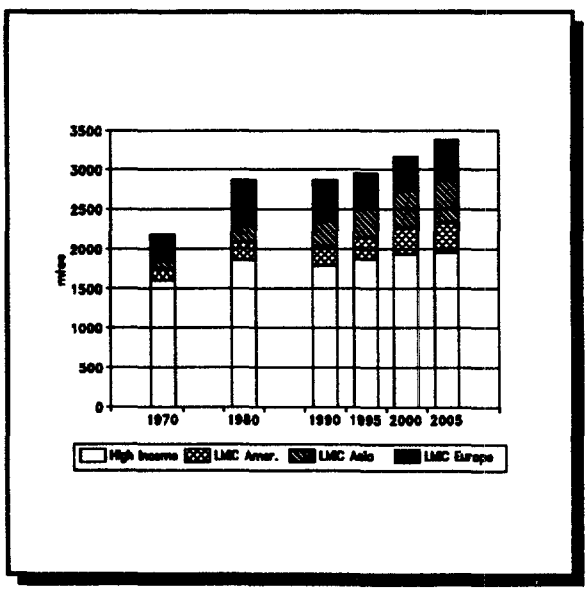
- OPEC's share of global output is expected to increase from 38% in 1991 to around 46% in 2005. The share of Middle East producers is expected to grow from 28% to 37%.

- The market outlook is for prices to decline slightly in real terms in the near term. In the latter half of the decade, we expect prices to increase in real terms as production begins to decline in several OPEC and non-OPEC producers.

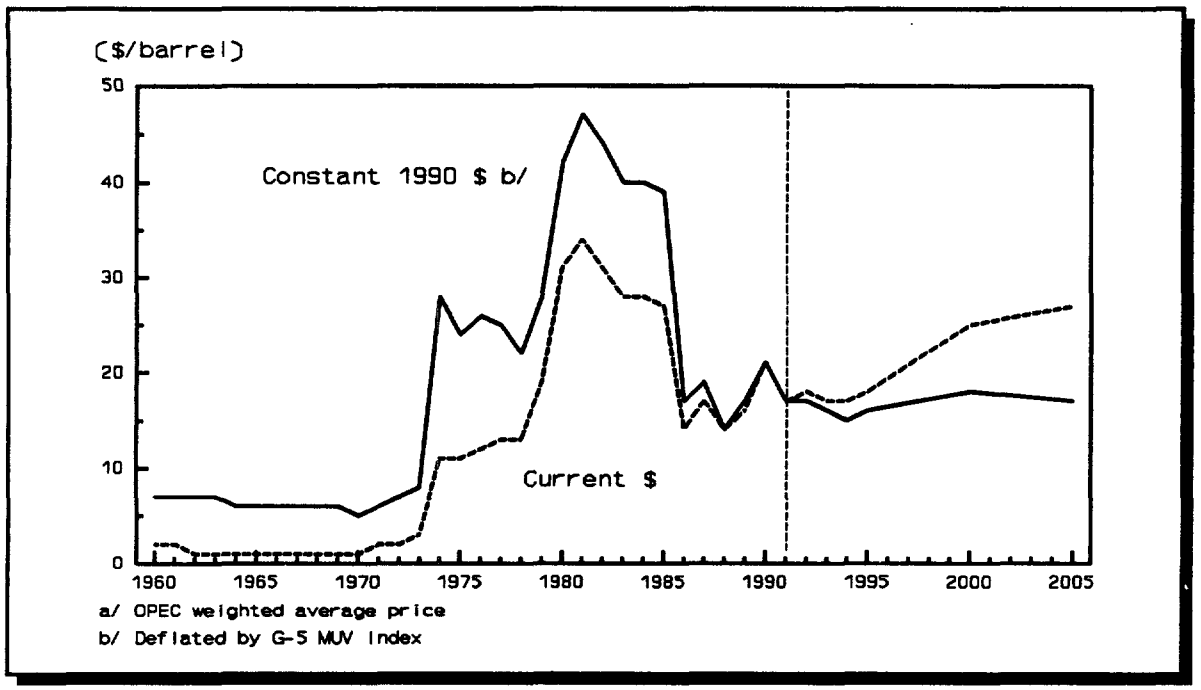
Projected Petroleum Production, by Region



Projected Petroleum Consumption, by Region



Petroleum Prices, a/ 1960-2005



Global petroleum consumption increased at a rate of 2.5% p.a. over the period 1985-89, reversing the declining trend of the early 1980s. However, since then, consumption growth has slowed significantly (to 0.2% p.a.), with modest increases in the industrial countries and developing countries partially offset by the decline in the FSU. In the FSU and Eastern Europe, petroleum consumption declined from 540 mtoe in 1989 to 503 mtoe in 1991. In the OECD and developing countries, sluggish growth in industrial production and incomes contributed to the slowdown in oil consumption growth. The oil price shock in late 1990 and the subsequent increased uncertainty about oil supplies may also have had an impact.

Under our long-term baseline economic growth assumption of 2.8% p.a. for industrial countries and 5% for developing countries, petroleum consumption is expected to grow throughout the forecast period (to 2005) at an average rate of 1.3% p.a. (Table 1).

Three fourths of the incremental oil consumption expected is anticipated to occur in developing countries. As a result, their share in global oil consumption should increase to 36% by 2005 (up from 16% in 1991). Increased motorization will be one of the main factors behind this strong performance. The transportation sector is likely to remain tied to liquid fuels over the forecast period, while the power generation and industrial and residential/commercial sectors are expected to be the main areas of substitution for petroleum products. However, the continuing introduction of more energy-efficient transport equipment should reduce the rate of growth of demand for transport fuels. In addition, higher gasoline prices resulting from compliance by refineries with environmental standards in the OECD and the continuation of the recent trends in developing countries to align domestic oil prices to reflect prices in the international market, are likely to constrain the increase in oil demand.

Table 1: Global Long-Run Petroleum Market Outlook to 2005

Regions	1991 MTOE	1991 %	2005 MTOE	2005 %	Incremental MTOE	Incremental %	Change % p.a.
Oil Consumption							
Industrial	1,740	56	1,884	50	144	23	0.6
Eastern Europe & FSU	503	28	517	14	14	2	0.2
Other Countries	879	16	1,343	36	464	75	3.1
Total	3,122	100	3,744	100	622	100	1.3
Oil Production							
Industrial Countries	779	26	708	19	71	-11	-0.7
Eastern Europe & FSU	541	17	550	15	9	1	0.1
Other Countries	1,802	58	2,486	66	684	110	2.3
Memo:							
Non-OPEC Developing Countries	625	20	773	21	148	24	1.5
Non-OPEC (excl. FSU)	1,404	45	1,481	40	77	12	0.4
Total Non-OPEC	1,945	62	2,031	54	86	14	0.3
OPEC	1,177	38	1,713	46	536	86	2.7
Middle East	864	28	1,379	37	515	83	3.4
Prices ($/bbl)							
Current	17.3		26.8		9.5		3.2
Constant ($1990)	17.0		17.0		0.0		0.0

Source: World Bank, International Economics Department.

We expect the declining trend in FSU oil consumption to continue up to the mid- to late 1990s. This decline will be forced by several factors including: (i) the expected decline in FSU oil output; (ii) the shift to market pricing; and (iii) improvements in the efficiency of oil/energy use. However, over the longer run, we expect oil consumption to increase under the influence of rising per capita incomes and transport demand.

Since 1980 non-OPEC crude oil output has increased by around 1.1% p.a. to 1,945 mtoe in 1991. Declines in the United States and the FSU (in the late 1980s) were more than offset by increases in the North Sea region and in developing countries. Based on estimates of recoverable oil reserves (and reserves-to-production ratios) and expected investments, the outlook for supplies from non-OPEC sources (excluding the FSU) is for an increase of around 0.4% p.a. to 1,481 mtoe in 2005 (up from 1,404 mtoe in 1991). Crude oil production in the FSU is expected to decline over the medium term, but due to the impact of foreign investment and the supply response to increases in domestic prices, is expected to recover to about 550 mtoe by the year 2005. In aggregate, therefore, non-OPEC production is expected to supply roughly 14% of the increment in the global oil demand up to 2005. Up to the mid-1990s, the

increase in output in industrial countries and in the developing countries should more than offset the decline in the FSU. While increased foreign participation and investment should increase supplies from non-OPEC developing countries, at the same time liberal fiscal terms for the development of new fields and the application of improved technologies are likely to support increases in the OECD (mainly in the North Sea region). However, given the high rate of depletion of OECD oil reserves in the 1980s, production from the industrial countries is projected to decline after 1995.

Non-OPEC (excluding the FSU) producers will contribute about one half of the incremental global output up to 1995. However, beyond the mid-1990s, the world will depend increasingly on OPEC for additional supplies as many producing regions will reach maturity and begin to deplete. Since a few OPEC members will also reach production plateaus by the mid-1990s and several others will enter the depletion phase towards the end of the century, a smaller group of producers including Saudi Arabia, Iran, the United Arab Emirates (UAE), Iraq, and Kuwait will attain a more dominant position in the world oil market. However, we do not believe that OPEC will be able to exert effective control over the market.

It is anticipated that by 2005, production in OPEC countries will increase to 1,713 mtoe with OPEC's share in total petroleum production rising to around 46% (up from 38% in 1991). Middle East OPEC production is expected to increase at a trend rate of roughly 3.4% p.a. over the forecast period and its market share to increase to over 37% in 2005 (up from 28% in 1991).

The market outlook for crude oil prices is presently for an increase to $18.40/bbl in the second half of 1992 compared with a $16.70/bbl first half 1992 average. Market expectations that crude oil supplies will constrain increases in oil consumption and the view that the UN embargo on Iraqi crude oil exports will continue underlie the expected price increase. However, in 1993 prices are expected to decline to an average of $17.30/bbl with any increase in global demand being more than offset by increases in supplies from OPEC and non-OPEC sources.

Over the period 1993-95, we expect (nominal) prices to increase by 2% p.a. However, in real terms, they are expected to remain unchanged. The impact on prices of economic recovery and growth, particularly in the United States, and further declines in supplies from the FSU is offset by increases in supplies from OPEC sources.

Based on our long-run macroeconomic assumptions, we expect global oil demand to increase at a rate of 1.5% p.a. (by 259 mtoe) over the period 1995-2000. Only modest increases are expected in non-OPEC supplies during this period which will put pressures on oil-producing capacity. Based on the expected increase in OPEC output capacity to 1,715 mtoe, an increase in OPEC output to 1,480 mtoe to meet demand translates into an OPEC capacity utilization rate of over 87%. Therefore, with the tightening market balance, prices should increase in real terms from $15.60/bbl to $18/bbl during this period.

To test the robustness of these results, we also carried out a model simulation which assumes flat prices (in real term) over the forecast period. We have found that if oil prices are held constant at $16.50/bbl (the average price expected in 1992 in constant 1990 US dollars) over the period 1992-2000, the projected demand and supply responses exert strong pressures on OPEC's oil production capacity. We estimate that in this situation, global oil demand would be roughly 100 mtoe (2 mb/d) higher and non-OPEC supply would be roughly 50 mtoe (1 mb/d) lower than assumed in the base case by the year 2000. This would lead to an increase in OPEC's capacity utilization rates to roughly 95%

thereby exerting strong upward pressure on prices. Alternatively, at a utilization rate of around 81%, it is estimated that OPEC's output capacity would need to expand to roughly 1,850 mtoe (37 mb/d) by 2000 to meet oil demand growth generated by flat oil prices. These estimates are outside the range of industry estimates (or at the very high end) for OPEC's output capacity.

Beyond the year 2000, we expect a downturn in prices. OPEC output capacity is expected to reach 2,000 mtoe by the year 2005 mainly in response to large investment incentives provided by the higher prices in the late 1990s. FSU output is also expected to increase as a result of increased foreign investments and application of improved technologies. At the same time, oil demand growth in the OECD should decline and developing countries' consumption growth should slowsdue to improvements in the efficiency of oil use and increased use of natural gas--primarily for environmental reasons.

The long-run base case price forecasts are based upon the following key assumptions: (i) GDP growth in the OECD and developing countries will be 2.8% p.a. and 5% p.a., respectively, through the year 2000; (ii) OPEC output capacity will increase to about 1,700 mtoe (34 mb/d) by 2000 and to over 2,000 mtoe (40 mb/d) by 2005; (iii) the income elasticity of oil demand is close to unity; (iv) non-OPEC oil output (excluding the FSU) will increase to 1,475 mtoe (29.5 mb/d) in 2000 and remain around this level; and (v) FSU output will continue to decline up to the mid-1990s but increase steadily thereafter to reach 550 mtoe (11 mb/d) in 2005 (see Table 1). Different assumptions for any of these variables would give different forecasts.

Under an assumption of higher OECD economic growth (from the 2.8% p.a. assumed in the base case up to 3.2% p.a.), the market-clearing price of oil (in real terms) trends above the baseline by about 2.5% in the medium term and about 5% in the long term. However, a corresponding decline in the economic growth assumption (down to about 2.5% p.a.) has a greater impact on prices. In this situation, prices trend below the projected baseline by about 3% in the medium term (1995) and about 8% in the long term (2005). We estimate the impact on world oil prices of alternative assumptions about the income elasticity of oil demand to be as follows: under an assumed higher income elasticity of demand of 1.4, prices trend about 3% higher in the medium term and 15% higher in the long term. Alternatively, a reduced income elasticity of demand to 0.6 results in price trending 3% and 14% lower in the medium and long term, respectively.

Adoption of environmental policies such as use of carbon taxes to achieve CO_2 reduction is assumed in the baseline. If more aggressive OECD policies are implemented to reduce dependence on oil imports than we have assumed, this would reduce crude oil prices even further. We estimate that reduction in oil demand (of 1-2 mb/d in the medium term and 3-4 mb/d in the long term) due to environmental policies would lower oil baseline forecast prices by 4-6% in the medium term and 8-10% in the long run, *ceteris paribus*.

Output forecasts for non-OPEC suppliers to the year 2000 have been made within a range of 1,200 to 1,700 mtoe. An assessment of the impact of different assumptions about non-OPEC output on the long-term price shows that an increase in non-OPEC oil supplies to 1,700 mtoe (as compared to our base case assumption of 1,475 mtoe, excluding the FSU) would result in the long-run price of oil trending about 11% below the baseline. However, assuming production from non-OPEC sources at the

lower end of the range (1,200 mtoe) results in the long-term oil prices trending about 18% above the baseline forecast, since it would lead to sharp increases in the utilization of OPEC's oil production capacity. In this case, the impact on prices would be lessened beyond the year 2000 because of lagged demand and supply (OPEC) side responses to the higher prices.

In assessing the impact of different FSU supply prospects, we see the price risks associated with unexpected changes in FSU oil supplies to be asymmetric. The medium-term impact on prices would be greater where the FSU output increases than would be the case of a decline. This is based on our view that a decline in FSU output would be offset by increases from other producers. However, in a situation of a higher-than- anticipated output, other producers would be reluctant to reduce output below prevailing levels.

In the case of sharply lower FSU output, say down to 400 mtoe in 1995 and 300 mtoe in 2000 (assumed under a disruption case), prices would trend only 6-10% higher than in the base case. By comparison, prices would trend 16-21% lower in a situation of higher-than-expected increases in FSU oil supplies (assuming 625 mtoe in 1995 and 700 mtoe in 2000). However, where increases in FSU output are accompanied by supply adjustments by OPEC producers (say mothballing of output capacities), or by increases in demand, the price decline would be moderated.

Given the uncertainties surrounding the key assumptions, we recommend strongly that the price forecasts be used with appropriate caution. In particular, since supplies will be increasingly concentrated in a few countries in the Middle East, the probability of supply-side shocks will remain high. Therefore, to cope with the inherent uncertainty in crude oil and petroleum product markets, decisionmakers should adopt suitable risk management strategies.

Demand Outlook

RECENT DEVELOPMENTS. Global petroleum consumption increased at a rate of about 2.5% p.a. over the period 1985-89, reversing the declining trend of the early 1980s (Table 2). The oil price shock in 1979, and the expectation that prices would continue to rise under the influence of OPEC production controls, resulted in declines in global oil consumption by about 2% p.a. over the period 1979-85. As a result, the share of oil in primary energy declined from 46.8% to 39.3%. The consumption increase during the late 1980s was in response to the sharp price decline in 1986, as well as the rapid growth in industrial production and income, both in industrial and developing countries. However, despite the resumption of consumption growth, global consumption is still below the annual average in 1979. The increases in the developing countries have been more than offset by declines in the OECD and FSU. In the OECD, lower oil consumption is attributed mainly to a reduction in the use of heavy fuel oil for industry and for power generation. In both these sectors, oil lost market share mainly to coal as well as to nuclear energy and natural gas in power generation. In the FSU, supply constraints and economic uncertainty resulted in an overall decline in oil use.

Global oil demand rose in 1991 following decline late in 1990. Petroleum consumption declined slightly in late 1990 in response to the sharp increase in price due to the hostilities in the Middle East. Initially, for inventory accumulation purposes, petroleum demand increased sharply in the third quarter of 1990, mainly in the industrial countries. However, in the fourth quarter, global oil offtake declined sharply. In the OECD region, the decline reflected higher end-use prices, as well as a slowdown in both inventory buildup and economic activity. In developing countries, such as India, the Philippines, and Pakistan, the slowdown in demand growth was a result of government policies that mandated cuts

Table 2: Recent Changes in World Petroleum Consumption, 1979-91

	1979		1985		1989		1991		Growth Rates (% p.a.)		
Regions	MTOE	%	MTOE	%	MTOE	%	MTOE	%	1979-85	1985-89	1989-91
Industrial	1,996.3	62.8	1,585	52.2	1,735	55.8	1,739.7	55.7	-3.8	2.3	1.3
E. Europe & FSU	550.7	17.3	545	19.3	540	17.4	503.0	16.1	-0.2	-0.2	-3.5
Other LMICs	631.0	19.9	690	24.5	832	26.8	879.0	28.2	1.5	4.8	2.8
Total	3,178	100.0	2,820	100	3,107	100	3,121.7	28.2	-2.0	2.5	0.02

Note: Details may not add up due to rounding.

Sources: United Nations Energy Statistics; Petroleum Economics Limited.; World Bank, International Economics Department.

in consumption to alleviate the economic impact of the high costs of petroleum imports. Despite that, developing countries registered an increase in 1990 which offset the decline in the industrial countries and the FSU. For 1990 as a whole, global oil demand remained largely unchanged at around 3,106 mtoe.

Consumption increased by roughly 0.5% in 1991 to 3,122 mtoe as a result of the sharp decline in oil prices following the end of the Middle East hostilities. The most significant increases occurred in the developing countries. There were, however, sharp declines in the FSU and Eastern Europe (5%) in response to the political and economic uncertainties there, and production declined in the FSU, reducing the availability of petroleum. In the industrial countries consumption was unchanged in aggregate with increases in Western Europe (mainly Germany) offset by declines in the United States due to sluggish economic growth.

DEMAND OUTLOOK: GLOBAL. ***Demand to increase through 1995 at 0.9% p.a., long-term growth rate 1.3% p.a.*** Based upon our assumptions about economic growth rates, over the near and medium term (1991-95) we expect global petroleum demand to increase by 0.9% p.a. (Table 3). Increases in developing countries (3.2% p.a.) and industrial countries (0.9% p.a.) will more than offset expected declines in the FSU (3% p.a.). OECD oil consumption is expected to increase by over 1% in 1992. The upturn in the industrial countries is predicated on economic recovery. The expected decline in oil consumption in the FSU is based on the response to higher oil prices and weak economic performance. Also, supply bottlenecks are likely to restrain consumption in the FSU.

Under our long-term baseline economic growth assumption of 2.8% p.a. for the industrial countries and 5% p.a. for the developing countries, we expect global oil demand to increase by 1.3% p.a. between 1991 and 2005, to reach 3,744 mtoe by the year 2005. This growth rate is slower than the 1.8% p.a. growth recorded over the 1985-91 period. Improvements in the efficiency of oil use and other conservation practices, and increases in energy taxes are expected to partially offset the impact of economic growth on oil demand. Another factor expected to moderate the long-run growth in global oil demand is the increased use of alternative fuels, such as natural gas in industrial and power generation applications, especially in the late 1990s and beyond. The substitution of natural gas for heating (gas) oil in the OECD's residential and commercial markets should contribute to a slowdown in oil demand. Over the long run, natural gas use is expected to increase rapidly in the FSU where gas reserves are

Table 3: Short- and Medium-Term Oil Demand Forecasts by Economic Regions, 1992-95

	1992		1993		1995		Growth Rates (% p.a.)		
Regions	MTOE	%	MTOE	%	MTOE	%	1991-93	1993-95	1991-95
Industrial	1,759	56.0	1,776	56.0	1,807.0	56.0	1.0	0.9	0.9
E. Europe & FSU	480	15.0	460	14.5	430.0	13.0	-4.2	-3.4	-3.0
Other LMICs	907	29.0	935	29.5	998.0	31.0	3.2	3.2	3.2
Total	3,145	100.0	3,172	100.0	3,235.0	100.0	0.9	1.0	0.9

Source: World Bank, International Economics Department.

abundant. However, in the developing countries, growing populations and rising per capita incomes will increase the demand for oil more rapidly than in other regions of the world. Within the developing countries, oil demand growth in the Asia-Pacific region is expected to be the fastest for transportation, industry, and electricity generation needs.

DEMAND OUTLOOK: INDUSTRIAL COUNTRIES. ***Industrial country demand to moderate.*** Oil demand in the industrial countries over the forecast period 1991-2005 is expected to increase at about 0.6% p.a. Growth will be tied mainly to petroleum's use in the transport sector, while there are likely to be declines in other major sectors (industrial and power). The introduction of more efficient transport vehicles, higher gasoline taxes, and tighter regulations should moderate the rate of growth in transport demand.

Other factors expected to contribute to the slowdown in demand growth include the perceived need to reduce dependence on imported oil and efforts to reduce CO_2 emissions. These two concerns have led to the development of a host of regulatory measures in the OECD to manage oil demand. However, contrasting approaches are being pursued in OECD countries. In the United States, reductions in gasoline demand growth are expected to be achieved through regulatory measures such as the Corporate Automobile Fuel Efficiency (CAFE) standards. This regulation mandates improvements in automobile fuel efficiency. In Western Europe, reductions are expected to be achieved through increases in taxes on gasoline. Gasoline taxes already make up about 70% of end-use prices in Western Europe compared with only 30% in the United States. Providing public information on the fuel efficiency of car models is a measure proposed to promote efficient use. It is argued that this information will encourage competitiveness between car manufacturing companies in improving their efficiency. Some governments are exploring the option of road pricing and greater use of congestion tolls.

Despite these measures, the use of transport fuels such as gasoline is expected to increase by 1.2% p.a., with the impact of fuel efficiency gains more than offset by the increase in the average miles driven per car as well as an increase in the number of cars (Table 4). However, the long-run demand for fuel oil will decline (-1.7% p.a.) mainly because it is highly substitutable and because its use will be influenced by environmental considerations. Fuel oil is expected to lose further market share to natural gas in the industrial and power-generation sectors as governments pursue a policy of favoring use of natural gas. Environmental concerns are likely to be manifested in the form of "carbon taxes" which should increase the price of all polluting fuels and reduce their consumption. However, the relative price impact should be greater on boiler fuels such as coal which is highly polluting. The substitution effect

Table 4: OECD: Forecast Petroleum Product Demand, 2005

	1990		2005		Increment	Growth
	MTOE	%	MTOE	%	MTOE	% p.a.
Gasoline	547	31.5	650	34.5	103.0	1.2
Middle distillates	565	32.5	607	32.2	28.5	0.5
Fuel oil	208	12.0	160	8.5	-48.0	-1.7
Others	417	24.0	467	24.8	50.0	0.8
Total	1,737	100.0	1,884	100.0	147.0	0.6

Sources: Petroleum Economics Limited and World Bank (1990); World Bank, International Economics Department (forecasts).

may favor fuel oil use vis-a-vis coal and therefore may moderate the decline in fuel-oil use. Switching to natural gas in the OECD residential sector is likely to moderate demand growth for home-heating oil.

The slowdown (or reduction in some OECD countries) in oil demand is likely to be influenced by energy-security concerns. However, in most cases the high costs of substituting for imported oil are likely to impose limits on the reductions that will be achieved. Increased flexibility in the use of factors of production and a buildup of strategic petroleum stocks are some of the policies being pursued in the OECD to reduce exposure to oil imports.

DEMAND OUTLOOK: DEVELOPING COUNTRIES. ***Developing country demand continues to be strong***. Under our baseline long-run economic growth assumption of 5% p.a., oil demand growth in developing countries should remain robust. However, sharp regional and sectoral differences are expected. Petroleum demand is expected to increase most rapidly in the Asia-Pacific region--although demand growth should be reasonably strong in other regions such as the Middle East and Latin America (Tables 5 and 6). In most countries in the Asia-Pacific region, the income elasticity of energy demand appears to be close to unity.

In several countries such as India, Indonesia, Malaysia, Pakistan, the Republic of Korea, and Thailand oil consumption increased by over 6% p.a. between 1985 and 1990. However, the forecast growth rates are much lower than recent growth rates in these countries. In the oil-importing developing countries, balance of payments and debt-servicing difficulties are likely to lead to policies such as market-based energy pricing to slow the rate of increase in demand. This will involve elimination of subsidies on oil products. Oil-producing countries such as Indonesia and Malaysia are expected to try to limit domestic use to maximize revenues from oil exports.

Indonesia and Malaysia are major producers of natural gas. Greater market penetration of natural gas is at the heart of fuel diversification policies in these countries. In the Middle East, diversification of the industrial base, increases in oil-fired power generation, and a shift in the mode of transportation from animals to greater use of cars and trucks should lead to oil demand increasing at a rate of 3% p.a. over the forecast period. In Latin America, structural adjustment policies and the resulting economic recovery is expected to lead to oil demand increasing at a rate of 2.8% over the long term (up from 2.2% p.a. in the 1980s) (see Tables 5 and 6).

Table 5: Non-OECD Oil Demand Forecasts by Income Group to 2005

	1991 a/		1993		1995		2005	
	MTOE	%	MTOE	%	MTOE	%	MTOE	%
High-Income	51	3.7	53	3.8	55	3.8	73	3.9
LMICs	1,329	96.3	1,343	96.2	1,373	96.2	1,787	96.1
Africa	52	3.8	54	3.9	57	4.0	70	3.7
Americas	262	19.0	277	19.8	293	20.5	386	20.8
Asia and Pacific	325	23.6	354	25.4	382	26.7	530	28.5
Europe b/	503	36.4	460	32.9	430	30.10	517	27.8
Others	187	13.5	198	14.2	211	14.8	284	15.3
Total	1,380	100.0	1,398	100.0	1,428	100.0	1,860	100.0

a/ World Bank estimates.
b/ Including the FSU.

Source: World Bank, International Economics Department.

Table 6: Forecast Growth Rates of Non-OECD Oil Demand by Income Group

	Growth Rates (% p.a.)			
	1991-93	1993-95	1995-2005	1991-2005
High-Income	1.9	1.9	2.9	2.6
LMICs	0.5	1.1	2.7	2.2
Africa	1.9	2.7	2.1	2.1
America	2.8	2.8	2.8	2.8
Asia and Pacific	4.4	4.0	3.3	3.6
Europe a/	-4.5	-3.4	1.9	0.2
Others	2.9	3.2	3.0	3.0
Total	0.6	1.1	2.7	2.2

a/ Including the FSU.

Source: World Bank, International Economics Department.

While all sectors are expected to contribute to the increase, oil demand growth should remain strongest in the transport sector. Rising per capita incomes and the growing demands for personal and commercial mobility should support increases in the use of both gasoline and diesel oil. Based on the anticipated growth in the number of vehicles per thousand people (expected to quadruple over the next 20 to 25 years), and given our economic growth assumptions, we expect the demand for transport fuels (gasoline) to increase at an average rate of 4.2% p.a. over the period to 2005 and their share to increase from 18% to 21% (Table 7). Supported by growth in the residential and commercial sectors, the long-run growth in middle distillate demand is expected to average 3.4% p.a. Factors contributing to the growth include: (i) the continued transition from biomass fuels to petroleum products; (ii) growth in the number of urban households; and (iii) rising levels of income and population. Distillate demand is also expected to be supported by its use for power generation.

Fuel oil demand (for power generation) is expected to increase almost as rapidly as the demand for residential fuels (3.2% p.a.), supported by its use in electricity generation. The demand for electricity is expected to grow faster than GDP in many developing countries. The implied income elasticity is between 1.2 and 1.5. The political limits to nuclear-power generation and the expectation that natural gas demand will be constrained by supply until the end of this decade are the key factors behind these forecasts. Given that gas is not likely to be available (because of the heavy investment needed to develop and transport natural gas), gas turbines should be fueled by distillates. Additional generation capacity--at least in the 1990s--therefore, is likely to be oil-fired. Countries facing severe capital constraints and therefore with limitations on their ability to install natural gas facilities are likely to put greater reliance on oil for new generation capacity and industrial installation, further supporting the use of oil. Several developing countries, including the Republic of Korea, are starting up oil-fired plants. These trends are also noticeable in Japan. Desulphurization of fuel oil should stimulate demand for low sulphur fuel oil at the expense of coal-powered generation.

DEMAND OUTLOOK: THE FSU AND EASTERN EUROPE. ***Declining trend in FSU and Eastern Europe to continue to late 1990s.*** Oil consumption in the FSU and Eastern Europe has declined sharply--from 560 mtoe in 1989 to 530 mtoe in 1990, and to an estimated 503 mtoe in 1991. The decline in demand is attributed to reduced oil supplies in the FSU, increases in domestic energy prices, and

Table 7: Developing Countries: Forecast Petroleum Product Demand to 2005 a/

	1990		2005		Increment	Growth
	MTOE	%	MTOE	%	MTOE	% p.a.
Gasoline	151	18.0	280	20.8	129	4.2
Middle Distillates	302	36.0	498	37.1	196	3.4
Fuel Oil	201	24.0	320	23.8	110	3.2
Others	185	22.0	245	18.3	60	2.0
Total	839.0	100.0	1,343	100.0	504	3.2

a/ Excluding FSU.

Sources: Petroleum Economics Limited, and World Bank (1990); World Bank, International Economics Department (forecasts).

economic contraction. These declines in production are attributed, inter alia, to the lack of replacement parts for rapidly deteriorating equipment. Roughly 12% of Russian wells have been shut-in for this reason. In Western Siberia, 20% of the wells are shut down due to the lack of spare parts.

Energy prices in the FSU and Eastern Europe have been kept at very low levels in comparison with international prices. Energy prices have been increased sharply since January 1992. Despite the price increase in May to between 1,800 and 2,000 rubles/ton (roughly $2.50-3/bbl), they are still significantly below world levels. In some Russian commodity exchanges, crude oil has at times been traded as high as 10,000 rubles ($14/bbl), even prior to the most recent price increase. The complete deregulation of domestic prices expected over the next one to two years will result in a significant increase in prices, thereby lowering oil demand further.

The inefficient practices of the past such as price controls and preferential trade have resulted in wasteful use of energy resources. Energy use is high both on the basis of per capita consumption and intensity of use per unit of output. In 1990, energy intensity in the FSU and Eastern Europe was roughly 32 barrels and 19 barrels, respectively, per 1980 US$1,000 of GDP, compared with 2.6 barrels in Western Europe. In the same year, per capita energy consumption in the FSU and Eastern Europe was roughly 32 barrels compared with 39 barrels in the OECD and only 4 barrels in the developing countries.

Thus, there exists large scope for improvement in the efficiency of energy use. The market-oriented reforms should lead to significant improvements in energy use in areas where initial low-cost savings are possible. The scope appears largest in the energy-intensive heavy industries such as steel, nonferrous metal fabrication, chemical industries and material building. In the transport sector where bad roads and large and heavy vehicles have contributed to high energy use, efficiency can be improved by reducing the size and weight of the vehicles.

Economic activity in the FSU is estimated to have fallen by about 20% between 1990-91 and 1991-92. We expect the declining trend in oil consumption to continue up to the mid- to late 1990s because of: (i) the expected decline in the FSU output; (ii) the elimination of preferential trade between the FSU and Eastern Europe and the shift to market pricing; and (iii) improvements in the efficiency of oil/energy use. However, over the long run, we expect oil consumption to increase under the influence of rising per capita income levels and transportation demands. But higher energy prices, due to market-based reforms, and efficiency improvements in the industry and transport sectors are expected to limit the growth in oil demand. Increased availability of natural gas is also likely to restrict the increase in oil demand in end-use markets. We expect oil consumption in the FSU and Eastern Europe to decline initially from 530 mtoe in 1990 to 430 mtoe in 1995, but to rise gradually in the late 1990s to reach 517 mtoe in 2005 (giving an average of 0.2% p.a. growth over the period 1991-2005) (see Table 5).

However, the outlook for oil demand in the FSU and Eastern Europe is highly uncertain. Underlying uncertainties are the economic and political developments and the speed with which any reforms will be implemented. While most forecasts of FSU oil demand foresee declines up to the mid-1990s, longer-run forecasts vary greatly. For instance, the SNS Energy group forecasts FSU oil demand to decline to as low as 290 mtoe (5.8 mb/d) by 2000.[1] The US Department of Energy forecasts oil demand in the FSU and Eastern Europe to fall within a range of 400-575 mtoe by 2000 and 435-750 mtoe

[1] Marian Radetzki et al., "Economic Reforms and Energy in the CIS," June 1992.

by 2010. Its base case forecasts for 1995, 2000 and 2010 are 425 mtoe, 490 mtoe, and 590 mtoe, respectively (compared with 515 mtoe in 1990).[2]

Supply Outlook

NON-OPEC OIL SUPPLY FORECASTS. ***Long-run non-OPEC supplies to rise at 0.3% p.a.*** Since 1980, non-OPEC oil supplies have increased by around 1.1% p.a. and reached 1,945 mtoe in 1991. Declines in the United States and the FSU were more than offset by increases in the North Sea and in developing countries (Table 8).

Based on the estimates of proven recoverable reserves (reserves-to-production ratios) and expected investments (to increase production capacities), the outlook for supplies from non-OPEC sources (excluding the FSU) is for an increase of around 0.4% p.a. to reach 1,482 mtoe in 2005 (up from 1,404 mtoe in 1991). With the inclusion of the FSU, non-OPEC supplies are expected to increase at an average rate of 0.3% p.a. and reach 2,032 mtoe in 2005 (from 1,945 mtoe in 1991). Non-OPEC oil production is expected to supply roughly 15% of the increase in the global demand for oil over the forecast period. The expected changes in production capacities of selected non-OPEC countries are presented in Table 9.

NORTH SEA PROSPECTS. ***North Sea production expands slowly.*** North Sea production increased by about 7% in 1991 to reach 196 mtoe. Increases in Norway (14%) and Denmark (17%) more than offset declines in United Kingdom (-0.3%) and Netherlands (-8.7%). In 1992, North Sea

Table 8: Non-OPEC Oil Production, 1980-91

	(mtoe)			Growth Rates (%)	
	1980	1989	1991 a/	1980-89	1988-91
Total Non-OPEC	1,732.0	1,978.0	1,945.0	1.5	-0.8
Norway	24.5	78.8	97.5	14.0	10.5
United Kingdom	80.6	92.2	92.0	1.5	0.0
United States	479.9	437.5	444.8	-1.0	0.8
FSU	612.4	615.7	544.0	0.06	-6.2
Developing Countries	397.0	597.0	622.0	4.6	2.1
Mexico	107.1	143.7	149.6	3.3	2.0

a/ Estimates.

Source: United Nations, Energy Statistics; Petroleum Economics Limited; World Bank, International Economics Department.

[2] US Department of Energy and Energy Information Agency, "International Energy Outlook 1992."

Table 9: Potential Petroleum Capacity Changes in Major Non-OPEC Countries a/

	1991	1995	2000	Change 1991-2000
	(mb/d)			
Developing Countries	10.12	11.44	12.64	2.52
Angola	0.50	0.60	0.60	0.10
Brazil	0.68	0.80	0.90	0.22
China	2.77	3.00	3.20	0.43
Colombia	0.46	0.55	0.55	0.09
India	0.69	0.79	0.90	0.21
Malaysia	0.65	0.75	0.85	0.20
Mexico	3.00	3.10	3.50	0.50
Oman	0.70	0.75	0.72	0.02
PNG	0.00	0.15	0.27	0.27
Syria	0.45	0.50	0.40	-0.06
Yemen (Unified)	0.21	0.45	0.75	0.54
Industrial Countries	14.87	15.20	13.90	-0.97
Canada	1.95	2.10	2.10	0.15
Norway	1.95	2.30	2.00	0.05
United Kingdom	1.97	2.60	2.00	0.03
United States	9.00	8.20	7.80	-1.20
FSU	10.30	10.00	10.50	0.10
Total	35.29	36.64	37.04	1.75

a/ Includes natural gas liquids.

Source: Petroleum Economics Limited; World Bank, International Economics Department.

output is expected to increase to about 215 mtoe with both the United Kingdom and Norway contributing to the increase. It is expected that North Sea production will increase up to the mid-1990s. The resource base and the incentives provided by the recent changes in the tax system are expected to support increases. In a bid to encourage exploration and development, several North Sea producing countries have introduced liberal fiscal terms for the development of new fields. As a result of the favorable tax regimes, North Sea output is expected to increase by about 45 mtoe (or 0.9 mb/d) to reach 245 mtoe in 1995. The application of improved technologies (which should reduce the rate of decline in mature fields), the development of new, small fields, and adoption of various cost-cutting methods are expected to support the increase.

In the United Kingdom, the projected increase partially reflects a recovery in production from fields affected by a series of accidents in 1989 and partially the result of policy changes which

provide incentives to develop new (less costly) fields. However, beyond the mid-1990s, output is expected to decline from large fields including the Brent, Forties, Ninian and Piper fields, it should also fall as replacement production from newer fields becomes more costly.

Supported by its reserves of about 7.6 billion barrels and with the expansion and enhanced recovery program on large existing fields (Gullfak and Oseberg fields), Norway's production should continue to increase beyond the mid-1990s. Development of smaller fields should also support increases in production. As a result, Norway's output is expected to increase to about 115 mtoe by the turn of the century.

UNITED STATES. ***US production to continue falling as investment declines***. Following a brief period of increase in late 1990 and early 1991, mainly from Alaskan fields in response to higher prices due to the Middle East crisis, crude oil production in the United States has resumed its decline. In 1992, US output is expected to decline to an average of 439 mtoe (from 445 mtoe in 1991). Declines in production from aging fields in Alaska and a slump in drilling activity are contributing to the decline. Total wells drilled in the United States are now roughly one third of the levels in 1985.

A shift in oil company investment out of the United States has contributed to the decline in production. Amid the general perception that most of the oil-producing areas in the United States have been tapped and because of the high costs of the fields (due to their size and age), oil companies have reduced exploration and development (E & D) investments in the United States in favor of more profitable regions elsewhere. The US share of worldwide capital spending for upstream activity declined from about 50% in 1988 to roughly 43% in 1990. These trends are expected to continue. As a result of declining investment, US oil production is expected to decline to 374 mtoe by the year 2005. This expectation is supported by the low levels of US proven reserves, the recent poor record in finding replacement reserves, and the constraints on E & D from environmental concerns. At the end of 1991, US proven reserves were estimated at about 26.25 billion barrels--a slight decline from the previous year. At current production levels, this translates into another ten years of reserves. In 1970, US proven reserves tallied about 39 billion barrels with a reserves-to-production ratio of 12:1. Given that the best prospects for discoveries lie in the environmentally sensitive areas such as the coastal plains of the arctic national wildlife refuge in Alaska (ANWRA) and in the outer continental shelf (Gulf of Mexico) environmental concerns will severely limit US prospects. In the ANWRA, reserves are assessed at about 3.57 billion barrels with a 5% chance of finding up to 9.24 billion barrels.

FSU AND EASTERN EUROPE. ***Significant capital injection needed in FSU and Eastern Europe***. From its peak of 628 mtoe in 1987, crude oil production in the FSU declined to 596 mtoe in 1990. Output in 1991 is estimated at 541 mtoe. The decline in output in the Russian Republic, mainly in the Western Siberian province of Tyumen, accounted for about 80% of the decline in FSU oil production in 1991. Production in Western Siberia declined by about 45 mtoe. Current FSU output (early 1992) is estimated to be below 500 mb/d. The Russian Republic accounts for about 90% of total FSU oil production (Table 10). Several factors have contributed to the recent sharp decline in FSU oil output: (i) ethnic disturbances; (ii) transportation problems; (iii) drastic cutbacks in investments; and (iv) oil well depletion caused by excessive injection of pressurized water. Capital constraints not only have restricted the replacement of aged and obsolete technology, but have also caused a severe shortage of spare parts and steel pipes needed for the repair and replacement of defective equipment.

Table 10: FSU Oil Production by Republics (1991)

	Production (MTOE)	%
Azerbaijan	11.0	2.1
Kazakhstan	32.0	6.1
Russia	455.0	88.6
Turkmenistan	8.0	1.5
Ukraine	5.0	0.8
Other	5.0	0.8
Total	516.0	100.0

Source: Petroleum Economics Limited; US Department of Energy; World Bank, International Economics Department.

Without significant injection of capital, importantly foreign capital which is accompanied by western technology, oil production should continue to decline in the FSU. In 1988, the oil sector accounted for about 20% of the total investment expenditure. The share has declined sharply since then as scarce capital was channelled into other activities, such as consumer goods. Capital needs are made more acute by the fact that new prospects lie in remote and difficult to explore areas.

In an effort to prevent further declines in energy production, the FSU republics are seeking joint ventures with international firms in oil/gas exploration and development activity. Bringing these to fruition will greatly improve the long-term prospects for oil supplies. While there is keen interest among leading energy companies in joint venture activities, progress appears to be slow and prospects remain very uncertain. Factors such as the following pose risks to such investments: (i) the political and economic instability in the Republics; (ii) unclear legal framework and ownership structure; (iii) export tariff on oil in Russia; and (iv) the underdeveloped commercial infrastructure. The deals being finalized are far fewer than generally perceived. Amid the rapid structural changes in the FSU's energy industry, international companies are confronted with lengthy negotiations. It is not always clear who the responsible authorities are and who owns the resources. Ill-defined property rights are causing costly delays in finalizing deals. The issue of ruble convertability and the uncertainty over its future value are further undermining international companies' efforts to invest. At the same time, foreign companies are no longer content to be contractors only They are likely to advance cautiously until the situation improves. Therefore, it will take some time before the desired investments needed to revitalize the FSU oil sector and the resulting output response are realized.

We, therefore, do not expect the declining trends in oil production to reverse in the short to medium term. However, it is generally perceived that the long-term prospects are favorable. Over the long run, if foreign participation grows and investments bear fruit, FSU oil production could increase to about 550 mtoe by the year 2005.

DEVELOPING COUNTRIES. ***New fields promise future production increases.*** While the bulk (about 60%) of oil discovered in recent years has been in traditional areas in the Middle East, Latin America (particularly, Venezuela) and the North Sea, wildcat drilling has uncovered some new fields in other areas. The latter has contributed to a significant increase in global oil reserves (Table 11).

Table 11: Global Oil Reserves, by Geographic Location, 1970-91

Region	1970	1980	1985	1991
	(billion barrels)			
Asia & Pacific	14.41	19.63	18.85	44.07
Western Europe	3.71	23.08	26.41	14.50
Middle East	344.57	362.07	398.02	661.57
Africa	74.76	55.15	56.73	60.49
Western Hemisphere	73.95	102.39	118.74	151.60
Eastern Europe, FSU, and China	100.00	86.30	81.37	58.77
Total	611.40	648.50	700.14	991.01

Source: Oil and Gas Journal (various issues).

In LATIN AMERICA, Brazil and Colombia have been the most active areas of E & D. In Brazil, discoveries in the Campos basin and the recent discoveries at the mouth of the Amazon River (deep water fields) have improved the outlook for Brazilian oil supplies considerably. While estimates are still highly speculative, reserves from these fields are reported to be as high as 10 billion barrels. However, the difficulty of developing deep water fields is likely to restrict output from these fields. In Colombia, the recent discovery of the Cusiana field is expected to add between 2 and 5 billion barrels to its present reserves of about 2 billion barrels. Given its large resource base (about 51 billion barrels) and high reserves-to-production ratio (50:1), the prospects for increased output in Mexico are favorable. However, the development of these reserves has suffered from reduced government investments as well as from restrictions on foreign investment. More accommodating government policies towards domestic and foreign investment could increase Mexico's output to about 173 mtoe by the turn of the century.

In the MIDDLE EAST, the Yemen, Syria, and Oman provide the most favorable outlook for oil supplies outside OPEC. Since oil was discovered in 1984, significant additions to Yemen's reserves have been made. Unified Yemen's reserves are now estimated at 4 billion barrels. These have been built up by increased participation of foreign oil companies. Based on the prospects for its several fields including Alif in the Mareb-Janof concessions and the Shebwa fields, it is expected that annual production could increase to over 37 mtoe by the turn of the century.

In Syria, the discovery of large fields at Al-Thayyem in the mid-1980s improved the prospects for increased supplies. Prospects have also been supported by the recent reversal of the decline in the Omar field. As a result, Syria's production reached 23.5 mtoe in 1991 (up from 19.5 mtoe in 1990). Extensive wildcat drilling has added about 1.5 billion barrels of reserves which are currently about 1.7 billion barrels. By the year 2000, Syria's crude oil output is expected to increase (mainly by additions from small fields) to 30 mtoe.

In the ASIA-PACIFIC region, significant production increases are expected in India and Malaysia. In recent years, foreign oil company participation has increased significantly in these two countries. Recent discoveries of three fields in the Northern Malay Basin (by Exxon) and improved

estimates of probable reserves in the frontier areas have resulted in the upward adjustment of reserves to about 3.6 billion barrels (from 3 billion barrels at the end of 1991). As a result, Malaysia's production is forecast to increase to about 37 mtoe (about a 19% increase from the 1991 level).

Indian oil production has more than doubled since 1981 to 32.4 mtoe in 1991. About two thirds of production comes from a single field--Bombay High off the West Coast. Although production has stabilized in this field (currently sustained by water injection), with prospects for developing small to marginal fields in Bombay and other regions (namely, Heera, Ratna, and Panra), Indian production is likely to increase to around 40 mtoe by the turn of the century. India has recently signed several new exploration and production contracts. If current and new exploration and production activity pays dividends, Indian production could exceed 40 mtoe annually by the year 2000.

Renewed talks of soft Japanese loans to China have improved the oil supply outlook from China. The recent decline in oil output can be attributed to the decline in industry investment (25% in 1989) and the suspension of loans by the United States and Japan, as well as the poor outcome of offshore exploration activity. However, the recent discoveries of the Weizhou Field in the South Sea, the Tarim on-shore basin in Xinjiang province, and another in the Liaodong Bay, north east of Bohai--together with the trend towards more liberal policies which allow increased foreign oil company participation in exploration and development--are likely to support increases in production. The promising potential offered by several fields, including the huge Xinjiang Field, should provide increases in production beyond the turn of the century. It is expected that China's annual oil production could reach 155 mtoe by the year 2000 and 165 mtoe by 2005. However, given the huge costs of developing infrastructure, these increases are contingent on active foreign participation in oil E & D.

There are many other developing countries that will provide additional sources of oil supplies. Supported by its estimated proven reserves of 4.2 billion barrels, Oman plans to develop a small reservoir in the future which is likely to result in marginal increases in output. Egypt has increased its proven reserves from 430 mtoe in 1981 to 616 mtoe, and modest increases in output are possible at least up to the mid-1990s. In a bid to raise capital for E & D, a move towards privatization and removal of restrictions on foreign investments in upstream operations have improved the supply prospects in Argentina and Peru. Foreign participation has recently been allowed by the Argentinean government in four key oil-producing areas. The Peruvian government's decision in late August 1991 to allow local private companies and foreigners to invest in both upstream and downstream activity has reduced Petroperu's monopoly position considerably. As a result of expected increases in investments, Argentina's output should increase by about 50% and Peru's by 7% by the year 2005. Proven reserves in Argentina and Peru are estimated at 1.57 billion barrels and 0.38 billion barrels, respectively.

In addition to the supply prospects referred to in the previous paragraphs, small increases are expected in many other countries such as Papua New Guinea, Viet Nam, Pakistan, and Thailand. However, these will necessarily involve significant foreign participation.

The supply forecasts for non-OECD economic regions are presented in Table 12. The outlook for supplies from non-OECD regions is for an increase from 1,802 mtoe in 1991 to 2,478 mtoe in 2005. Excluding the FSU and OPEC, supplies are expected to increase at an average rate of 1.4% p.a. and reach 765 mtoe by 2005.

OPEC OIL PRODUCTION FORECASTS. ***OPEC's world market share to increase.*** OPEC crude oil production has increased steadily since 1986. Between 1986 and 1989, OPEC oil production

Table 12: Non-OECD Petroleum Output Forecasts, by Income Group, to 2005

Countries/Regions	1991 a/ MTOE	1991 a/ %	2005 MTOE	2005 %	Increment MTOE	Growth 1991-2005 % p.a
High-Income	147	6.2	345	11.2	198	6.3
LMICs	2,196	93.8	2,733	88.8	537	1.6
Africa	149	6.4	146	4.7	-3	-0.01
America	380	16.2	463	15.0	83	1.4
Asia-Pacific	286	12.2	347	11.3	61	1.4
Europe	541	23.1	550	19.5	9	0.2
Middle East & North Africa	841	35.9	1,177	38.3	336	2.4
Total	2,343	100.0	3,028	100.0	685	1.9
Memo:						
Excl. FSU	1,802	77.0	2,478	80.5	676	2.3
Excl. OPEC	1,166	50.0	1,315	44.3	149	0.9
Excl. FSU & OPEC	625	27.0	765	25.0	140	1.4

a/ World Bank estimates.
Source: World Bank, International Economics Department.

increased by 180 mtoe (3.6 mb/d). Despite the Iraqi invasion of Kuwait in August 1990, and the subsequent embargo on Iraqi crude oil exports which affected supplies temporarily, OPEC production increased by 46 mtoe (0.92 mb/d) in 1990. The immediate impact of the embargo on Iraqi/Kuwaiti oil was a reduction by about 195 mtoe in world oil exports. However, because of the increased availabilities of replacement supplies, mainly from other OPEC producers, the shortfall in crude oil supplies was more than offset in volume terms. By December 1991, OPEC output reached 1,161 mtoe (23.22 mb/d), surpassing pre-invasion OPEC production of 1,153 mtoe (23.06 mb/d) in July 1990. Increases in supplies came mainly from Saudi Arabia (2.68 mb/d) and the UAE (0.43 mb/d). Other producers that contributed to the increases include Indonesia, Iran, Libya and Venezuela. OPEC's crude oil production increased further in 1992 to average 1,193 mtoe; in the first half of the year the increases largely reflected the recovery of output in Kuwait. At the end of June 1992, Kuwait's production capacity reached 50 mtoe.

OPEC production is expected to increase over the forecast period in line with the expected increase in their output capacities (Table 13). In the short and medium term (1992-95), the increases in OPEC output are expected to be mainly from Iraq and Kuwait as they rebuild capacity. However, short-term exports from Iraq will be contingent on the removal of the UN sanctions on its exports. Based on oil field rehabilitation plans, Iraqi output capacity is expected to reach roughly 3 mb/d by the mid-1990s, up from 0.4 mb/d in 1991. Kuwaiti output capacity is expected to increase to 2.5 mb/d by that time. The Middle East hostilities reduced Kuwait's output capacity to near zero. Prior to the Iraqi invasion of Kuwait, crude oil production capacities of Iraq and Kuwait were 3.5 mb/d and 2.4 mb/d, respectively. Kuwait is negotiating contract terms with several international companies for technical assistance in bringing fields back on-stream. In an effort to attract foreign investment, Iraq has begun talks with several international oil companies on oil exploration contracts.

Table 13: OPEC: Sustainable Capacity and Output in 1991, and Forecast Capacity to 2000

	Output Capacity 1991	Output Capacity 2000	Change in Capacity 1991-2000
	(mb/d)		
Algeria	0.8	0.9	+0.1
Ecuador	0.3	0.3	0.0
Gabon	0.3	0.3	0.0
Indonesia	1.5	1.3	-0.2
Iran	3.4	4.0	0.6
Libya	1.6	1.8	0.2
Nigeria	1.9	2.3	0.4
Qatar	0.4	0.4	0.0
Saudi Arabia a/	8.9	10.5	1.6
United Arab Emirates	2.5	3.3	0.8
Venezuela	2.5	3.4	0.9
Iraq	0.4	3.0	2.6
Kuwait	0.3	2.9	2.6
Total	24.4	34.0	9.6

a/ Includes 50% share of neutral zone.

Sources: Cambridge Energy Associates; Middle East Economic Survey; Petroleum Economics Ltd.

The recent Middle East conflict has had a significant impact on OPEC's long-term capacity expansion programs. While it has delayed expansion in Iraq and Kuwait, the development plans of other OPEC members have accelerated. Iraqi and Kuwaiti pre-war plans to expand output capacity to 4.5 mb/d and 3.5 mb/d by 1995, respectively, are now likely to be realized well after the turn of the century. Saudi Arabia's pre-war target of 10 mb/d by mid- to late 1990s is now likely to be achieved before 1995.

Saudi plans to increase output capacity involve the development of new fields and the expansion and upgrading of old fields. Plans also call for the installation of sea water injection capacity and wet crude handling facilities. In the north, plans include development of the Zuluf offshore field and the Marzen field. In the south, plans include the expansion of the offshore Safania field and the Uthmeniya field which is in the Howaiyah area of the Ghawer field. There are also plans for the development of the three new fields believed to be part of a giant field. By the year 2000, Saudi Arabia's capacity is expected to reach 10.5 mb/d (its level of the late 1970s). This capacity expansion program is likely to put Saudi Arabia in a more dominant position within OPEC.

Iran has plans to develop new oil and gas reserves, as well as reconstructing its oil production and export facilities damaged during the eight-year war with Iraq. These plans envisage increases in sustainable output capacity to as high as 5 mb/d by mid-1993. However, this is an optimistic target, one which is not likely to be achieved until after the turn of the century despite foreign involvement.

Venezuela expects to increase supply by roughly 0.2-0.3 mb/d from its more than 50 marginal fields over the next three years or so. Indonesia's plans to explore and develop the Timor Island region and the Belida oil field in the South China sea have marginally improved its prospects for oil supplies. Plans also call for increasing investment in enhanced recovery projects.

OPEC should supply increasing quantities of crude over the long term. However, since a few OPEC members will reach a production plateau by the early 1990s, and several others will enter the depletion phase towards the end of the century, a small group of producers including Saudi Arabia, Iran, the UAE, Iraq, Kuwait, and possibly Venezuela should attain a more dominant position in the world oil market, largely due to the enormous low-cost oil reserves in these countries (Table 14). Of the proven recoverable world oil reserves, only 236 billion barrels (22%) are located in the non-OPEC countries. The reserves-to-production ratio of the non-OPEC suppliers is around 16 compared with 89 for OPEC (see Table 14).

Therefore, by the late 1990s, the world is expected to be increasingly dependent on OPEC for additional supplies. It is anticipated that by 2005 production in OPEC countries should increase to 1,713 mtoe with OPEC's share in total petroleum production rising to around 46% (up from 38% in 1991). Middle East OPEC production is expected to increase at a trend rate of roughly 3.4% p.a. over the forecast period and its market share should increase to over 36% by 2005 (Table 15).

Table 14: Global Oil Reserves, 1991

			Reserves-to-Production a/
Regions/Countries	billion barrels	%	Years
Industrial	48.1	4.8	10
Eastern Europe & FSU	58.8	5.9	15
Other Countries	884.1	89.3	70
Total	991.0	100.0	44
Memo:			
Non-OPEC	221.6	22.4	16
OPEC	769.4	77.6	89
Saudi Arabia	257.8	26.0	86
Iraq b/	100.0	10.1	1,000
Iran	92.9	9.4	77
Kuwait b/	94.0	9.5	1,567
United Arab Emirates	96.3	9.7	119
Venezuela	59.1	6.0	67
Other OPEC	69.3	6.9	28

a/ Based on estimates of reserves at the end of 1991 and average production in 1991.
b/ Based on production estimates for the first half of 1990 the reserves-to-production ratio for Iraq and Kuwait is roughly 90 years and 140 years, respectively.

Note: Estimates of reserves range considerably from one source to another.

Source: Oil and Gas Journal.

Table 15: Petroleum Production Forecasts, to 2005 by Economic Regions

Regions	1991 MTOE	1991 %	1995 MTOE	1995 %	2000 MTOE	2000 %	2005 MTOE	2005 %	(Growth rate % p.a.) 1991-2005
Industrial	779	25.9	794	24.0	735	21.0	708	18.9	-0.7
Eastern Europe & FSU	541	17.3	500	15.4	530	15.5	550	14.9	0.1
Other Countries	1,802	57.7	1,941	60.0	2,219	63.5	2,486	66.4	2.3
Total	3,122	100.0	3,235	100.0	3,484	100.0	3,744	100.0	1.3
Memo:									
Non-OPEC	1,945	62.3	1,981	61.2	2,004	53.5	2,031	54.2	0.3
OPEC	1,177	37.7	1,254	38.8	1,480	42.4	1,713	45.8	2.7
Mid-East OPEC	864.1	27.7	976	30.1	1,152	33.0	1,379	36.8	3.4

Source: World Bank, International Economics Department.

Petroleum Price Outlook

We rely on three sources of information for our oil price forecasts. For the short run (1992-93), we use futures price quotations. For the medium term (1994-95), we use a combination of futures prices and, where available, over-the-counter quotations for long-dated underlying financial derivatives such as oil swaps. These quotations are acquired from industry sources engaged in swap trading activity. For the long-term price projections, we rely on our oil market model-based analysis. The price projections are presented in Table 16.

OIL MARKET MODEL. The oil market model includes the behavior of three key sets of market factors, namely, oil/energy demand, non-OPEC oil/energy supplies, and OPEC output capacity and capacity utilization rates. The model is used to study the interaction of various assumptions about these key market factors and to determine the market-clearing price of oil under various scenarios. Oil demand is divided into residual and nonresidual fuel oil and is influenced by economic growth and the opportunity for substitution between residual fuel oil and other energy sources. The magnitude of the price change depends upon the degree (elasticities) to which demand and supply are responsive to (past and current) prices and OPEC's capacity utilization rate.

The demand side consists of the following subregions: United States, Japan, OECD Europe, other OECD, OPEC, high-growth newly-industrializing countries, low-growth, newly-industrializing countries, low-growth oil-importing developing countries, and other developing countries. Non-OPEC supply is the sum of the exports of the FSU and supplies from the United States, Canada, United Kingdom and Norway, other OECD, and the developing countries. Net exports from the FSU are exogenous. OPEC is assumed to be the residual supplier to the market. Its production capacity is specified exogenously. For expected changes in the world demand for oil (in response to changes in income and the lagged effects of past prices), the model solves interactively for the market-clearing price at which the demand for OPEC oil equals a specified amount, given expected changes in non-OPEC supplies. For a given year, therefore, price is determined simultaneously by the interaction of OPEC's supply curve and the demand for OPEC oil.

Table 16: Petroleum Prices a/ 1989-91 (Actual) and 1992-2005 (Projected)

	Current	1990 Constant $ b/
	($/bbl)	
1989	16.3	17.2
1990	21.2	21.2
1991	17.3	17.0
1992	17.6	16.5
1993	17.3	15.7
1994	17.4	15.5
1995	18.0	15.6
2000	24.7	18.0
2005	26.8	17.0

a/ Refers to the weighted average f.o.b. price of petroleum exports from OPEC countries.
b/ Deflated by Manufacturing Unit Value (MUV) Index.

Sources: Platt's Oil Price Report and World Bank, International Economics Department (actual); and World Bank, International Economics Department (projected).

RATIONALE FOR USING FUTURES PRICES. The use of futures prices for short- and medium-term forecasts is based on the following argument. In recent years, the volume of oil traded in the futures markets and the number of active participants in this market have increased rapidly. Spot and futures tradings are now used by various market participants including national oil companies, refiners, producers and speculators. Many oil producers are now adopting pricing strategies that link term contract supplies to spot and futures prices. In fact, this practice has become so dominant that many of the contracts entered into by producers have price clauses that are in some way linked to this market-based pricing. OPEC exports based on spot pricing increased to 44% (in late 1991) up from about 26% in 1985. Due to the low transaction costs involved, information about perceived changes in market factors (demand, production, supply, OPEC policy) is instantaneously reflected in futures price. This has given credence to the view that the oil futures market performs a price discovery function. New exchanges have emerged around the world, and new oil products have been introduced to these markets. This has allowed arbitrage trading between contracts and between markets. The futures market is likely to continue to flourish in the presence of high price volatility in the petroleum market. To cope with the inherent uncertainty in crude oil and petroleum product prices, decisionmakers are adopting appropriate risk management strategies. Other financial instruments such as forwards, options, and oil swaps are now being used extensively by market participants to hedge risks stemming from fluctuations in the price of oil. This trend is expected to increase.

However, the use of long-dated instruments has not evolved as rapidly as futures. The use of complex hedging techniques by many financial institutions and the wide variation in costs to users are some of the reasons restricting their growth. Because the markets for these financial instruments are not very liquid, the underlying price quotations cannot be thought of as being as efficient as futures markets in incorporating information.

RECENT PRICE DEVELOPMENTS. Our indicator price for crude oil, OPEC average spot, declined 18.2% in 1991--from $21.20/bbl in 1990 to $17.35/bbl. The main factors contributing to this decline were: (i) reduced supply uncertainty following the cessation of the hostilities in the Middle East in early 1991; (ii) sluggish growth in global oil demand (by 0.5%) due to weak economic activity in the industrial countries and declines in oil consumption in the FSU and Eastern Europe; and (iii) increases in oil supplies from OPEC sources (by 1.1%).

Crude oil prices declined to an average of $15.60/bbl in the first quarter of this year. The decline from the fourth quarter 1991 average of $17.99/bbl is within the range expected for the seasonal decline at this time of the year--especially considering the mild northern hemisphere winter.

Prices increased to an average of $17.70/bbl and $18.40/bbl in the second and third quarters of 1992, respectively; an increase which also seems consistent with year-to-year changes at this time. There was some tightening of prospective supplies in light of declines in supplies from Russia and expected seasonal increase in oil demand. There was also some credence given to the view that Saudi Arabia had shifted its policy to support higher prices.

SHORT-TERM PRICE PROJECTIONS (1992-93). ***Prices firm in 1992 but downward pressures in 1993.*** Based on futures prices for oil, our indicator price is expected to increase to $18.40/bbl in the second half of 1992, by comparison with a first half average of $16.70/bbl. The expectation of increases in the near-term price of oil appears to be based on the following: (i) a seasonal increase in the global demand for oil; (ii) the UN embargo on Iraqi crude oil will remain in effect; and (iii) increases in non-OPEC oil supplies will be more than offset by declines in the FSU and the United States. The oil market is perceived to remain fairly tight during this period and highly susceptible to shocks. The increase in the precautionary demand for stocks to hedge against supply disruptions during the fourth quarter, when demand is seasonally high, is likely to put upward pressure on spot and nearby futures prices.

Prices are expected to decline to an average of $17.30/bbl in 1993. We expect global oil demand to increase by roughly 0.9% (or 45 mtoe). However, we expect the increase in oil demand, in response to economic recovery in the OECD and continuing growth in developing countries, to be more than offset by increases in supplies from OPEC and non-OPEC sources.

Looking at possible shocks during this period, it is reasonably likely that the sanctions on Iraq's exports will be removed. By the latter half of 1993, Iraq's output capacity could increase to above 2.5 mb/d (up from 1.5 mb/d in mid-1992). Other OPEC members such as Saudi Arabia and Iran could well be reluctant to yield market share to accommodate Iraq. In that case, prices could come under severe downward pressure.

MEDIUM-TERM PRICE PROJECTIONS (1993-95). ***Medium-term prices to remain flat.*** Over the period 1993-95, nominal prices are expected to increase by 2% p.a. However, in real terms, they are expected to remain unchanged. The impact on prices of economic recovery and growth, particularly in the United States, and further declines in supplies from the FSU should be offset by increases in supplies from OPEC sources. Following a period of modest increase over the period 1990-93 (0.7% p.a.), oil demand is expected to increase by roughly 1% p.a. over the period 1993-95 due largely to a pickup in global economic activity. However, increases in oil demand in OECD Europe will be sluggish compared with the early 1990s, despite solid economic growth. Improvements in the efficiency of oil use, increases in energy taxes (on environmental grounds), and concerns over energy security matters should contribute to the slowdown in oil demand in Europe. In the OECD, oil demand in the transport

sector should provide the most dynamic growth, although other end-uses, particularly for power generation, should also contribute. Oil demand in the FSU and Eastern Europe can be expected to decline due to sluggish economic growth, higher end-use oil prices, and reduced availabilities of oil supplies to the domestic markets. Energy-saving structural changes and improvements in energy efficiency will reduce the demand for all forms of energy including oil.

In the developing countries, we expect oil demand to increase in all sectors. Robust economic growth (projected at 5% p.a.) and rising per capita income should increase the demand for public and private transportation and induce sharp increases in transport fuel demand. In the residential and commercial sectors, the shift from traditional fuels to oil products as well as the expected increase in oil demand for electricity generation is likely to contribute to increases in oil use. The expected increase in the demand for oil for power generation (about 3.2% p.a.) is based upon the projected robust growth in electricity demand, limits to nuclear generation, and insufficient availability of gas for power generation over this period. However, the overall rate of growth in oil demand over the period 1991-2005 is likely to be lower (about 3.2% p.a.) than the roughly 4% p.a. achieved during the 1985-91 period. With a rising oil import bill, a shift to market-oriented pricing including reduction of subsidies should suppress growth in oil demand.

LONG-TERM PRICE PROJECTIONS (TO 2005). ***Tighter market to force prices to rise to 2000, then cyclical downturn to 2005.*** Over the longer run, between 1995 and 2000, we expect real prices to increase at 3% p.a. and then decline to 2005. This forecast assumes that global oil demand will increase at 1.5% p.a. over the period 1995-2000. In the OECD, oil demand is expected to increase at a rate of 0.7% p.a. as the effects of increases in energy taxes and efficiency improvements are more than offset by the income effect. The increase in transport demand and the substitution of petroleum products for coal in Japan should support increases in oil use in the power-generation sector. During this period, the bulk of the incremental oil consumption (69%) is expected to occur in the developing countries; the FSU and Eastern Europe will contribute marginally to the increase.

Oil production in non-OPEC regions (including the FSU) is expected to increase marginally, by 14 mtoe, mainly in developing countries and in the FSU. FSU oil production should recover in response to increased investments in exploration and development and increases in domestic prices. OECD oil production is likely to decline, however. The expected increases in global oil demand, by 259 mtoe over the 1995-2000 period, and modest increases in non-OPEC supplies will put pressure on oil-producing capacity. Based on the expected increases in OPEC output capacity to 1,700 mtoe, an increase in OPEC output to 1,480 mtoe to meet the increased demand translates into an OPEC capacity utilization rate of over 87%. Under this tight market balance, prices should increase in real terms.

Beyond the year 2000, we expect a cyclical downturn in prices. OPEC output capacity is expected to reach 2,000 mtoe by the year 2005, in response to the investment incentives provided by the higher prices in the late 1990s. The FSU is also expected to increase oil output as a result of increased foreign investment and the application of improved technologies. Developing countries' consumption growth should slow due to improvements in the efficiency of oil use and increased availability of natural gas. Increased dependence on Middle East oil in the late 1990s will accelerate policies to reduce this vulnerability and further reduce demand growth. A slowdown in population growth in the developing countries, aging population in the industrial countries, and the development of alternative energy technologies such as electric cars and gas-based substitutes for oil in the transport sector should moderate the growth in global oil demand considerably.

Uncertainties in the Petroleum Market Outlook

There is always a high degree of uncertainty with regard to the outlook for the global oil market and for international energy prices. This uncertainty is reflected in the wide range of forecasts of global oil demand, non-OPEC crude oil supplies, OPEC capacity expansion plans, and OPEC's policy responses to changes in market conditions. The dramatic turn of events in the FSU has widened the range of oil market uncertainty. Underlying this uncertainty are the different views on the oil industries' capital needs and its ability to generate these investments, as well as the impact of uncertain environmental policies. A review of the oil industry's investment needs is summarized in Annex I. Uncertainties about these factors is reflected in the wide range of oil price forecasts. For example, the Energy Modeling Forum (EMF) poll responses show oil price forecasts in the range of $15-35/bbl for the year 2000 and $20-55/bbl in 2010 (in constant 1990$).[3]

SENSITIVITY ANALYSIS. A key assumption underlying the short-term (late 1992 and 1993) oil price forecasts is that the embargo on Iraqi crude oil exports will continue. Over the long run, the base case demand and price forecasts rest upon the following key assumptions: (i) GDP growth in the OECD and developing countries will be 2.8% p.a. and 5% p.a. respectively, through the year 2000; (ii) OPEC output capacity will increase to about 1,700 mtoe (34 mb/d) by 2000 and to around 2,000 mtoe (40 mb/d) by 2005; (iii) non-OPEC oil output (excluding the FSU) will increase to 1,475 mtoe (29.50 mb/d) by 2000 and remain around this level to 2005; and (iv) FSU output will continue to decline up to the mid-1990s but increase steadily thereafter to reach 550 mtoe (11 mb/d) by 2005.

However, different rates of change in any of these long-term assumptions would give different forecasts to our baseline forecasts. To see the impact of changes in the baseline assumptions on crude oil prices, various model simulations were carried out. The results of this sensitivity analysis are presented in Table 17.

REMOVAL OF UN SANCTIONS ON IRAQI CRUDE OIL EXPORTS. A scenario is explored wherein the removal of UN sanctions would lead to Iraq's crude exports reaching about 125 mtoe (2.5 mb/d) in the latter part of 1993. Roughly, an unexpected increase in Iraqi exports of this magnitude would result in a $3/bbl (17%) decline in price in the second half of 1992 and about a $4/bbl (22%) decline in 1993.

UNCERTAINTIES IN OIL DEMAND FORECASTS. Oil demand in the western economies (excluding the FSU and China) has been forecast in the range 2,600-3,550 mtoe (52-71 mb/d) by the year 2000 (within a 70% confidence interval). Some estimates of oil demand are as high as 4,000 mtoe (80 mb/d) in 2000. The largest discrepancies are observed in demand forecasts for the developing countries where the relationships between demand and the variables that affect demand are not as clearly known as for the industrial countries.

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[3] Energy Modeling Forum, "International Oil Supplies and Demands, Summary Report," April 1992.

Table 17: Model Simulation Price Trends Under Alternative Assumptions

	1995	2000	2005
	($/bbl)		
Base Case	15.6	18.0	17.0
Economic Growth			
High	16.0	18.7	17.8
Low	15.2	17.1	15.9
Income Elasticity			
High	16.0	20.3	19.5
Low	15.1	16.0	14.9
Reduction in OECD Demand	15.1	17.1	15.4
Non-OPEC Supplies			
High	15.2	17.2	15.3
Low	16.1	21.1	20.0
FSU Oil Production			
High	13.5	14.9	14.0
Low	16.5	19.9	18.7

Source: World Bank, International Economics Department.

Differences in demand forecasts are due to different assumptions about: (i) economic growth prospects; (ii) prices; (iii) income and price elasticities; (iv) lagged effects of oil prices; and (v) efficiency improvements.[4]

Under an assumption of higher world economic growth (from 2.8% p.a. to 3.2% p.a.), the market-clearing price of oil (in real terms) would increase by about 2.5% in the medium term and about 5% in the long term. However, a corresponding decline in the economic growth assumption (down to about 2.5%) would translate into a larger decline in price–about 3% down in the medium term (1995) and about 8% lower in the long term (2005).

We estimate the impact on world oil prices of alternative assumptions about the income elasticity of oil demand to be as follows: under an assumed higher income elasticity of oil demand to 1.4 (the base case assumes a value of unity), prices trend about 3% higher in the medium term and 15% higher in the long term. Alternatively, reducing the income elasticity to 0.6 results in the price rending

[4] Energy Modeling Forum, "International Oil Supplies and Demands, Summary Report," April 1992. Models that generate high demand growth usually assume one or a combination of the following assumptions: (i) rapid economic growth; (ii) high income elasticities of demand; (iii) lagged effect on consumption of lower oil prices in the mid-1980s; and (iv) little or no energy efficiency improvements. Alternatively, assumptions behind slow demand growth forecasts include: (i) low economic growth and income elasticities; (ii) little or no effect of past prices; and (iii) substantial efficiency improvements.

3% and 14% lower in the medium and long run, respectively. Optimistic assumptions with regard to efficiency improvements can be reflected in lower income elasticity estimates.

IMPACT OF ENVIRONMENTAL AND ENERGY POLICY CHANGES. While the impact of policies such as use of carbon taxes to achieve CO_2 reduction is ambiguous because of offsetting own-price and substitution effects, we expect that OECD policies to reduce dependence on oil imports will have an impact on prices. We estimate that while environmental policies (carbon tax) should adversely affect oil demand through the price effect, the substitution effect should lead to an increase in oil demand. This is based on the assumption that, given the higher carbon content of coal, its price will rise relative to prices of oil and gas and induce shifts out of coal into oil and gas in electricity generation and industrial uses. Oil demand should increase more in regions where the availability of natural gas is limited. Concerns over the environment are likely to have a greater impact on the supplies of petroleum products and the refinery industry (see Annex II).

The impact on prices of more aggressive energy policies than we have assumed to reduce OECD oil dependence will depend upon how rapidly these policies are implemented (and on how much reduction is intended). A policy that targets a quick reduction in demand should have a greater impact on prices and higher adjustment costs than one which encourages gradual adjustment. We estimate that the impact of a gradual reduction in oil demand (1-2 mb/d in the medium term and 3-4 mb/d in the long term) would to be lower oil prices by 4-6% in the medium term and 8-10% in the long run, *ceteris paribus*.

UNCERTAINTY OF SUPPLIES FROM NON-OPEC SOURCES. Surprisingly, a review of the literature shows that the forecast range of non-OPEC oil supplies is not as large as the range of uncertainty for global oil demand--surprising, given the high level of uncertainty which must be attached to FSU output. Under the same oil price assumption, the forecasts in EMF models range between 1,200 mtoe and 1,700 mtoe (24-34 mb/d) in the year 2000 (excluding the FSU). Non-OPEC supply forecasts under various oil price scenarios, by the US DOE and other forecasting sources, are presented in Table 18. The relatively small range in non-OPEC supply forecasts is due mainly to the use of uniform estimates of oil reserves--despite the uncertainty with regard to the resource base. The variation is caused by differences in fiscal regimes and regulatory practices assumed by different analysts, as well as differences in price assumptions. In general, higher taxes on exploration and development activities yielded lower profiles for non-OPEC supplies.

Most sources forecast non-OPEC oil production to decline steadily through the turn of the century and more sharply beyond that. There appears to be a consensus that US oil production will decline steadily over the forecast period. The US DOE base-case estimates are for oil production capacity in the United States to decline to 425 mtoe by 2000 and to 415 mtoe by 2010 (from 484 mtoe in 1990), despite expected increases in price to $26.40/bbl and $33.40/bbl in 2000 and 2010, respectively.[5] The production declines in regions outside OPEC are based on several assumptions including: (i) rapid depletion of reserves; (ii) high costs of reserve replacements; and (iii) reduced possibilities of new finds in areas that possess the supporting infrastructure to expand drilling activity.

An assessment of the impact of the range of non-OPEC supply forecasts (1,200-1,700 mtoe, or 24-34 mb/d) from various industry sources shows that an increase in oil supplies from non-

[5] US Department of Energy, International Energy Agency, "International Energy Outlook 1992."

Table 18: Non-OPEC Supply Forecasts, 2000 and 2010 (mb/d) a/

Forecasters	2000	2010
IEO 92	31.2 (26.4) b/	27.4 (33.40) b/
IEO 91	27.5 (26.4)	24.6 (33.40)
Canada c/	26.1 (23.2)	25.0 (27.00)
DRI	26.6 (27.2)	26.9 (35.70)
County Natwest d/	30.0 (20.0)	- -

a/ Excludes the FSU and China.

b/ Figures in parentheses are assumed prices of crude oil in 1990 dollars per barrel.

c/ Estimates from Canada include only net exports from the former centrally planned economics, and not consumption/production estimates. For purposes of comparability, the consumption/production estimates underlying the net export projections (derived from the International Energy Outlook 1989) are added to the Canadian estimates.

d/ West Texas Intermediate oil price. The US refiner acquisition cost of imported crude oil used as the world oil price for the IEO92 and other projections listed here runs about $2-3/bbl less than West Texas Intermediate.

Source: IEO92--International Energy Outlook 1992, US Department of Energy/International Energy Agency-0484(92); IEO91--International Energy Outlook 1991, US Department of Energy/International Energy Agency-0484(91); Canada--Canadian Energy Supply and Demand 1990-2010, National Energy Board, June 1991; DRI--DRI/McGraw-Hill, International Oil Bulletin, Fall 1991; County NatWest USA, Oil Market Outlook, January 1992.

OPEC sources to 1,700 mtoe (34 mb/d) would result in about an 11% decline in the long-run price of oil. An assumed lower production from non-OPEC of 1,200 mtoe (24 mb/d) results in a sharper increase in oil price, by about 18%, since it would lead to sharp increases in the utilization of oil production capacity. However, the impact on prices would be lessened beyond the year 2000 because of lagged demand and supply (OPEC) side responses to higher prices in the late 1990s.

SUPPLY PROSPECTS FROM THE FSU. The recent dramatic turn of events in the FSU has obviously widened the band of uncertainty about the world oil supply outlook. In the medium term, the US DOE forecasts a decline in FSU and Eastern European oil production capacity to a range of 365-525 mtoe--down from 535 mtoe in 1991, and in the long term the forecasts are in the range of 425-585 mtoe in 2000 and 495-705 mtoe in 2010.

Petroleum Economics Limited has forecast FSU oil production to decline to 510 mtoe by 1995 (from a figure of 520 mtoe in 1991) but expects production to increase at about 2% p.a. beyond 1995 to reach 620 mtoe in 2005.[6] Under various scenarios for the speed of adjustment to economic reforms, Studiefonbundet Naringsliv Och Samballe forecasts FSU production to decline to 380-390 mtoe in 1995 (from 515 mtoe in 1991). The range of forecast in 2005 is 500-550 mtoe.[7]

[6] Petroleum Economics Limited, "World Long-Term Oil and Energy Outlook to 2005," 1991.

[7] Studiefonbundet Naringsliv Och Samballe, "Economic Reform and Energy in the CIS," 1992.

We have put together the following two scenarios about the development of the FSU oil sector in response to economic and political changes and have assessed their impact on oil prices.

(a) CONTINUED DISRUPTION: It is conceivable that prolonged political and economic uncertainties and the perceived high risks of investing will lead to prolonged disruptions in output. In this case, output should decline steadily to 400 mtoe by 1995 and to 300 mtoe by the turn of the century (roughly 240 mtoe lower than the base-case projection for 2000).

(b) RAPID RECOVERY: If efforts to reform prove successful and economic and political problems are relatively short-lived, the constraints on foreign technology imports and investment should be reduced. In this case, FSU oil production could increase to 625 mtoe by 1995 and could reach 700 mtoe by the year 2000.

In assessing the impact of different outlooks for supplies from the FSU, we find that the price risks associated with unexpected changes in FSU oil supplies could be asymmetric. Medium-term impact on prices are likely to be greater when FSU output increases sharply than would be the case if output declined sharply. Declines in FSU output are likely to be offset by increases from other producers. However, in a situation of a higher than anticipated output, other producers could be reluctant to reduce output below prevailing levels, thereby creating a glut in the market.

In the case of sharply lower FSU output, assumed under the disruption case, prices would trend only 6-10% higher than in the base case over the long run. In a situation of higher than expected increases in FSU oil supplies, prices would average 16-21% lower than the base case. However, where increases in FSU output were accompanied by offsetting supply adjustments by OPEC producers (say by mothballing of capacities) or increases in demand, the price decline would be substantially moderated.

The expected tightening of the market balance in the late 1990s is the key factor underlying our forecasted increase in the real price of oil over the 1995-2000 period. To test the robustness of these results, we also carried out a model simulation which assumes flat prices (in real terms) over the forecast period. We have found that if oil prices are held constant at $16.50/bbl (the average price expected in 1992 in constant 1990 US dollars) over the period 1992-2000, the projected demand and supply responses exert strong pressures on OPEC's oil production capacity. We estimate that in this situation, global oil demand would be roughly 100 mtoe (2 mb/d) higher and non-OPEC supply would be roughly 50 mtoe (1 mb/d) lower than assumed in the base case by the year 2000. This would lead to an increase in OPEC's capacity utilization rates to roughly 95% thereby exerting strong upward pressure on prices. Alternatively, at a utilization rate of around 81%, it is estimated that OPEC's output capacity would need to expand to roughly 1,850 mtoe (37 mb/d) by 2000 to meet oil demand growth generated by flat oil prices. These estimates are outside the range of industry estimates (or at the very high end) for OPEC's output capacity. Uncertain capacity expansion prospects for Saudi Arabia (estimated in the range of 9-12.5 mb/d) account for more than two thirds of OPEC's output capacity forecast range of 31-36 mb/d by the turn of the century (within a 70% confidence interval).

ANNEX I: *Investment Needs of the International Oil Industry*

Oil industry demand for capital is expected to increase sharply. British Petroleum (BP) has assessed the investment needs to be roughly $1 trillion to develop about 20 mb/d of additional capacity believed to be needed over the next decade or so. The capital needs are much higher when the costs of environmental compliance and revitalization of the FSU oil sector are included. Total investment estimates range between $1,350 and $1,850 billion over the next ten years. These are broken down as follows:

(a) Between $200 and $250 billion in OPEC countries to: (i) increase output capacity; (ii) reconstruct Kuwaiti and Iraqi oil production facilities; (iii) maintain existing and future capacities; and (iv) implement new technologies (especially enhanced recovery).

(b) Between $750 and $1,000 billion to expand output capacities in the non-OPEC regions. The bulk of the capital needs (about two thirds) are for the oil sector in the FSU.

(c) Between $50 and $100 billion to expand and upgrade refining capacity (mainly in the non-OECD countries).

(d) Between $200 and $250 billion for expanding oil transportation (mainly new tankers, pipelines, etc.) and distribution infrastructure, mainly in the developing countries where the systems are very rudimentary.

(e) Between $150 and $250 billion for environmental compliance. Roughly 75% is expected to be spent in the United States in accordance with the Clean Air Act. For other OECD countries, there is a large refinery component included. In developing countries, these include costs for diesel desulfurization and for reducing lead in gasoline.

The significant capital needs have changed the financial aspects of the oil industry. The industry's ability to generate capital will be crucial in shaping its future.

With rising external debt, many cash-strapped OPEC members are offering less stringent terms to foreign participants. Total OPEC official debt increased from around $151 billion in 1982 to roughly $225 billion in 1990 (Table A1). In an effort to reduce debt, several OPEC producers are now trying to attract equity partnerships in oil exploration and development activity. Majors with high debt-to-equity ratios (Chevron, Exxon, Mobil and mainly BP) are also attempting to reduce their debt overhang by selling assets.

In the United States, where the oil business has traditionally been financed by equity, capital shortages have resulted in sharp declines in drilling activity. Equity capital is very scarce. Many financial institutions are now reluctant to lend for oil exploration and development on the basis of reserve volumes, except to companies that have diversified cash flows to repay debt. The less integrated independent oil companies have suffered the most. They are now resorting to other sources of funding including acquisition financing, as well as selling assets.

The inability of governments to raise capital internally and to attract new technologies for the expansion of the oil/gas industry has also provided impetus towards privatization. Witness the developments in several developing countries, especially in Latin American countries such as Argentina and Chile, where large parts of industry, including the oil/gas sectors, have been privatized.

As capital markets become more competitive, potential investors will become more discriminating. An important determinant in investment decisions is likely to be the economic and political climate of the country. Factors such as currency convertability, repatriation of funds, control over domestic resources, and the legal and institutional framework will play a key role. We believe that given the pressures described, many more developing countries will become more open to foreign investment in this sector.

Table A1: Official Debt of OPEC Countries, 1982 and 1990

	1982	1990 a/
	($ million)	
Algeria	17,728	26,067
Ecuador	7,705	11,311
Gabon	1,000	3,176
Indonesia	26,305	53,111
Iran	8,350	8,575
Iraq	5,312	21,529
Kuwait	9,513	6,870
Libya	3,937	1,800
Nigeria	12,954	32,832
Qatar	806	916
Saudi Arabia	15,372	19,133
United Arab Emirates	9,652	7,197
Venezuela	32,153	33,144
Total OPEC	150,787	225,661

a/ 1990 or the latest year for which data are available. Figures for Iraq and Kuwait were assessed before the war.

Source: Shearson Lehman Brothers.

ANNEX II: *World Refining Outlook*

Changes in the demand for petroleum products have important implications for their supplies and, therefore, for the refining industry. During the early to mid-1980s, world refinery capacity declined sharply--in line with the decline in the demand for oil. Over the period 1979-85 world oil demand declined by about 320 mtoe (mainly in the OECD), while refinery capacity in the OECD declined by about 465 mtoe (Table A2). The decline was a response to the reduced profitability of refinery operations. In the FSU and Eastern Europe, however, oil demand was essentially unchanged during this period at around 560 mtoe (11.20 mb/d) and refinery capacity increased steadily from 660 mtoe (13.20 mb/d) in 1979 to around 750 mtoe (15 mb/d) in 1985.

Since the oil price collapse in 1986, however, world refinery capacity has increased in response to the increase in the world demand for oil (see Table A2). By the end of 1991, world refinery capacity had increased by 90 mtoe, despite the loss of Kuwaiti capacity of roughly 40 mtoe. Almost the entire increase occurred in the developing countries where demand growth was the most robust.

Since 1990, significant investment plans to expand refinery capacity have been announced worldwide. Based on this information, world refinery capacity is anticipated to increase by about 225 mtoe (4.50 mb/d) over the 1990-95 period. There is, of course, greater uncertainty about what will happen in the late 1990s. Between 1996 and 2000, world refinery capacity is expected to increase by 185 mtoe or 3.70 mb/d (based on firm industry investment plans) and by 330 mtoe or 6.60 mb/d (based on all plans). The increases in refining capacity are expected to take place mainly in the developing countries--although increases are also expected in Japan.

OECD

In the United States, refinery capacity is likely to decline over the forecast period from its current capacity of around 15.6 mb/d. The declines should be achieved by mothballing smaller units and closing Chevrons' (30-year old) Port Arther refinery (with 0.325 mb/d capacity). While US distillation capacity is expected to decline, significant upgrading plans are underway. In compliance with the Clean Air Legislation, more cokers and desulphurization plants are coming on line.

In Western Europe, increased capacity of between 0.16 and 0.30 mb/d is expected by 2000, with most of the increase taking place in Germany. In Japan, the joint-venture project with Saudi Aramco and other capacity expansion and demothballing projects are expected to add up to 1.20 mb/d of extra capacity. Low estimates are around 0.70 mb/d. Japan's current refinery capacity is about 4.55 mb/d.

Asia-Pacific

In the developing countries, the Asia-Pacific region is likely to be the front runner in building new refinery capacity. Upgrading and expansion plans are underway in several countries including Thailand (1.50-2.60 mb/d), India (0.20-0.32 mb/d), Taiwan, China (0.20 mb/d), the Philippines (0.20-0.30 mb/d), Indonesia (0.125 mb/d), and Malaysia (0.15-0.23 mb/d). Several countries, including Indonesia and Malaysia, are pulling together joint-venture schemes to support their expansion plans.

Table A2: Refinery Capacity and Utilization Rate by Economic Regions, 1979, 1985, and 1991

	1979		1985		1991	
	Capacity	Utilization Rate	Capacity	Utilization Rate	Capacity	Utilization Rate
	(mtoe p.a.)	%	(mtoe p.a.)	%	(mtoe p.a.)	%
OECD	2,355	75	1,890	71	1,865	82
North America	1,020	83	875	77	880	85
Western Europe	1,015	67	745	67	720	77
Pacific	320	77	270	65	265	85
Non-OECD	1,630	80	1,800	78	1,915	76
OPEC	3,985	77	3,690	74	3,780	78

Note: Refinery capacity relates to distillation capacity and not to other refinery processes.

Source: Petroleum Economics Ltd.

Latin America and the Caribbean

In Latin America and the Caribbean, between 1 mb/d and 2 mb/d of capacity expansion is expected over the next five years. Venezuela tops the list with plans to expand capacity by 0.40 mb/d, followed by Mexico (0.30 mb/d), Brazil (0.25 mb/d), and Colombia (0.075 mb/d). In line with the shift in the rest of the world, oil consumption in Latin America is moving towards lighter products. The increase in the demand for gasoline by roughly 3.7% p.a. over the past ten years has increased gasoline's share to 35% (up from 29% in the early 1980s). Over the same period, the shares of diesel oil and fuel oil fell from 27% for both to 25% and 23%, respectively.

Plans also call for a substantial upgrading of the region's refinery configuration to supply products to the US market. However, the completion of these plans is contingent upon the success with which investment capital can be secured. Restrictions on foreign participation and competition with capital for upstream investments, as well as other energy sector investments (such as for power plants), would limit investments in the refinery industry. However, the shift towards privatization and more liberal policies towards foreign participation are likely to alleviate the capital shortages.

Middle East

In the Middle East, significant capacity increases are expected in Kuwait (0.80 mb/d), Iran (0.50 mb/d), and the UAE (0.18 mb/d). Kuwait's increase mainly reflects the reconstruction of its refineries damaged during the Middle East conflict. Kuwait's pre-invasion capacity was around 0.82 mb/d. Current output (mid-May, 1992) of the most heavily damaged Magnae-al-Ahamadi refinery is around one third of its pre-war capacity of about 0.27 mb/d. Most of the refinery capacity restored so far supplies the domestic market. It is expected that capacity of about 0.65 mb/d will be restored by the end of 1993.

Iraq's plans to raise capacity to about 0.4 mb/d also reflect reconstruction efforts. Prior to the war, Iraq's capacity was around 0.65 mb/d, but war damage reduced it to between 0.10 and 0.20

mb/d. Post-war plans are to increase capacity to 0.80 mb/d by 1995. Iran is expected to be the most active in the region. The completion of the Arak refinery and the Bander Abbas refineries would add roughly 0.4 mb/d by the end of 1992 and another 0.20 mb/d by 1995. At that time, Iran's capacity would reach 1.4 mb/d.

While not much capacity expansion is planned in Saudi Arabia, the kingdom is planning a major shift in the product mix, as well as an improvement in the quality of the products. Therefore, most investments are geared to modernization and upgrading of existing refineries. Plans also include reducing the share of fuel oil exports (from the current 50%) while increasing gasoline output. This involves putting in additional reformation capacity.

The trend towards the lighter end of the barrel is common worldwide. The demand for lighter products is increasing faster than that for heavier products because fuel oil faces greater competition from low-priced natural gas for power generation. Plans also call for reducing the sulphur content of gas oil to below 0.5% for exports to the Far East market.

Current Saudi modification plans are focused on the Ras Tanura plants and will be extended to Yanbu and the Jubail refineries. Saudi plans to increase its processing capacity for lighter products are evident in its oil capacity expansion plans which favor the development of fields yielding light and sweet crude oil. In 1991, the capacity to produce light Arab crude increased by up to 0.4 mb/d. It is expected that most of the capacity expansion plans, 0.8-0.9 mb/d (an increase from 8.9 mb/d in 1991 to 10 mb/d by 1995), will be for lighter grade. Hawiyah (part of the large on-shore Ghawar structure with current output of 2.2 mb/d) is expected to add roughly 0.6 mb/d of 34° API Arab light, while 0.17 mb/d of very light and sweet crude of 49° API is expected to be available from the Hawtch field. The state-owned Saudi Aramco also plans to downsize its offshore fields producing Arab heavy (27° API) and Arab medium (31° API).

Planned increases in Africa are fairly limited. Plans are envisaged only in Nigeria (0.1 mb/d), Egypt (0.05 mb/d), Libya (0.04 mb/d), and Tunisia (0.03 mb/d). Nigeria is considering sites for two export refineries with a total capacity of 0.1 mb/d.

Impact of Environmental Concerns

Environmental concerns are pushing refiners towards improving the quality of their products. Most countries now have less tolerance for polluting fuels. While quality improvement plans are well under way in several industrial countries, large investments for this purpose are also planned in the developing countries.

The EC has agreed to adopt sulphur limits for petroleum products. Rules call for a cut in diesel sulphur (measured by weight) to a maximum of 0.2% by end-September 1994 and to 0.05% in 1996. In the United States, plans call for a cut in diesel sulphur to 0.05% by end-September 1993 (from 0.25%). In the Pacific Rim, where gas oil accounts for about 30% of oil consumption (of 13.4 mb/d), there are plans for a sharp reduction in sulphur--to as low as 0.05% in some plants in Singapore, the Republic of Korea, and Thailand by 1995. The current sulphur limit in these countries is roughly 0.5%. In other countries such as the Philippines and Malaysia, new standards mandate a cut in sulphur to 0.5% by 1995 (from 1%). Lead reduction in gasoline is also planned in many countries, noticeably Pakistan, Singapore and Malaysia. Lead is one of the major and most dangerous pollutants from gasoline.

The significant investment needs to expand capacity and for environmental compliance could restrict the realization of these plans. Conventional plant costs for the capacity expansion plans (by 4.2-4.8 mb/d) in the Asia-Pacific region are around $50 billion; the costs for environmental compliance add considerably to these costs. In the United States, costs to meet the Clean Air Legislation requirements amount to around $40 billion for the US refining industry (although these estimates are somewhat speculative). Since environmental compliance will involve the revamping of many front-end refineries, the failure of plants to generate investments for this purpose would result in their closures. Industry estimates are that between 0.5 and 2 mb/d of refining capacity may be shut down because of either inability or unwillingness to comply with environmental standards. Up to 0.6 mb/d of capacity shutdown is expected in California. These reductions will be achieved by phasing out older plants where compliance costs are very high. While stricter environmental standards should lead to a more modern and efficient refinery industry in the long run, there are concerns that the higher costs could increase the barriers to entry and reduce competition in the US refining industry. Other concerns are that the closing of US refineries would increase dependence on imported products and hence increase US vulnerability to supply-side shocks.

Table A3: Liquid Fuels - Production By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	(Million Tons of Oil Equivalent)										(% p.a.)		
High-Income	825	911	939	925	970	1,004	1,033	1,049	1,034	1,060	1.8	0.7	1.0
OECD	603	701	765	779	788	791	795	794	735	708	2.1	1.8	-0.7
United States	508	478	440	445	439	429	419	409	387	374	0.4	-0.2	-1.2
Canada	68	81	89	89	90	91	92	93	95	95	3.2	0.5	0.5
Germany	8	6	5	5	5	5	5	5	5	5	-1.5	-1.6	-0.7
United Kingdom	0	83	93	92	99	106	106	121	88	79	41.9	45.5	-1.1
Non-OECD	222	210	178	146	182	213	239	255	290	353	0.7	-2.9	6.5
United Arab Emirates	40	83	97	111	115	112	108	105	126	150		1.1	2.2
LMICs	1,501	2,184	2,167	2,193	2,175	2,168	2,173	2,186	2,464	2,683	4.0	0.8	1.5
Africa	62	120	139	149	148	148	146	146	152	146	11.9	0.9	-0.2
Nigeria	53	96	80	91	90	88	85	83	97	100	11.2	-1.3	0.7
Americas	269	301	360	380	374	375	375	377	424	463	1.7	2.1	1.5
Mexico	24	105	145	150	153	155	158	160	173	186	10.5	12.6	1.6
Venezuela	191	119	108	120	112	110	106	103	131	151	-2.8	-3.7	1.6
Asia & Pacific	82	211	268	273	286	286	289	292	297	340	347.0	5.6	1.6
Europe	384	634	596	541	519	511	504	500	520	550	4.6	2.6	0.1
Middle East & North Africa	705	918	799	841	849	845	857	871	1,008	1,177	3.2	-2.1	2.4
Saudi Arabia	197	501	342	419	412	404	380	362	431	519	4.5	-1.7	1.6
Iran	196	102	150	164	165	162	156	151	176	205	0.7	-5.8	1.6
Iraq	78	115	99	14	25	30	70	100	117	158	1.9	-0.1	19.0
Libya	148	84	63	69	71	70	67	65	76	90	3.4	-5.6	1.9
World	2,326	3,094	3,106	3,122	3,145	3,172	3,206	3,235	3,474	3,744	3.2	0.8	1.3

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: United Nations Energy Statistics (actual);
World Bank, International Economics Department (projected).

Table A4: Liquid Fuels - Apparent Consumption By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	(Million Tons of Oil Equivalent)										(% p.a.)		
High-Income	1,597	1,855	1,786	1,791	1,811	1,829	1,847	1,862	1,931	1,955	2.1	-0.4	0.6
OECD	1,564	1,797	1,737	1,740	1,759	1,777	1,793	1,807	1,869	1,884	2.1	-0.5	0.6
United States	673	792	793	776	781	788	795	802	831	835	1.5	0.2	0.5
Canada	71	88	78	74	75	76	77	77	79	79	1.6	-0.7	0.4
Germany	132	152	135	137	139	143	143	144	149	150	3.0	-0.7	0.6
United Kingdom	101	84	83	83	84	85	85	86	89	89	0.5	-2.1	0.5
France	96	111	88	92	94	96	97	98	101	103	2.6	-1.9	0.8
Italy	92	99	92	95	98	99	101	102	105	106	2.8	-0.8	0.8
LMICs	680	1,185	1,320	1,329	1,336	1,343	1,359	1,373	1,564	1,789	5.2	3.1	2.2
Africa	29	41	50	52	53	54	56	57	64	70	4.7	2.6	2.4
Americas	147	229	255	262	270	277	285	293	336	386	3.9	2.4	2.8
Mexico	25	61	81	82	84	86	88	89	99	110	7.3	6.8	2.1
Brazil	27	53	62	64	66	68	70	72	85	98	5.8	3.1	3.4
Asia & Pacific	104	218	310	325	341	354	368	382	464	530	8.0	4.7	3.6
China, People's Rep.	31	88	110	115	121	126	132	138	171	194	11.1	5.4	3.8
India	19	33	56	59	62	66	69	73	94	120	6.6	5.3	5.2
Korea, Rep. of	9	26	47	51	54	56	58	59	68	74	14.4	6.7	2.7
Europe	340	581	530	503	480	460	446	430	440	515	4.8	2.4	0.3
World	2,277	3,039	3,106	3,122	3,145	3,172	3,207	3,235	3,484	3,744	3.2	0.9	1.3

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: United Nations Energy Statistics (actual);
World Bank, International Economics Department (projected).

Table A5: Liquid Fuels - Gross Exports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	(Million Tons of Oil Equivalent)										(% p.a.)		
High-Income	392	508	584	561	592	618	646	678	682	700	4.2	1.4	1.6
OECD	155	246	351	353	356	358	360	362	350	330	6.6	4.9	-0.5
United Kingdom	17	58	59	58	64	70	80	84	60	50	10.6	11.4	-1.0
Non-OECD	238	263	233	208	236	260	286	316	332	370	1.9	-2.1	4.2
United Arab Emirates	40	81	89	101	102	103	106	109	116	138		0.5	2.3
Kuwait	145	87	50	10	39	70	98	117	136	157	-2.7	-5.5	21.7
LMICs	1,130	1,438	1,328	1,328	1,306	1,308	1,305	1,311	1,425	1,589	2.8	-0.9	1.4
Africa	62	114	127	133	129	127	127	125	125	120	11.1	0.3	-0.7
Nigeria	50	90	78	84	80	78	78	77	87	90	10.7	-1.8	0.5
Americas	251	205	207	221	213	210	209	205	230	225	-0.6	-0.7	0.2
Mexico	3	44	66	68	69	70	70	71	74	75	18.5	27.6	0.7
Venezuela	178	100	91	103	95	92	90	86	110	122	-3.3	-4.4	1.2
Asia & Pacific	41	91	105	109	112	115	117	120	100	86	7.5	4.9	-1.7
													-0.8
Europe	105	193	210	180	173	168	160	162	170	160	5.6	4.2	-0.8
Middle East & North Africa	672	836	679	685	679	688	692	699	805	963	2.5	-3.1	2.5
Saudi Arabia	180	472	302	370	362	337	336	320	376	450	4.2	-2.3	2.5
Iran	179	73	116	127	127	123	120	119	145	175	-0.4	-7.5	2.3
Iraq	75	107	84	-	-	40	50	75	90	125	1.5	-0.7	
Libya	147	80	55	61	62	61	60	60	66	77	2.9	-5.0	1.7
World	1,523	1,946	1,912	1,889	1,898	1,926	1,951	1,989	2,107	2,280	3.2	-0.3	1.4

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: United Nations Energy Statistics (actual);
World Bank, International Economics Department (projected).

Table A6: Liquid Fuels - Gross Imports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	(Million Tons of Oil Equivalent)										(% p.a.)		
High-Income	1,180	1,480	1,431	1,427	1,432	1,443	1,460	1,491	1,582	1,595	3.3	-0.6	0.8
OECD	1,128	1,366	1,327	1,315	1,326	1,344	1,357	1,375	1,484	1,507	3.0	-0.7	1.0
United States	173	350	396	401	407	413	419	424	450	492	5.0	1.8	1.5
Germany	134	160	136	138	139	140	141	142	150	156	3.2	-0.6	0.9
Netherlands	65	78	80	80	81	82	82	83	85	86	3.6	0.7	0.5
France	105	126	98	99	100	100	101	102	105	107	2.6	-1.8	0.6
Italy	114	114	109	110	110	111	112	112	115	117	2.4	-1.2	0.5
Non-OECD	51	114	104	112	106	99	103	116	98	88	7.5	1.5	-1.7
Singapore	20	39	58	64	65	66	66	67	69	72	7.7	4.8	1.0
LMICs	311	451	480	464	468	483	491	498	526	686	3.5	1.2	2.8
Africa	30	36	38	35	34	34	36	36	37	44	3.4	0.6	1.6
Americas	129	136	102	105	109	112	117	121	128	148	0.2	-2.7	2.5
Brazil	19	47	43	44	45	46	48	49	55	62	5.7	1.6	2.6
Asia & Pacific	65	101	147	161	167	183	196	210	267	276	5.6	3.4	3.8
Korea, Rep. of	10	27	144	45	47	48	49	51	61	70	14.7	7.0	3.0
Europe	51	120	144	142	134	117	102	92	92	110	7.7	3.8	-1.8
World	1,491	1,931	1,911	1,891	1,794	1,926	1,951	1,989	2,107	2,280	3.3	-0.2	1.4

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: United Nations Energy Statistics (actual);
World Bank, International Economics Department (projected).

Table A7: OPEC Crude Petroleum - Average Prices, a/ 1960-91 (Actual), 1992-2005 (Projected)

	($/barrel)		
	Current $	1990 Constant $	
		G-5 MUV b/	G-7 CPI c/
Actual			
1960	1.5	7.2	9.4
1961	1.5	7.1	9.2
1962	1.4	6.5	8.4
1963	1.4	6.6	8.1
1964	1.3	6.1	7.3
1965	1.3	6.0	7.1
1966	1.3	5.8	6.9
1967	1.3	5.8	6.7
1968	1.3	5.8	6.5
1969	1.3	5.5	6.2
1970	1.3	5.2	5.9
1971	1.7	6.4	7.2
1972	1.9	6.6	7.3
1973	2.7	8.1	9.1
1974	11.2	27.5	34.0
1975	10.9	24.1	29.4
1976	11.7	25.5	30.6
1977	12.8	25.4	30.3
1978	12.9	22.3	24.9
1979	18.6	28.3	33.9
1980	30.5	42.4	49.7
1981	34.3	47.5	55.5
1982	31.0	43.6	50.8
1983	28.1	40.4	45.3
1984	27.5	40.4	44.5
1985	26.7	38.9	42.3
1986	13.6	16.8	17.9
1987	17.2	19.4	20.0
1988	13.6	14.3	14.7
1989	16.3	17.2	17.7
1990	21.2	21.2	21.2
1991	17.3	17.0	16.5
Projected			
1992	17.6	16.5	15.8
1993	17.3	15.7	15.0
1994	17.4	15.5	14.7
1995	18.0	15.6	14.8
2000	24.7	18.0	16.8
2005	26.8	17.0	15.3

a/ For the period 1960-73, prices refers to Saudi Arabian light, 34-34.9 API, f.o.b. Ras Tanura; for the following years they are average OPEC spot prices weighted by their respective export volumes.

b/ Deflated by G-5 Manufacturing Unit Value (MUV) Index.

c/ Deflated by G-7 Consumer Price Index (CPI).

Sources: International Crude Oil and Product Prices, Energy Economic Research Ltd., Lebanon; Oil Industry Developments, Petroleum Economics Ltd. (actual); World Bank, International Economics Department (projected).

Coal

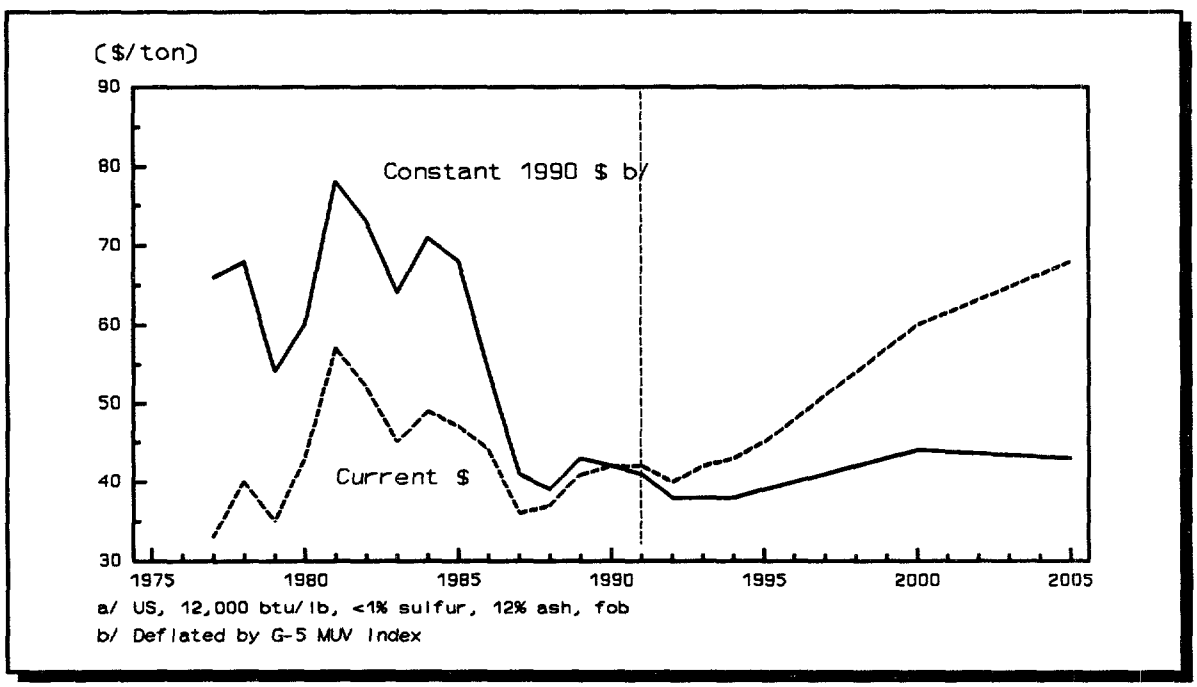
Summary

- Since early 1991 when crude oil prices returned to the levels prevailing before the Gulf conflict, thermal coal export prices have been declining. The current f.o.b. price of just over $40/ton for the US marker thermal coal represents a decline in real terms to its lowest level since the price series started in 1977.

- For the period up to 1995, thermal coal prices are expected to increase somewhat in nominal terms (enough to maintain constancy in real terms) as economic activity picks up and marginal coal capacities are trimmed. Over the long term, thermal coal prices are forecast at about the f.o.b. costs of the major coal exporters. The relatively low prices during the first half of the 1990s should dampen investment in capacity expansion to restore market balance over the longer term.

- During 1985-89, world coal consumption increased at 2.2% p.a. compared with 2.9% p.a. growth during 1980-85. However, in 1990 world consumption increased only 0.2%, mainly because of sharp downturns in the FSU and Eastern Europe. Although demand growth for coal has slowed in recent years, the latest figures represent robust demand growth in view of the adverse economic conditions and heightened environmental concerns.

Coal Prices, a/ 1975-2005



- Coal's share in world primary energy consumption increased for most of the 1980s, but recent data show that the share has stabilized and we expect it to decline slightly over the forecast period. World coal consumption is projected to increase at 1.8% p.a. over the 1991-2005 period, while world thermal coal consumption is forecast to grow at 2.5% p.a. in this period.

- The coal export capacity of major coal-exporting countries is expected to increase by 50 million tons over the 1991-95 period, a large enough quantity to keep supply slightly in excess of demand. Future production increases should come principally from the traditional coal-producing countries such as Australia, China, India, South Africa, and the United States. Most European countries and Japan are expected to phase down their coal industries due to high costs, while Colombia, Indonesia, and Venezuela are likely to become more important coal exporters.

Demand Outlook

Over the second half of the 1980s, OECD's coal consumption growth rate steadily decelerated from a 3.6% increase in 1987 to a 0.3% decrease in 1990. A large part of this decline is attributable to the slowdown in economic activity--from 3.4% growth in GDP in 1987 to 2.3% growth in 1990. However, the decline also appears to have been the result of changes in relative fuel prices and expectations of more stringent environmental restrictions, as discussed below. In the non-OECD countries, coal consumption grew at much faster rates, by 8.1% in 1987 and 3.3% in 1988, but declined by 1.7% in 1990, largely due to sharp declines in the FSU and Eastern Europe. For China, the world's largest coal producer and consumer, consumption continued to grow through 1990, as it did in other developing countries such as India and South Africa.

Coal losing market share, mostly to natural gas. The much lower petroleum prices since 1986 clearly have had an impact on fuel choices, favoring oil and natural gas in place of coal. Coal's share in primary energy consumption had been increasing since the first oil price shock, but after the 1986 collapse of petroleum prices its share started to decline, both in the OECD and developing countries (see Table 1). Many EC member countries have shown a preference for natural gas, available from nearby areas (e.g., the North Sea, the Netherlands, the FSU, and Algeria), rather than coal, especially as some countries (the United Kingdom and Germany) have reduced subsidies to domestic coal producers. The proposed EC carbon tax has also been a factor. Japan, however, has continued to rely heavily on imported coal in its plans for power generation capacities, partly because imported natural gas is much more costly in Japan than in Europe (see Table 3). In Eastern Europe and the FSU, both coal and petroleum have been losing ground to natural gas.

Growth in thermal coal consumption for electricity generation increases. By far the largest and fastest-growing market for coal is in thermal electricity generation. The growth rate of world coal consumption for electricity generation accelerated from 3.3% p.a. during 1980-86 to 4.6% p.a. during 1986-89. The growth rate accelerated in all major country groups over this period: in the OECD from 2.3% to 3%; in developing countries (including China) from 7.9% to 9.5%; in the FSU and Eastern Europe from 1.2% to 2.2%. In terms of volume, the bulk of the increases took place in the traditionally large coal consumers, i.e., China, the United States, and India, while the most rapid rates of increase were in the industrializing developing countries in Asia, particularly in recent years.

The post-1986 acceleration in thermal coal consumption for power generation in the OECD is explained mostly by increased demand for electricity, because as Table 2 shows, coal's share

Table 1: Trends in Fuel Shares, by Region, 1980-90

	1980	1985	1987	1989	1990
	(%)				
OECD					
Coal	20.4	22.4	21.7	21.4	21.4
Oil	49.8	43.4	43.6	43.3	42.9
Gas	20.1	19.3	18.9	19.4	19.5
Others	9.6	14.9	15.8	16.0	16.3
Developing Countries a/					
Coal	37.6	40.6	40.9	40.6	39.9
Oil	40.8	35.1	33.5	33.5	36.6
Gas	9.0	10.8	11.5	12.5	12.6
Others	12.6	13.5	14.1	13.4	10.9
Eastern Europe & the FSU					
Coal	36.7	33.3	32.6	30.5	29.1
Oil	35.3	30.6	29.6	29.3	28.5
Gas	24.7	31.2	32.6	34.6	36.7
Others	3.3	4.9	5.2	5.6	5.7

a/ Defined as non-OECD countries excluding the FSU and Eastern Europe.

Sources: International Energy Agency (IEA), Coal Information 1992, and Energy Statistics and Balances of Non-OECD Countries 1988/89, Paris, OECD.

in total thermal power generation in the OECD declined slightly in recent years. In developing countries, coal's share continued to increase through 1989, while in Eastern Europe and the FSU an abundance of natural gas in the FSU has allowed steady increases in its share to the detriment of oil and coal.

Natural gas-fired power generation to grow more rapidly than coal-fired. Between 1982 and 1989, OECD's coal-fired power generating capacity (including multi-fuel units that can use coal) increased at 0.8% p.a. and its share of total thermal power capacity also increased slightly. Thus, the bulk of the increase in coal-fired power generation was achieved through enhanced capacity utilization of coal-fired units. According to a recent OECD member governments' survey, coal-fired power capacity is expected to grow at 1.1% p.a. between 1989 and the year 2000, oil-fired units should decline marginally, and natural gas-fired capacity should increase most rapidly at 3.5% p.a. Natural gas is available to many OECD countries on attractive terms either from domestic production (for Canada, United States, United Kingdom, Norway, and the Netherlands) or through imports (for most other countries in Western Europe). Among the industrial countries, Western Europe is leading the way in terms of the speed with which natural gas use for power generation is expected to increase (3.9% p.a.), followed by North America (3.4% p.a.) and the Pacific region (3%).

Table 2: Fuel Shares in Thermal Power Generation, by Region, 1980-90

	1980	1985	1987	1989	1990
	(%)				
OECD					
Coal	58.0	69.1	69.9	68.1	68.7
Oil	25.3	14.4	14.2	16.2	15.4
Gas	16.7	16.5	15.9	15.7	15.9
Developing Countries a/					
Coal	49.5	49.7	50.9	52.8	52.9
Oil	33.1	25.6	22.2	18.6	19.0
Gas	17.4	24.7	26.9	28.6	28.1
Eastern Europe & the FSU					
Coal	50.0	44.6	45.0	43.9	43.1
Oil	28.0	21.2	17.8	12.6	13.4
Gas	22.0	34.2	37.2	43.5	43.5

a/ Non-OECD countries excluding the FSU and Eastern Europe.

Source: See Table 1.

Relative fuel prices vary within OECD. Table 3 shows fuel prices delivered to electric utilities in four major industrial countries. At the relative fuel prices prevailing in the United States in 1991, coal is hardly more advantageous than natural gas even without environmental considerations--that is, according to the conventional rule of thumb that coal costs should not be more than one half the costs of oil or natural gas per unit of heat value in order to be competitive in the thermal power market. In other countries, coal's cost disadvantage is far more apparent. In Italy, for example, where domestic prices reflect international prices more closely than in other European countries, natural gas appears to be highly attractive compared with coal. The advantage coal had during 1980-85 is no longer apparent. In Japan and Germany, fuel prices are distorted by subsidies; the prices in Table 3 therefore do not reflect their true costs to these countries. If natural gas prices in these countries reflected the true import costs and coal prices were to come down to a level similar to that in Italy, coal would be highly competitive against natural gas. This is the reason why Japan still has an ambitious plan to expand coal-fired power capacity. Germany strongly leans to natural gas rather than imported coal, but commitments to import coal from Poland are likely to be maintained.

Developing country coal consumption growth strong. Rapid increases in coal consumption in developing countries have been seen in both thermal and metallurgical coals. Coal-fired thermal power generation expanded rapidly between 1980 and 1989: in India (at 11.4% p.a.), China (8% p.a.), Indonesia (from zero in 1980 to 3.4 million tons in 1989), Thailand (20.1% p.a.), South Africa (4% p.a.), the Republic of Korea (17% p.a.), Hong Kong (from practically zero in 1980 to 9.9 million tons in 1989), Israel, and Taiwan, China (15.3% p.a.). Metallurgical coal consumption for steel production also increased rapidly in the Republic of Korea (9.6% p.a.) and Brazil (8.1%). We expect these countries to continue to provide the main source of growth for coal demand in developing countries.

Table 3: Fuel Prices Delivered to Electric Utilities in Major Industrial Countries, 1980-91

	1980	1985	1987	1989	1990	1991
	(US$/ton of oil equivalent)					
United States						
Thermal Coal	57.1	68.5	63.2	59.8	60.4	60.1
Heavy Fuel Oil	178.2	177.3	124.3	119.5	139.5	102.1
Natural Gas	97.0	151.3	98.5	104.0	102.3	94.4
Japan						
Thermal Coal	120.8	105.2	151.6	170.1	168.8	176.1
Heavy Fuel Oil	260.7	233.1	179.0	190.3	215.8	n.a
Natural Gas	217.4	214.6	151.3	164.0	185.7	n.a.
Germany, Fed. Rep. of						
Thermal Coal	148.3	130.3	192.7	191.1	224.3	215.7
Heavy Fuel Oil	203.6	184.5	131.5	129.9	149.2	149.2
Natural Gas	140.8	164.0	165.7	143.0	175.7	n.a.
Italy						
Thermal Coal	81.9	82.0	74.5	83.6	96.8	94.8
Heavy Fuel Oil	188.7	179.7	116.7	105.4	140.2	148.1
Natural Gas	192.2	167.4	111.6	101.3	129.9	134.3

Source: IEA/OECD, Energy Prices and Taxes, various issues.

Supply Outlook

Coal resources plentiful and major producers plan capacity increases. Between 1980 and 1989, world coal production increased steadily at an average annual rate of 2.8%. However, in 1990 world production declined 0.8%, led by sharp falls in the FSU and Eastern Europe (by 9.1%) and in Western Europe (by 4.6%). Production losses in these countries are a part of the ongoing structural adjustments in the industry--although of a different nature for Eastern and Western Europe--and are likely to continue for several more years at least. During the 1980s, production increases were achieved mostly in the traditional coal-producing countries such as Australia, China, India, South Africa, and the United States, and in newcomers such as Colombia, Indonesia, and Venezuela.

World coal resources are ample to meet expected demand increases. The major coal-producing countries mentioned above will continue to provide most of future incremental production. Most firm or planned capacity expansion projects are located in these countries. Projects considered firm and expected to be completed between 1991 and 1995 amount to 50 million tons of annual capacity. Australia alone accounts for more than one half (28.6 million tons) of this total. The largest single project is the 10 million ton/year La Loma project in Colombia. Indonesia has two large projects totaling 10 million tons/year.

Over the longer term, many new projects, either extensions of exiting mines or greenfield projects, could be brought into production. Most are located in countries that are already major producers and exporters. Projects geared mainly for the export market amount to 187 million tons, of which Australia accounts for 118 million tons. Indonesia, Colombia, and Venezuela each could add 10-15 million tons. As political conditions in South Africa improve, more export projects could be added to that country's current plans. Most new projects in the United States are geared to domestic markets; the only large project considered for the export market is in Alaska, which has obvious transportation advantages for Asian markets but faces serious environmental constraints.

Exporters' relative costs consistent with capacity expansion plans. Competition among the major coal exporters for world markets will be determined by their relative cost competitiveness. Table 4 summarizes the results of a recent study of coal costs for the main coal exporters in supplying the two main markets--Western Europe and East Asia. These are intended to show the typical (average) cost configuration; it should be kept in mind that a significant proportion of mines may have costs below or above the levels shown. In the European market, the United States and Colombia are roughly at par, although Australia is not far behind. Australia has a clear advantage in East Asian markets. The sub-bituminous coal from the US Midwest faces tough competition in the Asian market from Australian coal; it is therefore unlikely that the abundant low-sulphur coal from the US Midwest will find its way into the export market much beyond the current low levels. South Africa can export to both Europe and Asia. However, South African coal is of relatively low quality and hence its cost advantage is not as large as what the figures suggest. Nevertheless, it is not difficult to see that South Africa will play a greater role as a coal exporter in the long term provided the political conditions improve enough to attract more investment. The planned capacity increases summarized above are roughly consistent with the current relative cost structure.

Australia's coal production has apparently benefitted from its new labor practices, with production increasing 9.5% in 1990 and 8.1% in 1991. Partly to offset appreciation of the Australian dollar vis-a-vis the US dollar since the mid-1980s, Australian coal exporters have been under considerable pressure to remain profitable. Measures taken to reduce costs have included lowering rail freights and royalties, in addition to adopting new labor practices.

At current export prices, some marginal producers in the United States are reportedly hard-pressed to remain in business, and industry consolidation (closures, mergers, and takeovers) has been reported among US coal producers. US exports benefitted from US dollar depreciation in the second half of the 1980s, but competition from Colombia, South Africa, and Venezuela is likely to keep export volumes from growing significantly over the remainder of this decade. Over the longer term, only the US coal industry has a resource base large enough to supply a big volume to the European market.

Most production for domestic market in China and India. In China and India, the two largest coal producers within the developing world, the coal industry is heavily regulated. About 65% of China's coal production comes from publicly-owned mines and their prices to domestic users are set well below economic costs to the country. Coal India Limited (CIL), a state-owned enterprise, controls 90% of India's coal production. Only in recent years have CIL's prices to domestic users been allowed to increase to the level of CIL's costs, assuming efficient operation. In both of these countries, coal serves as the predominant source of energy, so as to minimize imports of oil. Thus, domestic needs have taken precedence over exports and export volumes have been relatively small compared with total production. China has been known to occasionally divert export coal to domestic uses. It is believed that China is the least-cost supplier to Asian markets and has the potential to become a major supplier to the

Table 4: Representative Costs of Thermal Coal Production in Major Producing Countries

	United States		Australia		South Africa	Colombia
	Under-ground	Surface	Under-ground	Surface	Surface	Surface
	(1990 US$/ton)					
Mining Cost	22.0	28.1	27.5	12.2	9.3	25.0
Capital Charge a/	1.0	1.2	6.3	6.6	1.0	12.7
Inland Trans.	20.0	12.5	6.0	10.0	10.0	4.0
Loading Cost	2.5	1.4	3.7	3.5	2.3	3.0
Total f.o.b. cost	45.5	43.2	43.5	32.3	22.6	44.7
Ocean Freight						
to Japan	14.8	12.8	8.5	7.2	9.7	N.A.
to Europe	6.7	8.5	12.5	11.6	8.7	6.7
Total c.i.f. Cost						
c.i.f. Japan	60.3	56.0	52.0	39.5	32.3	N.A.
c.i.f. Europe	52.2	51.7	56.0	43.9	31.3	51.4

a/ Assuming 10% rate of return on investment.

Source: IEA, Coal Information 1991, OECD, Paris, 1991.

region. However, rapid increases in domestic consumption, partly stimulated by subsidies, have prevented it from becoming a large exporter. India's coal is of relatively low quality and not suitable for export without extensive preparation.

In a number of countries where coal has been mined for a long time, the remaining resources are becoming scarce and increasingly costly to mine. These countries include Germany, the United Kingdom, most other European countries, Japan, and the Republic of Korea. Almost all of these countries have plans to phase out subsidies to domestic coal production, so that their production levels are expected to decline over time. The system of contracts and subsidies currently in force in Germany is likely to slow down the decline in its coal production, while lignite production in the former East Germany may be phased out quickly for environmental reasons. Privatization of electric utilities in the United Kingdom should speed up the substitution of imported coal and natural gas for domestic coal in that country.

Limited expansion of FSU coal production foreseen. The FSU and Eastern Europe are significant coal producers and coal resources in the FSU are believed to be large. They are located in three major fields--Moscow Basin, Donbass Basin north of the Black Sea, and the Kuzbass/Yakut fields in western Siberia and Kuznetsk and Kansk-Achinsk Basins in southern Siberia. The Siberian coal fields

have high-quality metallurgical coal and there are high-capacity rail links to Asian market ports. These characteristics have attracted Japanese investments, which explains the current export volume to Japan, and Japan has shown an interest in further investments in an effort to diversify its supply sources. For the domestic market and exports to Europe, coal's position in the FSU's energy supplies depends on its competitiveness with the region's vast natural gas resources. European markets clearly prefer natural gas to coal. At the same time, the FSU's coal resources and infrastructure requirements to serve the European markets put it at a significant disadvantage to natural gas. Therefore, the FSU's coal sector is not likely to grow significantly either in the domestic or export market.

Polish industry needs to become more efficient. Poland has been an important coal producer and exporter for a long time but still has sizable high-quality reserves. However, good-quality hard coals are mined from deep underground mines and production costs have been rising rapidly. With the shift to a market-oriented system, the Polish coal industry suffered losses partly because of the existence of inefficient mines. The ongoing industry restructuring is likely to result in permanent closures of marginal hard coal mines and most brown coal mines, and sharp declines in production over the near term. But Poland needs coal for its long-term energy supplies, so investments in the industry and appropriate changes in its management and regulatory environments will be required to meet these needs economically. Other East European countries rely heavily on brown coal production for electric power generation and industrial and domestic uses. Because of the high sulphur content of brown coal, its production and consumption is likely to be phased out in these countries.

Price Outlook

Since early 1991 when crude oil prices began to turn downward, thermal coal prices in international markets have also been declining, albeit mildly. In terms of the US export prices of the marker thermal coal, the total decline from the last quarter of 1990 to the second quarter of 1992 amounted to $1.75/ton or 4.2%. The fall in prices has been caused by weak economic conditions, stronger competition from oil and natural gas, and the re-emergence of South Africa as a major coal exporter. Although the market is currently burdened with excess supply capacity, production has been restrained so as not to cause a large buildup of stocks. At just over $40/ton currently for the US marker thermal coal, prices are at their lowest level in real terms since the price series commenced (in 1977).

No increase in real prices in medium term, small increase in long term. Over the period to 1995, thermal coal prices are expected to increase somewhat in nominal terms as the industrial economies recover from recession and marginal coal capacities are removed from the market. At current prices, the industry faces consolidation and restructuring; investments for capacity expansion are also being restrained. This is likely to relieve some of the excess supply pressure but not by enough to result in price increases in real terms. New export coal projects expected to come on-stream over the 1991-95 period amount to 50 million tons, or about 16% of world exports. Given that world import demand is expected to increase by 14.5% over this period, the market balance is not expected to improve significantly, if at all.

Over the long term, thermal coal prices are forecast at about the f.o.b. costs of the major coal exporters (see Table 4). For example, the price for the US benchmark thermal coal is forecast at US$43-44/ton for the years 2000 and 1990 in 1990 constant dollars, in line with US costs shown in Table 4. The long-term price forecasts imply small increases in real terms for thermal coal export prices. These forecast increases can be justified on several grounds. First, relatively low prices during the first half of

the 1990s should discourage investments in coal capacity expansion and hence result in a more balanced market towards the year 2000. Next, petroleum prices are expected to rise in real terms in the second half of the 1990s, and this expectation keeps coal as a viable energy option. Finally, production costs of coal are expected to rise moderately over the long term as production moves to more difficult locations and opportunities for efficiency improvements become harder to find. The long-term forecasts in this report are virtually the same as those made two years ago.

Coal and the Environment

Coal use generates environmentally harmful side-effects throughout its life cycle, from mining to waste disposal. The most serious environmental impact arises from its combustion, which discharges sulfur dioxide, nitrogen oxide, carbon dioxide, and various particulates. Reasonably cost-effective technology exists for removing sulphur dioxide, nitrogen oxide, and particulates from the effluent gas. Recently, attention has been focused on the possible "greenhouse" effect of the carbon dioxide emissions from coal burning. This aspect is much more difficult to deal with because no effective way of reducing coal's carbon dioxide emissions is known.

Carbon taxes becoming more popular. Coal discharges about twice the carbon dioxide emissions of natural gas, per unit of energy produced, and about 23% more than oil. Thus, greenhouse considerations have led to a preference for natural gas or oil. On May 26, 1992, the EC Council of Ministers failed to reach agreement on a proposed energy/carbon tax. The main point of contention appears to have been the issue of conditionality, i.e., whether the EC should adopt the proposal irrespective of whether the United States and Japan adopt similar measures. Four European countries (Finland, the Netherlands, Norway, and Sweden) already have carbon taxes. Nine other industrial countries, including France, Germany, Japan, and Italy, are planning to impose carbon taxes. Thus, the likelihood of some form of carbon tax coming into force in the EC remains high. This is one reason why EC members are opting for natural gas for a large part of their future utility plans.

Most industrial countries have adopted stringent emission standards for sulfur dioxide, nitrogen oxide and particulates. However, a large proportion of coal users in industrial countries lack effective measures for reducing the discharge of these pollutants, and the situation in developing countries, the FSU, and Eastern Europe is far worse than it is in industrial countries.

Table A1: Solid Fuels - Production By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990 b/	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	(Million Tons of Oil Equivalent)										(% p.a.)		
High-Income	723.2	773.9	894.6	852.6	855.5	859.5	860.5	863.5	883.5	921.5	0.8	1.5	0.6
OECD	720.2	772.3	893.1	851.1	854.0	858.0	859.0	862.0	882.0	920.0	0.8	1.5	0.6
United States	363.3	430.9	537.9	515.7	525.0	535.0	540.0	545.0	580.0	615.0	2.0	2.2	1.3
Germany	154.0	141.5	130.0	104.0	100.0	97.0	95.0	95.0	80.0	70.0	-0.7	-0.2	-2.8
United Kingdom	88.5	72.8	52.3	54.0	50.0	45.0	40.0	35.0	20.0	15.0	-3.0	-2.3	-8.7
Australia	32.1	57.8	106.9	112.4	115.0	118.0	121.0	124.0	140.0	160.0	7.0	6.0	2.6
LMICs	753.0	1,051.5	1,409.9	1,404.0	1,405.3	1,431.1	1,473.9	1,511.4	1,691.5	1,886.5	3.5	3.4	2.1
Africa	36.6	69.1	108.1	108.6	111.3	116.6	116.9	118.4	134.5	154.5	5.3	6.5	2.5
South Africa	33.7	66.1	104.0	104.5	107.0	112.0	112.0	113.0	128.0	147.0	5.6	6.7	2.5
Americas	6.1	10.5	24.1	26.4	27.0	27.5	28.0	35.0	49.0	65.0	5.3	6.7	6.6
Asia & Pacific	231.3	414.9	652.7	695.0	717.0	737.0	759.0	768.0	868.0	977.0	6.3	5.7	2.5
China, People's Rep.	165.7	305.5	480.0	505.0	520.0	535.0	550.0	553.0	618.0	690.0	6.8	5.8	2.3
India	36.3	65.3	112.7	130.0	133.0	136.0	139.0	142.0	160.0	177.0	5.3	6.7	2.2
Europe	478.3	555.7	625.0	574.0	550.0	550.0	570.0	590.0	640.0	690.0	1.6	1.3	1.3
World	1,476.2	1,825.4	2,304.5	2,256.6	2,260.8	2,290.6	2,334.4	2,374.9	2,575.0	2,808.0	2.2	2.6	1.6

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: United Nations Energy Statistics (actual);
World Bank, International Economics Department (projected).

Table A2: Solid Fuels - Apparent Consumption By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990 b/	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	(Million Tons of Oil Equivalent)										(% p.a.)		
High-Income	755.0	790.4	856.0	835.0	842.0	851.0	874.0	896.0	953.0	1,009.0	0.8	1.5	1.4
OECD	751.9	786.3	850.0	829.0	836.0	845.0	868.0	890.0	947.0	1,003.0	0.8	1.5	1.4
United States	325.1	370.9	458.0	449.0	455.0	460.0	470.0	480.0	497.0	515.0	1.9	2.2	1.0
United Kingdom	90.9	71.6	62.0	63.0	60.0	57.0	54.0	50.0	50.0	48.0	-2.5	-1.6	-1.9
Germany	157.8	140.7	135.0	112.0	113.0	114.0	114.0	115.0	105.0	100.0	-0.5	0.0	-0.8
LMICs	733.5	1,023.6	1,321.9	1,318.1	1,320.2	1,338.5	1,381.7	1,414.3	1,573.8	1,736.2	3.5	3.4	2.0
Africa	35.9	51.6	70.3	72.4	74.5	77.7	79.8	83.0	94.0	105.0	3.7	4.0	2.7
South Africa	32.7	48.4	65.0	67.0	69.0	72.0	74.0	77.0	87.0	98.0	3.9	4.1	2.8
Americas	8.6	14.8	24.0	25.0	26.0	27.0	28.0	30.0	36.0	43.0	5.0	5.8	3.9
Asia & Pacific	230.1	419.1	639.6	681.1	702.7	722.3	743.8	752.6	855.0	967.2	6.4	5.9	2.5
China, People's Rep.	164.5	303.8	470.4	494.9	509.6	524.3	539.0	540.8	598.2	659.0	6.8	5.8	2.1
India	35.6	65.4	111.6	128.7	131.7	134.6	137.6	140.6	158.4	175.2	5.3	6.6	2.2
Europe	457.5	535.9	588.0	539.6	517.0	511.5	530.1	548.7	588.8	621.0	1.7	1.4	1.0
World	1,488.5	1,814.0	2,177.9	2,153.1	2,162.2	2,189.5	2,255.7	2,310.3	2,526.8	2,745.2	2.2	2.5	1.8

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: United Nations Energy Statistics (actual);
World Bank, International Economics Department (projected).

Table A3: Solid Fuels - Gross Exports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990 b/	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	(Million Tons of Oil Equivalent)										(% p.a.)		
High-Income	77.9	113.0	169.7	183.0	180.0	181.0	183.0	183.0	202.1	227.1	3.5	4.0	1.6
OECD	77.9	113.0	169.7	183.0	180.0	181.0	183.0	183.0	202.1	227.1	3.5	4.0	1.6
United States	37.0	49.6	67.0	69.0	70.0	70.0	70.0	70.0	77.2	87.7	2.6	2.7	1.7
Australia	11.3	27.3	67.7	78.0	78.0	80.0	83.0	85.0	99.9	117.4	13.4	8.9	3.0
LMICs	42.1	62.3	112.7	109.8	134.8	147.6	149.6	158.6	204.7	239.7	4.3	5.0	5.7
Africa	1.6	18.6	29.1	31.3	38.4	40.4	38.4	36.4	39.5	46.5	14.8	22.7	2.9
South Africa	1.1	18.2	30.0	31.0	38.0	40.0	38.0	36.0	39.1	46.1	18.9	24.4	2.9
Americas	0.0	0.1	11.4	12.0	12.0	14.2	14.3	18.9	35.0	42.0	31.6	38.0	9.4
Colombia	0.0	0.1	9.5	10.0	10.0	12.0	12.0	16.5	22.0	27.0		44.1	7.4
Asia & Pacific	1.8	3.8	15.2	16.5	18.4	19.5	21.0	24.0	32.0	40.0			6.5
Europe	38.6	39.7	57.0	50.0	66.0	73.5	75.9	79.3	98.2	111.2	2.3	1.6	5.9
World	120.0	175.2	282.4	292.8	314.8	328.6	332.6	341.6	406.7	466.8	3.8	4.4	3.4

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: United Nations Energy Statistics (actual);
World Bank, International Economics Department (projected).

Table A4: Solid Fuels - Gross Imports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990 b/	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	(Million Tons of Oil Equivalent)										(% p.a.)		
High-Income	104.1	147.2	191.5	211.9	211.9	219.2	226.9	240.0	276.2	318.5	3.3	3.2	3.0
OECD	104.0	144.4	171.5	190.9	190.4	197.2	202.9	215.0	246.2	283.5	3.1	2.9	2.9
Japan	33.0	48.6	70.0	75.9	74.0	76.0	79.0	82.0	95.0	110.0	7.9	4.0	2.7
Germany	14.7	14.5	14.7	12.2	13.0	17.0	19.0	20.0	25.0	30.0	-1.2	-1.1	6.6
Belgium-Luxembourg	7.8	9.1	10.1	9.8	9.9	10.2	10.4	10.7	12.2	13.7	0.9	1.0	2.4
France	10.8	20.2	13.7	14.8	15.0	15.2	15.4	15.7	17.5	19.3	0.4	-0.8	1.9
Italy	8.1	11.1	13.9	13.4	13.7	14.0	14.3	14.6	16.5	18.5	2.6	3.6	2.3
LMICs	23.5	37.1	72.8	72.4	73.8	76.6	79.0	82.5	107.6	132.5	5.2	6.4	4.4
Africa	0.9	0.4	2.7	2.7	2.8	2.8	2.9	2.9	3.6	4.5	-4.3	-1.7	3.7
Americas	2.6	4.7	9.5	9.7	10.0	10.3	10.6	11.0	14.0	17.0	6.7	7.7	4.1
Asia & Pacific	1.4	8.3	26.7	27.0	28.0	28.5	29.5	30.6	43.0	55.0	12.9	21.9	5.2
Europe	18.1	22.5	33.9	33.0	33.0	35.0	36.0	38.0	47.0	56.0	3.5	3.2	3.8
World	127.7	184.2	264.3	284.3	285.7	295.8	305.9	322.5	383.8	451.0	3.7	3.9	3.4

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: United Nations Energy Statistics (actual);
World Bank, International Economics Department (projected).

Table A5: Thermal Coal - Prices, 1977-91 (Actual), 1992-2005 (Projected)

	($/ton)					
	United States a/			Australia b/		
	Current $	1990 Constant $		Current $	1990 Constant $	
		G-5 MUV c/	G-7 CPI d/		G-5 MUV c/	G-7 CPI d/
Actual						
1977 e/	33.4	66.3	79.0	29.0	57.6	68.6
1978	39.6	68.4	76.4	28.6	49.4	55.2
1979	35.4	54.0	64.6	29.7	45.3	54.2
1980	43.1	59.9	70.3	39.4	54.7	64.3
1981	56.5	78.2	91.4	52.8	73.1	85.4
1982	52.2	73.4	85.5	54.8	77.0	89.8
1983	44.5	64.0	71.8	38.2	54.9	61.6
1984	48.6	71.4	78.6	31.0	45.6	50.1
1985	46.6	67.9	73.9	33.8	49.3	53.6
1986	43.9	54.3	57.7	31.1	38.4	40.8
1987	36.2	40.7	42.1	27.5	31.0	32.0
1988	37.1	38.9	40.1	34.9	36.6	37.7
1989	40.5	42.8	43.9	38.0	40.1	41.2
1990	41.8	41.8	41.8	39.7	39.7	39.7
1991	41.5	40.7	39.5	39.7	38.9	37.8
Projected						
1992	40.4	37.9	36.2	39.0	36.6	34.9
1993	42.0	38.0	36.3	41.0	37.1	35.5
1994	43.0	38.2	36.3	42.0	37.3	35.5
1995	45.0	38.9	37.0	44.0	38.1	36.1
2000	60.0	43.7	40.9	57.0	41.5	38.8
2005	68.0	43.1	38.7	65.0	41.2	37.0

a/ 12,000 btu/lb, <1% sulfur, 12% ash, f.o.b. piers, Hampton Roads, Norfolk, United States.
b/ 12,000 btu/lb, <1% sulfur, 14 ash, f.o.b. piers, Newcastle/Port Kembla, Australia.
c/ Deflated by G-5 Manufacturing Unit Value (MUV) Index.
d/ Deflated by G-7 Consumer Price Index (CPI).
e/ May-December 1977.

Sources: Coal Week, and Coal Week International, various issues (actual); World Bank, International Economics Department (projected).

Copper

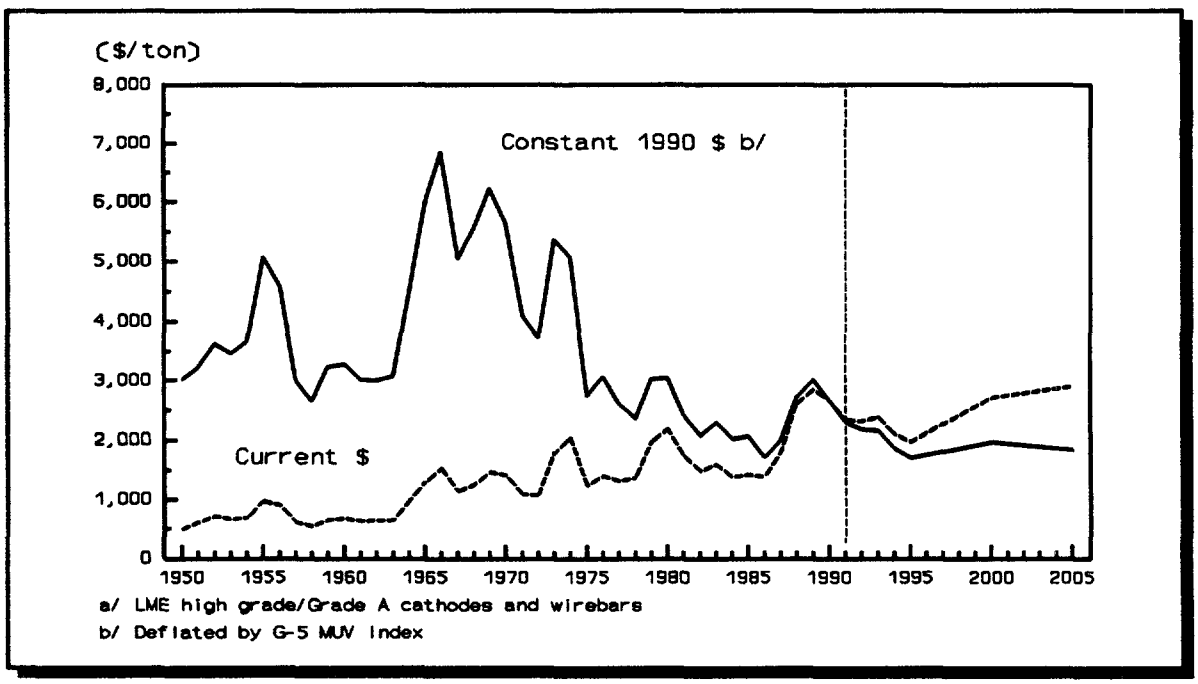
Summary

- Among base metals, copper has continued to enjoy relatively high prices over the past several years, supported by a series of supply disruptions at a time of sustained and substantial demand growth. Copper prices rarely fell below $1/lb over the 1988-92 period and lately rose to $1.10/lb on fears of supply disruptions and a surge in demand.

- 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 a fragile one easily wiped out if industrial economies recover strongly.

- If the 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 the 2000-2005 period. Long-term copper prices are forecast to be roughly at a level sufficient to bring on-stream new projects currently envisaged for the 1990s and beyond.

Copper Prices, a/ 1950-2005



- World consumption of refined copper is forecast to be relatively robust with an average growth rate of 2% p.a. over the 1991-2005 period. As before, industrializing developing 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 the capital goods sector. Demand in the FSU and Eastern Europe is expected to remain depressed in the near term but it should grow quickly from the mid-1990s as these economies require huge investments in infrastructure and equipment.

- A tally of announced projects indicates that over the 1992-95 period, world mine and refined copper capacities will expand by as much as 1 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.

Demand Outlook

Recent copper consumption growth mirrors growth of industrial production. Despite economic recession, preliminary statistics show that refined copper consumption in the world excluding the centrally planned economies (CPEs) (former and present)[1] increased 1.4% in 1991, following increases of 5.1% and 1.5% in 1989 and 1990, respectively. Most of the increase in 1991 (and the preceding years as well) came from the LMICs, with an 8.1% increase, while consumption in the high-income countries remained largely unchanged. Refined copper consumption in the CPEs (former and present) declined 14.4% in 1990, the latest year for complete data, resulting in a 1.9% decline in world consumption in that year. Among industrial and developing countries, there have been clear regional disparities in consumption growth. In Western Europe, substantial demand increases in Germany were offset by decreases in other countries so that the total for Western Europe for 1991 was unchanged. US copper consumption declined 4.3% in 1991, while Japan's consumption increased 2.3%. The above changes in copper consumption closely reflect the performance of industrial production in these countries. For example, US industrial production declined 2% in 1991, while Japan's and Germany's industrial production increased 2.3% and 3.2%, respectively. The industrializing developing countries in East Asia again provided the most sparkle in the copper market (Taiwan, China led the region with a 50% increase in 1991). The latest consumption figures are broadly consistent with the post-1985 trend that suggests a revival of copper demand growth in relation to economic activity.

Because of its superior electrical conductivity, copper's main use has been in electrical wires. Its other important uses have been in plumbing tubes, in various hardware in the form of alloys with other metals, and in automobile radiators. As electricity has found uses in a diverse range of processes and products, so has copper. According to 1990 US data, about 72% of refined copper consumption was related to electrical uses, 15% was in construction, 5% in machinery, 4% in transportation, 1% in ordinance, and 3% in other uses. The construction industry is an important end-user of electrical wires; copper used in construction is estimated at 40% of total US consumption. Over the years, copper's market share in electrical uses in the United States has been increasing, despite significant market penetration by aluminum in long-distance electrical cables and by optical fibers in telecommunications. The predominance of electrical uses of copper can also be seen in other industrial and developing countries. In LMICs, the shares of the construction and transportation sectors have been low because copper tubes in household plumbing are too costly in relation to income and because the

[1] These include the FSU, Eastern Europe, China, Cuba, and the Democratic People's Republic of Korea.

automobile manufacturing industry has been small. The situation has started to change, however. In industrializing developing countries, copper demand typically increases rapidly as a result of rapid increases in exports of copper-containing parts and finished products. Then as income levels increase, more copper is demanded for the domestic market in consumer durables and construction. Both Taiwan, China and the Republic of Korea are good examples of this pattern.

Effect of energy/capital complementarily on copper demand. Although copper is an important industrial raw material, its share in total manufacturing value-added is small. Thus, the elasticity of copper demand with respect to its own price has been estimated to be relatively small, usually not exceeding 0.1-0.2 in the long run, and highly unstable. The conventional copper demand models that explain copper consumption in terms of industrial production and prices of copper and its substitutes thus could be leaving out other important factors. In particular, the energy price increases in the 1970s and early 1980s seem to have had a significant impact on copper consumption through energy-capital complementarily in the short run. In many cases, energy saving also meant metals saving. For example, high electricity prices reduced electricity demand, which in turn reduced the demand for power cables and building wires. The converse of this is the revival of copper demand following the post-1986 decline in energy prices. Increases in copper demand in the second half of the 1980s can be attributed in large part to increased manufacturing output and capital investment, which can be partly explained by energy-capital complementarily. The increases can also be attributed to wider use of electronic devices in most types of products, and because few new opportunities for replacement of copper with other materials have been found in recent years.

Substantial long-term demand growth expected. This report forecasts the long-term demand for copper using a copper demand model that has as explanatory variables industrial production, relative prices of copper to energy, aluminum, and labor, and trend changes in technology. Based on the demand model and the base-case assumptions about industrial production growth, exchange rates, and inflation in the major copper-consuming countries, world demand for refined copper is projected to increase at 2% p.a. over the 1991-2005 period. The current economic difficulties in the FSU and Eastern Europe, and the long time it is likely to take for these countries to resume stronger economic growth have led to reductions in the forecasts of copper demand growth rates for these countries from those previously anticipated. Nevertheless, the world demand growth projected for the 1990s and beyond is substantial and would require large capacity expansions of both mines and smelters.

To show the sensitivity of the demand forecasts to assumptions made about the growth of industrial production and relative prices, Table 1 presents simulation results under different assumptions, that is, the levels of industrial production and prices of copper and other production inputs are 10% higher than the base case for the entire forecast period and for all countries. It is apparent from Table 1 that a higher industrial production level would have the most profound impact on copper demand. Slight changes in the world economic growth scenario, say a 4% p.a. growth rate instead of 3%, could mean an additional copper demand of 80-100,000 tons. The effects of changes in oil prices and prices of copper and its substitutes are relatively minor compared with that of industrial activity.

Copper intensity of production forecast to fall in developing countries. Over the forecast period, the base-case forecast of refined copper consumption implies a 19.4% decline in the copper intensity of industrial production (copper consumption per unit of industrial output) for a sample of five large industrial economies (France, Germany, Italy, Japan, and the United States) and an 8.8% decline for a sample of four developing economies (Brazil, India, Republic of Korea, and Mexico). These reductions in copper intensity represent a change from the historical pattern--over the 1973-90 period, for example, copper intensity declined by 22.8% in the five industrial countries and increased by 35.9% in the four developing countries. We believe that the rate of decline in copper intensity in the industrial economies should slow slightly due to lower energy prices and the prospect of large and increasing demand for investment in infrastructure and equipment. For the four developing countries, the historical copper intensity is heavily influenced by a rapid increase in copper use followed by a sharp slowdown in recent years in the Republic of Korea. This pattern resulted from the rapid expansion of certain copper-intensive industrial sectors which after reaching their potential suddenly reduced their copper consumption growth rate. A similar pattern is probably being repeated in Taiwan, China. In the years ahead, it is likely that copper consumption growth in industrializing Asia will slow to substantially below the growth rate of industrial production.

For the LMICs as a whole, copper consumption increased only at 3.1% p.a. during 1970-90, while GDP grew at 4.5%. For the period 1991-2005, the growth rate of copper consumption for this group is projected to slow only slightly to 2.8%. Figure 1 plots past and projected copper intensities for the representative countries in the two income groups.

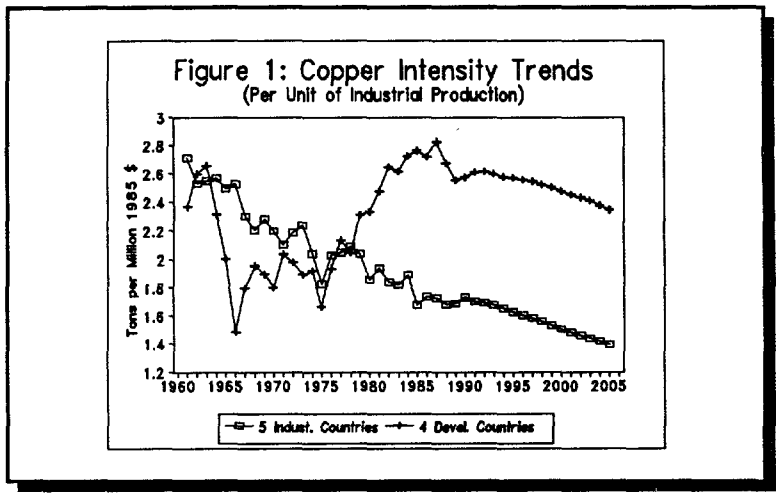
Slow recovery of FSU and Eastern European demand. Over the next few years, the FSU and Eastern Europe should continue to experience the low levels of copper demand seen in 1991 as they transform to market-oriented economies. The FSU has been the third largest consumer of copper in the world after the United States and Japan. Declines in copper consumption in recent years led to sharp increases in exports; exports in 1990 amounted to 176,800 tons, mostly in low-grade cathodes. The most serious problem these countries face is outdated industrial machinery and infrastructure that require retrofitting and modernization in order to compete with the rest of the world. This means huge capital investments, mostly from foreign sources. Once this transformation process begins, copper demand should rise. But a return to the levels of a few years ago is likely to take a long time because these levels were inflated by inefficiencies in raw materials use and large consumption for military purposes.

Table 1: Sensitivity of Copper Demand to Economic Assumptions a/

	1992	1995	2000
		(%)	
Industrial Production	7.2	8.4	8.6
Copper Price	-0.3	-1.1	-1.3
Oil Price	-0.4	-1.3	-1.5
Aluminum Price	0.1	0.4	0.5

a/ Percentage change in copper demand as a result of a 10% increase in industrial production, copper price, oil price, or aluminum price over that assumed in the base case.

Source: World Bank, International Economics Department.



Technological innovations should continue to play a major role in shaping the copper industry although in an unpredictable manner. The latest development in the telecommunications market is the discovery by AT&T that copper wires can pack as many lines of communication as optical fibers. Thus, it now appears that the telecommunications market for copper is at least not completely lost to optical fibers. However, the race to find a room-temperature, superconducting material seems to have stalled and its final outcome in relation to copper use is highly uncertain. At least for the moment copper does not face serious challenges from new technologies.

Supply Outlook

MINE PRODUCTION. ***Production expansion during 1987-91 despite big supply disruptions.*** Between 1987 and 1991, mine production of copper in the West (in the form of copper concentrates and leach output) increased by about 822,000 tons (a 2.9% p.a. increase). The net increase in mine production would have been much larger, by more than 500,000 tons, had the Bougainville mine in Papua New Guinea not shut down and Zambia and Zaire maintained production at their 1987 levels. Chile and the United States contributed most to the increase, each with a net increase of more than 400,000 tons, while Australia, Indonesia and Portugal were also large contributors. Several large projects that came on-stream during this period account for most of the increases; for example, the new Escondida mine, the Chuquicamata sulphide expansion and a new SxEw plant in Chile; the Bingham Canyon expansion and the Morenci SxEw plant in the United States; the new Neves Corbo mine in Portugal; the Ok Tedi mine in Papua New Guinea; and the Ertsberg mine expansion in Indonesia.

Production disruptions of various kinds were a major factor in shaping the market during the 1987-91 period. In addition to the problems in Papua New Guinea, Zambia, and Zaire, there were production losses due to strikes (in Canada, Chile, Mexico, and Peru to name only the most disruptive ones) civil unrest (most seriously in Peru), accidents (for example, rock-bursts in Chile's El Teniente mine), and adverse weather conditions (drought in Papua New Guinea that inhibited barge transportation).

Since the collapse of communism, the copper mining industry in the FSU and Eastern Europe has been undergoing radical changes in terms of ownership, management, and pricing. The impact of the changes has been felt in world markets in the form of greater availability of low-grade copper from these countries. In the FSU, copper ore is found mainly in the Urals, Caucasus, Kola Peninsula, Kazakhstan, Georgia, Northern and Central Siberia, and Uzbekistan; it is likely that the FSU has abundant undiscovered resources of copper including some high-grade ore bodies and valuable by-products. Poland and former Yugoslavia are significant producers of copper. Poland's underground copper mines have relatively rich ores with significant by-products; proven reserves are large enough to support production for a long time. The FSU and Poland both experienced declines by 110,000 tons in copper mine production (or by 11% and 25%, respectively) during the 1987-90 transitional period. Both suffered from lack of supplies, environmental problems, and poor maintenance. Significant recent discoveries of copper deposits, together with other metals, are likely to maintain Yugoslavia's production at its historical levels.

Long-term mine capacity changes uncertain. Table 2 shows the mine capacity forecasts to the year 2005. Copper mine projects already being implemented or in the planning stage give fairly good indications of likely capacity changes to 1995, but capacity forecasts for the years 2000 and 2005 should be considered highly conjectural. A number of large and small projects in the pipeline should come on-stream by 1995, with an expected net addition of about 600,000 tons to western world capacity. The large ones among them include new projects at Chuqui Mansa Mina, La Candelaria, and Quebrada Blanca SxEw, and expansions at Escondida, Los Blonces (all in Chile), Sar Cheshmeh (Iran), and Mt. Isa (Australia).

Between 1995 and 2000, the net increase in mine capacity is expected to be relatively small because only a few large projects have a reasonable chance of being realized, for example, Chuqui Norte SxEw, and the Bingham Canyon and Escondida expansions. (We assume that the Bougainville mine will restart production at least partially by the year 2000). However, the forecasts here may turn out to be too conservative, since the high copper prices of recent years have attracted a great deal of interest in new copper mining projects--the list of probable and potential new mine projects at different stages of investigation around the world keeps growing. The total mine capacity of these projects presently amounts to more than 2 million tons of copper. These projects are only partially reflected in the forecasts given in Table 2 but more of them could come on-stream by 2005 if copper prices are favorable and the growth in copper demand remains strong. At the same time, the industry faces much more stringent environmental constraints in both industrial and developing countries than before, and the difficulties experienced during the 1980s have taught it to adopt lofty economic feasibility criteria. So if copper prices decline to the relatively low levels forecast here for the mid-1990s, a good number of these projects are likely to be put on hold beyond the year 2000. Over the long term, however, most of them should be realized if demand growth is to be met and the depletion of existing mines is to be compensated.

REFINED COPPER PRODUCTION. ***In the 1980s industrial country producers cut costs and increased output.*** Between 1987 and 1991, the western economies' refined copper production increased by 924,000 tons, which slightly exceeded increases in refined copper consumption over the same period. Some 86% of the increase was accounted for by the United States, Chile, and Australia. Most developing countries experienced production stagnation or decline. Between 1987 and 1990, the FSU and Eastern Europe suffered substantial losses in refined copper production; however, Poland's production recovered strongly in 1991. Refined copper production increased slightly more than mine production largely due to an increase in secondary copper production (scrap recovery).

Table 2: Western World Copper Mine Capacities, 1990-2005

	Production		Mine Capacity			
	1990	1991	1992	1995	2000	2005
	('000 tons Cu in Concentrates and Leach Output)					
Africa						
Zambia	496	412	360	340	300	250
Zaire	356	292	120	250	320	400
Other Africa	280	285	280	280	200	200
Asia & Pacific						
Australia	327	311	315	350	380	420
Papua New Guinea	170	205	190	172	250	250
Philippines	182	144	150	175	160	150
Indonesia	170	200	290	300	400	550
Other Asia	212	238	235	315	305	305
America						
United States	1,587	1,635	1,720	1,750	1,670	1,800
Canada	802	777	770	700	650	680
Chile	1,588	1,814	1,855	2,260	2,570	2,850
Peru	317	381	380	390	370	410
Mexico	291	267	310	363	365	370
Brazil	37	37	37	15	125	150
Europe						
Portugal	160	165	170	145	105	80
Yugoslavia	119	113	60	70	70	70
Other Europe	122	120	110	90	70	50
Total	7,216	7,396	7,352	7,965	8,310	8,985

Source: World Bank, International Economics Department.

The average direct cash cost[2] of producing refined copper in the western economies is estimated at about ¢62/lb, while the total cost is estimated at ¢86/lb. Most of the world's major copper-producing countries have direct cash costs of less than ¢80/lb. At today's copper prices, almost all copper producers can operate profitably, and those that have brought costs down in recent years (see below) are making good profits. In terms of direct cash costs, Finland, Peru, Philippines, Sweden, and Zaire are relatively high-cost producers among the significant copper-producing countries; low-cost producers include Chile, Indonesia, Portugal, Zambia, and the United States. The ranking on a total cost basis is not much different, except that developing countries tend to shift to the higher-cost group because of higher investment costs and high debt service.

[2] Direct cash cost is defined as the sum of mining, milling, smelting and refining costs, plus cash outlays for freight and marketing. Total cost is the sum of direct cash cost, depreciation and interest charges, royalties, taxes and duties other than income or profit taxes, all indirect cash and non-cash costs for administration and overhead, research and exploration, and extraordinary items such as strike costs and pension shortfalls.

Throughout the 1980s, copper producers in industrial countries achieved remarkable cost savings in response to adverse market conditions. In sharp contrast, however, producers in developing countries, many of them state-owned companies, failed to make similar adjustments to enhance productive efficiency. In order to maintain competitiveness, developing country producers have relied heavily on exchange rate adjustments. Table 3 shows estimates of direct cash costs for major copper-producing countries in both nominal and real terms.[3] Although most developing countries were cost-competitive in 1990 in nominal dollar terms compared with the United States, it is clear that many of them would have become high-cost producers had their exchange rates been adjusted to compensate only for inflation (though depreciation in excess of inflation was probably justified in some of the countries because their exchange rates were already overvalued). In a matter of less than a decade, US copper producers have been transformed from high- to low-cost suppliers, while increasing production. If the currencies of developing countries appreciate, as in the case of Chile in recent years, their competitive position in world markets could be seriously jeopardized.

The contrast between developing and industrial country copper producers has indeed been a major feature of the industry's adjustments in the 1980s. US copper producers led the industrial country group. A variety of methods were used by US producers to cut costs, for example, labor costs were reduced by cuts in wages and benefits, by downsizing, and by work force training; open-pit mine costs were reduced by introducing in-pit crushers and conveyors to replace costly hauling by trucks; metal recovery was increased and costs reduced by leaching of waste dumps, heap leaching of low-grade ore, in-situ leaching, and SxEw production; and concentration mills were improved with column flotation and semi-autogenous grinding.

Developing country producers failed to improve efficiency. The record of efficiency improvements in the 1980s among the developing-country producers falls far short of that of industrial countries, and the experience at Codelco, Chile's state-owned mining company and the world's largest copper producer, illustrates some of the basic problems common to most state-owned mining entities in developing countries. Faced with a sharp deterioration in ore grade, Codelco embarked on ambitious investment programs in 1984 and again in 1988 to increase production and reduce costs. The programs contained many of the cost-saving measures adopted in industrial countries, such as mobile in-pit crushers and conveyors and SxEw production. But implementation of the programs was hampered by government diversion of funding to other purposes and frequent management changes. As a result, the programs fell short of attaining the desired objectives. Furthermore, other basic issues such as increasing labor efficiency and work force downsizing have not been seriously addressed. Codelco is widely considered to be relatively well managed as a state-owned company. At the other extreme, the performance of ZCCM in Zambia and Gecamines in Zaire, both state-owned copper producers, has been abysmal. They failed not only to improve productivity, but also to maintain existing production capacity, resulting in sharp declines in output. In these countries, almost all of the profits from the copper operation were diverted to other uses, and the copper mines and related infrastructure were allowed to deteriorate. Records of other state-owned companies (in Peru and Mexico) fall somewhere in between. Recently, Mexico privatized its two state-owned copper mining companies. Chile has passed a law that allows Codelco to form joint ventures with the private sector, domestic and foreign, in developing new mining properties owned by Codelco. Indonesia and Papua New Guinea have allowed foreign participation and

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[3] Real cash costs are defined as the constant local-currency operating costs of mining, milling, and smelting/refining per unit of refined copper, using local currency deflators and converting into US dollars at January 1990 exchange rates.

their copper mining operations have been run efficiently. This partly explains why Indonesia had the lowest cash costs among major copper-producing countries in 1990 (see Table 3).

Recently, concerns have been raised about the adequacy of smelter and refinery capacities over the near term. These concerns reflect the current high capacity utilization rates (the average capacity utilization rate of Japanese smelters in 1991 was 94.3%) and the consequent rise in treatment and refining charges. The western economies' refined copper production capacity is expected to increase by 1.3 million tons of copper between 1991 and 1995. Of this total, approximately 370,000 tons should be coming from SxEw/hydromet production that does not require the smelting and refining process. Primary smelter and refinery capacities are expected to increase by about 950,000 tons, sufficient to process the expected increase in mine production shown in Table 2. If these anticipated increases materialize, concern about near-term smelter/refinery capacity would be unwarranted. We assume that investments in smelter and refinery capacities will be adequate over the longer term (to the year 2005) on the grounds that mining, smelting and refining are normally a part of the same investment decision.

The dominant smelter technology today is flash smelting and its variants which have higher productivity and better environmental characteristics than the reverberatory furnace technology of the 1960s. However, reverberatory furnaces remain the dominant technology in Latin America, Africa, and Australia. Reverberatory furnaces require costly scrubbing of furnace off-gas to control sulfur dioxide emission to acceptable levels. Such controls have not yet been strongly implemented or enforced in developing countries. Sulfuric acid, mostly used for fertilizer production, is a valuable by-product of environmental controls to reduce sulfur dioxide emissions, and the cost of emissions control can be significantly reduced if a ready market for the by-product exists. This is a serious problem for smelters located in remote areas of developing countries.

Table 3: Direct Cash Costs of Copper Production in Selected Countries, 1982-90

	Chile	Mexico	Peru	Zaire	Zambia	Indonesia	Philippines	Canada	US
	(nominal ¢/lb)								
1982	41.3	33.6	57.2	49.3	62.5	48.5	60.4	63.7	75.0
1984	34.4	38.7	54.4	26.4	42.2	43.5	54.1	50.4	66.2
1986	33.0	34.1	51.7	42.5	31.9	35.3	48.1	49.0	57.2
1988	41.4	48.5	51.7	54.1	59.9	40.9	64.6	58.8	55.3
1990	51.6	51.1	81.5	82.2	47.6	44.7	80.0	73.6	60.6
	(constant ¢/lb) a/								
1982	41.3	33.6	57.2	49.3	62.5	48.5	60.4	63.7	75.0
1984	36.9	32.5	63.9	61.6	63.3	51.1	41.9	49.2	63.8
1986	40.3	36.1	52.1	90.7	49.7	48.8	39.1	49.6	57.1
1988	50.9	40.0	33.8	103.4	51.1	59.3	43.9	49.1	51.7
1990	56.3	35.5	29.3	163.3	36.1	59.3	51.4	57.5	52.1

a/ In constant 1982 local currencies at 1982 exchange rates, using wholesale prices as deflators.

Source: Brook Hunt Associates and World Bank, International Economics Department.

The current situation and prospects for the major copper-producing countries are summarized below.

UNITED STATES. US mine production continued to expand in 1991 due to expansions at a number of mines and SxEw facilities. Over the 1987-91 period, US production achieved a remarkable 400,000 ton net increase without a single greenfield project. In the next five years (1991-96), the net increment is expected to be only 150,000 tons, largely through further expansions at Bingham Canyon, Mission, Morenci, and Ray mines. The long-term outlook for US production is not promising because of the apparent difficulties in developing new large-scale mines.

CHILE. Although Chile's mine production increased sharply in 1991 due to the large Escondida mine coming on-stream, other copper mines continued to have production problems despite Codelco's large investments in increasing production capacity to compensate for declining ore grade. El Teniente production continued to slide and the Chuquicamata open-pit mine suffered a decline in production for the first time in 1991, a decline which is considered irreversible. Because of these difficulties, Codelco has started to look for new opportunities at other Codelco-owned mining properties, such as Chuquicamata Norte SxEw and Mansa Mina. Recently, the government passed a law that allows Codelco to form joint ventures with private entities, including multinational mining companies, in developing new mines on state-owned properties. This measure is expected to attract a great deal of interest from foreign companies and probably change the nature of state-owned mining in Chile. In fact, the private sector has provided the largest increments to Chile's copper production in recent years, and several large projects financed to some extent by foreign companies are expected to be the main source of incremental production in Chile for the remainder of 1990s.

PERU. Peru's mine production in 1991 benefited from a relative easing of production disruptions. However, Peru's economic and political problems remain unresolved and new investments in capacity expansion have not been forthcoming, thus preventing Peru from realizing its substantial potential as a copper producer.

ZAIRE AND ZAMBIA. The economic and political problems in these countries further worsened and sharply reduced copper production in 1991, particularly in Zaire. As the paralysis in Zaire continues, the prospect of returning to normal production slips further away as it becomes more difficult to rehabilitate ill-maintained mines. The new government in Zambia announced its intention to improve ZCCM operations by allowing foreign participation or by privatizing ZCCM, but it has a long way to go to create conditions favorable for the large foreign investments Zambia needs. These countries are endowed with high-grade ore bodies that have kept costs low despite production inefficiencies. The decline in ore grade has been relatively minor during the past ten years.

Other Countries. CHINA plans to allow greater freedom for foreign participation in the development of its base-metal mining industry. The copper ores discovered so far have been mostly low grade, requiring advanced technology such as in-situ SxEw. Expansion of the Dexing mine, as well as development of two other medium-sized mines, is progressing on schedule. The Grasberg deposit in INDONESIA's Erstberg complex came on-stream in 1990 and, as a result, Indonesia became a major low-cost copper producer. Proven reserves at the site continue to increase.

Price Outlook

Despite the economic slowdown in major industrial economies over the past year or so, copper prices have remained firm. Among the base metals, only the copper price has not experienced a major decline from the peak reached in 1989. This unique strength is largely attributable to supply-side factors. Of late, sharp reductions in supplies from Zaire and Zambia, due to political and economic problems, have been the most important contributing factor to this price strength. At the same time, smelter capacity constraints and consequently higher treatment and refining charges have meant relatively high prices for refined copper compared with prices of copper concentrates. For the exporters of copper concentrates, the net back from concentrate exports was substantially reduced, by as much as ¢15/lb, between 1989 and 1991. Another important factor in keeping copper prices firm has been sporadic but substantial import demand from China. Also, world commercial stock levels have increased during this period, although not excessively. Figure 2 shows commercial stocks in terms of weeks' consumption since 1987. The current stock level, roughly at five weeks' consumption, is considered normal.

The long-term price forecasts for copper have been made on the basis of our econometric model, given assumptions about industrial production growth, exchange rates, and interest rates. Unanticipated supply disruptions have not been included. The forecasts of constant dollar prices are virtually identical to those made two years ago.

Uncertainties on demand side in medium term. Table 4 shows the base-case forecasts of supply and demand balance and the implied stock changes for refined copper. Forecasts over the short to medium term indicate the likelihood of moderate excess supplies and a buildup of stocks. The excess supplies arise because of capacity expansions due to come on-stream in the near term, at a time when demand growth is expected to be relatively weak. However, the size of this imbalance is not expected to be overwhelming and therefore its impact on copper prices is likely to be mild. In the case of stronger-than-expected economic activity, the excess supplies could be easily wiped out and copper prices

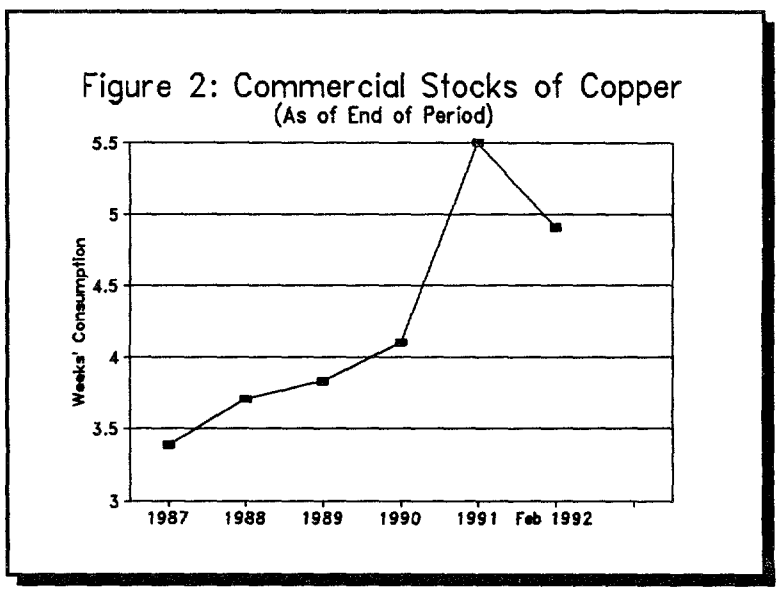


Table 4: World Supply/Demand Balance and Stock Changes

	Actual 1990	Estimate 1991	Projected 1992	1993	1994	1995	2000
	(million tons of copper content)						
Mine Production	9.03	9.08	9.08	9.26	9.46	10.03	10.41
Smelter Losses	0.34	0.34	0.34	0.35	0.36	0.38	0.39
Primary Smeltes Production	8.63	8.74	8.74	8.91	9.10	9.65	10.02
Scrap	1.31	1.28	1.33	1.35	1.37	1.39	1.45
Electro-refined	9.94	10.02	10.07	10.26	10.47	11.04	11.47
SxEw	0.80	0.81	0.81	0.88	1.06	1.19	1.50
Refined Production	10.74	10.83	10.88	11.14	11.53	12.23	12.97
Demand	10.79	10.73	10.79	11.05	11.29	11.54	12.89
Stock Changes	0.06	0.25	0.10	0.09	0.25	0.69	0.08

Source: World Bank, International Economics Department.

could move upward. Given that the strength of economic recovery in the industrial countries remains highly uncertain at this moment, it seems fair to say that, over the short to medium term, the main source of uncertainty for copper prices lies on the demand side rather than on the supply side.

Supply factors more important in long term. Over the longer term, the market outlook hinges to a large degree on the response of the copper mining industry to the recent relatively high level of prices. One important feature of the 1987-92 period of relatively high prices is the fact that few large-scale greenfield projects have been initiated. Such projects as have been touted in the industrial countries have met environmental constraints. Political and economic disarray in some developing countries have precluded them from potential new investments for copper mining--e.g., most of Africa, Peru, and Papua New Guinea. Thus, new large-scale greenfield projects are considered only for a few developing countries such as Chile and Indonesia. However, important changes in the investment climate have started to take place in some developing countries and in the former CPEs. An increasing number of developing countries have taken steps to reduce state intervention in mining and to phase down the role of state-owned mining companies in favor of private ownership and foreign participation. These changes lend support to the view that over the long term, supply should become more responsive to price signals than in the past and adequate supplies are likely to be forthcoming in response to higher prices.

Given the market balance projections for the medium term, the market trough is likely to occur at around mid-1990; the 1995-96 period is likely to see relatively low prices, probably in the ¢85-90/lb range. This means another period of relatively higher prices towards the late 1990s, followed by a downturn in copper prices towards the year 2005. This cyclical pattern, which would also be implied by extrapolation of the historical pattern, is highly conjectural. The pattern should also depend on the business cycle, which has not been explicitly built into the long-term forecasts.

For the long term, it is reasonable to expect the price level to average out to the long-term marginal cost. The average forecast price for the 2000-2005 period is within the range ¢83-90/lb (in

constant 1990 dollars), at which most of the new greenfield projects currently being studied are likely to be economically viable. The cash costs of new sulphide projects and extensions of existing mines expected to come on-stream in the 1990s are estimated in the range of ¢46-50/lb; and on a total cost basis the range is ¢80-85/lb. In the recent past, production costs of new mines tended to be lower than those of existing mines, thus reducing the overall costs, for example Chile's Escondida, Indonesia's Grasberg, and Portugal's Neves Corbo mines, and various SxEw projects. However, a number of new greenfield projects envisaged for the 1990s and beyond have somewhat less favorable cost characteristics in terms of ore grade than those of the recent past. In addition, heightened environmental concerns could add to the costs of new and existing mines and smelters. These potential cost increases, mostly among producers in developing countries, could be substantially moderated by efficiency improvements. The long-term price forecasts assume that costs increase only marginally in the 1990s.

Table A1: Copper Ore - Production By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	2,494	2,549	2,869	2,868	2,931	2,977	2,948	2,904	2,787	2,983	1.0	-0.4	0.3
OECD	2,462	2,546	2,855	2,854	2,918	2,964	2,935	2,891	2,774	2,970	1.0	-0.4	0.3
United States	1,447	1,388	1,587	1,634	1,720	1,770	1,750	1,750	1,670	1,800	0.5	-0.7	0.7
Canada	595	681	802	777	770	745	720	700	650	680	2.0	0.3	-0.9
Australia	155	237	327	311	315	350	360	350	380	420	4.1	2.1	2.2
LMICs	3,762	5,383	6,179	6,346	6,190	6,365	6,700	6,980	7,585	8,280	3.3	2.4	1.9
Africa	1,277	1,340	1,116	987	760	785	840	870	820	810	0.7	-0.7	-1.4
Zambia	685	591	496	412	360	350	350	340	300	250	-0.9	-2.0	-3.5
Zaire	386	455	356	292	120	150	200	250	320	400	1.9	0.2	2.3
Americas	984	1,619	2,237	2,503	2,590	2,660	2,805	3,023	3,405	3,780	4.0	4.6	3.0
Chile	694	1,071	1,588	1,814	1,855	1,900	2,050	2,260	2,570	2,850	4.0	4.4	3.3
Mexico	63	171	291	267	310	330	345	363	365	370	6.9	8.5	2.4
Peru	204	364	318	381	380	385	385	390	370	410	3.2	3.3	0.5
Asia & Pacific	295	800	1,224	1,267	1,390	1,470	1,585	1,627	1,840	2,040	8.5	5.5	3.5
China, People's Rep.	107	165	360	370	370	430	500	510	570	630	5.3	6.0	3.9
Indonesia	-	59	170	212	290	290	300	300	400	550	-	-	7.0
Philippines	163	302	182	147	150	160	170	175	160	150	5.3	0.1	0.1
Papua New Guinea	-	161	170	205	190	180	175	172	250	250	-	-	1.4
Europe	1,202	1,615	1,614	1,589	1,450	1,450	1,470	1,460	1,520	1,650	3.1	1.2	0.3
World	6,256	7,932	9,048	9,214	9,121	9,342	9,648	9,884	10,372	11,263	2.5	1.4	1.4

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: World Bureau of Metal Statistics, Metal Statistics (actual);
World Bank, International Economics Department (projected).

Table A2: Copper Ore - Gross Exports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	261	550	720	669	685	682	669	660	627	660	6.5	3.9	-0.1
OECD	240	550	720	669	685	682	669	660	627	660	7.5	4.3	-0.1
Canada	170	294	349	320	323	313	302	294	273	286	6.2	1.9	-0.8
United States	21	101	258	253	267	274	271	271	259	279	17.9	18.1	0.7
LMICs	297	858	971	1,228	1,405	1,353	1,434	1,461	1,630	1,775	8.1	4.4	2.7
Africa	19	75	42	40	38	38	40	40	43	43	6.5	3.8	0.5
Zaire	-	33	17	13	10	10	12	12	15	15			1.0
Americas	108	225	354	603	645	636	722	859	920	1,015	7.6	7.3	3.8
Chile	52	112	257	508	540	510	580	700	750	830	9.5	7.7	3.6
Peru	39	25	26	29	30	31	32	34	40	50	1.3	0.0	4.0
Asia & Pacific	149	539	380	399	547	507	502	409	537	627	8.8	2.2	3.3
Indonesia	-	54	83	115	280	280	290	210	260	350			
Philippines	149	296	103	98	50	20	10	0	0	0	2.9	-4.1	-
Papua New Guinea	-	161	156	160	190	180	175	172	250	250			3.2
Europe	17	11	195	186	175	172	170	153	130	90			-5.1
Portugal	-	1	177	176	165	162	160	143	120	80			-5.5
World	558	1,408	1,691	1,897	2,090	2,035	2,103	2,121	2,257	2,435	7.4	4.2	1.8

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: World Bureau of Metal Statistics, Metal Statistics (actual);
World Bank, International Economics Department (projected).

Table A3: Copper Ore - Gross Imports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	544	1,169	1,378	1,395	1,417	1,471	1,548	1,686	1,812	1,986	7.0	2.7	2.6
OECD	544	1,135	1,375	1,394	1,415	1,469	1,546	1,684	1,810	1,984	6.9	2.5	2.6
United States	31	39	154	62	62	61	88	171	290	273	-1.6	-3.5	11.2
Japan	387	843	880	930	928	928	928	928	885	851	7.4	2.1	-0.6
Germany	74	141	122	131	125	130	130	135	145	160	6.1	1.0	1.4
LMICs	12	141	184	203	219	214	222	341	399	485	16.2	16.4	6.4
Asia & Pacific	4	94	150	173	189	184	191	308	360	440		24.3	6.9
Korea, Rep. of	3	72	92	107	104	104	104	104	109	109		22.8	0.2
Europe	5	44	17	12	12	12	13	13	15	17	7.8	3.9	2.5
World	556	1,310	1,562	1,598	1,636	1,685	1,770	2,027	2,211	2,471	7.8	3.8	3.2

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: World Bureau of Metal Statistics, Metal Statistics (actual);
World Bank, International Economics Department (projected).

Table A4: Copper Blister - Production By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	3,106	3,401	4,057	4,082	4,126	4,216	4,231	4,316	4,356	4,456	1.9	0.7	0.6
OECD	3,103	3,373	4,045	4,067	4,110	4,200	4,215	4,300	4,340	4,440	1.9	0.6	0.6
United States	1,497	1,261	1,463	1,450	1,470	1,510	1,520	1,600	1,650	1,740	0.0	-1.0	1.3
Canada	439	445	525	546	530	530	530	530	540	550	1.1	0.3	0.1
Japan	589	930	1,041	1,085	1,090	1,090	1,090	1,090	1,040	1,000	4.8	1.6	-0.6
Australia	132	173	202	207	240	290	295	300	330	370	3.5	1.4	4.2
LMICs	3,458	4,668	5,427	5,197	5,124	5,324	5,464	5,869	6,370	7,030	3.0	2.4	2.2
Africa	1,270	1,269	1,033	901	664	694	644	689	650	640	0.6	-0.9	-2.4
Zambia	677	592	461	409	390	370	270	275	260	220	-0.9	-2.1	-4.3
Zaire	385	421	338	268	50	100	150	190	190	240	1.6	0.2	-0.8
Americas	878	1,363	1,912	1,888	1,970	2,060	2,130	2,230	2,560	2,880	3.6	4.3	3.1
Chile	640	952	1,329	1,296	1,300	1,380	1,450	1,550	1,790	2,010	3.3	3.9	3.2
Peru	171	333	261	265	300	310	310	310	320	350	3.1	3.4	2.0
Asia & Pacific	126	299	805	938	980	1,090	1,210	1,450	1,580	1,760	8.9	10.6	4.6
China, People's Rep.	98	178	425	430	460	520	580	580	650	750	6.2	7.6	4.1
Philippines	-	-	154	168	160	200	200	200	200	230			2.3
Korea, Rep. of	5	74	161	186	180	180	180	180	190	190	20.3	19.3	0.2
Europe	1,183	1,737	1,582	1,470	1,510	1,480	1,480	1,500	1,580	1,750	3.4	1.4	1.3
World	6,564	8,069	9,483	9,279	9,250	9,540	9,695	10,185	10,726	11,486	2.5	1.6	1.5

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: World Bureau of Metal Statistics, Metal Statistics (actual);
World Bank, International Economics Department (projected).

Table A5: Copper Blister - Gross Exports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	44	90	65	76	70	70	72	72	75	80	6.1	1.5	0.4
OECD	44	90	65	76	70	70	72	72	75	80	6.2	1.6	0.4
Finland	-	12	25	25	25	25	25	25	25	25			0.0
LMICs	735	663	567	460	382	417	448	465	459	489	-1.1	-1.1	0.4
Africa	409	371	271	172	94	124	154	164	144	154	-0.5	-1.5	-0.8
Namibia	28	42	30	30	30	30	30	30	-	-		1.0	-
Zaire	193	272	216	120	40	70	100	110	120	130	2.3	0.4	0.6
Americas	320	291	296	279	280	285	287	295	310	330	-1.5	-0.6	1.2
Chile	183	163	151	92	95	100	100	100	105	110	-1.8	-0.3	1.3
Peru	130	123	93	101	95	95	95	100	100	100	-1.5	-2.1	-0.1
Europe	5	1	4	9	8	8	7	6	5	5			-4.1
World	779	753	631	536	452	487	520	537	534	569	-0.6	-0.8	0.4

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: World Bureau of Metal Statistics, Metal Statistics (actual);
World Bank, International Economics Department (projected).

Table A6: Copper Blister - Gross Imports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a)		
High-Income	736	533	455	447	410	437	465	475	475	480	-1.8	-2.4	0.5
OECD	735	533	455	447	410	437	465	475	475	480	-1.8	-2.3	0.5
United States	187	64	84	94	95	92	90	90	90	80	-6.5	-3.6	-1.1
United Kingdom	40	67	64	32	35	35	40	40	40	40	-0.1	1.8	1.6
Japan	136	80	27	33	30	30	35	35	35	40	-	-6.9	1.4
LMICs	29	95	103	56	41	47	49	57	57	78	11.0	5.4	2.4
Americas	1	4	3	1	1	1	1	2	2	5	-	-	12.2
Asia & Pacific	10	49	48	55	40	45	45	50	50	65	16.7	5.6	1.2
Europe	17	42	52	-	-	1	3	5	5	8	10.2	5.3	-
World	764	627	557	503	451 452	484 487	514 520	532 537	532 534	558 569	-0.9	-1.4	0.7

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: World Bureau of Metal Statistics, Metal Statistics (actual);
World Bank, International Economics Department (projected).

Table A7: Copper Refined - Production By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	4,497	4,911	5,327	5,359	5,457	5,548	5,628	5,794	5,925	6,365	1.2	0.4	1.2
OECD	4,493	4,881	5,299	5,348	5,445	5,535	5,615	5,780	5,910	6,350	1.2	0.3	1.2
United States	1,941	1,886	2,017	1,995	2,050	2,030	2,070	2,200	2,300	2,500	-0.2	-0.7	1.6
Canada	459	460	516	538	530	540	540	540	580	650	1.0	0.0	1.4
Japan	683	1,016	1,008	1,076	1,080	1,080	1,080	1,080	1,030	1,020	4.5	1.2	-0.4
Australia	149	182	274	280	310	350	360	360	400	500	3.4	1.8	4.2
Germany	498	433	533	522	520	520	520	560	560	600	0.8	0.1	1.0
United Kingdom	194	140	122	70	55	55	55	50	50	30	-2.3	-1.9	-5.9
LMICs	2,953	4,417	5,413	5,472	5,427	5,591	5,905	6,434	6,969	7,875	4.1	2.9	2.6
Africa	869	870	813	734	650	675	700	710	720	725	171.0	-0.6	-0.1
Zaire	194	133	173	140	80	120	170	210	260	300	0.9	0.7	5.6
Zambia	573	578	479	428	400	380	350	320	280	240	0.1	-1.5	-4.0
Americas	569	1,131	1,694	1,793	1,785	1,816	1,945	2,122	2,433	2,900	6.3	5.9	3.5
Chile	462	789	1,192	1,238	1,200	1,200	1,300	1,400	1,680	1,900	5.5	4.9	3.1
Mexico	54	90	152	154	190	210	240	280	310	350	5.1	4.7	6.0
Peru	34	218	182	244	240	250	248	270	270	300	9.1	10.6	1.5
Asia & Pacific	157	429	999	1,075	1,202	1,300	1,420	1,732	1,866	2,100	8.6	9.0	4.9
China, People's Rep.	127	295	490	510	550	590	650	700	780	900	6.3	5.9	4.1
Korea, Rep. of	6	89	187	201	200	200	200	210	210	210		20.7	0.3
Philippines	-	-	126	116	122	160	160	162	166	190			3.6
Europe	1,350	1,984	1,907	1,870	1,790	1,800	1,840	1,870	1,950	2,150	3.6	1.7	1.0
FSU	1,082	1,307	1,260	1,210	1,200	1,220	1,230	1,250	1,350	1,550	2.4	0.6	1.8
World	7,450	9,328	10,740	10,831	10,884	11,139	11,533	12,228	12,894	14,240	2.5	1.5	2.0

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: World Bureau of Metal Statistics, Metal Statistics (actual);
World Bank, International Economics Department (projected).

Table A8: Copper Refined - Apparent Consumption By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	5,509	6,497	7,311	7,415	7,511	7,649	7,791	7,931	8,625	9,349	19.1	1.1	1.7
OECD	5,499	6,407	7,006	6,975	7,066	7,192	7,321	7,444	8,040	8,661	1.7	0.9	1.6
United States	1,881	2,021	2,150	2,058	2,140	2,170	2,200	2,230	2,310	2,400	0.9	0.7	1.1
Japan	811	1,248	1,577	1,613	1,600	1,640	1,680	1,710	1,940	2,180	5.0	2.6	2.2
Germany	841	934	1,028	995	990	1,005	1,020	1,040	1,120	1,200	1.5	0.5	1.3
France	336	407	478	481	480	487	496	505	545	585	1.9	1.1	1.4
Italy	261	369	475	470	480	490	500	510	560	610	3.0	2.5	1.9
Non-OECD	9	90	305	440	445	457	470	487	585	688	17.4	17.7	3.2
LMICs	1,812	3,141	3,478	3,313	3,280	3,403	3,494	3,604	4,269	4,891	4.2	3.1	2.8
Africa	44	97	96	97	97	98	99	101	111	122	4.5	3.0	1.7
Americas	196	463	372	386	383	392	402	416	497	597	5.7	3.5	3.2
Mexico	60	123	120	118	123	127	132	140	185	240	5.8	3.9	5.2
Brazil	75	215	137	145	142	147	150	155	180	210	7.4	3.2	2.7
Asia & Pacific	258	579	1,364	1,390	1,460	1,513	1,554	1,597	1,872	2,183	7.1	7.4	3.3
China, People's Rep.	180	367	512	530	560	580	590	600	680	780	5.8	4.5	2.8
India	54	73	135	145	150	155	160	166	197	230	2.7	4.8	3.4
Korea, Rep. of	8	104	324	344	360	374	389	405	495	590	25.3	20.9	3.9
Europe	1,300	1,987	1,646	1,440	1,340	1,400	1,440	1,490	1,790	1,990	3.0	1.6	2.3
World	7,321	9,637	10,789	10,728	10,790	11,052	11,286	11,536	12,895	14,241	2.5	1.7	2.0

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: World Bureau of Metal Statistics, Metal Statistics (actual);
World Bank, International Economics Department (projected).

Table A9: Copper Refined - Gross Exports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	1,046	1,026	1,331	1,415	1,383	1,440	1,395	1,403	1,553	1,690	0.1	-0.2	1.3
OECD	1,045	1,026	1,290	1,372	1,340	1,390	1,350	1,360	1,510	1,640	0.0	-0.4	1.3
Canada	246	263	333	375	380	390	400	380	440	500	1.5	0.4	2.1
United States	189	50	213	271	230	220	210	230	200	180	-7.4	-6.3	-2.9
Australia	38	51	150	174	180	190	190	200	270	360	7.3	3.8	5.3
LMICs	1,486	2,165	2,597	2,591	2,656	2,786	2,901	2,909	3,385	3,705	3.7	2.4	2.6
Africa	826	789	664	594	548	579	600	585	635	640	0.5	-1.0	0.5
Zambia	578	599	460	389	390	380	350	300	280	240	0.1	-1.7	-3.4
Zaire	187	125	141	128	80	120	170	200	260	300	0.7	0.5	6.3
South Africa	62	65	63	77	78	79	80	85	95	100	5.5	1.0	1.9
Americas	465	960	1,271	1,357	1,382	1,422	1,503	1,559	1,930	2,155	6.2	5.8	3.4
Chile	434	756	1,134	1,122	1,150	1,180	1,260	1,300	1,640	1,840	5.9	5.3	3.6
Peru	30	205	137	208	203	212	212	230	240	270	8.5	10.5	1.9
Asia & Pacific	1	3	167	135	136	185	188	185	200	230			3.9
Philippines	-	-	116	94	95	140	140	140	145	170			4.3
Europe	194	414	483	505	590	600	610	580	620	680	5.8	0.8	2.1
World	2,532	3,191	3,929	4,006	4,039	4,226	4,296	4,312	4,938	5,395	2.3	1.5	2.1

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: World Bureau of Metal Statistics, Metal Statistics (actual);
World Bank, International Economics Department (projected).

Table A10: Copper Refined - Gross Imports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	2,198	2,648	3,358	3,413	3,375	3,525	3,578	3,540	4,090	4,400	1.8	1.2	1.8
OECD	2,193	2,595	3,030	2,940	2,899	3,038	3,080	3,027	3,477	3,680	1.5	0.7	1.6
United States	129	343	287	295	320	360	340	260	210	80	5.6	5.3	-8.9
Japan	171	258	618	624	580	620	660	690	970	1,220	6.3	5.3	4.9
France	313	382	430	437	430	430	440	450	480	510	1.8	0.7	1.1
Germany	502	512	614	557	550	565	580	580	640	680	1.2	-0.5	1.4
Italy	254	343	412	407	400	405	415	425	455	505	2.8	1.9	1.6
Non-OECD	5	54	328	473	476	487	498	513	613	720	21.6	19.3	3.0
LMICs	363	670	671	670	663	678	714	715	884	1,037	4.2	3.9	3.2
Americas	90	231	40	30	30	30	32	35	45	60	2.9	-1.8	5.1
Asia & Pacific	111	211	373	425	432	446	479	485	619	732	8.6	9.1	4.0
India	47	52	92	60	102	107	112	118	149	182	2.7	5.1	8.2
Korea, Rep. of	3	17	136	144	160	174	189	195	285	380		22.0	7.2
China, People's Rep.	56	123	40	114	60	50	60	50	50	20	12.0	4.2	-11.7
Europe	156	223	211	165	150	150	150	140	160	180	1.6	1.3	0.6
World	2,561	3,318	4,028	4,083	4,038	4,203	4,292	4,255	4,974	5,437	2.2	1.7	2.1

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: World Bureau of Metal Statistics, Metal Statistics (actual);
World Bank, International Economics Department (projected).

Table A11: Copper - Prices, a/ 1950-91 (Actual) and 1992-2005 (Projected)

	($/ton)		
	Current $	1990 Constant $	
		G-5 MUV b/	G-7 CPI c/
Actual			
1950	493	3,019	3,976
1951	607	3,224	4,418
1952	715	3,623	4,990
1953	664	3,462	4,595
1954	686	3,658	4,676
1955	968	5,064	6,576
1956	906	4,576	6,024
1957	605	2,993	3,936
1958	545	2,651	3,480
1959	655	3,231	4,191
1960	677	3,271	4,250
1961	633	3,007	3,883
1962	644	2,999	3,842
1963	646	3,067	3,734
1964	968	4,517	5,454
1965	1,290	5,975	7,041
1966	1,530	6,847	8,078
1967	1,138	5,034	5,857
1968	1,241	5,543	6,214
1969	1,466	6,212	7,035
1970	1,413	5,634	6,391
1971	1,080	4,086	4,576
1972	1,071	3,718	4,113
1973	1,786	5,352	6,001
1974	2,059	5,064	6,247
1975	1,237	2,737	3,341
1976	1,401	3,057	3,662
1977	1,310	2,602	3,098
1978	1,367	2,360	2,638
1979	1,985	3,025	3,620
1980	2,182	3,032	3,558
1981	1,742	2,411	2,818
1982	1,480	2,081	2,425
1983	1,592	2,290	2,567
1984	1,379	2,027	2,230
1985	1,417	2,066	2,246
1986	1,374	1,699	1,804
1987	1,783	2,006	2,072
1988	2,602	2,730	2,810
1989	2,848	3,009	3,090
1990	2,662	2,662	2,662
1991	2,339	2,292	2,225
Projected			
1992	2,315	2,173	2,073
1993	2,380	2,153	2,058
1994	2,100	1,865	1,774
1995	1,970	1,704	1,618
2000	2,710	1,974	1,847
2005	2,900	1,840	1,652

a/ London Metal Exchange, cash, electrolytic wirebar up to 1981; 1982-June 1986, high-grade cathodes, minimum 99.9935% cu; from July 1986 onward, Grade A cathodes and wirebars.

b/ Deflated by G-5 Manufacturing Unit Value (MUV) Index.

c/ Deflated by G-7 Consumer Price Index (CPI).

Sources: Engineering and Mining Journal and Metals Week (actual); World Bank, International Economics Department (projected).

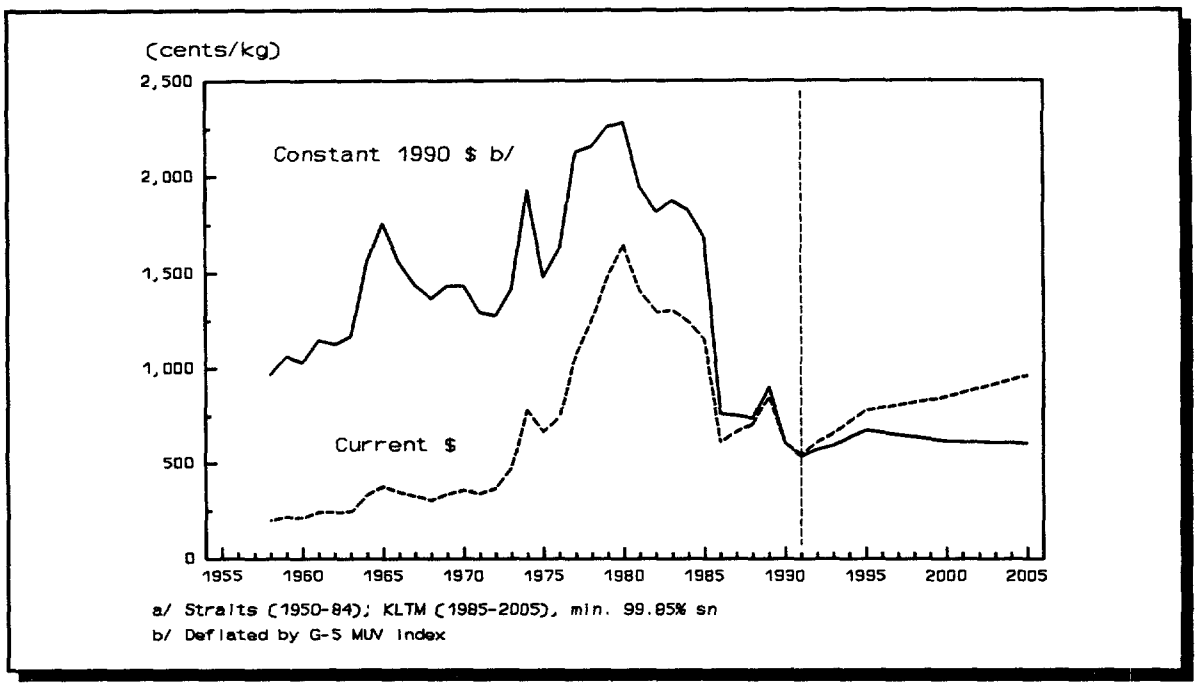
Tin

Summary

- After reaching a peak of over US$10/kg in April 1989, tin prices turned sharply downward to below US$6/kg by mid-1990 and remained low until the beginning of 1992. This decline resulted mainly from large production increases in 1988 and 1989, followed by a sharp fall in consumption in 1990.

- Prices are expected to rise in real terms through 1993 to a peak in 1995. After that the long-term outlook for real prices is slow decline (to US$6.10/kg in constant 1990 dollar terms by the year 2005) because of the potential for large production increases at low cost, particularly from Brazil and China.

Tin Prices a/, 1955-2005



- World consumption of refined tin increased to a remarkable degree over the 1983-89 period but turned downward with the recession in 1990 and 1991. Substitution of other materials for tin may be close to its limit and tin's remaining market share appears to be relatively secure. In the long term, tin demand is expected to increase, albeit slowly.

- The size of the production changes in the last few years has shown that the price elasticity of tin supplies can be substantial, even in the short term. With prices at levels substantially lower than in the International Tin Agreement days, marginal producers in Malaysia and elsewhere wound down their operations. Their share in world production will be taken over by low-cost producers in Brazil and China.

Demand Outlook

Tin gains market strength in 1980s. Over the 1983-89 period, tin consumption increased at an average annual rate of 2.9% (Table 1), remarkable for a metal previously deemed to have been following a path of long-term decline. In the 1970s, consumption in major tin-consuming OECD countries, except for Japan, declined sharply--at 1.1% p.a. for the OECD as a whole. Consumption growth in non-OECD high-income countries and LMICs over the same period was not sufficient to offset the decline in the OECD countries. Although the six-year recovery period is not long enough to draw any firm conclusions about its long-term implications, the increases have been unmistakable in that they included most tin-consuming countries and end-use sectors. World consumption of tin declined in the latest recession (1990-92). However, the sharpest decline was concentrated in Eastern European countries where economy-wide industry restructuring has been in progress, while elsewhere, tin consumption seems to have held up very well for a recession period. The image of tin as a high-priced, raw material in decline has changed.

Among the end-use sectors, tinplate production accounted for about 31% of tin consumption in major industrial countries in 1987, followed by 30% for solders, 15% for chemicals, and 24% for others (brass/bronze, babbitt, white metal and other alloys, pewter, and miscellaneous others). According to the International Tin Council (ITC) statistics for the major industrial economies (G-5 countries), consumption by the tinplate sector suffered the biggest loss over the 1970-85 period with a 4.4% p.a. decline, followed by a 3.7% decline for brass/bronze, while solder and chemical uses scored small increases. Because of the ITC's dissolution in late 1985, updates of the data to 1991 are not available. However, estimates by industry sources indicate that the tinplate and solder uses gained significantly, while chemicals and others at least held steady.

Lower prices improve prospects in long term. The main factor that distinguishes the periods before and after 1986 is the collapse of the ITC in late 1985 and the consequent sharp decline of international tin prices. The contribution of lower tin prices to the increase in tin consumption in the short term probably was relatively small, because it takes time to adjust inputs to a change in relative prices. Over the long term, however, tin demand is likely to be stimulated by lower tin prices, through substitution of tin for other materials and through technological changes induced by the lower prices. For most of the past 25 years, tin consumption per unit of industrial output has declined in two major ways, namely, through substitution of aluminum and plastics for tin cans in the packaging market, and through technological innovations that progressively lead to thinner coatings of tin in tinplate making. Since tin prices were maintained at high levels for a long time, tin-saving activities seemed like a permanent feature of tin-using industries. However, given the highly competitive nature of the packaging market and other tin-using industries, we believe that lower tin prices will have a significant positive impact on long-term tin consumption.

About 30% of tin consumption in high-income countries goes to tinplate making. Until recently, tinplate had been steadily losing market share in the packaging market, to aluminum in beverage cans and to plastics and paper in other packaging markets. This trend seems to have been reversed in the second half of the 1980s at least in Japan, the EC, and the United States. Much of the increase in tinplate use has been in food packaging, which is the main market for tinplate, and in general packaging of liquids such as paints, motor oils, and aerosol sprays. The increased demand for tinplate for these latter purposes mostly reflects increased industrial production and income. The return of tin cans in the beverage can market reflects the renewed competitiveness of tin cans; tin cans have become economic vis-a-vis aluminum cans because of lower tin prices and reductions in the cost of manufacturing tin cans.

Table 1: Tin--Consumption, 1961-91 (Actual) and 2005 (Projected)

Country/Region	Actual (3-Year Averages) 1961-63	1969-71	1979-81	89-91	Projected 2005	Annual Average Growth Rate 1960-1970	1970-1980	1980-1990	1960-1990	1990-2005
	('000 tons)					(% p.a.)				
High Income	141	154	138	140	157	0.9	-1.0	0.1	0.0	0.8
OECD	141	153	136	130	142	0.8	-1.1	-0.4	-0.3	0.6
OECD Europe	63	62	53	53	56	-0.1	-1.7	0.2	-0.5	0.3
France	11	11	10	8	8	0.3	-1.3	-1.8	-0.9	0.0
Germany	16	18	18	22	24	1.2	0.0	1.8	1.0	0.6
Italy	6	7	5	6	6	2.1	-2.7	0.8	0.1	0.2
United Kingdom	21	17	11	10	10	-2.2	-4.6	-0.6	-2.5	0.0
Japan	15	27	31	35	41	5.9	1.5	1.1	2.8	1.1
Australia	4	4	3	2	2	0.0	-1.8	-6.2	-2.7	0.8
Canada	5	5	5	3	4	0.0	0.0	-3.2	-1.1	1.2
United States	54	55	45	37	39	0.2	-2.1	-1.9	-1.3	0.3
Non-OECD	0	1	2	10	15	-	11.6	17.0	-	3.0
LMICs	57	66	76	90	105	1.5	1.5	1.7	1.6	1.0
Americas	10	12	15	18	21	2.5	2.0	1.9	2.1	1.0
Asia & Pacific	18	19	18	37	44	0.4	-0.7	7.6	2.3	1.2
China	11	13	11	18	21	1.4	-1.7	5.0	1.6	1.0
India	5	5	3	3	4	-0.7	-5.4	1.2	-1.7	1.9
Korea, Rep. of	0	0	2	7	10	0.0	19.6	13.3	0.0	2.4
Europe	26	32	41	32	37	2.3	2.3	-2.3	0.7	1.0
FSU	18	17	25	21	25	-0.8	3.9	-1.7	0.5	1.2
Middle East/North Africa	1	0	1	1	1	0.0	0.0	1.3	0.4	-0.8
Africa	2	2	2	2	2	0.0	0.0	0.3	0.1	-0.2
World	198	219	215	230	262	1.0	-0.2	0.7	0.5	0.9

Sources: Metallgesellschaft AG, *Metall Statistik*, various issues; World Bureau of Metal Statistics, *Metal Statistics*, various issues.

The demand outlook for tin in the tinplate sector appears to be brighter than before because both tinplate demand and tin intensity of tinplate are likely to follow a pattern different from the past. Tinplate's share in the packaging market has stabilized at a low level after years of substitution away from tin cans, and, with tinplate's enhanced cost competitiveness, there appears to be little downside potential. LMICs hold the greatest potential for increased demand through growth in the market for food cans. The tin intensity of tinplate is likely to decline further, but the speed of decline should slow down.

Outlook varies among end uses. In many OECD countries, tin in solder is the largest single end use of tin, accounting for about one third of total tin consumption. The main user of tin solder is the electronics industry which has experienced rapid production increases, particularly in East Asia. However, consumption of tin solder has increased at a far slower rate than that of electronics production because of technological innovations replacing soldered electronic components with surface-mounted units. This process of substitution is expected to continue and, therefore, the demand outlook for tin solder in this sector is not bright. Another important end use for tin solder is in plumbing where substantial demand increases are expected as the tin content of tin/lead solder increases because of concerns over lead poisoning in water supplies.

The most rapid increases in tin consumption have taken place in the chemical uses of tin, for example, in the manufacture of PVC as stabilizers, pesticides, paints, and catalysts. Sharply lower tin prices have helped lower prices of tin chemicals and hence increase their use. It is expected that this end-use sector will continue to provide the most rapidly expanding outlet for tin.

Consumption of tin in other uses includes tinning of copperware, electroplating, white-metals, bearings, bronzes, pewter and other alloys. Individually, these end uses have experienced significant changes over the years, but collectively their consumption has remained more or less constant.

Supply Outlook

Price elasticity of supply evident. Two prominent features of tin supply behavior in recent years have been the speed and extent of the supply changes in response to tin price changes since the mid-1980s, and the emergence of Brazil and China as the world's leading producers. World tin mine production decreased from 236,000 tons in 1980 to 187,000 tons in 1987 (Table 2), following the collapse of tin prices in 1986. Prices recovered in 1987 and were quite strong by 1989 (see Table A1). Mine production of tin-in-concentrate also recovered and had reached 210,000 tons by 1990. In addition to new deposits tapped in Brazil and China, many of the old facilities that had been closed down in the wake of the ITC's collapse were brought back into production in Malaysia, Indonesia, Thailand, and Bolivia, among others. The experience illustrates that supplies can be quite price-elastic even in the short term because tin mining often involves little capital equipment, particularly in Southeast Asia.

Brazil dominates world production. In the 1988-90 period, Brazil was the world's largest producer of tin-in-concentrate, ahead of Malaysia. China has also become an important exporter of tin concentrates. Since Brazil can support even larger production increases at low cost, what happens in Brazil will in effect dictate the future of the world tin market.

After the collapse of the ITC, seven major tin-producing countries (Australia, Bolivia, Indonesia, Malaysia, Nigeria, Thailand, and Zaire) formed the Association of Tin Producing Countries (ATPC). Brazil and China were included only as observers. ATPC's main function has been to implement Supply Rationalization Schemes (SRS), or export quotas. These efforts have been moderately successful in that most of the members complied with their quotas. However, as tin prices recovered in 1988-89, most producers responded to the higher prices with increased production, in particular, the "garimpeiros" (independent miners) of Brazil, whose production was uncontrollable, even by the Brazilian government. In 1991, however, Brazil's tin-in-concentrate production declined sharply, mainly because of the Brazilian government's concern that indiscriminate mining activities in the Amazon region were environmentally harmful but also possibly because of the realization by the largest Brazilian tin exporting company that large production increases might not be in its own interest.

Table 2: Tin--Mine Production (Metal Content), 1980-1991 (Actual) and 1995-2005 (Projected)

	1980	1985	1987	1990	1991	1995	2000	2005	Growth Rate 1980-91	Growth Rate 1991-2005
	('000 tons of tin-in-concentrate)								(% p.a.)	
High Income	17.8	15.1	17.9	15.6	11.8	13.5	13.5	13.0	-3.7	0.7
Australia	11.6	6.4	7.7	7.4	5.7	6.0	6.5	7.0	-6.3	1.5
Canada	0.2	0.1	3.4	2.8	3.0	3.0	3.0	2.5	27.9	-1.3
United Kingdom	3.3	5.2	4.1	3.4	1.1	2.5	2.0	1.5	-9.5	2.2
Other	2.7	3.4	2.7	2.0	2.0	2.0	2.0	2.0	-2.7	0.0
LMICs	217.9	182.9	169.0	194.6	175.4	201.0	216.0	234.5	-2.0	2.1
Americas	36.0	47.2	44.3	61.6	52.7	65.0	72.0	84.0	3.5	3.4
Bolivia	27.5	16.1	8.1	17.3	16.8	18.0	20.0	22.0	-4.4	1.9
Brazil	6.9	26.4	30.4	39.1	29.3	40.0	45.0	55.0	14.0	4.6
Other	1.6	4.7	5.8	5.2	6.6	7.0	7.0	7.0	13.7	0.4
Asia & Pacific	152.9	110.1	102.4	112.9	103.0	113.5	119.0	123.5	-3.5	1.3
China	16.0	20.0	28.0	35.8	36.0	40.0	45.0	50.0	7.7	2.4
Indonesia	32.5	21.8	26.2	31.7	30.1	30.0	28.0	27.0	-0.7	-0.8
Malaysia	61.4	36.9	30.4	28.5	20.7	25.0	27.0	27.0	-9.4	1.9
Thailand	33.7	16.6	14.8	14.6	14.2	15.5	16.0	16.5	-7.6	1.1
Other	9.3	14.8	3.0	2.3	2.0	3.0	3.0	3.0	-13.0	2.9
Europe	16.5	16.4	15.6	14.7	14.4	16.5	19.0	21.0	-1.2	2.7
FSU	16.0	16.0	15.0	13.0	11.0	13.0	15.0	16.0	-3.3	2.7
Other	0.5	0.4	0.6	1.7	3.4	3.5	4.0	5.0	19.0	2.8
Middle East/North Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Africa	12.5	9.2	6.7	5.4	5.3	6.0	6.0	6.0	-7.5	0.9
World	235.7	198.0	186.9	210.2	187.2	214.5	229.5	247.5	-2.1	2.0

Sources: Metallgesellschaft AG, *Metall Statistik 1980-1990*; World Bureau of Metal Statistics, *Metal Statistics*, June 1992; World Bank, International Economics Department (projected).

Potential for production increases substantial. Table 2 provides forecasts of mine production of tin in terms of tin-in-concentrate. A brief description of our expectations for the most important tin-producing countries is given below:

BOLIVIA. Bolivia's tin industry has been restructured, partly with World Bank assistance. Since Bolivia's tin production comes mostly from underground mines, it had one of the highest production costs and its production level had been steadily declining until recently. Current plans call for production increases, to almost double the present level by 2000. Reorganization of COMIBOL and assistance given to small- and medium-scale mines have reduced costs, but it is not clear to what extent the planned increases will be adversely affected by the lower tin prices expected in the 1990s. Although not yet proven, Bolivia has the potential to find low-cost tin resources in areas close to Brazil's Rondonian tin province.

BRAZIL. It is estimated that Brazil produced more than 52,800 tons of tin-in-concentrate in 1989, of which approximately 56% was produced by garimpeiros. Discovery in 1987 of the high-grade Ariquemes deposit in Rondonia has made garimpeiros' "pick and shovel" mining profitable. The recent discovery of the Suracananus deposit in the Roraima province, probably the largest in Brazil, could invite another run by garimpeiros unless the government enforces strict controls. It is highly likely that other large deposits will be found. From known deposits alone, Brazil's production could easily reach more than 60,000 tons of tin-in-concentrate in a few years. Currently, Brazil has the lowest production cost in the world.

CHINA. Recently, China emerged as an important exporter of tin, with production estimated at 36,000 tons of tin-in-concentrate and tin metals in 1990. China's tin resources are believed to be large enough to support substantial production increases.

SOUTHEAST ASIA. Characteristics of tin mining are similar in Malaysia, Indonesia, and Thailand. Gravel pumps and dredges are the two dominant mining techniques used in Southeast Asia. The long history of tin mining in these countries has resulted in declines in ore grade and cost increases. Thus, as tin prices declined in 1991, production in Malaysia declined dramatically. In the 1990s, these countries' production is likely to stabilize at approximately the level in 1987.

Price Outlook

Slow price recovery as stocks and production decline. After the tin price peaked at over US$10/kg in April 1989, reported tin stocks increased from 43,000 tons in March 1989 to 58,700 tons at the end of September 1990 and tin prices declined to below US$6/kg for the July-September period. The price decline and stock increase were caused mainly by sharp production increases. LME and Penang exchange stocks began to decline from March 1991 onwards, but prices remained at US$5.50/kg or lower during most of 1991. The Kuala Lumpur market price declined to a bottom of US$5.35/kg in December 1991. With the sharp decline in production during 1991 and signs that stocks were edging down, tin prices have been recovering slowly during 1992.

We expect tin prices to increase slowly in the 1992-95 period, based on the assumption that ATPC, with Brazil's cooperation, will be moderately successful in managing potential excess supplies so that stocks decrease.

Over the longer term, the market balance will depend critically on the extent of Brazil's production expansion. Under the assumption that Brazil's production, which declined sharply in 1991 and apparently in 1992 as well, increases only gradually from 29,000 tons of tin-in-concentrate in 1991 to 55,000 tons by 2005, prices are expected to decline slowly to US$6.10/kg in 1990 dollars by the year 2005.

Table A1: Tin - Prices, 1950-91 (Actual) and 1992-2005 (Projected)

	(c/kg)					
			1990 Constant $			
	Current $		G-5 MUV a/		G-7 CPI b/	
	LME c/	Kuala Lumpur d/	LME c/	Kuala Lumpur d/	LME c/	Kuala Lumpur d/
Actual						
1950	206		1,258		1,657	
1951	298		1,581		2,166	
1952	266		1,347		1,855	
1953	201		1,050		1,394	
1954	198		1,056		1,350	
1955	204		1,070		1,389	
1956	217		1,097		1,443	
1957	208		1,029		1,353	
1958	203	200	985	970	1,294	1,274
1959	216	214	1,057	1,058	1,385	1,372
1960	220	213	1,061	1,028	1,379	1,335
1961	245	241	1,162	1,147	1,501	1,481
1962	247	242	1,151	1,126	1,474	1,443
1963	251	246	1,190	1,168	1,449	1,422
1964	341	335	1,590	1,561	1,920	1,885
1965	389	380	1,804	1,758	2,126	2,072
1966	357	349	1,599	1,560	1,887	1,840
1967	333	324	1,474	1,434	1,714	1,669
1968	313	306	1,396	1,365	1,565	1,530
1969	343	338	1,453	1,433	1,645	1,623
1970	367	359	1,464	1,432	1,661	1,625
1971	350	342	1,324	1,294	1,483	1,449
1972	377	368	1,309	1,276	1,448	1,411
1973	483	472	1,447	1,414	1,622	1,586
1974	820	784	2,017	1,929	2,488	2,379
1975	687	669	1,520	1,480	1,855	1,807
1976	758	747	1,654	1,630	1,982	1,953
1977	1,076	1,071	2,138	2,128	2,545	2,533
1978	1,291	1,252	2,228	2,160	2,491	2,415
1979	1,546	1,482	2,356	2,259	2,819	2,703
1980	1,678	1,644	2,331	2,284	2,736	2,681
1981	1,416	1,406	1,959	1,946	2,290	2,275
1982	1,283	1,295	1,803	1,820	2,101	2,121
1983	1,299	1,303	1,868	1,875	2,095	2,102
1984	1,227	1,246	1,804	1,830	1,985	2,014
1985	1,195 e/	1,154	1,741	1,682	1,893	1,829
1986	n.a.	616	n.a.	762	n.a.	809
1987	n.a.	669	n.a.	753	n.a.	778
1988	n.a.	705	n.a.	740	n.a.	762
1989	n.a.	853	n.a.	902	n.a.	926
1990	599 e/	609	599	609	599	609
1991	560	548	548	537	532	521
Projected						
1992		615		577		551
1993		660		597		571
1994		720		640		608
1995		780		675		640
2000		851		620		580
2005		961		610		547

a/ Deflated by G-5 Manufacturing Unit Value (MUV) Index.

b/ Deflated by G-7 Consumer Price Index (CPI).

c/ London Metal Exchange (LME), standard grade, minimum 99.75% sn, settlement price.

d/ For 1950-1984, Malaysian, Straits, minimum 99.85% sn, official selling price, ex-smelter, Penang; beginning 1985, Kuala Lumpur Tin Market (KLTM), settlement price.

e/ During October 24, 1985 through June 1990, tin trading at the LME was suspended.

Sources: International Tin Council, Tin Statistics, and Metals Week (actual); World Bank, International Economics Department (projected).

Nickel

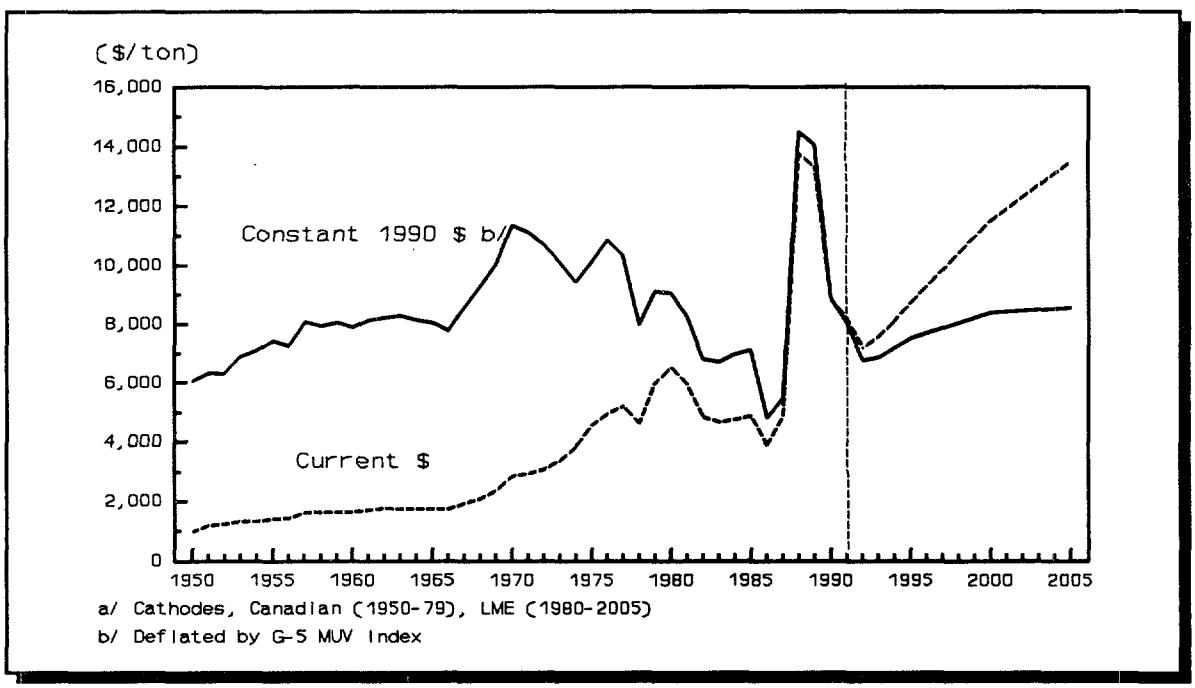
Summary

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

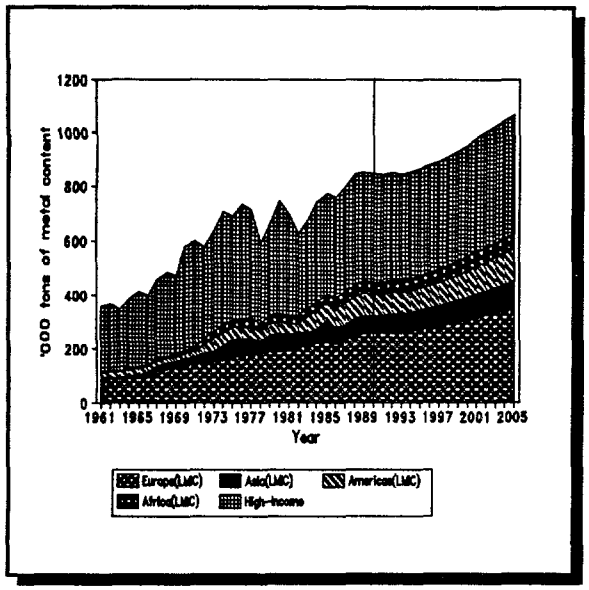
- Nickel production capacity worldwide is expected to increase by at least 100,000 tons over the next five years, with expected major expansions in Australia, Brazil, China, Cuba, and Colombia. Such capacity expansion would allow a 2.1% p.a. production growth over this period.

- The nickel price is expected to decline in 1992 (by about 17% in constant terms), stabilize during 1993-94 period, and rise in constant terms during the 1996-2000 period (by 2% p.a.). The long-term forecast (2000-2005) for the nickel price is for it to be essentially flat in constant terms.

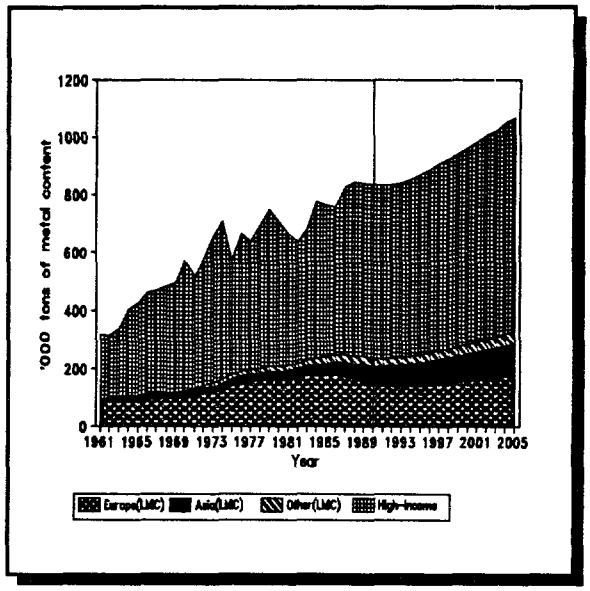
Nickel Prices a/, 1950-2005



Nickel Production
Actual and Forecasts, 1961-2005



Apparent Nickel Consumption
Actual and Forecasts, 1961-2005

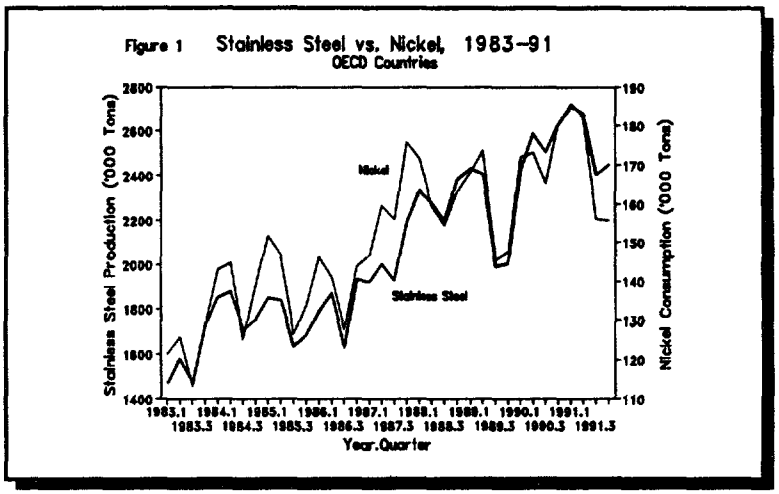


Demand Outlook

RECENT DEVELOPMENTS. Because of its desirable characteristics such as high resistance to corrosion and high tensile strength at elevated temperatures, nickel is used primarily as a metal industry additive in the manufacture of stainless steel, alloy steel, high- and/or special-performance alloys, nonferrous alloys, and nickel-based plating. A relatively new area of application is in rechargeable electrical batteries. Currently, about 60% of total nickel consumption goes to stainless steel, 10% is used in alloy steel, 15% in other nickel-based alloys, and the rest in coating and foundry uses.

Nickel metals are divided into two classes based on their nickel content and physical appearance. Class I nickel products have a nickel content of at least 99% (e.g., electrolytic cathodes have 99.9% nickel and carbonyl pellets have 99.7%). Products of this type can be used directly for almost any application. Class II metals are suitable for limited applications (e.g., stainless steel and alloy steel). Their nickel content is between 20% and 96%. The majority of class II products are ferronickels with a nickel content of 25-45%. Less common products include nickel oxide sinter (76-90%) and nickel sand (20-25%), mainly used as catalysts in batteries, fuel cells, and insecticides.

Stainless steel has been by far the largest consumer of nickel. Figure 1 plots stainless steel production and primary nickel consumption of the OECD countries during the period 1983-91. Primary nickel consumption has closely followed stainless steel production. For example, stainless steel production increased 14% in 1984 and nickel consumption increased by 12%. In 1989, stainless steel production dropped 4% and nickel consumption fell 2.2%. However, the link between stainless steel production and primary nickel consumption is complicated by two factors: (i) not all stainless steel contains nickel (nickel containing (austenitic) stainless steel accounts for about 75% of total stainless steel production); and (ii) not all nickel used in stainless steel is primary nickel (a considerable amount of nickel comes from ferronickel materials and secondary sources such as stainless steel scrap). This means that stainless steel producers have substitution possibilities when the price of primary nickel is high.



Indeed, due to the nickel price boom in the late 1980s, the ratio of primary nickel consumption to stainless steel production declined from about 8% in 1983 to about 6% in 1991. The average annual growth rate for stainless steel production over the nine-year period was 6.2% and for nickel it was 4.1%.

Table 1 presents apparent nickel consumption data for the past two decades. Because of the close association between nickel use and the high-tech durable goods industries, it is not surprising to find that the OECD countries have been the dominating nickel consumer, accounting for about 70% of world consumption. Among the OECD countries, Germany, Japan, and the United States are by far the three largest consumers, with about 65% of total OECD nickel consumption. Nickel consumption in the LMICs has been relatively small but has been increasing rapidly. During the 1970-90 period, the average annual growth rate of consumption for this group of countries was 3.2%, compared with 1.5% for OECD countries. Within the LMIC group, the Asia and Pacific region posted the fastest growth (5.8% p. a.) during the 20-year period.

OUTLOOK. ***Long-term potential for nickel demand solid.*** The outlook for nickel demand is generally upbeat because of its indispensability in products that have strong growth potential. The global push for environmental protection should boost nickel demand in the form of stainless steel and high nickel alloys used in flue gas desulphurization in power plants. Additionally, recent technological innovations in nickel-based rechargeable batteries for use in electric cars and trucks present enormous potential.

However, the sharp increase in nickel prices in the 1988-89 period resulted in declines in nickel consumption in the past two years (about -1% each year). The expected slow economic recovery in OECD countries should keep world nickel consumption growth flat or negative in the near term (1992-93). During the 1994-2000 period, the projected healthier growth in industrial production of OECD countries and the strong showing in some LMICs (e.g., China and India) would be likely to push the growth rate of world nickel consumption to above 2% p.a. Over the long term (2000-2005), growth in nickel consumption should be sustained at around 2% p.a.--a better performance than other base metals.

Table 1: Nickel Apparent Consumption, by Main Countries and Economic Regions, 1969-90
('000 tons of metal content)

Countries	1969-71	1979-81	1983-85	1988	1989	1990
High-Income	407	497	505	602	595	601
OECD	406	494	499	582	577	582
United States	140	145	142	135	127	125
Germany	43	79	72	91	89	89
France	33	37	35	40	40	45
United Kingdom	34	27	24	33	30	33
Sweden	19	20	18	20	18	19
Italy	18	25	27	29	31	27
Japan	88	121	132	162	163	159
LMICs	129	211	237	243	247	234
Asia and Pacific	22	30	39	51	62	66
China, People's Rep. of	19	19	19	28	27	28
Korea, Rep. of	-	3	3	6	18	24
Europe	101	161	177	165	157	144
FSU	87	130	141	130	120	115
World	535	709	742	845	842	835

Source: World Bank, International Economics Department.

Supply Prospects

PRODUCTION CHARACTERISTICS. Table 2 shows the trends in nickel production by main countries and economic regions over the past 20 years. World nickel production grew at 2.1% p.a. over the 1970-90 period, with most of the growth taking place in the LMICs (4.1% p.a.); the high-income countries registered only 0.5% p.a. growth. Among the OECD countries, Australia and Canada have been the two dominant suppliers of nickel, from mining to refining. For nickel metal production, Japan depends entirely on imports of nickel ore and concentrates from Australia, Indonesia, New Caledonia, and the Philippines. The FSU is the world's largest producer of nickel. Newcomers to the ranks of nickel producers include Brazil and China, where production growth has exceeded 5% p.a. over the past 20 years.

The nickel industry is characterized by significant vertical integration. Most nickel mining companies also produce finished ferronickels and/or nickel metals. Further downstream, however, integration is rare. Inco, the Canadian producer, has a significant presence in nickel metal fabrication. Outokumpu, the Finnish producer, also has downstream operations such as stainless steel production.

Table 2: Nickel Production, by Main Countries and Economic Regions, 1969-90
('000 tons of metal content)

Countries	1969-71	1979-81	1983-85	1988	1989	1990
High-Income	358	377	356	411	397	402
OECD	358	377	356	400	387	392
Canada	162	115	110	146	130	127
France	10	8	6	10	10	10
United Kingdom	35	21	21	28	26	27
Finland	4	11	15	16	13	17
Australia	5	39	40	42	43	47
Japan	87	103	89	101	106	102
LMICs	197	327	379	439	460	450
Africa	14	32	33	46	49	47
South Africa	9	18	21	27	30	28
Zimbabwe	5	14	12	18	19	19
Americas	20	43	67	83	88	82
Cuba	18	20	18	24	27	21
Brazil	2	2	12	13	14	13
Dominican Republic	-	20	23	29	31	29
Asia and Pacific	27	66	60	68	68	65
China, People's Rep. of	-	11	18	26	26	28
Europe	135	187	219	242	255	257
FSU	123	165	194	215	225	230
Greece	8	13	15	13	16	16
World	555	704	735	850	857	853

Source: World Bank, International Economics Department.

Nickel is mined from either sulphide or oxide ores. Nickel sulphide ores usually occur in hard rock, vein-type underground mines, and also contain by-product copper, cobalt, and precious metals. Oxide deposits occur in laterites formed by the weathering of such rocks as peridotites. Sulphide ores are mined in Australia, Canada, China, Finland, South Africa, the FSU, and Zimbabwe. Laterite ores are mined in Australia, Brazil, Cuba, Dominican Republic, Greece, Indonesia, New Caledonia, Philippines, and the FSU.

Sulphide ores are mined by either surface or underground mining. Nickel concentrates from sulphide ores are smelted and refined to nickel metal containing 90% or more nickel. There are almost as many metallurgical processes developed and commercially used as there are nickel recovery plants.

Laterites are usually mined by surface mining. A major problem associated with laterites is the high moisture content (up to 30%), which adds weight and significantly reduces equipment efficiency. Unlike sulphide ores, oxide ores cannot be readily upgraded to higher grade concentrates for refining. Therefore, metallurgical recovery is more costly for the oxide ores. However, this is compensated somewhat by the much lower costs of open-pit mining. Laterites are processed mostly to ferronickel containing 20-40% of nickel.

Identified world nickel reserves with an average ore grade of 1% or better amount to 143 million tons of nickel. About 60% of the total is in laterites and 40% is in sulphides. World reserves of lower grade nickel are large. There are extensive deep-sea deposits of nickel in manganese crusts and nodules covering large areas of the ocean floor, particularly in the Pacific Ocean. Table 3 presents estimates of nickel reserves and reserve bases of major producing countries. Given the current rate of extraction, the available reserves would last for 50-100 years.

By-products and co-products of nickel--such as cobalt, copper, and precious metals--are significant factors in nickel recovery. For example, Canada's Sudbury nickel mine yields nearly three-quarters of a pound of copper for each pound of nickel produced, together with large quantities of platinum, gold, silver, and cobalt. The choice of the metallurgical process to recover nickel usually is highly influenced by the presence of by-products.

Because of the wide range of variations described above, production costs may vary considerably, depending on the kinds of deposits and metallurgical processes. Table 4 presents estimates of nickel production costs for major nickel operations. Costs of energy and labor and by-product credits significantly affect direct cash costs. Under the assumption that crude oil cost is $15/bbl, the share of energy in the total cost of nickel production is 15% for sulphide ores and 45% for laterite ores. Some laterite operations have made efforts to decrease their reliance on oil by converting to coal, natural gas, and hydroelectric power. The cost of labor accounts for 50% of the total cost for sulphide operations and 20% for laterites, because sulfides are more labor intensive due to underground mining. Materials used in nickel recovery include ammonia, naphtha, acid, sulfur, electrodes and other materials. They represent on average about 35% of the total production cost for both sulfides and laterites. Revenues from co-products and by-products play a more important role in most sulphide operations than for laterites.

SUPPLY OUTLOOK. ***Sustaining 2% p.a. growth after 1995 is doubtful.*** Nickel production capacity worldwide is expected to increase by about 100,000 tons over the next five years, with major expansions in Australia, Brazil, China, Cuba and Colombia. In Australia, annual nickel production capacity currently stands at 69,000 tons. However, the development of the Mt. Keith and Yakabindie deposit will push the output of refined nickel as high as 130,000 tons per year (tpy). Several Brazilian nickel producers have announced intentions to expand, and about 20,000 tpy of additional capacity is expected there. China's largest nickel producer, Jinchuan, will double its capacity from 30,000 tpy to 60,000 tpy when a new smelter comes onstream in 1994. Cuba has plans to continue development of its Las Camariocas project, which could have 30,000 tpy of capacity by the mid-1990s. In Colombia, Cero Matoso is to expand refined nickel production capacity by 18,000 tpy by 1993. If all plans come to fruition, this would imply a total of 2.1% p.a. production growth over the next five years, which is approximately the same rate as in the recent past.

Table 3: World Nickel Mine Production, Reserves, and Reserve Base
('000 tons of nickel content)

	Mine Production			Reserve
	1990	1991	Reserve a/	Base b/
Albania	9.0	9.1	181.4	181.4
Australia	69.8	72.6	2,176.8	6,802.5
Botswana	25.0	27.2	476.2	907.0
Brazil	20.9	22.7	665.7	4,262.9
Canada	201.8	204.1	6,167.6	13,605.0
China	25.0	25.4	725.6	907.0
Colombia	17.0	17.2	557.8	739.2
Cuba	38.4	36.3	18,140.0	22,675.0
Dominican Republic	32.7	32.7	453.5	680.3
Finland	10.5	10.9	79.8	99.8
FSU	258.5	258.5	6,621.1	7,346.7
Former Yugoslavia	1.0	0.9	157.8	204.1
Greece	18.1	18.1	453.5	907.0
Indonesia	58.0	59.0	3,201.7	12,698.0
New Caledonia	88.0	90.7	4,535.0	14,965.5
Philippines	12.0	12.7	408.2	10,974.7
South Africa	36.3	36.3	2,539.6	2,630.3
United States	0.3	7.6	22.7	2,539.6
Zimbabwe	7.5	8.2	77.1	99.8
Other	4.5	4.5	0.0	7,890.9
World Total	934.4	954.5	47,641.1	111,116.6

a/ That part of the reserve base that could be economically extracted or produced at the time of determination.

b/ That part of an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices.

Source: United States Bureau of Mines, Mineral Industry Surveys (Nickel in 1991).

However, almost all projects discussed above are incremental expansions to existing facilities because the nickel price necessary to meet the stringent financial criteria for investing in a greenfield project is about $13,000/ton and capacity additions can be justified at about one half of that price. The only announced greenfield project, the Mt. Keith and Yakabindie project, is still in the stage of feasibility study. Thus, it is questionable that production growth worldwide can be sustained at 2% p.a. in the mid to long term (1995-2005) when incremental expansion possibilities are exhausted.

Table 4: Nickel Production Costs (1990 US$/lb)

Producer	Country	Ore Type a/	Mlbs b/	C1 c/	C2 d/	C3 e/
Cerro Matoso	Colombia	L	40	1.32	2.02	3.11
Namew Lake	Canada	S	16	1.54	2.21	2.33
Inco	Canada	S	330	1.84	2.28	2.84
Codemin	Brazil	L	14	1.89	2.47	2.71
Selebi-Phikwe	Botswana	S	40	1.92	2.09	5.09
Greenvale	Australia	L	32	1.95	2.50	2.58
Falconbridge	Canada	S	58	1.99	2.89	3.32
PT Inco	Indonesia	L	60	2.04	2.60	2.91
Falcondo	Dominican Republic	L	60	2.25	2.41	2.60
Bindura	Zimbabwe	S	24	2.36	2.41	2.53
Enonkoski	Finland	S	12	2.37	2.73	2.85
Western Mining	Australia	S	95	2.46	3.02	3.19
SLN	New Caledonia	L	85	2.76	3.08	3.28
PT Aneka Tambang	Indonesia	L	74	3.14	3.39	3.54
Redstone	Canada	S	4	3.39	3.74	3.89
Glenbrook	United States	L	8	4.72	5.22	5.42
Total/Weighted Average			952	2.16	2.61	3.09

a/ Ore types include sulphide (S) and laterite (L) ores.
b/ Production capacity in million pounds of nickel content.
c/ Direct cash costs (C1) which include costs incurred in mining, milling, ore freight, on-site administration expenses, smelting, refining, intermediate and final freight, marketing, and by-product credit.
d/ Operating costs (C2) which includes direct cash costs (C1) and depreciation.
e/ Fully allocated costs which includes operating costs (C2), indirect costs, and interest charges. Indirect costs include the portion of corporate overheads attributable to the operation, research and exploration attributable to operation, royalties, and other extraordinary costs.

Source: Brook Hunt & Associates Limited, Nickel Mine Cost Study (1982-95), 1990 Edition.

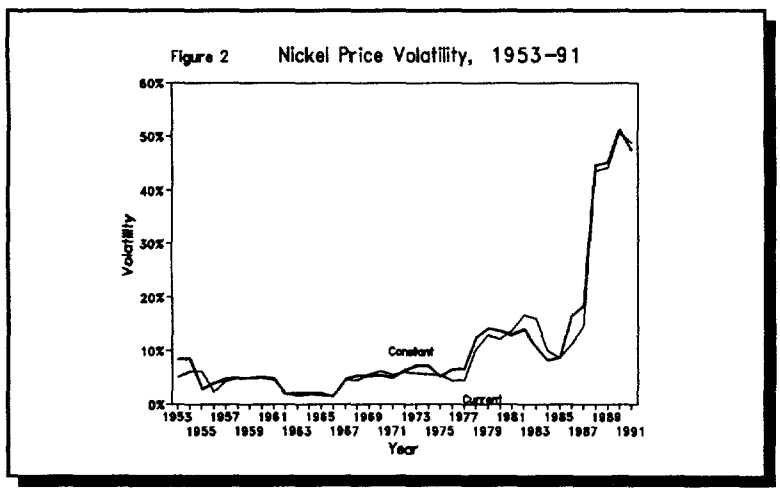
The most important issue for nickel market analysts is the future development of the FSU nickel industry. The FSU nickel industry was re-organized in 1989 when the nickel complexes at Norilsk (in eastern Siberia), Pechenga and Monchegorsk (on the Kola Peninsula), and the Krasnoyarsk platinum plant (in eastern Siberia) were grouped together as the Norilsk Nikel Kombinate (NNK). The new organization controls some 80% of total FSU nickel production (300,000 tons in 1991). Other important nickel deposits are in the central Urals and the Ukraine. About 85% of FSU nickel is contained in sulphide ore and 15% in laterites. At present, NNK's largest complex is at Norilsk, which produces 200,000 tpy of nickel in concentrates. About 30,000 tons are shipped to Pechenga for smelting, with the balance smelted at Norilsk. Nickel was traditionally treated as a strategic material in the FSU because of its use in military weaponry. The statistics on nickel production and consumption were kept secret. Following the political and economic transition in the FSU, military applications of nickel have been greatly reduced, and the surplus nickel has been channeled to the international market in order to generate

foreign exchange. In 1991, the FSU exported 120,000 tons of nickel, more than double the exports of 55,000 tons of four years ago.

One school of thought believes that the combination of ever-pressing hard currency needs and declining domestic consumption will result in an unabated outflow of nickel, even exceeding the high of 1991. However, another school of thought, citing the depletion of the stockpiled nickel, transportation difficulties, inability to secure raw materials and spare parts, pollution-forced shutdowns, long-delayed repairs and modernization, the confusing maze of export taxes and licenses and foreign exchange requirements, believes that FSU exports of nickel will definitely decline from the 1991 level.

Price Prospects

Prices to stabilize before resuming growth after 1995. The nickel market is by far the smallest of the base metals markets in terms of tonnages. In addition, the cost of nickel is only a small part of the total cost of downstream products such as stainless steel. Thus, the price elasticity of demand for nickel is relatively small, and a minor imbalance of nickel demand and supply can often cause large price fluctuations. Historically, market prices for virtually all nickel products were related to Inco's prices for electrolytic cathodes. After 1980, however, Inco gradually lost its position as the price setter with the number of nickel producers worldwide increasing significantly and exports from Cuba and the FSU expanding. Subsequently, spot nickel prices on the LME became the market benchmark, although they have been very volatile. Figure 2 plots the price volatility (calculated as the five-year standard deviation of the first differences in price) of nickel, in both current and constant terms, over the 1950-91 period. Before 1980, the price volatility was moderate (averaging 5% both in current and constant terms). However, after 1980, volatility increased significantly, surpassing 15% in the early 1980s and exceeding 40% in some years in the late 1980s.



Nickel price movements (LME cash price) in the late 1980s were characterized by large shocks, both up and down. After declining 40% in constant terms in 1986, nickel prices doubled in 1988 (a 97% increase in constant terms and a 104% increase in current terms), to reach a historical high. The high prices in 1988 were caused by strong demand, low inventories, and the threat of disruptions to

production by strikes and technical problems at several major mines. However, prices fell 46% in constant terms in 1990 and 11% in 1991, because of weakening demand and greatly increased FSU exports to European markets.

Nickel prices are expected to decline further in 1992 (by about 17% in constant terms) before stabilizing in 1993-94. The causes for the decline remain the poor economic outlook for the OECD countries and expectations of continued large exports from the FSU. The steady and robust economic growth assumed for the second half of the 1990s would push up the demand for stainless steel and other nickel-containing durable goods. Due to the low prices in the early 1990s, capacity expansions, particularly greenfield projects, during the second half of the 1990s may fall behind demand increases. Thus, nickel prices are forecast to increase at an average annual rate of 2% in real terms over the 1995-2000 period. For the long term (2000-2005), nickel prices are forecast at the level of production costs of the potential new mines likely to be brought into production by that time. This assumes that the market will be approximately balanced over the long term.

Table A1: Nickel - Prices, a/ 1950-91 (Actual) and 1992-2005 (Projected)

	($/ton)		
	Current $	1990 Constant $	
		G-5 MUV b/	G-7 CPI c/
Actual			
1950	988	6,049	7,965
1951	1,191	6,323	8,664
1952	1,246	6,312	8,692
1953	1,321	6,886	9,139
1954	1,334	7,112	9,092
1955	1,422	7,439	9,660
1956	1,437	7,260	9,557
1957	1,631	8,070	10,614
1958	1,631	7,934	10,418
1959	1,631	8,047	10,438
1960	1,631	7,882	10,241
1961	1,711	8,127	10,496
1962	1,762	8,202	10,510
1963	1,742	8,268	10,067
1964	1,742	8,126	9,812
1965	1,735	8,036	9,471
1966	1,739	7,784	9,184
1967	1,936	8,563	9,962
1968	2,075	9,266	10,388
1969	2,363	10,015	11,341
1970	2,846	11,348	12,873
1971	2,932	11,092	12,424
1972	3,080	10,691	11,828
1973	3,373	10,108	11,334
1974	3,825	9,407	11,605
1975	4,570	10,110	12,342
1976	4,974	10,852	12,999
1977	5,203	10,335	12,303
1978	4,610	7,957	8,896
1979	5,986	9,122	10,914
1980	6,519	9,058	10,631
1981	5,953	8,238	9,630
1982	4,838	6,799	7,925
1983	4,673	6,721	7,536
1984	4,752	6,984	7,685
1985	4,899	7,142	7,764
1986	3,881	4,798	5,097
1987	4,872	5,484	5,664
1988	13,778	14,457	14,879
1989	13,308	14,061	14,437
1990	8,864	8,864	8,864
1991	8,156	7,993	7,759
Projected			
1992	7,200	6,759	6,449
1993	7,600	6,876	6,572
1994	8,100	7,195	6,843
1995	8,700	7,527	7,144
2000	11,500	8,377	7,837
2005	13,500	8,566	7,690

a/ For 1950-79, Canadian electrolytic cathodes, minimum 99.9% ni; from 1980 onward, London Metal Exchange cathodes, 99.8% ni.

b/ Deflated by G-5 Manufacturing Unit Value (MUV) Index.

c/ Deflated by G-7 Consumer Price Index (CPI).

Sources: Metals Week (actual); World Bank, International Economics Department (projected).

Aluminum and Bauxite

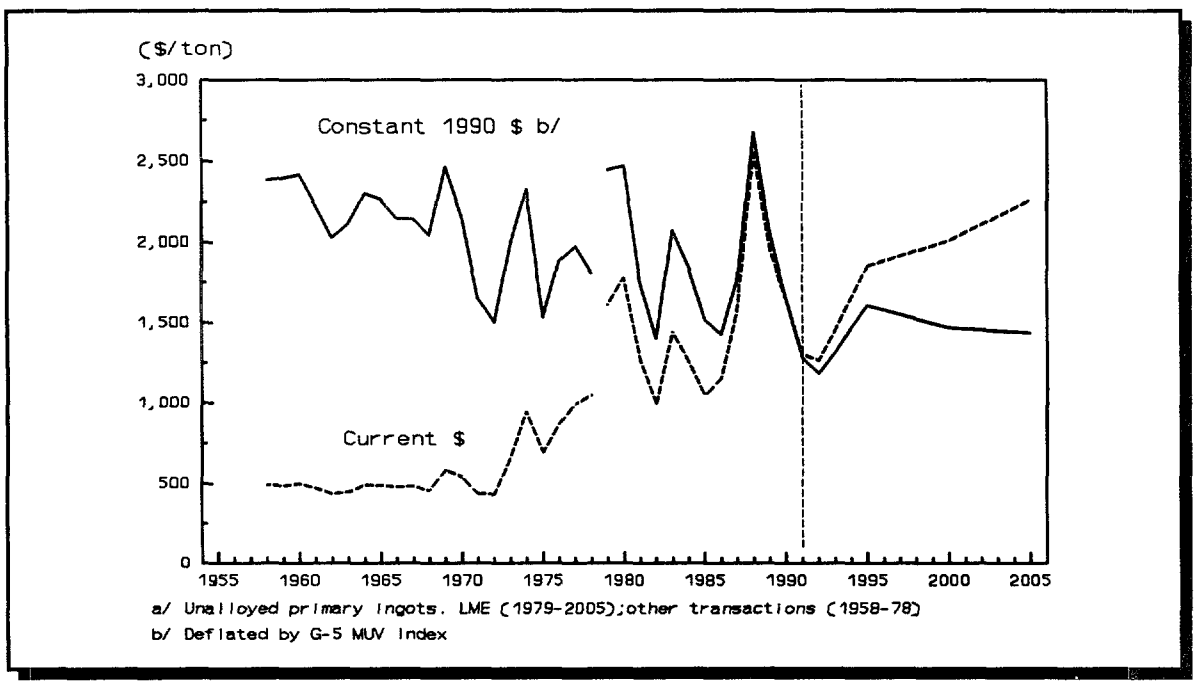
Summary

- Aluminum consumption growth has slowed over the past three decades from an annual growth rate of 9.1% in the 1960s, to 4.8% in the 1970s, and to a 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%, with the share of LMICs rising from 31% in 1991 to 36% in 2005.

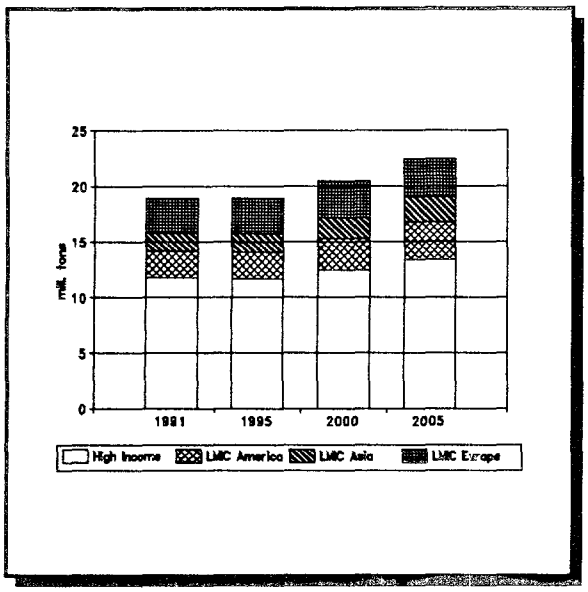
- As aluminum prices and consumption growth are expected to remain relatively low (by historical standards) in the 1992-2005 period, aluminum smelting capacity growth should be slow. Most investments in new smelting capacity are likely to take place in Australia, Canada, the Middle East, South America, and southern Africa where both bauxite and low-cost energy are available. The ratio of exports to production in aluminum is expected to rise substantially, reflecting the ongoing global restructuring of the industry.

- Prices of aluminum and bauxite are expected to increase in the period 1992-94, as the market balance adjusts from the gross surplus in 1991, then to peak around 1995 at relatively low real prices. The greatest source of uncertainty regarding the course of aluminum prices in the medium term is the level of FSU exports to international markets, which will depend on the pace of domestic demand recovery and the renovation of antiquated smelting facilities. Over the long term (2000 and 2005), aluminum prices are projected at levels that cover the costs of production of new capacities, estimated at about $1,400/ton in constant 1990 dollars.

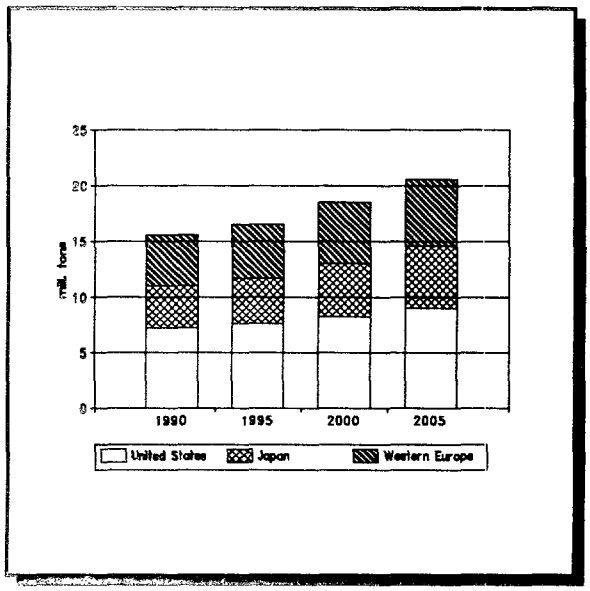
Aluminum Prices a/, 1955-2005



Projected Aluminum Smelting Capacity, by Region



Projected Aluminum Consumption, by Major OECD Countries



Demand Outlook

From 1960 to 1970, world consumption of aluminum grew at an annual rate of 9.1%. In the 1970s the annual growth rate was reduced by one half to 4.1%. In the 1980s, consumption grew at only 1.6% p.a. The fast growth in consumption of the earlier period was due to end-users replacing other metals with aluminum because of its declining real prices and special characteristics–i.e., aluminum is light and has a density about one third that of steel; it conducts electricity and heat well; it is resistant to corrosion from exposure to air, water, and many foodstuffs and liquids; it has some decorative properties that make it suitable for interior and exterior architectural applications; and finally, although it is a strong material, it is easy to work with.

With the recession of 1975 and the increase in energy prices (which increased the costs of aluminum production), the boom years came to an end. However, consumption of aluminum has continued to increase in several important end-use sectors, namely, packaging, construction, and transportation.

Total aluminum consumption can be divided into primary and secondary components. The ratio of secondary (recycled) to total consumption has increased from 19% in 1960 to 29% in 1990. The main reason for the increase in recycling is the major energy savings associated with the use of recycled aluminum.

Per capita consumption of aluminum in the United States, the largest consumer, increased from 10.8 kg in 1960 to 27 kg in 1990. In Japan and Germany, the amount of aluminum consumed per head of population also reached similar levels, 26.6 kg and 25.7 kg, respectively.

Data on consumption by end-uses are available for only a few industrial countries. Table 1 shows consumption by main end-use sectors for the United States, Japan, and four major Western

European countries for selected years over the past two decades. Packaging is the most important consumer of aluminum in the United States, followed by transportation and construction. In Japan and Western Europe, transportation and construction are the two most important end-uses.

Consumption of aluminum for packaging slowed in 1980s. In the United States, growth in the consumption of aluminum in packaging slowed down sharply in the 1980s--from 8.5% p.a. in the 1970s to 3.6% p.a. Similarly, in Japan, the growth of aluminum use in packaging slowed from 21% p.a. in the 1970s to 5.8% p.a. in the 1980s. In Europe, however, the growth rate was sustained at around 3.8% over the whole period. The slowdown in the growth of aluminum consumption in packaging in the United States and Japan is attributed mainly to three factors: (i) aluminum cans are much lighter today than previously; (ii) aluminum packaging has not been as successful in the food sector as in the beverage sector; and (iii) competition from "newer" materials, e.g., plastics, has been increasing.

Demand for primary aluminum will be affected by the characteristics and prices of substitutes as well as levels of GDP or industrial production and the price of aluminum. Technological advances have made plastics a major competitor, especially in automobile production. However, the difficulty of recycling plastics has limited their use in this area. In the food industry, technological progress is improving the resistance of aluminum to corrosion so that is becoming more likely to replace steel in packaging.

LMICs lead growth in primary aluminum consumption. World consumption of primary aluminum is expected to increase over the period from 1991 to 2005 at an average annual rate of 2.2% (Table A8). Aluminum consumption should grow faster in LMICs (3.4% p.a.) than in high-income countries (1.7% p.a.) mainly because income growth rates are expected to be higher in the former group. Consumption in Japan and non-OECD high-income countries should grow at a faster rate than in other high-income countries partly because of their higher expected economic growth rates and partly because of expected shifts of major aluminum-using industrial activities (particularly, electrical engineering) to these countries from other high-income countries.

Among the LMICs, consumption in Asia should grow faster than in other regions (4.3% p.a.) mainly due to continued fast growth there (see Table A8). The intensity of use of aluminum in these countries has increased because they have devoted a large share of their GDP to construction and capital equipment, which are metal-intensive activities. However, as per capita incomes continue to rise and basic needs are satisfied, an increasing share of their expenditures will be expected to shift toward services such as medical care and education. The intensity of use of metals should thus decline.

Uncertainties in Eastern Europe and the FSU. One important source of uncertainty regarding world aluminum consumption growth is the future consumption trend in Eastern European countries and the FSU. Consumption in these countries stagnated in the 1980s, and indeed declined in the early 1990s. A number of competing influences are now at work. Tending to decrease the intensity of use of aluminum is the emphasis on product quality and more efficient materials management as well as the decline in production of military hardware, which has been an important end-user of aluminum. On the other hand, these changes should help to stimulate economic recovery and growth, although how rapidly consumption recovers is uncertain.

Table 1: Total Aluminum Consumption by Main Sectors, Selected Major Industrial Countries, 1970-90

	1970	1974	1976	1980	1985	1986	1987	1988	1989	1990
	('000 tons)									
United States										
Transportation	734	1,169	1,163	1,042	1,364	1,372	1,500	1,536	1,448	1,320
Electrical engineering	574	780	555	612	642	616	620	671	663	594
Construction	1,006	1,363	1,221	1,165	1,381	1,432	1,441	1,316	1,294	1,208
Packaging	665	1,027	1,166	1,512	1,863	1,929	2,052	2,036	2,112	2,157
Other	1,080	1,411	1,188	1,115	1,134	1,195	1,247	1,105	876	740
Exports of semi-manufactures a/	527	428	379	995	546	413	569	786	1,060	1,131
Total	4,586	6,178	5,782	6,441	6,930	6,958	7,430	7,450	7,452	7,151
Japan										
Transportation	257	325	371	582	763	785	834	930	1,039	1,140
Electrical engineering	156	163	178	226	155	165	237	238	244	254
Construction	298	546	668	732	701	733	819	897	902	934
Packaging	20	83	104	134	177	202	223	266	270	310
Other	409	472	523	553	632	602	746	901	925	964
Exports of semi-manufactures a/	53	34	77	82	258	231	194	122	123	169
Total	1,193	1,623	1,921	2,309	2,686	2,724	3,054	3,365	3,502	3,771
Western Europe b/										
Transportation	611	617	667	741	766	841	902	923	782	764
Electrical engineering	259	265	244	277	237	232	232	241	249	286
Construction	234	376	409	486	438	487	539	570	687	761
Packaging	178	250	238	258	291	298	301	294	379	381
Other	641	858	848	826	856	887	887	926	936	954
Exports of semi-manufactures	300	493	570	759	1,048	1,062	1,130	1,240	1,310	1,403
Total	2,223	2,859	2,976	3,347	3,636	3,807	3,991	4,194	4,342	4,549

a/ Exports of semi-manufactures are not broken down into various end-uses but are included because they represent a component of domestic consumption.

b/ Historical end-use data are available only for the Federal Republic of Germany, France, Italy, and the United Kingdom. The ratio of D.R. Germany's primary consumption to that of these four countries averaged only 8% in the 1980-1990 period.

Note: Total aluminum consumption includes both primary and secondary aluminum. Thus, country totals in this Table will be greater than primary consumption data shown elsewhere.

Sources: Metallgesellschaft AG, Metal Statistics (various issues).

Outlook in packaging and transportation remains strong in OECD. Projections by end-use for the United States, Japan, and four major industrial countries in Europe are presented in Table 2. In the United States, packaging is expected to remain the most important consumer of the metal, due to improvements in its technical properties that make it more resistant to corrosive materials. However, the fastest growth of aluminum use is expected to occur in the transportation sector as the automobile industry is likely to increase its use of aluminum to improve the fuel efficiency of its products. In Europe and Japan, the transportation sector has been the most important consumer, but the relative importance of the packaging sector will increase as marketed beverage consumption increases rapidly.

Consumption of aluminum in the transportation sector in the United States is expected to increase on average by 3% p.a. from 1990 to 2005. The use of aluminum is expected to reduce the midsize car's overall weight by about 300 kg. This would cut gasoline consumption by 1 gallon for each 100 miles driven. In Western Europe and Japan, expected growth rates in transportation are 3.3% and 2.2%, respectively. In the construction sector, the consumption of aluminum is expected to increase over the long term by 1.8% p.a. in the United States, by 3.2% in Japan and by 1.7% p.a. in Western Europe. Due to aluminum's bulkiness and poorer electrical conductivity than copper, its use in the electrical engineering sector is expected to experience a virtual standstill in the United States, and indeed to decrease in Western Europe and Japan.

Supply Outlook

Reflecting the decline in the growth rate of consumption in the 1980s, investments in aluminum smelting capacity slowed in the 1980s, from an annual increase of 2.3% in the 1970s to 1.5% in the 1980s. Following the upturn in demand in 1987, capacity utilization improved, and in 1989, 1990 and the first half of 1991, smelters were producing at close to 100% of name-plate capacity in the western world. However, capacity utilization declined in Eastern Europe and the FSU, and the slowdown in the growth of consumption in 1990 led to a decline in the capacity utilization rate in the western world in the second half of 1991 and early 1992, despite a decline in smelting capacity in this period.

Table 3 shows projected worldwide primary aluminum smelting capacity in the period 1991-2005. Expansion of capacity depends on the expected price of aluminum, the expected growth in demand, and the expected trend in costs. The most important factor determining the location of a new investment for aluminum smelting capacity is cost and availability of an energy source. The abundance of bauxite also has an important influence. For these reasons, most investments in new aluminum smelting capacity in the 1990s are expected to take place in Australia, Canada, the Middle East, South America, and southern Africa.

Little change in geographic spread of smelting capacity. Worldwide aluminum capacity is expected to increase from 20.3 million tpy in 1991 to 24.3 million tpy in the year 2005. In 1991, the LMICs accounted for 42% of world aluminum smelting capacity. This share is expected to remain unchanged through 2005. On the one hand, within this group the share of Europe, which includes all of Eastern Europe and the FSU, is expected to decline as industrial restructuring takes place. On the other hand, there will be significant capacity increases in all other LMICs. In particular, large increases in capacity are expected in Venezuela and possibly Chile and Trinidad and Tobago in the Americas; China and India in Asia; South Africa in Sub-Sahara; and possibly in Algeria, Iran, and Qatar in the Middle East and North Africa.

Table 2: Aluminum Consumption by End-Uses, Major OECD Countries, 1990-2005

	Actual	Projected			Growth Rate
	1990	1995	2000	2005	1990-2005
		('000 tons)			(%)
United States					
Transportation	1,320	1,550	1,800	2,050	3.0
Electrical engineering	594	600	600	600	0.1
Construction	1208	1,320	1,450	1,580	1.8
Packaging	2157	2,300	2,500	2,720	1.6
Other	740	800	950	1,050	2.4
Exports of semi-manufactures	1131	1,000	1,000	1,100	-0.2
Total	7151	7,570	8,300	9,100	1.6
Japan					
Transportation	1,140	1,200	1,380	1,590	2.2
Electrical engineering	254	250	245	245	-0.2
Construction	934	1,100	1,290	1,470	3.1
Packaging	310	420	570	680	5.4
Other	964	1,000	1,130	1,250	1.7
Exports of semi-manufactures	169	170	200	230	2.1
Total	3,771	4,140	4,815	5,465	2.5
Western Europe a/					
Transportation	764	950	1,150	1,225	3.2
Electrical engineering	286	270	260	260	-0.6
Construction	761	795	850	980	1.7
Packaging	381	430	540	650	3.6
Other	954	1,025	1,090	1170	1.4
Exports of semi-manufactures	1,403	1,450	1,570	1,700	1.3
Total	4,549	4,920	5,460	5,985	1.8

a/ Historical end-use data are available only for the Federal Republic of Germany, France, Italy and the United Kingdom. The ratio of D. R. of Germany's primary consumption to that of these four countries averaged only 8% in the 1980-90 period.

Note: Total aluminum consumption includes both primary and secondary aluminum.

Sources: Metallgesellschaft Metal Statistics (actual); World Bank, International Economics Department (projections).

Among the high-income countries, significant capacity increases are expected in Australia, Canada and Norway. Unless political and social conflicts delay investments, aluminum capacity in Canada is expected to reach 2.8 million tpy by the year 2005. Australia, which expanded its capacity significantly in the last decade, has a range of further possibilities. Australia benefits from its large reserves of high-grade bauxite.

Table 4 provides the projected pattern of increases in alumina refinery capacity from 1991 to the year 2005. World alumina refinery capacity is expected to grow from 41.4 million tons in 1991

Table 3: Aluminum Smelting Capacity, 1991-2005

Countries/Economies	Actual 1991	Projected 1995	2000	2005	Growth Rate 1991 -2005	Share of World 1991	2005
	('000 tons)				(% p.a.)	(%)	(%)
High Income	11,845	11,677	12,452	13,382	0.9	58.3	58.0
OECD	11,599	11,437	12,212	12,962	0.8	57.1	56.8
OECD Europe	3,454	3,340	3,572	4,012	1.1	17.0	16.6
Germany	720	720	720	720	0.0	3.5	3.6
France	456	440	440	440	-0.3	2.2	2.2
Italy	196	127	127	127	-3.1	1.0	0.6
United Kingdom	307	278	200	200	-3.0	1.5	1.4
Netherlands	282	282	282	362	1.8	1.4	1.4
Norway	880	880	980	1,280	2.7	4.3	4.4
Spain	355	355	355	355	0.0	1.7	1.8
Other OECD Europe	258	258	468	528	5.2	1.3	1.3
Japan	35	35	35	35	0.0	0.2	0.2
Canada	2,347	2,300	2,640	2,750	1.1	11.5	11.4
United States	4,101	4,100	4,100	4,100	0.0	20.2	20.3
Australia	1,397	1,397	1,600	1,800	1.8	6.9	6.9
New Zealand	265	265	265	265	0.0	1.3	1.3
Non-OECD High-Income	246	240	240	420	3.9	1.2	1.2
LMICs	8,486	8,473	9,521	10,892	1.8	41.7	42.0
Americas	2,443	2,417	2,786	3,450	2.5	12.0	12.0
Argentina	165	165	165	165	0.0	0.8	0.8
Brazil	1,202	1,206	1,206	1,206	0.0	5.9	6.0
Venezuela	974	974	1,200	1,450	2.9	4.8	4.8
Other Americas	102	72	215	629	13.9	0.5	0.4
Asia & Pacific	1,686	1,686	1,893	2,305	2.3	8.3	8.4
China	850	850	850	1,050	1.5	4.2	4.2
India	604	604	811	910	3.0	3.0	3.0
Indonesia	225	225	225	225	0.0	1.1	1.1
Other Asia/Pacific	7	7	7	120	22.5	0.0	0.0
Europe	3,134	3,207	3,299	3,379	0.5	15.4	15.9
Greece	155	155	155	155	0.0	0.8	0.8
Romania	178	247	240	240	2.2	0.9	1.2
Yugoslavia	350	350	350	350	0.0	1.7	1.7
FSU	2,200	2,200	2,300	2,300	0.3	10.8	10.9
Other Europe	251	255	254	334	2.1	1.2	1.3
Middle East & North Africa	760	700	880	905	1.3	3.7	3.5
Egypt	180	180	180	180	0.0	0.9	0.9
Bahrain	460	460	460	460	0.0	2.3	2.3
Other Middle East/North Africa	120	60	240	265	5.8	0.6	0.3
Africa	463	463	663	853	4.5	2.3	2.3
Ghana	200	200	200	200	0.0	1.0	1.0
South Africa	175	175	375	565	8.7	0.9	0.9
Other Africa	88	88	88	88	0.0	0.4	0.4
World Total	20,331	20,150	21,973	24,274	1.3	100.0	100.0

Sources: World Bank, International Economics Department; based on information provided by industry sources, including, in particular, Anthony Bird Associates.

Table 4: Alumina Refinery Capacity, 1991-2005

	Actual	Projected			Growth Rate	Share in World	
	1991	1995	2000	2005	1991-2005	1991	2005
	('000 tpy)				(% p.a.)	(%)	
High Income	21,495	22,590	23,435	24,635	0.98	51.9	45.9
OECD	21,495	22,345	23,195	24,395	0.91	51.9	45.4
OECD Europe	3,680	3,670	3,670	3,670	-0.02	8.9	6.8
Germany	640	630	630	630	-0.11	1.5	1.2
France	310	310	310	310	0.00	0.7	0.6
Italy	730	730	730	730	0.00	1.8	1.4
Spain	1,000	1,000	1,000	1,000	0.00	2.4	1.9
Ireland	1,000	1,000	1,000	1,000	0.00	2.4	1.9
Japan	180	180	180	180	0.00	0.4	0.3
Canada	1,015	1,015	1,015	1,015	0.00	2.4	1.9
United States	5,030	5,030	5,030	5,030	0.00	12.1	9.4
Australia	11,590	12,450	13,300	14,500	1.61	28.0	27.0
Non-OECD High-Income	0	245	240	240	105.53	0.0	0.4
LMICs	19,939	20,895	25,100	29,050	2.72	48.1	54.1
Americas	8,731	9,590	11,320	14,580	3.73	21.1	27.2
Brazil	1,665	2,065	3,200	4530	7.41	4.0	8.4
Jamaica	3,450	3,925	4,500	5,450	3.32	8.3	10.2
Suriname	1,616	1,600	1,600	1,600	-0.07	3.9	3.0
Venezuela	2,000	2,000	2,020	3,000	2.94	4.8	5.6
Asia & Pacific	3,275	3,330	4,855	5,375	3.60	7.9	10.0
China	1,700	1,700	1,720	1,720	0.08	4.1	3.2
India	1,575	1,630	3,135	3,655	6.20	3.8	6.8
Europe	7,263	7,305	8,195	8,365	1.01	17.5	15.6
Greece	600	600	1,300	1,300	5.68	1.4	2.4
Turkey	160	175	200	200	1.61	0.4	0.4
Czechoslovakia	209	209	209	209	0.00	0.5	0.4
Hungary	848	875	900	900	0.43	2.0	1.7
Romania	410	410	400	400	-0.18	1.0	0.7
Yugoslavia	1,036	1,036	1,086	1,086	0.34	2.5	2.0
FSU	4,000	4,000	4,100	4,270	0.47	9.7	8.0
Middle East/North Africa	0	0	0	0	0.00	0.0	0.0
Africa	670	670	730	730	0.61	1.6	1.4
Guinea	670	670	730	730	0.61	1.6	1.4
World Total	41,434	43,485	48,535	53,685	1.87	100.0	100.0

Source: World Bank, International Economics Department; based on information provided by industry sources, in particular, Anthony Bird Associates and James F. King.

to 53.7 million tons in the year 2005. The share of the high-income countries will decrease from 52% in 1991 to 46% in 2005. LMICs are expected to increase their share from 48% to 54%.

Alumina refinery growth in Latin America, India, Greece, Australia. The bulk of the increase in alumina refinery capacity is expected to occur in bauxite-producing countries in Latin America, with projects located in Brazil, Jamaica, and Venezuela. Latin America's alumina capacity is expected to increase on average by 3.7% p.a. over the projection period. During this period, Asia's capacity is expected to increase by 3.6% p.a. due to some major investments in India. Greece is the only other LMIC that is expected to experience a significant increase in alumina capacity in the period. Among the high-income countries, Australia is expected to increase its alumina capacity significantly.

Significant LMIC bauxite capacity increases. Table 5 shows our forecasts of bauxite producing capacity by countries and regions. Worldwide, capacity is expected to increase from 113 million tons in 1991 to 145 million tons in 2005--about 1.9% p.a. The share of LMICs will remain at the same level in 2005 as in 1991, around 64%. Among the high-income countries, significant increases in bauxite capacity are expected to take place only in Australia. Significant bauxite capacity increases are expected to materialize in a number of LMICs, however: China and India in Asia; Guinea in Africa; several countries in Europe, including possibly Greece, Turkey, Hungary, Yugoslavia, and the FSU; and several Latin American/Caribbean countries such as Brazil, Guyana, Jamaica, Suriname, and Venezuela.

Aluminum's real costs decreased as components "indexed." Aluminum production costs have been increasing in current US dollar terms, as can be seen from Table 6. The average total cost is estimated to have increased by 14% from 1984 to 1991--or an average annual increase of 1.9%, far lower than the average rate of inflation in the G-5 countries of about 6% p.a. over the same period (refer to the MUV index shown in Table 6). Thus, the cost of production of aluminum decreased substantially in real terms in this period. One important reason for this decrease was the fact that electricity prices hardly increased in current dollar terms over this period as most aluminum producers benefitted from discounted electricity prices.

Another reason for the fall in the real cost of producing aluminum was that the price of alumina, another important cost component for aluminum, increased only moderately--again by far less than the inflation represented by the MUV index. In fact, it is increasingly prevalent to "index" the alumina and electricity prices to be paid by aluminum producers to the price of aluminum. The LME price of aluminum rose by only 4% in current dollar terms over the period 1984-91. Furthermore, in some cases, even wages, or labor compensation, were "conceded" by labor unions at the time of depressed aluminum prices. Because of this indexing feature of aluminum cost components, when aluminum prices decline, costs of producing aluminum also decline. This indexing of cost components could be said to be at least partly responsible for the unexpectedly modest scale of production cutbacks implemented during 1991 when the aluminum market suffered a significant oversupply problem, with the LME stocks steadily mounting to record levels.

Trade Outlook

Exports of bauxite worldwide are expected to increase at only 0.2% p.a. from 1991 to 2005, compared with the average rate of 0.5% p.a. in the 1970-90 period (see Table A2). This rate of increase is far less than that for production of bauxite, indicating that the trend for bauxite to be transformed to alumina in bauxite-producing countries will continue. In Latin America and the

Table 5: Bauxite Producing Capacity, 1991-2005

	Actual	Projected			Growth Rate	Share in World	
	1991	1995	2000	2005	1990-2005	1991	2005
		('000 tpy)			(% p.a.)	(%)	
High Income	41,105	43,100	47,100	52,100	1.71	36.5	35.8
OECD	41,105	43,100	47,100	52,100	1.71	36.5	35.8
OECD Europe	5	0	0	0	-	0.0	0.0
United States	100	100	100	100	0.00	0.1	0.1
Australia	41,000	43,000	47,000	52,000	1.71	36.4	35.8
Non-OECD High-Income	0	0	0	0	0.00	0.0	0.0
LMICs	71,400	74,395	82,204	93,304	1.93	63.5	64.2
Americas	29,030	29,520	32,900	37,700	1.88	25.8	25.9
Brazil	10,500	10,800	11,700	13,000	1.54	9.3	8.9
Guyana	2,200	2,000	2,300	2,500	0.92	2.0	1.7
Jamaica	11,610	12,000	13,300	15,000	1.85	10.3	10.3
Suriname	3,200	3,200	3,600	4,200	1.96	2.8	2.9
Other America	1,520	1,520	2,000	3,000	4.98	1.4	2.1
Asia & Pacific	10,790	10,900	11,600	13,400	1.56	9.6	9.2
China	4,200	4,300	4,700	5,100	1.40	3.7	3.5
India	4,810	4,800	4,800	6,000	1.59	4.3	4.1
Indonesia	1,400	1,400	1,700	1,900	2.21	1.2	1.3
Other Asia & Pacific	380	400	400	400	0.37	0.3	0.3
Europe	12,855	14,900	17,904	20,904	3.53	11.4	14.4
Greece	2,225	2,550	4,100	5,000	5.95	2.0	3.4
Turkey	480	700	800	1,000	5.38	0.4	0.7
Hungary	2,050	2,450	2,800	3,000	2.76	1.8	2.1
Romania	200	200	204	204	0.14	0.2	0.1
Yugoslavia	2,550	3,000	3,000	3,100	1.40	2.3	2.1
FSU	5,350	6,000	7,000	8,600	3.45	4.8	5.9
Middle East/North Africa	0	0	0	0	0.00	0.0	0.0
Africa	18,725	19,075	19,800	21,300	0.92	16.6	14.6
Ghana	325	325	400	400	1.49	0.3	0.3
Guinea	17,100	17,400	17,900	19,200	0.83	15.2	13.2
Other Africa	1,300	1,350	1,500	1,700	1.93	1.2	1.2
World Total	112,505	11,7495	129,304	145,404	1.85	100.0	100.0

Sources: The World Bank, International Economics Department; based on information available from industry sources, in particular, James F. King.

Table 6: Estimated Aluminum Production Costs, 1982-91 a/

Year	Average Marginal Cost	Average Total Cost	Average Electricity Price	Average Alumina Price b/	LME Aluminum Price	MUV Index
	($/ton)		(mills/KWh)	($/ton)		1990=100
1982	1,279	N.A.	20.3	206	991	71.1
1983	1,257	N.A.	20.0	212	1,440	69.5
1984	1,140	1,400	18.2	204	1,251	68.1
1985	1,052	1,390	16.2	180	1,041	68.6
1986	1,010	1,365	16.8	158	1,150	80.9
1987	1,043	1,395	18.4	156	1,565	88.8
1988	1,166	1,533	20.7	198	2,551	95.3
1989	1,336	1,680	20.5	258	1,951	94.7
1990	1,404	1,705	20.8	273	1,639	100.0
1991	1,254	1,598	18.6	228	1,302	102.1

a/ All costs and prices in this table are measured in current US dollars.
b/ C.i.f. import price.

Sources: Anthony Bird Associates, Aluminum Annual Review 1992, March 1992; World Bank, International Economics Department.

Caribbean, where significant increases in bauxite production are expected, bauxite exports are expected to decrease.

Big increase in LMICs' share of alumina exports. Exports of alumina are expected to increase worldwide at an annual rate of 1.9%. This is comparable to the 1.8% p.a. increase projected for alumina production, indicating that a marginally rising share of alumina will be exported without being transformed into aluminum in the country of origin. The Latin America and the Caribbean region is representative of the pattern of an increasing portion of alumina produced being exported in the form of alumina. The share of LMICs in world exports of alumina should increase from 31% in 1991 to 44% by 2005. The high-income countries should remain the major importers of alumina, with Canada and the United States being the major importers, and Australia should continue to be the leading exporter (see Tables A5 and A6).

Faster aluminum trade growth expected. Exports of aluminum, in contrast, are expected to expand worldwide at an annual rate of 3.9%, which is faster than the expected growth of aluminum production. The shares of some LMICs (e.g., Bahrain and Venezuela) should rise as their production increases. Canada's exports are expected to increase at an average annual rate of 3%. The share of LMICs will grow at over 4% p.a., with exports from Latin America and the Caribbean growing at an average annual rate of about 5.7%. Since Japan does not plan to increase its production, it is expected to remain the largest importer of aluminum, with imports growing at an annual rate of about 2.4% (see Tables A9 and A10).

Price Outlook

Like most primary commodities, aluminum prices have been highly volatile in recent years. Since the London Metal Exchange (LME) price was established in 1979, it has fluctuated significantly. Statistical tests carried out at the World Bank support the notion of the aluminum market being "efficient."[1] The volatility of the price is seen to be due mostly to fluctuations in industrial production, as well as to changes in aluminum production capacity. In addition, the "indexing" of some cost components in aluminum production may have contributed to the price volatility, as discussed above.

Stocks rise with recession and increased FSU sales. Aluminum prices peaked in 1988, when the LME price averaged US$2,551/ton. But with the slowdown of industrial production growth, particularly in the US economy, prices declined in the 1989-91 period until the LME price reached a low monthly average of less than US$1,100/ton in December 1991. LME stocks of aluminum, which were as low as 57,000 tons at the end of 1989, rose steadily in 1990 and 1991 and in the first half of 1992, reaching a recent peak of over 1.3 million tons in April 1992. In addition to the worldwide recessionary tendency, one important factor fueling this surplus has been the rising sales of aluminum by the FSU. Hard-pressed for hard currency revenues and with the collapse of domestic consumption due to the industrial confusion associated with radical political changes, the FSU increased aluminum exports to western markets, selling out of stocks and increasingly out of current production.

Price outlook remains weak for aluminum and bauxite. Aluminum prices are expected to increase in the 1992-95 period as the size of the market surplus is reduced and a balance between demand and supply is restored; the LME price is likely to rise from US$1,302/ton in 1991 to US$1,850/ton in 1995 in current dollar terms. After peaking around that level in 1995, aluminum prices are expected to enter the declining phase of another price cycle. The recent decline in aluminum prices has discouraged investments in smelter capacity. Many previously announced projects have been delayed. It is clear from Table 6 that the total costs were higher than LME prices in 1990 and 1991, and thus, any new smelter will be unable to cover full costs. The expected pick-up in aluminum prices should encourage some of the low-cost smelting projects to go ahead. Price increases, however, are likely to be only modest, given adequate stocks and the short-term supply response. As capacity expansions come on-stream, prices are expected to remain relatively weak (by historical standards) in real terms through 1995.

For the longer term, the trend in prices is primarily determined by estimated production costs. Thus, our projections for aluminum prices for the 2000-2005 period are set at slightly above expected average total costs. We expect the average total cost of producing aluminum to decline gradually over the projection period, from US$1,565/ton in 1991 (in 1990 dollars) to US$1,400/ton by 2005--a declining trend of 0.7% p.a. Thus, we expect the price of aluminum (in 1990 constant dollars) to be at about US$1,465/ton in the year 2000 and US$1,435/ton in the year 2005.

Unlike aluminum, bauxite is not traded on exchanges such as the LME or COMEX. Bauxite prices vary widely depending on the sources of supply, as quality and transport convenience differ from producer to producer. Spot prices also differ substantially from contract prices. It is estimated that roughly 75% of internationally-traded bauxite is priced on a contract basis, with the rest transacted

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[1] See L. Hobeika, "On the Efficiency of the Aluminum Market," presented at the Metal Bulletin 6th International Aluminum Conference in Singapore, Nov. 11-13, 1990.

on a spot basis. Naturally, contract prices tend to be more stable than spot prices. For the purpose of this report, the US import price is used as the indicator price for bauxite (see Table A12).

The price for a ton of bauxite in current dollar terms is expected to increase from US$34/ton in 1991 to $41/ton by 2000 and to $47/ton by 2005. These prices imply a slight increase in real terms to the year 2000, and then a slight decline to the year 2005, in line with the forecast for aluminum prices. Bauxite-exporting countries, such as Jamaica, Guyana, and Guinea, depend heavily on bauxite exports for their foreign exchange earnings. These countries cannot easily decrease their production whenever there is a slowdown in the major industrial economies. As long as the price of bauxite remains above their own estimated costs, they will continue to produce it. Bauxite prices, therefore, are likely to average at close to their recent low levels in real terms over the forecast period.

Table A1: Bauxite - Production By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	15,203	30,291	42,376	41,052	41,055	42,055	42,055	43,055	47,105	52,105	8.4	3.9	1.7
OECD	15,203	30,291	42,376	41,052	41,055	42,055	42,055	43,055	47,105	52,105	8.4	3.9	1.7
France	3,010	1,897	490	0	0	0	0	0	0	0	-3.8	-7.1	0.0
Australia	9,970	26,734	41,391	41,000	41,000	42,000	42,000	43,000	47,000	52,000	20.6	5.7	1.7
LMICs	44,818	59,750	71,149	71,272	69,375	70,725	72,875	74,125	81,504	91,204	3.2	1.6	1.8
Africa	3,344	14,245	19,357	18,674	18,225	18,625	19,075	19,075	19,800	21,300	10.2	8.5	0.9
Guinea	2,526	13,371	17,524	17,054	16,700	17,000	17,300	17,400	17,900	19,200	11.0	9.6	0.9
Americas	24,703	23,706	26,360	28,969	28,000	28,600	28,600	29,520	32,900	37,700	0.9	-1.1	1.9
Jamaica	11,684	11,696	10,937	11,609	11,600	11,700	11,700	12,000	13,300	15,000	0.0	-2.9	1.8
Suriname	6,325	4,590	3,267	3,136	3,100	3,200	3,300	3,300	3,300	3,300	-1.4	-4.3	0.4
Guyana	4,319	2,934	1,424	2,204	2,000	2,000	2,000	2,000	2,300	2,500	-2.1	-5.1	0.9
Brazil	476	3,486	9,876	10,500	10,000	10,500	10,600	10,800	11,700	13,000	17.6	17.2	1.5
Venezuela	0	0	771	1,514	1,300	1,200	1,500	1,520	2,000	3,000	-	-	5.0
Asia & Pacific	4,021	5,391	11,084	10,794	10,770	10,800	10,850	10,900	11,600	13,400	5.1	4.6	1.6
India	1,326	1,887	5,277	4,811	4,800	4,800	4,800	4,800	4,800	6,000	6.8	6.0	1.6
Indonesia	1,131	1,168	1,206	1,406	1,400	1,400	1,400	1,400	1,700	1,900	1.0	-2.8	2.2
Europe	12,750	16,408	14,348	12,835	12,380	12,700	14,350	14,900	17,904	20,904	2.4	0.4	3.5
Yugoslavia	2,062	3,133	2,952	2,542	2,500	2,500	3,000	3,000	3,000	3,100	3.5	3.0	1.4
Greece	2,367	3,014	2,504	2,224	2,200	2,400	2,500	2,550	4,100	5,000	2.7	-0.4	6.0
World	60,021	90,041	113,525	112,324	110,430	112,400	114,900	117,500	129,300	145,400	4.5	2.3	1.9

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: Metallgesellschaft, Metal Statistics, UNCTAD (actual);
World Bank, International Economics Department (projected).

Table A2: Bauxite - Gross Exports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	3,904	6,735	5,344	5,459	5,270	6,175	6,100	5,900	9,900	12,100	7.9	-0.9	5.9
OECD	3,904	6,735	5,344	5,459	5,300	6,175	6,100	5,900	9,900	12,100	7.9	-0.9	5.9
Australia	3,705	6,540	5,200	5,300	5,200	6,050	6,000	5,750	9,550	11,600	14.4	-1.1	5.8
LMICs	23,565	29,036	30,082	31,642	28,300	27,250	27,600	28,160	25,750	25,270	1.8	0.8	-1.6
Africa	1,595	11,293	16,048	16,767	16,438	15,420	15,830	15,830	15,850	16,400	15.9	11.8	-0.2
Guinea	777	10,459	14,300	15,486	15,090	15,100	15,510	15,510	15,500	16,000	23.0	15.8	0.2
Americas	16,095	12,787	10,907	11,710	9,800	8,525	8,250	9,000	7,000	4,050	-1.6	-3.0	-7.3
Jamaica	7,722	5,987	4,169	4,170	3,000	2,000	1,500	1,500	1,400	600	-2.5	-4.7	-12.9
Suriname	3,565	1,707	0	0	0	0	0	0	0	0			
Guyana	2,810	1,559	1,254	2,200	2,000	2,000	2,000	2,000	2,300	2,500	-1.7	-4.3	0.9
Asia & Pacific	2,057	2,113	3,300	3,050	2,450	2,400	2,400	2,300	2,100	2,300	0.1	-2.2	-2.0
Indonesia	988	1,053	1,240	1,400	1,400	1,400	1,400	1,400	1,400	1,400	0.3	-3.4	0.0
Europe	3,819	2,844	1,500	700	700	870	1,280	1,300	1,200	2,900	-2.0	-4.5	10.7
World	27,469	35,771	35,426	36,530	33,600	33,450	33,700	34,100	35,700	37,400	2.4	0.5	0.2

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: Metallgesellschaft, Metal Statistics, UNCTAD (actual);
World Bank, International Economics Department (projected).

Table A3: Bauxite - Gross Imports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	24,880	30,961	28,989	29,600	24,525	24,600	24,800	25,000	25,000	25,000	1.5	-0.7	-1.2
OECD	24,758	30,756	28,953	29,600	24,010	24,010	24,200	24,200	24,150	24,150	1.5	-0.7	-1.4
United States	13,584	14,043	13,816	14,150	13,350	13,350	13,430	13,430	13,380	13,380	-0.3	-2.0	-0.4
Canada	2,416	2,785	2,311	2,910	2,680	2,700	2,720	2,730	2,720	2,720	1.2	-0.4	-0.5
Germany	2,754	4,034	3,077	3,200	1,715	1,730	1,700	1,720	1,700	1,700	2.4	-0.5	-4.4
France	491	1,689	1,389	1,620	830	830	830	830	830	830	9.5	2.6	-4.7
Italy	621	2,095	1,681	2,015	1,875	1,900	1,915	1,940	1,930	1,930	6.3	2.6	-0.3
Japan	3,817	4,886	2,302	2,385	480	500	480	480	480	480	2.1	-4.3	-10.8
LMICs	2,447	4,588	8,763	8,000	9,000	9,050	9,100	9,330	11,000	12,750	9.3	7.6	3.4
Europe	2,373	4,391	6,232	6,000	5,970	6,115	5,650	6,355	6,430	6,200	7.8	4.9	0.2
World	27,327	35,549	37,752	37,410	33,500	33,575	33,900	34,125	35,735	37,500	2.6	0.7	0.0

a/ Least squares trend for historical periods (1961-90); end-point for projected Periods (1991-2005).
b/ Estimate.

Sources: Metallgesellschaft, Metal Statistics, UNCTAD (actual);
World Bank, International Economics Department (projected).

Table A4: Alumina - Production By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates/a		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	13,070	21,007	23,248	23,720	21,620	21,730	22,561	22,591	23,440	24,640	NA	2.3	0.3
OECD	13,028	20,954	23,248	23,720	21,420	21,530	22,315	22,345	23,195	24,395	NA	2.3	0.2
United States	6,089	6,623	5,430	5,430	5,000	5,000	5,030	5,030	5,030	5,030	NA	-1.8	-0.5
Canada	1,083	1,078	1,087	1,087	1,000	1,000	1,015	1,015	1,015	1,015	NA	-0.2	-0.5
Japan	1,317	1,886	890	890	180	180	180	180	180	180	NA	-3.7	-10.8
Australia	2,265	7,247	11,231	11,703	11,590	11,700	12,420	12,450	13,300	14,500	NA	7.2	1.5
LMICs	8,222	12,954	18,382	18,205	19,060	19,810	20,568	20,869	25,100	29,050	NA	3.8	3.4
Americas	3,138	4,409	7,458	7,781	8,600	9,300	9,590	9,590	11,300	14,580	NA	3.0	4.6
Jamaica	1,625	2,340	2,869	3,000	3,300	3,800	3,925	3,925	4,500	5,450	NA	-0.6	4.4
Suriname	1,091	1,333	1,531	1,531	1,550	1,550	1,600	1,600	1,600	1,600	NA	1.1	0.3
Brazil	124	487	1,653	1,700	1,850	2,050	2,065	2,065	3,200	4,530	NA	13.8	7.3
Europe	3,872	6,468	7,305	6,805	6,610	6,660	7,003	7,304	8,195	8,365	NA	3.6	1.5
World	21,291	33,961	41,630	41,925	40,680	41,540	43,129	43,460	48,540	53,690	NA	2.9	1.8

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: Metallgesellschaft, Metal Statistics, UNCTAD (actual);
World Bank, International Economics Department (projected).

Table A5: Alumina (Metal Contents) - Gross Exports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates/a		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	1,784	4,555	6,757	7,138	6,848	6,893	7,175	7,191	7,028	7,482	11.9	5.6	0.3
OECD	1,784	4,555	6,757	7,138	6,848	6,893	7,176	7,191	7,028	7,482	11.9	5.6	0.3
United States	533	403	550	400	300	300	200	200	0	0	4.0	-1.4	-60.2
Australia	902	3,352	4,150	4,679	6,024	6,069	6,348	6,369	6,496	6,951		6.7	2.9
LMICs	2,041	3,000	2,980	3,200	3,495	3,633	3,796	3,843	4,770	5,887	4.8	1.0	4.5
Africa	304	342	300	303	315	315	365	365	426	426	0.7	-0.4	2.5
Guinea	304	342	300	303	315	315	365	365	426	426	0.7	-0.4	2.5
Americas	1,431	1,903	1,840	1,971	2,229	2,430	2,550	2,597	2,895	3,943	4.8	0.3	5.1
Jamaica	790	1,173	800	1,050	1,155	1,330	1,374	1,374	1,575	1,907	3.5	-1.3	4.4
Suriname	485	642	800	811	822	822	848	848	848	848		2.0	0.3
Europe	303	718	775	880	863	800	784	785	1,125	1,182	8.9	3.9	2.1
World	3,824	7,556	9,737	10,337	10,343	10,526	10,971	11,034	11,797	13,369	8.2	3.7	1.9

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: Metallgesellschaft, Metal Statistics, UNCTAD (actual);
World Bank, International Economics Department (projected).

Table A6: Alumina (Metal Contents) - Gross Imports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates/a		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	3,047	5,490	6,238	6,718	7,353	7,722	7,870	8,161	8,640	9,738	7.0	2.8	2.7
OECD	3,040	5,411	5,998	6,346	7,194	7,571	7,769	8,066	8,555	9,282	6.8	2.6	2.8
United States	1,111	2,059	2,050	2,182	2,412	2,412	2,394	2,394	2,394	2,394	11.0	2.3	0.7
Canada	472	495	1,000	1,256	1,330	1,462	1,550	1,739	2,061	2,165	3.8	5.2	4.0
Japan	178	359	30	30	30	30	30	30	30	30	7.2	-13.6	0.0
LMICs	717	1,880	2,015	2,518	2,413	2,248	2,610	2,716	3,380	3,962	11.7	5.2	3.3
Africa	164	320	405	419	418	418	418	424	697	927	8.4	3.8	5.8
Americas	62	466	312	808	702	546	575	575	640	640	16.5	10.6	-1.7
Europe	463	768	454	642	583	506	502	476	432	483	9.0	0.1	-2.0
World	3,765	7,370	8,254	9,236	9,767	9,970	10,480	10,877	12,020	13,701	7.8	3.4	2.9

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: Metallgesellschaft, Metal Statistics, UNCTAD (actual);
World Bank, International Economics Department (projected).

Table A7: Primary Aluminum - Production By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	7,493	10,572	10,747	11,036	10,827	11,132	11,449	11,677	12,452	13,382	3.4	1.0	1.4
OECD	7,468	10,475	10,573	10,797	10,587	10,892	11,209	11,437	12,212	12,962	3.3	1.0	1.3
United States	3,536	4,566	4,048	4,121	4,100	4,100	4,100	4,100	4,100	4,100	2.0	-0.3	0.0
Canada	981	1,019	1,567	1,822	1,860	2,000	2,100	2,300	2,640	2,750	2.8	3.1	3.0
Germany	390	754	720	710	710	710	720	720	720	720	4.9	2.0	0.1
France	379	421	326	286	240	380	420	440	440	440	0.2	-1.1	3.1
Australia	185	318	1,233	1,229	1,230	1,250	1,390	1,390	1,600	1,800	13.4	11.1	2.8
LMICs	2,781	5,080	7,290	7,428	7,351	7,384	7,881	8,078	9,521	10,890	6.6	4.8	2.8
Africa	172	319	422	432	431	431	433	438	663	853	7.9	3.6	5.0
Americas	169	758	1,789	1,998	2,048	2,078	2,130	2,130	2,786	3,450	16.7	13.7	4.0
Brazil	60	252	931	1,140	1,160	1,180	1,200	1,200	1,200	1,200	15.7	15.2	0.4
Venezuela	19	282	594	610	640	650	670	670	1,200	1,450		21.0	6.4
Asia & Pacific	308	583	1,499	1,545	1,545	1,552	1,578	1,603	1,893	2,303	9.4	8.5	2.9
China, People's Rep.	137	353	850	850	850	850	850	850	950	1,050	9.3	9.5	1.5
India	157	203	433	504	504	504	510	510	700	900	7.6	4.6	4.2
Europe	2,129	3,154	3,130	2,997	2,867	2,867	3,090	3,207	3,299	3,379	4.2	1.8	0.9
Middle East & North Africa	3	265	451	456	460	456	650	700	880	905	NA	NA	5.0
Bahrain	3	131	212	208	208	208	400	450	450	450	NA	NA	5.7
World	10,274	15,652	18,037	18,464	18,178	18,516	19,330	19,755	21,973	24,272	4.4	2.3	2.0

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: Metallgesellschaft, Metal Statistics & World Bureau of Metal Statistics (actual);
World Bank, International Economics Department (projected).

Table A8: Primary Aluminum - Apparent Consumption By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	7,735	10,696	12,269	12,384	12,528	12,904	13,303	13,081	14,438	15,635	3.8	1.7	1.7
OECD	7,679	10,549	11,994	11,984	12,109	12,464	12,833	12,601	13,813	14,845	3.7	1.6	1.5
United States	3,707	4,561	4,325	4,236	4,280	4,350	4,450	4,400	4,600	4,731	2.3	0.3	0.8
Germany	976	1,344	1,379	1,423	1,432	1,465	1,500	1,435	1,535	1,620	4.0	1.7	0.9
France	386	579	721	708	710	752	785	765	829	888	4.1	2.8	1.6
Japan	897	1,671	2,414	2,443	2,470	2,570	2,665	2,650	3,090	3,496	8.4	3.4	2.6
LMICs	2,530	4,620	5,651	5,431	5,510	5,777	6,149	6,293	7,535	8,637	6.0	3.8	3.4
Americas	200	544	733	708	711	782	858	839	1,030	1,196	9.3	6.4	3.8
Asia & Pacific	416	1,025	1,842	1,884	1,930	2,042	2,195	2,256	2,795	3,390	9.8	6.9	4.3
Europe	1,829	2,824	2,638	2,436	2,455	2,522	2,644	2,729	3,157	3,414	4.1	1.9	2.4
Middle East & North Africa	22	118	316	262	264	278	297	311	382	451		13.9	4.0
World	10,265	15,316	17,998	17,815	18,038	18,681	19,453	19,374	21,973	24,272	4.4	2.3	2.2

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: Metallgesellschaft, Metal Statistics & World Bureau of Metal Statistics (actual);
World Bank, International Economics Department (projected).

Table A9: Primary Aluminum - Gross Exports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	1,998	3,177	5,579	5,924	5,930	6,534	7,118	7,171	8,501	9,853	4.8	5.3	3.7
OECD	1,998	3,145	5,406	5,808	5,820	6,414	6,988	7,021	8,301	9,553	4.6	5.0	3.6
Canada	791	687	1,253	1,470	1,515	1,638	1,735	1,921	2,202	2,212	2.3	3.3	3.0
United States	261	381	798	902	900	900	950	950	1,000	1,000	2.9	6.9	0.7
Netherlands	72	359	362	332	330	325	325	325	370	400	13.7	5.1	1.3
France	154	175	135	128	130	140	150	145	170	200	-0.9	-1.4	3.2
Germany	62	250	314	290	280	290	310	290	350	400	8.3	7.2	2.3
Australia	62	82	910	951	920	970	1,100	1,130	1,350	1,500		16.3	3.3
LMICs	802	1,458	2,951	3,200	3,300	3,275	3,658	3,493	4,920	5,660	9.2	6.3	4.2
Africa	149	195	290	306	310	340	375	335	590	715	6.1	3.5	6.2
Ghana	111	151	150	166	165	165	165	165	165	165		-0.6	0.0
Americas	54	296	1,092	1,150	1,337	1,300	1,270	1,270	2,100	2,500		19.6	5.7
Europe	587	806	1,127	1,103	993	1,010	1,240	1,180	1,280	1,390	6.3	2.3	1.7
World	2,800	4,636	8,530	9,124	9,230	9,810	10,775	10,665	13,420	15,510	5.8	5.6	3.9

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: Metallgesellschaft, Metal Statistics, UNCTAD (actual);
World Bank, International Economics Department (projected).

Table A10: Primary Aluminum - Gross Imports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	2,343	3,725	7,446	7,631	7,895	8,343	9,230	8,985	11,265	12,975	6.8	6.2	3.9
OECD	2,312	3,611	7,099	7,205	7,510	7,915	8,745	8,470	10,435	12,180	6.6	6.0	3.8
United States	417	563	976	1,039	1,195	1,550	2,135	1,920	3,200	4,040	4.5	5.5	10.2
Germany	498	582	899	1,007	953	960	975	930	1,060	1,170	5.6	3.3	1.1
France	164	316	541	552	565	445	440	390	465	540	8.4	5.4	-0.2
Netherlands	45	182	190	183	170	180	180	190	190	190	10.9	6.3	0.3
Japan	266	929	2,652	2,830	2,790	2,845	2,975	2,990	3,495	3,960	18.7	12.8	2.4
LMICs	380	896	1,286	1,318	1,335	1,465	1,555	1,685	2,150	2,540	9.1	6.1	4.8
Asia & Pacific	65	322	601	708	735	775	830	880	1,175	1,395	14.4	12.7	5.0
Europe	224	455	608	536	525	605	645	705	975	1,150	10.9	4.9	5.6
World	2,723	4,621	8,732	8,950	9,230	9,810	10,785	10,670	13,410	15,515	7.1	6.2	4.0

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: Metallgesellschaft, Metal Statistics & World Bureau of Metal Statistics (actual);
World Bank, International Economics Department (projected).

Table A11: Primary Aluminum - Prices, 1958-91 (Actual) and 1992-2005 (Projected)

	($/ton)					
			1990 Constant $			
	Current $		G-5 MUV a/		G-7 CPI b/	
	LME c/	Other European Transactions d/	LME c/	Other European Transactions d/	LME c/	Other European Transactions d/
Actual						
1958		490		2,383		3,129
1959		486		2,397		3,109
1960		500		2,416		3,139
1961		470		2,233		2,883
1962		435		2,026		2,595
1963		444		2,108		2,566
1964		493		2,300		2,777
1965		489		2,265		2,669
1966		479		2,144		2,529
1967		484		2,141		2,491
1968		457		2,041		2,288
1969		581		2,462		2,788
1970		540		2,153		2,442
1971		435		1,646		1,843
1972		432		1,500		1,659
1973		663		1,987		2,228
1974		944		2,322		2,864
1975		690		1,526		1,863
1976		862		1,881		2,253
1977		991		1,969		2,343
1978		1,045		1,804		2,017
1979	1,603	1,520	2,442	2,316	2,923	2,772
1980	1,775	1,730	2,466	2,404	2,894	2,821
1981	1,263	1,336	1,748	1,849	2,043	2,161
1982	992	1,061	1,394	1,491	1,625	1,738
1983	1,439	1,495	2,069	2,150	2,320	2,411
1984	1,251	1,371	1,839	2,015	2,023	2,217
1985	1,041	1,112	1,517	1,621	1,649	1,762
1986	1,150	1,261	1,422	1,559	1,510	1,656
1987	1,565	1,608	1,762	1,810	1,820	1,870
1988	2,551	2,545	2,677	2,670	2,755	2,748
1989	1,951	2,040	2,062	2,155	2,117	2,213
1990	1,639	1,721	1,639	1,721	1,639	1,721
1991	1,302	1,390	1,275	1,361	1,239	1,322
Projected						
1992	1,260		1,183		1,129	
1993	1,450		1,312		1,254	
1994	1,650		1,466		1,394	
1995	1,850		1,600		1,519	
2000	2,011		1,465		1,370	
2005	2,261		1,435		1,288	

a/ Deflated by G-5 Manufacturing Unit Value (MUV) Index.

b/ Deflated by G-7 Consumer Price Index (CPI).

c/ London Metal Exchange (LME), unalloyed primary ingots, average bid/asked, as published by the Metals Week. Until November 1988, standard grade, minimum 99.5% al; thereafter, high grade, minimum 99.7% al, cash price.

d/ Certain other transactions, US shipments to Europe, Minimum 99.5%, in-warehouse, EC duty paid, c.i.f. Europe. This quotation has been published regularly by the Metal Bulletin since December 1975.

Sources: Metallgesellschaft AG, Metal Statistics, Metal Bulletin & Metals Week (actual); World Bank, International Economics Department (projected).

Table A12: Bauxite - Prices, a/ 1975-1991 (Actual) and 1992-2005 (Projected)

	($/ton)		
	Current $	1990 Constant $	
		G-5 MUV b/	G-7 CPI c/
Actual			
1975	22	49	60
1976	25	55	66
1977	30	60	72
1978	31	54	60
1979	31	47	56
1980	32	44	52
1981	35	48	57
1982	40	57	66
1983	37	54	60
1984	37	54	60
1985	36	52	57
1986	34	42	44
1987	30	33	34
1988	30	32	33
1989	34	36	37
1990	34	34	34
1991	34	33	32
Projected			
1992	32	30	29
1993	33	30	29
1994	34	30	29
1995	36	31	30
2000	41	30	28
2005	47	30	27

a/ US import price, c.i.f. US ports.
b/ Deflated by G-5 Manufacturing Unit Value (MUV) Index.
c/ Deflated by G-7 Consumer Price Index (CPI).

Sources: US Bureau of Mines, Minerals Yearbook: Bauxite and Alumina, various issues (actual); World Bank, International Economics Department (projected).

Iron Ore

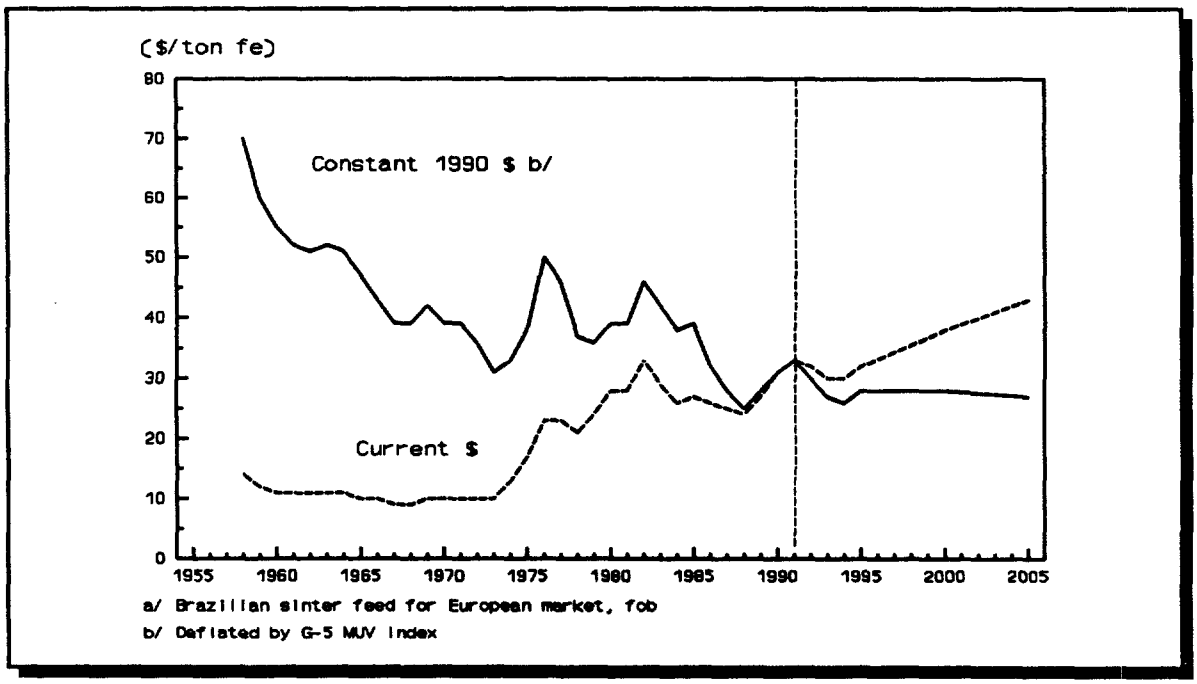
Summary

- World iron ore consumption fell 1.6% in 1990 and 4.5% in 1991. Further declines are expected in the short term and recovery to the 1989 level in not likely to occur until mid-1990s. The outlook for world iron ore consumption follows the forecasts for world steel production very closely. The projected long-term growth rate for world iron ore consumption over the 1991-2005 period is 1.3% p.a., in line with the expected rate of growth of 1.4% p.a. for world steel production.

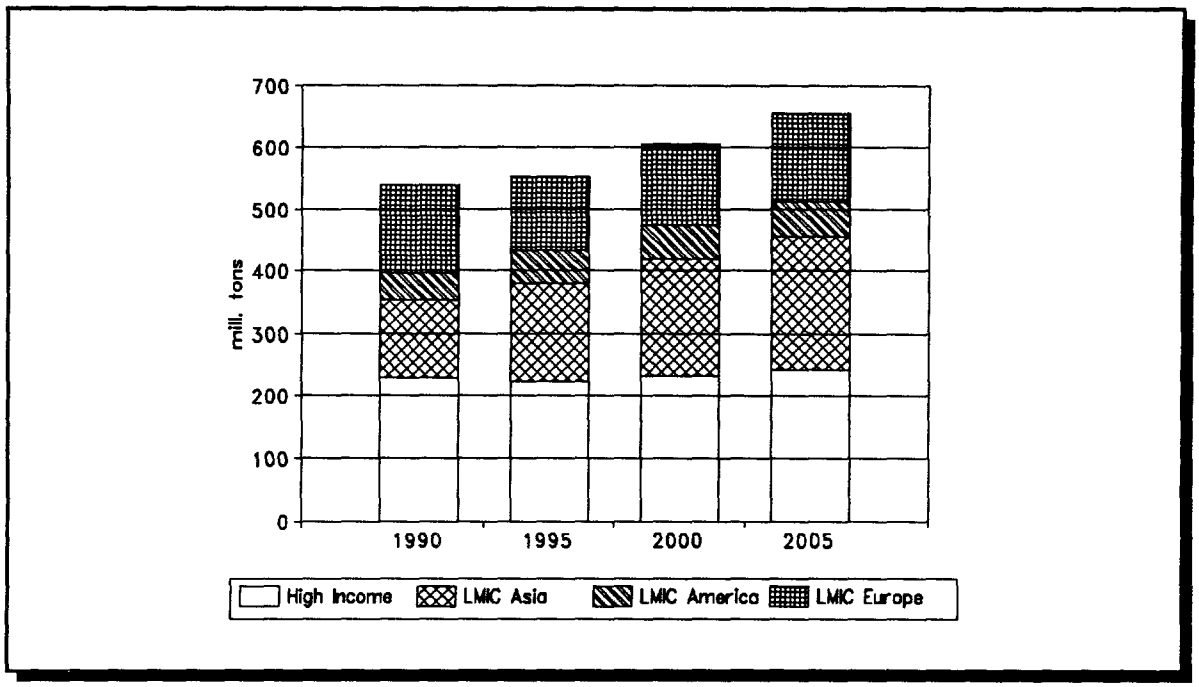
- About 30 million tpy of additional iron ore production capacity is expected to come on-line around the mid-1990s, mainly from upgrading existing operations in traditional iron ore-producing countries. World iron ore production is expected to decline further in 1992 before recovery in mid-1990s. The projected average growth rate is 1.3% over the 1991-2005 period. Australia and Brazil should strengthen their dominant positions in iron ore production.

- The iron ore price is projected to decline in real terms by 1.4% p.a. over the 1991-2005 period. Over the medium term, the expected upturn in the global steel market should lead to an increase of around 5% in the iron ore price in real terms by the 1995-96 period.

Iron Ore Prices a/, 1955-2005



Projected Iron Ore Consumption, by Region



Demand Outlook

Broadly, there are three kinds of iron ore, distinguished by their physical appearance and purity. The most common is called "sinter feed." About 60% of iron ore consumed by the steel industry undergoes a process known as "sintering" prior to smelting. Sintering is normally carried out in steel mills. It is an agglomeration process, which involves roasting of iron ore concentrates (sinter feed or fines) in specially-built machines to produce a self-fluxing sinter. High sinter ratios (up to 70% of blast furnace burden is sinter) are common in the Japanese and European steel mills but not in United States and Canada where pellets, the second type of iron ore, form the main ore burden in blast furnaces. Pelletization is generally undertaken as a part of iron ore mining and treatment activities. The third kind of iron ore is called directly-reduced iron (DRI) or sponge iron. It is used mainly in mini-mills as a substitute for steel scrap. However, the DRI technology has not gained much popularity as yet, currently accounting for no more than 1% of ferrous input. Since DRI is mostly produced through a gas-based direct reduction route, countries with abundant natural gas may have the comparative advantage in its production. Global environmental concerns favor direct smelting technologies that require DRI as the feed. Improvements in DRI technology, such as the production of hot briquetted iron (HBI), have made sponge iron a more stable product, suitable for shipment.

Iron ore demand may be directly derived from crude steel production, but the ratio of iron ore consumption per ton of steel production may vary over time or across regions depending on the use of steel scrap. Table 1 presents estimates of this ratio for the 1980s (iron ore consumption is defined as production plus imports minus exports). High-income countries have a lower ratio than LMICs because they use more steel scrap (mini-mills use 100% steel scrap and in the United States contribute 25% of

Table 1: Ratio of Iron Ore Consumption to Steel Production, by Region, 1980-90

Regions	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
	(%)										
High-Income	64.4	61.1	59.5	51.7	58.1	59.6	59.5	60.1	57.8	60.2	59.8
OECD	64.6	61.3	59.6	51.6	58.1	59.7	59.6	60.1	57.8	60.3	60.0
LMICs	78.4	80.1	77.8	75.1	75.4	77.0	76.8	75.5	76.6	77.9	79.0
Americas	82.9	73.2	87.5	81.0	78.3	83.3	88.1	90.8	96.7	95.8	112.0
Asia	130.0	136.9	114.4	110.9	113.9	114.3	116.2	110.6	106.6	107.2	105.3
Europe	71.5	70.1	71.7	70.1	69.5	70.1	67.2	65.4	67.9	68.5	67.5
World	70.5	69.4	68.4	63.1	66.4	68.0	68.4	68.1	67.3	69.1	69.4

Source: World Bank, International Economics Department.

steel production). In the Asia and Pacific region of the LMIC group, however, the ratio exceeded 100% for all 11 years because of the low availability of steel scrap. About 30% of global steel production comes from scrap.

Slow growth in second half of the 1990s, stronger after 2000. During the 1962-73 period, world steel production grew at 5.4% p.a., while iron ore consumption increased by 5% p.a.. During the 1974-90 period, however, the growth rate of steel production dropped to 0.2% p.a., and ironore consumption growth fell to 0.6% p.a. Due to declines in crude steel output in the high-income countries, and in Eastern Europe and the FSU, world iron ore consumption declined 1.6% in 1990 and 4.5% in 1991. Only the Asia and Pacific region registered positive growth in these two years.

World steel production is projected to grow at 1.4% p.a. over the 1991-2005 period (see the steel chapter). This implies a 1.3% p.a. growth in world iron ore demand. As for steel production, the demand outlook for iron ore is sharply different between high income and LMICs (see Table 2). Since global steel production is not expected to recover fully until the mid-1990s, world iron ore consumption is expected to decline slightly (-0.14% p.a.) over the near term (1990-95).

The outlook for the long-term is somewhat brighter. Steady growth in steel production in the 2000-05 period should translate into solid growth in iron ore consumption in all regions. By then, steel industries in Eastern Europe and the FSU are likely to have emerged from the current transition and to require increasing amounts of steel and iron ore. However, by 2000-05 Latin America is expected to have reached a saturation point in steel production and hence in iron ore consumption with their competitive position in the world steel market deteriorating.

Supply Outlook

Iron ore is an abundant resource. Table 3 shows mine production (in gross weight), reserves, and reserve base estimates for major iron ore-producing countries. At the current level of world iron ore production, the existing economically recoverable iron ore reserves can last for another 100 years. Major iron ore producers (ranked by average production in 1990-91) are: the FSU, Brazil, Australia, China, United States, India, and Canada. Iron ore mined in the FSU, China, and the United States is of low quality (in terms of iron content, at about 30%) and therefore its production is less

Table 2: Projected Growth Rates of Iron Ore Consumption, 1990-2005

	1990-95	1995-2000	2000-2005	1990-2005
	(% p.a.)			
High-Income	-0.57	0.81	0.95	0.40
OECD	-0.61	0.76	0.92	0.36
United States	-2.37	-0.03	-0.04	-0.81
Japan	-0.12	0.99	1.19	0.69
Germany	-0.92	1.35	1.36	0.60
France	-0.15	0.85	0.79	0.50
United Kingdom	-1.75	0.24	0.12	-0.46
Italy	-0.83	1.55	1.56	0.76
LMICs	0.18	2.41	2.16	1.58
Americas	4.18	0.78	0.47	1.81
Asia	4.63	3.37	2.81	3.60
China, People's Republic	3.84	3.00	2.53	3.12
Korea, Republic of	6.81	3.19	2.74	4.25
Europe	-3.53	1.75	1.76	-0.01
World	-0.14	1.75	1.68	1.10

Source: World Bank, International Economics Department.

economically viable than in Australia, South Africa, India, and Brazil which have high-quality ore reserves (around 60% iron content). In terms of mine capacity and reserves, Australia and Brazil are and should continue to be the two dominant producers.

After reaching a record level in 1989, world iron ore production fell 5% in the recent two years. Declines took place mostly in the FSU (-19%) and Liberia (-250%), in both cases because of abnormal situations (economic transition in the FSU and civil war in Liberia). Australia registered a robust growth of 6% in the two years, while Brazil's production remained flat. Other countries more or less managed to maintain their productions levels.

Capacity expansions in near term. Owing to relatively favorable iron ore prices during the 1989-91 period, major iron ore producers have undergone significant capacity expansions. Most of them are in export-oriented mines in Australia and West Africa. Table 4 lists the expected iron ore capacity expansions for the near term (1991-95)--West Africa has four major projects at various stages of development, and about 30 million tpy of capacity is expected be brought on-stream; Brazil's CVRD is spending $130-150 million dollars to increase the capacity of the Carajas mine (in Northern Brazil) by 15 million tpy; Venezuela's CVG Ferrominera is concentrating on increasing its DRI production capacity in response to strong domestic and export demand; Australia is the most active country in terms of mine capacity expansion, focusing on both increasing the productivity of existing mines and expanding capacities within existing operations (no significant greenfield projects have been announced); LKAB of Sweden is expected to implement a $600 million capital expenditure program to renovate the Kiruna mine and expand pelletizing capacity; India has decided to go ahead with its third major iron ore mine in order to supply the DRI plant in Andhra Pradesh; and Iran and Pakistan have plans to exploit new iron ore mines in the 1990s.

Table 3: World Mine Production, Reserves, and Reserve Base, by Major Producers, 1990 and 1991

	Mine Production		Crude Ore		Iron Content	
			Reserves a/	Reserve Base b/	Reserves	Reserve Base
	1990	1991	1991	1991	1991	1991
	(million tons)					
United States	56.4	53.7	16,100	25,200	3,800	6,000
Australia	112.0	115.0	16,000	28,100	10,200	17,900
Brazil	154.4	155.0	11,100	17,300	6,500	10,100
Canada	36.4	38.0	11,900	25,500	4,600	10,000
China	108.0	116.0	9,000	9,000	3,500	3,500
France	8.7	8.0	2,200	2,200	900	900
India	53.7	56.0	5,400	12,100	3,300	6,300
Liberia	4.1	0.5	900	1,600	500	800
Mauritania	11.4	11.0	400	700	200	300
South Africa	30.3	31.0	4,000	9,300	2,500	5,900
Sweden	19.9	20.0	3,000	4,600	1,600	2,400
FSU	236.2	216.0	63,700	78,000	23,500	29,000
Venezuela	20.4	21.0	2,000	3,300	1,200	1,700
Other	67.4	65.0	5,400	12,500	2,300	6,300
World Total	919.3	906.2	151,100	229,400	64,600	101,100

a/ That part of the reserve base that could be economically extracted or produced at the time of determination.
b/ That part of an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices.

Source: United States Bureau of Mines, Mineral Industry Surveys (Iron Ore in 1991).

Production to expand from 1993. World iron ore production is expected to continue declining in 1992 (-4.9% p.a.), before recovering in 1993 (1.4% p.a.) and 1994 (2.7%). The projected average growth rate is 1.3% p.a. over the 1991-2005 period. The high-income countries as a group should see their iron ore output drop significantly in 1992 and 1993. Most countries in this group are expected to lose ground in iron ore production compared with their 1990 levels; only Australia is expected to gain with a 7 million tons' additional to its annual production by 2000 and 15 million tons by 2005. The LMICs should accomplish a 1.9% p.a. average annual growth rate in iron ore production during the 1991-2005 period. The centers of this growth will be in Latin America and Asia. Brazil should utilize its high-quality iron ore reserves and strong competitive position to expand production at 4.7% p.a. over the forecast period. Iron ore production in Asia should be fueled by the region's strong growth in steel production. China is likely to seek new high-grade iron ore mines (one possible site is in the Hainan island). China's production is expected to grow at 3.3% p.a. during 1991-2005. Economic transition in Eastern Europe and the FSU will greatly alter the historical pattern of production and consumption; the FSU will no longer be the exclusive iron ore supplier in the region. We expect that iron ore production in the FSU will not be able to regain its pre-transition level during the 1991-2005 period.

Table 4: Expected Iron Ore Capacity Expansions, to 1995

Country	Supplier	Mine	Annual Production Capacity (Mill. Tons)
Guinea	Nimco	Nimba	7.5-9.0
Gabon	Somifer	Mekambo	10.0
Senegal	Miferso	Faleme	3.0-12.0
Mauritania	SNIM	M'haoudat	6.0
Brazil	CVRD	Carajas	15.0
Brazil	MBR	Itabirito	3.4
Brazil	Samarco	Alegria	4.0
Venezuela	CVG	DRI facility	5.0
Australia	BHP	Mt. Whaleback	3.0
Australia	BHP	Yandicoogina	5.0
Australia	BHP	McCamery's Monster	5.0
Australia	BHP	Goldsworthy	?
Australia	Hamersley	Marandoo	10.0
Australia	Hamersley	Channar	2.5-7.0
Australia	Robe River	Robe River	7.0
India	NMDC	DRI facility	?

Source: Drewry Shipping Consultants Ltd, "Growth Prospects for Iron Ore and Coking Coal," 1991.

Rapid growth using DRI/HBI technology. World production of DRI/HBI is expected to grow rapidly because: (i) mini-mills with the EAF technology will greatly increase their share of world steel output; and (ii) the supply of high quality steel scrap will be rather limited. Total DRI/HBI production is foreseen to climb to 34-45 million tpy (from the current 18 million tpy) by the end of this century, equivalent to a rise from 1% to 2% in its share of total world ferrous input.

Trade Outlook

More than 40% of the world's iron ore demand is met by imports, of which 90% is transported by sea. About 20% of the iron ore trade takes the form of pellets, 10% are lumps, and the rest are fines for sintering or direct blast furnace feed. Table 5 compares world seaborne trade in different types of cargos. Iron ore ranks second in terms of tonnage and ton-miles to crude oil, which illustrates the enormous size of the world steel industry and the fact that the leading steel producers in Europe and Japan have to import virtually all of their iron ore requirements amounting to 65% of the total iron ore trade in 1990. Another 14% went to Asian countries other than Japan.

Long-term contracts dominate market. Iron ore is generally traded on a long-term contract basis; only marginal tonnages enter the "spot" market. Brazil's CVRD, for example, has several 15-year contracts extending to 1999 covering deliveries of more than 10 million tpy to the Japanese

Table 5: World Seaborne Trade Volumes, 1975-90

Tonnages (Mills.)	Crude Oil	Oil Products	Iron Ore	Coal	Grain	Other Cargo	Total
1975	1,263	233	292	127	137	995	3,047
1980	1,320	276	314	188	198	1,310	3,606
1985	871	288	321	272	181	1,360	3,293
1990	1,190	336	347	342	192	1,570	3,977
Ton-Miles (Bills.)	**Crude Oil**	**Oil Products**	**Iron Ore**	**Coal**	**Grain**	**Other Cargo**	
1975	8,885	845	1,504	618	734	2,810	15,396
1980	8,219	1,020	1,651	957	1,087	3,720	16,654
1985	4,007	1,150	1,702	1,473	1,004	3,750	13,086
1990	6,261	1,560	1,978	1,849	1,073	4,400	17,121

Source: The TEX Report, Feb. 6, 1992.

market. Contracts are usually negotiated between steel producers or their intermediaries and iron ore suppliers, and they can cover as little as one year or as long as the anticipated "life" of a particular mine. Contracts typically fix the quantities to be traded in each year (or allow relatively narrow upper/lower bounds), but leave the price open for "annual renegotiation."

Steel producers have strong incentives to secure long-term supplies of iron ore. Besides long-term contracts, they also make significant investments (as partners) in iron ore mines known as "captive mines." Examples of "captive mines" are investments of Germany's Thyssen AG in mines in Liberia and Brazil, Italy's ILVA SpA in Brazil and Canada, and China's CMIEC in Australia.

Major iron ore importers are large integrated steel mills in Europe and East Asia (Japan and Korea). They have a fairly well established pattern of supply based on medium- and long-term contracts with major iron ore suppliers. In the European market, contracts are usually written between iron ore suppliers and individual steel companies. An exception is Germany where two trading agents handle all the purchasing and transportation businesses. In Japan, the six large integrated steel companies tend to cooperate with each other in iron ore trading activities. Other major importers are integrated steel mills in China, the Republic of Korea, and Turkey, and some smaller, DRI-based mini-mills in Malaysia, Indonesia, and the Middle East. Major iron ore exporters are located in Australia, Brazil, Canada, India, and in African countries. Since the 1970s, Australia and Brazil have become the leaders in contract negotiations with iron ore importers by virtue of their ability to supply large quantities of high-grade ore at relatively low prices.

Shipping costs important determinant of trade patterns. Importers are usually responsible for transportation of the iron ore because the majority of contracts are on f.o.b. terms. Importers can use this arrangement as a means of controlling inventories and final import costs. Some long-term contracts involving long-distance shipping are on c&f terms. A notable example is Australian exports to Europe because of the long distance involved. Such an arrangement can work to the advantage of both exporters and importers because exporters can cut a better deal with shipping companies due to

Table 6: Iron Ore Freight Costs (as of 1991) (US$/dwct a/)

Ship Size (dwt) b/	65,000	120,000	180,000
Sweden To North West Europe			
Operating + Voyage c/	2.92	2.40	2.12
Operating + Voyage + Capital d/	5.35/5.44	4.33/4.42	3.89/3.97
Brazil To North West Europe			
Operating + Voyage	5.37	4.23	3.74
Operating + Voyage + Capital	10.99/11.19	8.58/8.79	7.60/7.78
West Australia To North West Europe			
Operating + Voyage	9.51	7.56	5.93
Operating + Voyage + Capital	16.60/16.85	13.14/13.41	11.47/11.73

a/ dwct: deadweight cargo tons.
b/ dwt: deadweight tons.
c/ Voyage cost includes bunker costs, port charges and canal tolls.
d/ Newbuilding/secondhand.

Source: Drewry Shipping Consultants Ltd.

their ability to place large orders. An innovative use of f.o.b. and/or c&f type contracts is the "freight sharing" system adopted between Japanese steel mills and Brazilian iron ore suppliers where the differences in freight costs for shipments between Japan-Brazil and Europe-Brazil are shared by both parties. Table 6 shows freight costs for different iron ore suppliers to Europe. The main factors affecting shipping costs are: (i) size of ship; (ii) age of ship; and (iii) shipping distance. Sweden has the lowest shipping cost to the European markets, and f.o.b. prices of its iron ore are normally set at a premium. Shipping costs can be prohibitively high for particular iron ore suppliers (e.g., as high as 50% of the f.o.b. price for Australian iron ore in the Europe market).

Table 7 presents recent data on iron ore trade from Australia, Brazil, and Canada to major destinations. Due to the high shipping costs, only 19% of Australia's exports goes to Europe while 80% goes to Japan and the rest of Asia. However, because the "freight sharing" system between Japan and Brazil, Brazil's iron ore exports to Japan and Europe are much more balanced than are Australia's. Canada has been concentrating mostly in the US and European markets.

Strong import growth in LMIC Asia. The current structure of world iron ore trade is likely to persist. The high-income countries will continue to be net importers and the LMICs net exporters. Because of the projected near flat growth in iron ore production, iron ore imports will continue to grow faster than consumption in the high-income countries. The two most important iron ore importers, Japan and Germany, should see their imports grow at 1.2% p.a. and 1.3% p.a., respectively, over the 1991-2005 period. Australia and Brazil should further strengthen their position as major exporters with 1.9% p.a. and 2.9% p.a. growth, respectively, over 1991-2005. Gross iron ore imports of the LMICs are expected to increase at 2.5% p.a. The strongest growth is expected in Asia. Thus, the share of LMICs in world gross imports is expected to increase from 20% in 1991 to 24% in 2005.

Table 7: Iron Ore Exports of Major Suppliers (million tons, gross weight)

	EC-12	US	Japan	Asia a/	Total
Australia 1986	14.5	-	47.3	16.6	79.5
1990	18.9	0.1	52.2	24.4	96.2
Brazil 1986	37.1	3.8	28.3	7.3	92.3
1990	48.4	4.1	31.6	13.4	114.3
Canada 1986	17.9	9.5	2.1	-	31.0
1990	14.5	9.2	1.8	-	27.0

a/ Includes China, Republic of Korea, and other Asian economies.

Source: UNCTAD Trust "Iron Ore Statistics 1991."

Changes in Eastern Europe and FSU trade. Future developments in the FSU iron ore industry remain highly uncertain. However, the current consensus seems to be that: (i) Eastern Europe and the FSU will experience a sizable reduction in crude steel production and iron ore consumption; (ii) Eastern European steel mills will look for supply sources other than the FSU, because FSU iron ore has lower quality and the past favorable deals no longer exist; and (iii) the FSU will have to restructure its iron ore industry significantly.

Price Prospects

Prices for iron ore are determined by annual negotiations at specific times of the year. In Europe, contracts run on the calendar year basis and price talks are normally conducted in November or December. In Japan, contracts are on a fiscal year basis (i.e., April-March), and thus negotiations over price do not normally commence until January or February.

Prices set during annual negotiations. Negotiations usually take place in the two major markets independently (i.e., Europe and Japan). In both markets, there is a dominant supplier whose price agreement with an importer serves as the reference for subsequent negotiations. In the European market, the reference price is the c&f Rotterdam price of Brazil's CVRD fines. This reference price, negotiated between Brazil's CVRD and German steel mills, takes into account expectations of market conditions, exchange rates, and ocean freight rates. Once the benchmark price is known, other suppliers to the European market adjust their f.o.b. prices to enable them to compete on a c&f Rotterdam basis. Australia has the transportation advantage in the Pacific region, particularly in the large Japan market. Producers like Hamersley and BHP are the market leaders. A unique feature of price negotiations in the Japanese market is that both parties agree on a percentage change in the reference f.o.b. price, which is then applied to all import brands.

There have been close interactions between the two markets, particularly over the past six to seven years. Table 8 shows the settlement prices of the past 13 years for the two major brands of iron ore. As can be seen the differences between columns (4) and (1) have been small and almost unchanged over the past six years. This implies that iron ore from Hamersley in the Japanese market and CVRD in the European market are treated as essentially identical (the small gaps in prices are due to slight differences in purity). However, even under the freight sharing system between the Japanese steel mills and Brazilian iron ore suppliers, the differences between CVRD and Hamersley f.o.b. prices (columns (1) and (2)) are relatively large, and the differences between CVRD f.o.b. prices in the European and Japanese markets (columns (4) and (2)) are even larger.

Negotiations in the European market have tended to be delayed in recent years, with the Japanese steel mills able to set the tone for the market. With better organization among themselves, Japanese buyers have been able to obtain price concessions from Australian iron ore suppliers. Table 9 shows that in the past 12 years the European market set the price seven times and the Japanese market, five times.

The CVRD f.o.b. price of Standard Sinter Feed (64.5% purity ores from Itabira and other southern mines, or Southern System) in the European market (column (4) in Table 8) is the World Bank's indicator price for iron ore. Figure 1 shows the historical movements of the indicator price for iron ore and the World Bank Steel Price (WBSP) index. Iron ore prices move closely with steel prices but with a lag. During the 1970s, the lag seems to have been about two years. In the early 1980s, the lag was reduced to 1.5 years, and most recently, to about 1.25 years. Such lagged behavior is reasonable because price negotiations have been conducted one year ahead of time and expectations formation has been somewhat adaptive. Nevertheless, it appears that the adaptive process has become quicker in recent years. The steel industry in the high-income countries suffered losses in the 1990-91 period as the WBSP index dropped by 11% and 3.5% in constant dollar terms over these two years. This translated into a decline by 8% in constant dollar terms for the iron ore contract price in 1992.

Iron ore prices to decline then rise after 1995. Given that steel prices are forecast to decline at an average rate of -0.8% p.a. in constant dollar terms over the 1991-2005 period, iron ore prices also are projected to fall, at -1.4% p.a. over the same period (see Table A4). This is equivalent to a 2.1% p.a. increase in current dollar terms--slower than the expected inflation rate. In the medium term, the expected upturn in the global steel market should lead to constant dollar increases in iron ore prices in 1995-96.

Table 8: Price Premiums of Major Iron Ore Brands, 1980-92

	Japanese Market		European Market		Price Differentials		
	(1) Hamersley	(2) CVRD	(3) Hamersley *	(4) CVRD	(4)-(1)	(1)-(2)	(4)-(2)
	(US$/metric ton of metal content)						
1980	27.16	25.00	39.60	28.10	0.94	2.16	3.10
1981	29.23	26.88	38.60	28.10	-1.13	2.35	1.22
1982	34.25	30.53	40.40	32.50	-1.75	3.72	1.97
1983	29.97	27.04	34.90	29.00	-0.97	2.93	1.96
1984	26.25	23.89	32.90	26.15	-0.10	2.36	2.26
1985	26.62	24.26	34.30	26.56	-0.06	2.36	2.30
1986	25.56	23.29	32.40	26.26	0.70	2.27	2.97
1987	24.28	21.89	29.35	24.50	0.22	2.39	2.61
1988	23.31	20.90	31.35	23.50	0.19	2.41	2.60
1989	26.34	23.61	35.30	26.56	0.22	2.73	2.95
1990	30.54	27.38	41.47	30.80	0.26	3.16	3.42
1991	32.97	29.56	44.77	33.25	0.28	3.41	3.69
1992	31.35	28.11	42.57	31.62	0.27	3.24	3.51

* Price per Fe 1% c.i.f. Rotterdam.

Source: The TEX Report - "Iron Ore Manual."

Figure 1

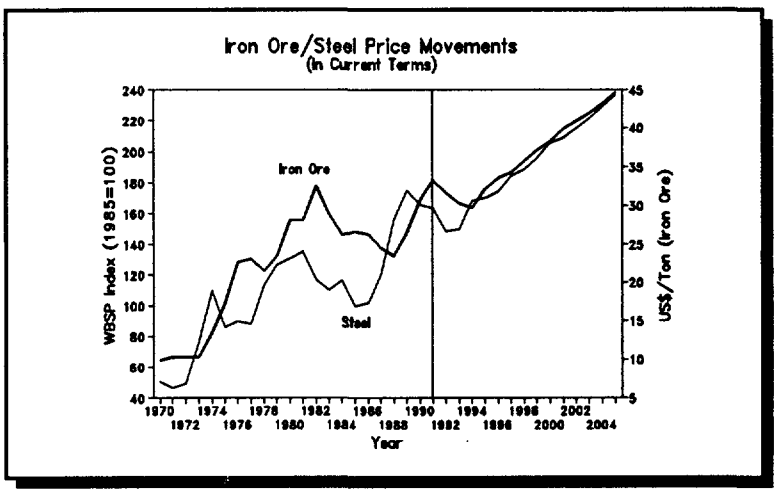


Table 9: Iron Ore Market Price Setting Process in Japanese and European Markets, 1981-92

	Japanese Market			European Market		
	Date	Setter	Change	Date	Setter	Change
1981	02/26/81	CVRD	7.5%	02/15/81	Venezuela/Belgium	6.1%
1982	03/26/82	Newman	17.2%	02/05/82	CVRD/Germany	15.7%
1983	03/28/83	CVRD	-11.4%	03/08/83	Carol/Germany	-11.2%
1984	01/20/84	CVRD	-11.6%	12/07/83	QCM/Germany	-8.5%
1985	01/31/85	MMTC	0.0%	12/07/84	QCM.Carol/Germany	0.0%
1986	02/14/86	MMTC	-1.9%	12/03/85	QCM.Carol/Germany	-1.1%
1987	02/20/87	Newman	-5.0%	03/05/87	QCM/Holland	-9.3%
1988	12/22/87	Hamersley	-4.0%	12/24/87	Hamersley/Britain	8.6%
1989	12/14/88	Hamersley	13.0%	12/19/88	CVRD/Germany	13.0%
1990	01/24/90	Hamersley	16.0%	01/27/90	CVRD/Germany	16.0%
1991	01/30/91	Hamersley	7.9%	01/31/91	CVRD/Germany	7.9%
1992	12/17/91	Hamersley	-4.9%	12/17/91	CVRD/Germany	-4.9%

Note: Producers belong to the following countries: CVRD (Brazil); MMTC (India); Hamersley & Newman (Australia); QCM & Carol Lake (Canada).

Source: The TEX Report, May 6, 1992.

Table A1: Iron Ore (Metal Contents) - Production By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	165,002	173,991	148,713	153,134	133,114	132,018	135,488	134,588	136,647	140,179	0.5	-1.6	-0.6
OECD	164,909	173,974	148,713	153,134	133,060	131,964	135,455	134,561	136,650	140,241	0.5	-1.6	-0.6
United States	52,052	48,769	35,650	35,088	31,310	30,729	32,060	31,543	31,216	30,745	-1.8	-3.3	-0.9
Canada	26,396	33,211	22,628	18,811	20,004	19,767	19,986	19,824	19,588	19,520	1.5	-1.2	0.3
France	17,523	8,339	2,650	2,270	2,793	2,812	2,978	2,858	2,495	2,180	-7.1	-10.1	-0.3
Sweden	20,700	16,296	12,901	10,093	9,930	9,942	10,269	10,326	10,980	11,702	-1.4	-3.3	1.1
Australia	32,417	55,489	70,560	70,210	64,902	66,165	68,098	69,449	76,920	84,457	10.9	2.1	1.3
LMICs	248,667	347,653	412,058	386,245	380,579	388,994	399,562	408,955	456,465	503,613	3.5	2.0	1.9
Africa	34,762	35,801	30,286	17,559	31,554	31,581	31,867	31,940	32,662	33,521	3.1	-0.8	4.6
South Africa	5,686	17,770	19,689	10,092	12,048	12,275	12,860	13,136	14,899	16,701	7.5	6.0	3.6
Liberia	15,557	11,344	2,667	668	916	954	1,061	1,961	3,682	3,446	0.7	-5.3	11.7
Mauritania	5,640	5,790	7,009	6,798	5,103	5,169	5,350	5,431	5,969	6,525	5.6	0.3	-0.3
Americas	49,784	87,208	128,693	127,499	124,707	129,077	134,450	138,750	154,243	168,894	5.6	3.8	2.0
Brazil	21,864	62,627	102,659	72,659	95,974	99,139	103,356	106,629	123,954	141,133	9.8	6.4	4.7
Asia & Pacific	50,757	81,533	98,972	101,285	110,344	115,043	119,848	124,371	146,215	166,458	4.0	2.7	3.5
China, People's Rep.	23,400	51,417	59,378	61,566	64,638	67,174	69,418	71,842	83,170	93,749	5.5	3.7	3.0
India	19,686	25,619	34,369	39,719	39,696	41,576	43,808	45,634	54,785	63,194	4.1	2.3	3.3
Europe	110,549	140,248	148,232	123,911	119,729	120,057	121,434	122,950	131,326	140,410	2.4	1.2	0.9
World	413,670	521,643	560,771	539,378	513,693	521,012	535,049	543,543	593,113	643,791	2.5	0.8	1.3

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: UNCTAD (actual);
World Bank, International Economics Department (projected).

Table A2: Iron Ore (Metal Contents) - Gross Exports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	77,291	99,814	94,130	78,486	76,438	76,753	78,419	78,939	83,152	87,728	3.3	0.2	0.8
OECD	77,291	99,814	94,130	78,486	76,438	76,753	78,419	78,939	83,152	87,728	3.3	0.2	0.8
Canada	22,738	26,812	17,101	15,060	14,320	14,150	14,307	14,191	14,022	13,973	0.8	-1.5	-0.5
France	5,750	2,609	1,033	1,172	1,128	1,236	1,344	1,320	1,186	1,060	-7.3	-10.0	-0.7
Sweden	17,521	13,423	10,679	8,214	7,786	7,795	8,051	8,097	8,609	9,175	-1.4	-3.1	0.8
Australia	25,710	48,925	60,578	52,698	52,778	53,805	55,377	56,475	62,551	68,680		2.6	1.9
LMICs	105,525	137,017	153,174	132,206	131,331	133,598	137,659	140,169	154,687	169,441	3.6	1.4	1.8
Africa	27,135	29,133	21,057	21,053	20,780	20,798	20,986	21,034	21,510	22,076	3.2	-1.5	0.3
Liberia	12,993	12,902	2,607	568	848	883	983	1,816	3,409	3,191	1.5	-4.1	12.3
Americas	41,383	66,678	87,303	74,391	74,835	77,109	80,421	82,814	95,786	108,706	5.0	3.0	2.7
Brazil	17,807	50,861	72,292	63,142	64,016	66,126	68,939	71,123	82,678	94,137	10.4	6.0	2.9
Europe	20,163	24,361	22,025	13,326	17,183	16,822	16,670	16,356	15,400	14,127	3.1	0.3	0.4
World	182,816	236,831	247,304	210,691	207,769	210,351	216,078	219,109	237,839	257,169	3.5	0.9	1.4

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: UNCTAD (actual);
World Bank, International Economics Department (projected).

Table A3: Iron Ore (Metal Contents) - Gross Imports By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	159,701	184,103	175,149	167,488	164,964	166,076	170,739	172,127	183,569	195,771	2.5	-0.4	1.1
OECD	159,636	181,883	169,162	161,295	159,229	160,158	164,748	165,949	176,523	187,957	2.4	-0.6	1.1
United States	25,929	18,008	13,026	11,542	11,382	11,292	11,762	11,702	11,968	12,085	-3.3	-5.8	0.3
Germany	26,761	30,345	26,219	26,288	24,821	25,136	26,257	26,630	29,174	31,708	1.2	-0.7	1.3
France	5,306	10,675	11,297	10,892	10,902	10,973	11,258	11,339	12,116	12,774	7.6	2.7	1.1
United Kingdom	11,492	8,338	12,146	11,154	10,953	11,063	11,127	11,251	11,661	11,901	0.1	-0.6	0.5
Italy	6,534	9,721	9,356	9,121	8,818	8,609	8,799	9,077	10,043	11,039	4.6	1.5	1.4
Japan	61,283	77,572	70,915	70,090	67,986	68,854	70,528	71,273	76,691	82,929	5.4	-0.2	1.2
LMICs	20,626	44,297	46,038	43,203	42,805	44,275	45,339	46,981	54,270	61,398	6.2	4.8	2.5
Americas	800	1,633	2,151	2,211	2,383	2,506	2,602	2,717	2,894	3,017	6.9	5.8	2.2
Asia & Pacific	23	10,265	25,740	28,104	29,212	30,763	32,001	33,552	40,666	47,375		38.9	3.7
China, People's Rep.	-	2,807	8,288	8,750	8,983	9,421	9,722	10,155	12,082	13,903			3.3
Korea, Rep. of	23	5,466	13,926	15,572	17,397	18,219	18,953	19,788	23,775	27,624		35.3	4.1
Europe	19,799	32,376	17,358	14,698	14,052	14,276	14,468	14,859	16,610	18,474	3.5	0.8	1.6
World	180,327	228,401	221,187	210,691	207,769	210,351	216,078	219,109	237,839	257,169	3.1	0.5	1.4

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: UNCTAD (actual);
World Bank, International Economics Department (projected).

Table A4: Iron Ore - Prices, a/ 1958-91 (Actual), 1992-2005 (Projected)

	($/ton fe b/)		
	Current $	1990 Constant $	
		G-5 MUV c/	G-7 CPI d/
Actual			
1958	14.4	69.9	91.8
1959	12.2	60.3	78.3
1960	11.4	55.2	71.7
1961	11.0	52.4	67.6
1962	11.0	51.3	65.7
1963	11.0	52.3	63.7
1964	11.0	51.4	62.0
1965	10.2	47.4	55.9
1966 e/	9.5	42.6	50.3
1967 e/	8.9	39.2	45.6
1968	8.8	39.2	43.9
1969	9.8	41.7	47.2
1970	9.8	39.2	44.5
1971	10.3	39.1	43.8
1972	10.3	35.9	39.7
1973	10.3	31.0	34.7
1974	13.4	32.9	40.6
1975	17.3	38.3	46.7
1976	22.7	49.6	59.4
1977	23.1	45.8	54.5
1978	21.5	37.0	41.4
1979	23.5	35.8	42.9
1980	28.1	39.0	45.8
1981	28.1	38.9	45.4
1982	32.5	45.7	53.2
1983	29.0	41.7	46.8
1984	26.2	38.4	42.3
1985	26.6	38.7	42.1
1986	26.3	32.5	34.5
1987	24.5	27.6	28.5
1988	23.5	24.7	25.4
1989	26.5	28.0	28.8
1990	30.8	30.8	30.8
1991	33.3	32.6	31.6
Projected			
1992	31.6	29.7	28.3
1993	30.3	27.4	26.2
1994	29.7	26.4	25.1
1995	32.1	27.8	26.4
2000	38.3	27.9	26.1
2005	42.7	27.1	24.3

a/ Brazilian sinter feed, Companhia Vale do Rio Doce (CVRD). For 1958-65, Itabira 68% fe in dry weight, f.o.b. prices for European markets; 1966-74, contract price to Germany (Federal Republic) for 64.2% fe; 1975-85, standard sinter feed 64% fe; beginning 1986, Southern System (Itabira and other southern mines) 64% fe; 1988-89, 64.2% fe; from 1990 onwards, 64.3% fe.

b/ Prices are shown in US dollars per metric ton of iron content (fe), equivalent to US cents per fe unit (1%).

c/ Deflated by G-5 Manufacturing Unit Value (MUV) Index.

d/ Deflated by G-7 Consumer Price Index (CPI).

e/ Estimates.

Sources: Companhia Vale do Rio Doce (actual); World Bank; International Economics Department (projected).

Steel

Summary

- Steel consumption in high-income countries declined 7% in 1991 because of the global economic slowdown. Full recovery is not expected until the mid-1990s, and the average annual growth rate for the 1991-2005 period is forecast at only 0.7%.

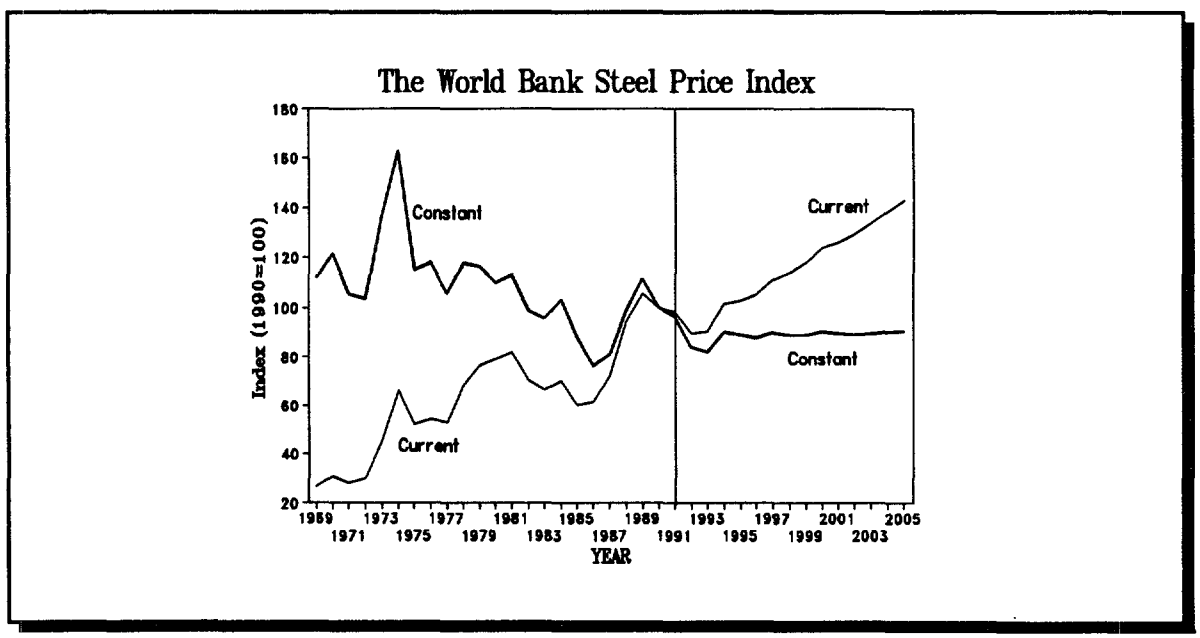
- Steel consumption in the LMICs fell 8% in the past two years, mainly because of the sharp declines in the Eastern European countries and the FSU republics, but LMIC growth over the 1991-2005 period is projected at 2.1% p.a..

- The steel industry worldwide has entered an era of restructuring. 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.

- The World Bank steel price index in real terms is expected to decline in 1992 and to hold relatively constant over the forecast period, with slight upswings in the mid-1990s and around the year 2000.

Steel Prices a/, 1969-2005



Demand Outlook

HIGH-INCOME COUNTRIES. ***Sluggish growth overall, some decline.*** Steel consumption in high-income countries is affected by the ups and downs of general economic activity and the continued decline in the share of steel-using sectors in GDP. Over the past 20 years steel consumption has been notably volatile, reacting strongly to the two oil price shocks in the 1970s and the boom in industrial activity in 1988. The current economic slowdown in high-income countries has not spared steel consumption, which declined by 7% in 1991. Steel consumption in high-income countries has also shown a slow or negative long-term growth since the 1970s, because of: (i) relative sluggishness in the construction and infrastructure sectors; (ii) the shift from heavy industries to information industries and services; and (iii) substitution by lighter and stronger materials in the automobile industry due to higher energy prices. Table 1 shows the change in the composition of materials used in a passenger car between 1985 and 1990. Steel lost about 10% of its share of the total weight of a car, or about 185 kg.

Based on present indications, steel consumption in high-income countries in 1992 is expected to decline again, by about 2%. For the 1991-2005 period, the average annual growth rate is forecast at 0.7% p.a. for the 1991-2005 period--from 354 million tons in 1991 to 390 million tons in 2005. The United States is expected to register a slight decline (-0.3% p.a.) during the period, while other major OECD countries should show slight increases ranging from 0.02% p.a. (France) to 0.77% p.a. (Italy). Japan, which has been the leader in steel consumption over the past two decades, is expected to lose its momentum and behave much like other OECD countries in the forecast period because of intensified competition in the exports of manufactured goods and the forecast slower growth of industrial output.

LOW- AND MIDDLE-INCOME COUNTRIES. ***GDP steel intensity mostly rising.*** Steel consumption in the LMICs is also affected by the fluctuations in general economic activity and by the changing shares of steel-using sectors in GDP. Global economic downturns in 1980-82 and 1990-91 made dents in steel consumption of this group of countries, with declines of 2% and 8% in the respective periods.

Table 1: Materials Used in a Car, 1985 and 1990

	1985		1990	
	(kg)	(%)	(kg)	(%)
Steel	822.2	75.6	637.0	65.0
Aluminum	32.6	3.0	53.9	5.5
Rubber	54.4	5.0	53.9	5.5
Glass	34.8	3.2	34.3	3.5
Cardboard/Fibers	27.2	2.5	78.4	8.0
Mastics/Paints	29.4	2.7	24.5	2.5
Plastic Materials	87.0	8.0	98.0	10.0
Total	1,087.5	100.0	980.0	100.0

Source: Ferruzzi Group Economic Research Department, March 1990.

Nevertheless, many LMICs are in the early stage of industrialization and so require large quantities of steel for infrastructure, plant and equipment, and consumer durables. A useful measure for looking at steel consumption is to rank countries according to "steel intensity," defined as crude steel consumption per unit of GDP. Table 2 shows steel intensities (historical and projected) for selected countries at different stages of industrialization. OECD countries generally have lower steel intensities than the LMICs, and are trending downward. Trends in steel intensity in the LMICs are mostly upwards (Brazil is somewhat of an exception) although we are projecting declining intensities in countries such as China, India, and the Republic of Korea.

Eastern Europe and the FSU outlook uncertain. Eastern Europe and the FSU account for nearly 50% of crude steel consumption of the LMIC group, and both have been major steel producers and consumers. However, over the last two years, their steel consumption fell–8% in 1990 and 20.3% in 1991--because of the widespread slowdown in manufacturing output. Forecasts of steel consumption for these countries are extremely uncertain. Upon completion of the transition from planned to market economies, economic growth in this region could accelerate to a faster rate than under the old system and replacement of outdated infrastructure and increased demand for consumer durables could lead to a strong increase in the demand for steel (particularly for high quality steel products). For this reason, the long-term steel demand of Eastern Europe and the FSU is projected to grow at rates similar to other developing countries.

Asia continues strong. In Latin America, there are signs of recovery after a long period of government policies that strongly curtailed steel consumption. For example, Brazil is expected to have a 10.5% increase in steel consumption in 1992, and an average annual growth of 1.6% p.a. during the forecast period. Asia, the high growth region in steel consumption over the past 20 years, is the only region in the world that has done well despite the current global economic slowdown. During the 1990-91 period, steel consumption in the region grew 12%; the Republic of Korea posted an impressive 23%

Table 2: Steel Intensities in Major Markets, 1975-2005

	Historical				Forecast		
	1975	1980	1985	1990	1995	2000	2005
	(kg/'000 1985 US$) a/						
Brazil	59.8	63.9	53.8	31.3	38.3	33.4	28.7
China, People's Rep. of	119.6	151.3	248.9	274.7	271.8	221.0	179.3
France	36.9	31.8	28.1	22.5	20.0	18.3	16.9
Germany	62.6	57.4	63.9	38.6	37.9	36.2	33.5
India	58.5	71.0	67.3	107.1	128.9	88.1	81.2
Italy	55.1	61.9	51.2	39.0	34.6	31.6	29.8
Japan	89.6	77.9	54.2	48.8	39.8	39.0	37.1
Korea, Rep. of	92.4	102.2	121.7	133.4	105.9	75.9	50.7
United Kingdom	58.3	31.4	31.3	25.0	20.6	18.3	16.7
United States	48.6	44.6	26.6	27.5	23.7	20.8	18.1

a/ Steel intensity is defined as the ratio of crude steel consumption to GDP in constant terms.

Source: World Bank, International Economics Department.

gain. China's steel consumption forecasts have been revised downwards from our previous projection, because the country has switched the focus of steel consumption from simply pursuing high tonnages to emphasizing a better balance in different steel products. However, China is still expected to have an average annual growth rate of 2.9% p.a. during the 1991-2005 period, to reach 100 million tons by 2000. The Republic of Korea is forecast to keep its strong growth momentum in the first half of the 1990s with an average 5% p.a. increase, and gradually slow to 3.5% p.a. growth for the remainder of the forecast period. With reform of the steel sector, India has positioned itself to embrace strong growth in domestic steel demand--at an estimated 2.8% p.a. for the forecast period.

Combining steel consumption forecasts from high-income countries and LMICs, the total world steel consumption is expected to decline by 1.4% in 1992 before recovering in 1993. The average annual rate of growth during the 1991-2005 period is expected to be 1.42% p.a., and the total tonnage of steel consumption would be around 830 million tons in 2000 and 895 million tons in 2005. Ironically, world total gross capacity for steel production in 1991 is 970 million tons, more than enough to cover the projected consumption growth over the next 14 years.

Supply Outlook

According to 1990 statistics, the world's major steel-producing countries were the FSU (154 million tons), Japan (110 million tons), United States (89 million tons), China (66 million tons), Germany (44 million tons), Republic of Korea (26 million tons), and Brazil (20 million tons). The high-income countries and LMICs each produce about one half of total crude steel. However, the prospects for steel production in these two groups of countries are distinctively different.

In the high-income countries, excess steel-producing capacity has been a serious problem for most of the past 20 years despite efforts to cut capacity. Table 3 presents the capacity utilization rates of major steel-producing countries, capacity utilization defined as the ratio of production to gross producing capacity. High-income countries had relatively low capacity utilization rates until very recent years, when they increased to levels comparable with the LMICs. Steel industries in the LMICs, on the other hand, have been expanding in order to meet domestic demand, and capacity utilization rates have been generally higher. In particular, capacity utilization rates in Asia reached abnormal levels in 1990-91 (i.e., 86% is considered normal and economically viable according industry standard). Eastern Europe and the FSU previously had relatively high capacity utilization rates, but since the collapse of the centrally planned economic systems in those countries, capacity utilization rates have plunged.

Capacity reductions in OECD countries continue. Table 4 shows recent changes in steelmaking capacities. Total capacity in high-income countries declined 20.6% during the 1980-91 period. About 8 million tons of capacity was cut during 1990-91 alone, largely due to reductions in the United States, Japan, and Italy. In the United States, further closures of integrated steel mills are likely during the next few years. However, those closures will be partly offset by increases in mini-mills using electric arc furnace (EAF) technology. Overall, US capacity is expected to decline by about 4 million tons before the year 2000. In Japan, the major integrated steel producers have already reduced their capacity considerably over past three years. Additional reductions by about 5 million tons are likely to follow in the 1990s. In the EC, Italy, Spain, and the United Kingdom have reduced capacity, and in Germany, particularly in the eastern part of the country, further plant closures are expected. Capacities in other EC countries are likely to remain constant. Total EC capacity is expected to decline by 9-13 million tons during this decade.

Table 3: Capacity Utilization Rates for Major Steel-Producing Countries, 1980-91

Regions/Countries	1980	1985	1990	1991
	(%)			
High-Income	62.0	61.8	71.7	70.0
OECD	62.0	61.8	71.9	70.0
United States	66.2	59.8	72.9	66.3
Japan	70.2	65.2	78.7	78.6
Germany	66.1	79.5	78.9	75.8
Italy	67.1	66.6	81.8	88.1
France	71.3	65.8	78.6	76.5
United Kingdom	40.1	65.5	80.4	75.6
LMICs	86.8	85.1	83.8	77.5
Americas	76.2	70.8	66.8	67.4
Brazil	84.9	82.8	71.1	78.2
Asia and Pacific	85.7	88.1	95.9	98.2
China, People's Rep. of	87.0	96.4	105.2	109.3
Korea, Rep. of	91.5	93.6	103.5	101.8
India	76.4	76.7	76.9	80.1
Europe	89.3	87.9	82.9	69.9
FSU	86.9	86.8	81.4	69.6
World Total	70.9	71.3	77.3	73.5

Source: World Bank, International Economics Department, estimates (derived from Paine Webber and IISI statistics).

LMICs expand capacity. In contrast, the LMICs registered a capacity increase of 26% during the 1980-91 period. During the 1991-2000 period, these countries are likely to achieve considerable capacity expansion (although many financial and political uncertainties remain): in Latin America, Brazil could add 7-8 millions tons of steelmaking capacity by 1995 if its privatization program proves successful; Argentina is expected to increase capacity by about 1.1 million tons by the mid-1990s; a new integrated plant based on the direct reduction technology could add 1 million tons to Venezuela's total capacity; in Africa, 3-4 million tons of additional capacity is expected in Egypt, Algeria, and Nigeria; in the Asia and Pacific region, China could continue its rapid expansion and add 15-25 million tons before the end of this century; India is expected to add 7 million tons; the Republic of Korea increased capacity by 3.2 million tons in 1991 and another 5 million tons are in the pipeline; and Indonesia is expected to almost triple its capacity from the current 3 million tons level to 8 million tons by the year 2000. However, the FSU and Eastern Europe are likely to experience a decline in total capacity of 6-9 million tons during this decade because most steel mills in these countries are economically and technologically uncompetitive.

Table 4: Gross Steel-Making Capacities, 1980-91

Regions/Countries	1980	1985	1988	1989	1990	1991
	(million tons)					
High-Income	649.0	598.2	543.3	537.5	536.3	527.9
OECD	641.0	587.1	528.1	521.2	518.5	510.4
United States	153.2	133.9	121.8	121.9	121.9	119.4
Japan	158.8	161.6	146.0	144.9	140.2	139.6
Germany	77.4	60.8	56.4	56.2	55.8	55.6
Italy	39.5	35.9	31.7	31.2	31.2	28.4
France	32.5	28.6	24.4	24.3	24.2	24.1
United Kingdom	28.1	24.0	22.2	22.2	22.2	21.8
Belgium	19.6	14.7	13.4	13.2	13.2	13.2
Netherlands	8.5	8.0	8.0	8.0	8.0	8.0
Luxembourg	6.4	5.5	5.5	5.5	5.5	5.5
LMICs	361.8	410.8	441.4	454.6	460.7	469.8
Africa	10.1	11.0	11.9	11.8	11.7	9.5
South Africa	10.1	10.5	10.7	10.6	10.6	10.6
Americas	38.2	51.0	53.8	56.0	57.8	58.4
Brazil	18.1	24.7	27.9	28.9	28.9	28.9
Mexico	10.1	11.6	10.7	11.7	13.4	13.6
Argentina	4.9	5.3	5.1	5.1	5.1	5.4
Venezuela	2.9	5.5	5.7	5.7	5.6	5.6
Asia and Pacific	73.2	93.3	112.1	119.2	123.4	129.5
China, People's Rep. of	42.7	48.6	56.4	61.4	63.1	64.5
Korea, Rep. of	9.4	14.5	20.1	21.8	22.4	25.6
India	12.5	15.6	17.7	17.9	19.5	20.5
Indonesia	1.3	2.4	2.5	2.6	2.8	2.8
Pakistan	0.5	1.7	1.7	1.7	1.7	2.1
Middle East	5.5	8.7	10.5	11.4	11.4	15.9
Iran	1.6	2.3	2.3	2.9	2.9	5.3
Egypt	1.6	2.3	2.3	2.9	2.9	5.3
Algeria	1.0	2.1	2.2	2.2	2.2	2.2
Saudi Arabia	0.0	1.2	1.7	2.0	2.0	2.0
Europe	234.8	246.8	253.1	256.2	256.4	256.5
FSU	170.3	178.1	185.3	188.4	189.7	190.5
World Total	1,010.8	1,009.1	984.7	992.1	997.1	997.7

Source: Paine Webber, World Steel Dynamics, Capacity Monitor (various issues); and World Bank, International Economics Department, estimates.

NEW TECHNOLOGY AND CHANGING COST STRUCTURES. ***Labor costs fall but total pre-tax costs rise.*** Besides closing inefficient plants and raising capacity utilization rates, major steel producers have also introduced technological innovations to enhance efficiency in steel production. Such innovations include mini-mill technology, alternative iron-making technologies (e.g., the direct smelting process), continuous casting, thin slab casting, and computerized production planning and management. Table 5 shows the current cost structure of major steel-producing countries. Comparisons with the cost table in our previous report, *Price Prospects for Major Primary Commodities*, 1990, show an overall improvement in terms of man hours per ton of output, with Brazil making the largest gains from 14 to 10.9 (no updated information on the FSU and China is available). Relative pre-tax cost relationships among these countries have changed quite significantly. In comparable 1991 dollars, Germany's pre-tax costs increased by $100/ton which made it the highest cost producer. Brazil's cost advantage has been eroded from two years ago with a $78 increase in pre-tax costs. The United States is the only country that has managed to reduce its pre-tax costs (by $31), largely through the depreciation of the dollar. In 1991, fixed costs accounted for about 30% of pre-tax costs for EC steel producers, 40% for Japanese producers, and about 20% for US producers.

Cost advantages of mini-mills for high-income countries. The Republic of Korea and Brazil had the lowest operating costs because of their relatively low labor costs. However, they do not possess a significant total pre-tax cost advantage over the high-income countries because of high capital depreciation charges for newer facilities. For other developing countries that plan large integrated steel mills, capital costs can be prohibitively high. However, the recent development of mini-mill technologies gives these countries an alternative route to increase their steelmaking capacity. The core of a mini-mill is the EAF, which uses scrap or directly-reduced iron as feedstock. Modern mini-mills have a yearly capacity of 0.5-1.0 million tons, compared with 2-3 million tons for integrated steel mills. Mini-mills have a significant cost advantage because of the lower initial investment. Of the total cost of producing a ton of liquid steel in the United States, the material costs account for 59.3% for EAF and 43.7% for basic oxygen furnace (BOF); energy accounts for 19% for EAF and 16.6% for BOF; labor cost shares are about the same; but capital costs (depreciation and interest) amount to 11.6% for EAF and 24.7% for BOF. Moreover, the smaller size of mini-mills gives them more flexibility in adapting to technical changes. Mini-mills traditionally have specialized in lower-valued long products such as wire rod and beams, rather than the higher-valued, flat-rolled products. However, the emergence of new technology such as thin-slab casting has made it possible for mini-mills to enter the flat-rolled products market.

Table 6 presents a cost structures of mini-mills for three typical regions. It can be seen that mini-mills have a cost advantage over integrated steel mills in developed countries, but it is not clear whether that cost advantage holds in developing countries where electricity is costly and steel scrap has to be imported.

The United States is currently the leading country in terms of the number of operating mini-mills and related technological advances. About 50 mini-mills produced 25% of total US steel output in 1991, and this share is projected to increase to 40% by the year 2000. Turkey also has a notable mini-mill sector, where about 15 mini-mills produce more than one-half of the country's steel output. Brazil, the Republic of Korea, and Mexico are other countries where mini-mills have found success. In Venezuela, directly-reduced iron is used to feed EAFs, to take advantage of this country's high quality iron ore and natural gas.

Table 5: Cost Structure of Integrated Steel mills in Major Steel-Producing Countries a/

	US	Japan	Germany	France	UK	Korea	Brazil
Operating rate (%)	90	90	90	90	90	90	90
Raw materials	142	141	162	150	156	153	150
Coking Coal	38	40	45	42	43	44	60
Iron Ore	66	66	80	71	75	67	43
Scrap	38	35	37	37	38	42	47
Other material	174	189	190	171	185	156	186
Labor cost	151	146	178	153	124	67	82
Cost/hour ($)	28.5	27.5	33.0	28.8	22.5	10.0	7.5
Man hour/ton (hour)	5.3	5.3	5.4	5.3	5.5	6.7	10.9
Operating cost	467	476	530	474	465	376	418
Financial cost	41	90	55	51	26	125	130
Depreciation	26	70	44	37	25	110	80
Interest	15	20	11	14	1	15	50
Pretax cost	508	566	585	525	491	501	548
Cost thru. process							
Coke	108	112	133	122	117	109	124
Blast furnace	145	145	173	155	152	141	128
Liquid steel	203	202	229	210	209	193	192
Slabs	246	235	271	247	248	222	224
Hot rolling	319	310	260	322	322	271	285
Cold rolling	467	476	530	474	465	376	418

a/ Unit is $/ton of cold-rolled sheet shipped as of December 1991 unless otherwise noted.

Source: Paine Webber, World Steel Dynamics, Cost Monitor, January 13, 1992.

PRIVATIZATION. ***Gains from privatization require supporting policies.*** The world steel industry has entered an era of restructuring. In particular, privatization of state-owned steel companies in developing countries has progressed significantly. Mexico has sold two government-owned companies, Sicartsa and AHMSA, to private interests. In Brazil, the state-owned integrated steel company, Usiminas, has been sold to a group of companies. An other smaller plant, Cosinor, was bought by German interests. The Argentine government sold SOMISA in 1992. In India, the government-owned steel company SAIL will be 20% privatized. Privatization of the steel sector in these countries is motivated by: (i) a re-orientation of the role of the state away from activities that can be more effectively managed by the private sector; (ii) the need to reduce public debt; (iii) a desire to modernize the industry through private-sector investments; and (iv) the strengthening of the domestic capital market.

Despite widespread enthusiasm for privatization, some questions remain. One concern is that certain privatization practices lack clearly defined objectives, or that the objectives defined are in

Table 6: Cost Structure of Mini Steel mills, 1991

	Developing Economies	Newly Industrializing Economies	Developed Economies
	($/ton of liquid steel)		
Materials	137.15	137.15	109.58
Electricity	43.86	27.80	19.76
Electrode	10.04	10.04	10.04
Labor	2.06	3.43	14.39
Maintenance	6.90	6.90	6.90
Interest	20.71	17.25	14.02
Depreciation	17.25	17.25	17.25
Total cost	237.96	219.81	191.94

Source: "International Trends in Steel Mini-Mills," World Bank, Industry and Energy Department Working Paper, No. 52, Dec. 1991.

conflict. An other concern is that privatization tends to enhance industry concentration and oligopoly power, discourage competition, and increase domestic prices. A study conducted by International Economics Department staff suggests: (i) that industry concentration raises domestic prices above the competitive level; (ii) that the degree of domestic price distortion depends positively on the degree of market segregation (defined by the elasticity of substitution and trade protection mechanisms) between domestic products and imports; and thus (iii) that the incentives for trade protection in a concentrated industry are far greater than in a competitive industry. In light of these findings, it is important to recognize that industry competitiveness and trade liberalization are indispensable parts of the privatization process, it will not be successful without them.

DEVELOPMENTS IN THE FSU. ***Huge steel industry faces formidable problems.*** The dissolution of the FSU will have major implications for the development of the world steel market. The FSU is the world's largest steel producer with 20% of total steelmaking capacity. The iron and steel industry in the FSU was almost completely closed to the outside world. All iron ore requirements were met from domestic production of which 44% came from Russia, 46% from the Ukraine, and 10% from Kazakhstan. Steel is produced mostly in Russia (58%) and the Ukraine (34%). The FSU steel industry is beset by: (i) production inefficiency due to general disrepair of facilities and long disregard for technological modernization; (ii) shortages of energy supplies; (iii) disastrous environmental pollution, disproportionally large relative to the level of output; and (iv) an unbalanced product mix, with too many low quality steel products and too few high quality products such as cold-rolled products, pipes and tubes in demand by the oil and gas industry. The outlook depends on how these problems are dealt with.

World production and trade patterns generally unchanged. For the rest of the world, the recent pattern of steel production growth is likely to persist in the 1990s. Steel production in high-income countries is expected to decline 1.7% in 1992, stay flat in 1993, and increase by 2.9% in 1994.

The average growth rate of steel production in high-income countries is projected at 0.7% p.a. over the 1991-2005 period. Among OECD countries, US steel production will decline slightly over the 1991-2005 period. Germany's production is expected to grow at 1% p.a., due to her new technologies and better access to Eastern Europe. Japan will continue to be the largest steel producer among high-income countries, with 0.7% p.a. production growth.

Most capacity expansions will take place in the LMICs, where excess demand for steel still prevails. However, these countries face: (i) scarcity of capital investment, (ii) shortage of energy and raw materials, and (iii) strong global environmental pressure. Therefore, they are not likely to increase steel production sufficiently to change the global pattern of steel trade. Rather, we expect steel production in these countries to grow in line with consumption; both production and consumption are forecast to grow at slightly over 2% p.a. over the 1991-2005 period. After successful privatization, Brazil could utilize its abundant high-grade iron ore resources to strengthen her position as a major steel exporter. China should to continue to expand production but at a rate slower than previously forecast due to adjustments towards high quality products. Steel production in the Republic of Korea should continue to grow fast in the near term (1991-95); the growth rate will slow down somewhat in the long term. India's steel industry could also benefit from domestic market liberalizations. Eastern Europe and the FSU will continue to lose ground in steel production in the next one to two years, but it is conceivable that steel industries in this region could start regaining ground three to four years from now.

Trade Prospects

International trade in steel has become increasingly important. Exports accounted for 28% of total crude steel production in 1990, compared with 19.7% in 1970 and 25.6% in 1980. The trade flow is primarily from high-income countries to LMICs (see Table 7), although some LMICs (e.g., Brazil, Turkey, and former Yugoslavia) have exported significant quantities of low quality steel to high-income countries.

Table 7 shows the historical data and forecasts (derived from production and consumption forecasts) for net trade. The traditional trade pattern is expected to persist during the 1991-2005 period, with high-income countries being net exporters and LMICs being the net importers. Individually, Japan, Germany, and Brazil are likely to be major exporters of steel, and India, China, and the United States, major importers.

Price Outlook

Complex price structure for steel. Unlike other metals such as copper, steel prices are not driven by "spot" trading on the LME. In fact, no steel product is traded on a commodity exchange. Steel is mostly traded directly between producers and consumers and pricing on international or domestic markets can be complex and confusing. The relationship between international and domestic prices is far from being transparent because of the complicated trade restrictions in place.

Depending on the domestic market structure (oligopolistic, competitive, oligopsonistic, etc), there can be more than one price for a product. For example, in the United States the same cold-rolled sheet can have a list price, a real price, a normal three-month spot price, a distress spot price, a

Table 7: Net Trade of Steel, by Main Countries and Regions, 1969-2005

	1969-71	1979-81	1989-91	1995	2000	2005
	('000 tons)					
High-Income	1,629	32,456	10,390	15,106	14,575	16,887
OECD	1,742	3,826	16,376	19,543	18,988	21,258
United	-1,239	-1,696	-12,986	-13,970	-11,617	-9,499
Japan	24,952	32,171	13,251	17,455	19,847	18,618
Germany	-1,988	-436	3,642	2,878	4,330	5,323
France	79	3,149	1,457	2,894	3,252	3,581
Italy	-2,335	131	1,215	930	623	371
United Kingdom	2,767	-1,328	-2,805	-2,475	-2,572	-2,421
LMICs	-1,962	-44,237	-17,121	-15,106	-14,575	-16,887
Americas	-6,647	-6,189	11,893	16,508	17,465	17,760
Brazil	-898	114	11,407	14,062	16,673	19,417
Asia and Pacific	-8,638	-1,768	-21,893	-23,781	-23,529	-24,601
China, People's Rep. of	-389	-662	-6,489	-8,588	-8,794	-10,307
Korea, Rep. of	-845	1,947	2,693	4,139	4,447	6,016
India	-43	-2,542	-6,263	-7,260	-9,037	-11,133
Europe	4,498	-221	4,896	1,780	1,466	1,261
FSU	5,468	-2,458	-1,624	-655	-1,338	-1,998
World	-3,394	-11,781	-6,731	0	0	0

Source: World Bank, International Economics Department.

primary price, a regular price, and a special deal price. The list price is often not the actual price but rather a reference for negotiating discounts to buyers. Japan has two major pricing systems. The big buyer price is the discounted price given to large buyers such as the automobile industry; the dealer price is used mostly by Japanese mini-mills to sell their products to the residual market. However, the oligopolistic nature of the Japanese steel industry has resulted in domestic prices being almost twice as high as export prices. The EC steel pricing system is similar to that of the United States. Prices vary moderately from country to country within the EC. Given the substantial intra-EC trade in steel, intra-EC export prices can serve as a good indicator of the actual price level in the EC.

Three different export prices are generally considered as representative of the international market. They are: the spot export price, f.o.b., Antwerp; the German extra-EC export price, f.o.b.; and the Japanese export price, f.o.b., to non-US destinations. The German extra-EC export prices and the Japanese export prices are contract prices announced monthly. In a declining market, these prices often lag behind the Antwerp spot prices which change from week to week. Since most steel available at the Antwerp spot market comes from Germany, the Antwerp and German export prices are closely related. Since Japan was the largest steel exporter during the 1980s and its export prices were the lowest among the three, we take Japanese prices as the indicator prices of international steel trade.

High volatility in export prices. Japanese export prices for eight carbon steel products are used to calculate the World Bank steel price (WBSP) index. Products included are cold-rolled sheet, hot-rolled sheet, galvanized sheet, merchant bar, plate, section, wire rod, and re-enforcing bar. The weights are shares of each product in the total output of Japan, the United States, and Germany during the 1984-86 period. The WBSP index in constant terms has been declining from the peak reached in 1974; it has fluctuated widely both in current and constant dollar terms, particularly during 1973-77 and 1988-91. The coefficient of variation (c.v.) of the 5-year moving average of current dollar prices exceeds 20% in 5 of the 18 years (1973-91), with an average of 15%. The c.v. for constant dollar prices averages 11% for the 18-year period. The high volatility of steel prices reflects the highly competitive nature of the international steel market. Large fixed costs and excess capacity are predominant features of the steel industry. When domestic demand is weak, steel producers tend to maintain production levels and channel the excess supplies to exports. Since demand tends to weaken in countries simultaneously, exports can increase significantly, forcing export prices to plummet. The opposite can happen in the case of an economic upturn.

1990-91 decrease to continue until upturn in 1994. Table 8 presents the historical statistics and forecasts for the WBSP index and the associated Japanese export prices. Steel prices were riding a roller coaster from 1987 to 1989. The general metals price boom in 1988-89 pushed the WBSP up by a cumulative 38.3% in current dollar terms in the two-year period. Construction-related products such as merchant bars and re-enforcing bars enjoyed the largest price increases--by 45-50% in two years. Auto-industry related products such as cold-rolled and galvanized sheets came in second with 30-40% increases. Prices of general purpose products such as hot-rolled sheets, plates and wire rods increased 25-30%. During the 1990-91 period, the economic slowdown pushed steel product prices down acrosss the board. For example, galvanized sheet prices fell by 23.3% in two years, prices for sections and cold-rolled sheets by 16.3%, and the WBSP index by 14.5%.

Steel prices are expected to decline further in 1992, with falls ranging from 25.5% for sections to 4.7% for plates, resulting an aggregate 12.3% drop in the WBSP index. For 1993, continued declines in steel prices are expected, although only marginally (-2.8% for the WBSP index). The strong growth expected in the mid-1990s should contribute to an upturn in steel prices; the WBSP index is projected to increase by 11.4% in 1994. Among individual products, merchant bars, sections, re-enforcing bars and galvanized sheets are likely to enjoy higher price increases because they suffered larger losses previously. As can be seen from Figure 1, the projected long-term trend for the WBSP index over the 1995-2005 period is almost flat in constant terms.

Table 8: Steel Product Prices, a/ 1969-1991 (Actual) and 1992-2005 (Projected)

Year	World Bank Steel Index b/	CR Sheets	HR Sheets	Galv. Sheets	Merchant Bars	Plates	Sections	Wire Rod	Rebar
	(1990=100)	(current $/ton)							
Actual									
1969	26.5	126.9	107.5	155.9		108.0	130.4	99.3	
1970	30.5	154.2	134.2	169.3		106.0	137.1	129.0	
1971	27.9	135.9	112.2	169.4		105.9	127.8	116.5	
1972	29.8	147.7	110.6	173.0		130.8	129.2	129.3	
1973	45.5	233.3	165.8	255.0		211.3	195.4	183.8	
1974	66.2	299.2	245.0	353.3		363.3	269.2	325.4	
1975	52.1	228.8	216.3	296.0		237.9	227.5	248.3	
1976	54.1	260.6	221.1	328.4		217.5	227.9	227.5	
1977	53.1	256.3	217.5	311.3		216.7	229.5	228.3	
1978	68.2	314.1	276.3	412.8		290.4	308.0	284.2	
1979	76.3	365.0	298.3	448.7		340.0	332.9	315.8	
1980	79.1	380.3	323.1	472.8	342.5	341.7	357.5	351.7	330.8
1981	81.7	398.7	326.8	503.7	328.8	357.1	383.3	390.0	313.3
1982	70.4	367.9	281.7	425.0	258.3	309.2	333.3	353.3	242.5
1983	66.5	360.4	269.2	419.2	245.8	286.3	285.0	311.7	222.5
1984	70.2	377.1	284.7	455.0	266.4	305.1	293.3	308.8	233.3
1985	60.4	325.4	245.0	369.6	229.6	266.7	246.7	272.9	225.4
1986	61.5	324.6	268.8	383.7	229.2	285.0	247.9	238.8	219.6
1987	72.0	386.3	323.3	454.2	244.2	360.8	330.8	248.3	202.9
1988	94.1	501.2	395.8	625.8	370.4	432.5	433.3	313.8	262.5
1989	105.7	550.4	441.9	735.0	416.3	478.8	441.7	350.8	341.7
1990	100.0	511.7	411.3	634.2	412.9	458.8	438.3	362.9	364.2
1991	98.6	504.2	408.3	627.1	385.0	469.2	404.2	383.3	367.1
Projected									
1992	89.6	481.5	381.5	566.8	312.5	460.0	322.0	364.0	305.0
1993	90.5	486.4	385.4	572.5	315.7	464.7	325.3	367.7	308.1
1994	101.4	518.9	420.3	645.4	396.2	482.9	416.0	394.5	377.8
1995	102.6	524.9	425.2	652.9	400.9	488.5	420.8	399.1	382.2
2000	124.0	634.2	513.6	788.8	484.3	590.1	508.4	482.2	461.8
2005	142.9	731.1	592.1	909.4	558.3	680.4	586.1	555.9	532.3

a/ Steel prices are f.o.b. Japan excluding shipments to China and the United States. All products items refer to base size: cold-rolled coil/sheet, hot-rolled coil/sheet, galvanized iron sheet, merchant bars, medium plates, H-shape sections, wire rod, concrete reinforcing bars (rebars).

b/ Composite steel price index is a weighted average price index (1990=100) based on available data for products given in the table. Weights used are shares of apparent consumption of each product in the Federal Republic of Germany, Japan and the United States during the period 1984-86.

Source: Japan Metal Bulletin; Commodities Research Unit LTD, CRU Metal Monitor (actual); World Bank, International Economics Department (projected).

Table A1: Steel (Crude Equiv.) - Production By Main Countries and Economic Regions

Countries/ Economies	Actual				Projected						Growth Rates a/		
	Averages												
	1969-71	1979-81	1990	1991 b/	1992	1993	1994	1995	2000	2005	1961-90	1970-90	1991-2005
	('000 Tons)										(% p.a.)		
High-Income	388,478	412,081	383,782	369,572	363,375	362,936	373,562	373,559	388,983	407,453	1.0	-0.8	0.7
OECD	387,770	407,753	372,638	357,271	352,086	351,344	361,834	361,530	375,487	392,689	0.9	-0.9	0.7
United States	118,907	111,586	88,900	79,203	77,970	76,746	80,036	78,980	78,870	78,224	-1.1	-2.5	-0.1
Germany	54,430	51,096	44,000	42,169	39,748	39,934	41,763	42,015	44,942	47,975	0.1	-1.4	0.9
France	23,042	22,598	19,015	18,434	18,419	18,392	18,893	18,875	19,693	20,392	-0.1	-1.7	0.7
United Kingdom	26,316	16,105	17,841	16,474	16,149	16,182	16,296	16,344	16,539	16,580	-1.9	-2.5	0.0
Italy	17,052	25,176	25,510	25,007	24,135	23,378	23,920	24,477	26,444	28,549	3.3	1.2	0.9
Japan	88,015	108,273	110,331	109,649	106,173	106,680	109,402	109,664	115,214	122,369	4.1	0.2	0.8
LMICs	201,205	311,199	385,923	364,162	360,180	369,613	378,932	389,489	439,291	488,140	4.3	3.3	2.1
Americas	13,108	27,928	38,587	39,341	42,325	44,152	45,891	47,546	49,442	50,616	7.3	6.2	1.8
Brazil	5,437	14,152	20,567	22,617	25,088	25,725	26,389	27,008	30,183	33,463	8.9	8.0	2.8
Asia & Pacific	27,732	61,994	118,383	127,071	131,853	137,759	143,468	149,209	176,573	202,045	7.5	7.6	3.3
China, People's Rep.	18,333	35,736	66,349	70,436	72,188	75,104	77,600	80,401	93,398	105,556	7.0	6.6	2.9
Korea, Rep. of	442	8,974	23,125	26,001	28,999	30,129	31,380	32,498	38,124	43,506	23.7	21.8	3.7
India	6,311	10,135	14,963	16,394	17,063	17,441	18,062	18,487	20,578	22,933	3.8	4.4	2.4
Europe	154,481	208,638	212,671	179,301	171,126	172,474	175,007	178,274	194,581	212,563	3.0	1.7	1.2
FSU	115,613	148,512	154,414	132,666	128,527	128,033	129,924	132,277	144,113	157,150	2.7	1.4	1.2
World	589,682	723,280	769,704	733,734	723,555	732,549	752,494	763,048	828,274	895,592	2.4	1.0	1.4

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: International Iron and Steel Institute (actual);
World Bank, International Economics Department (projected).

Table A2: Steel (Crude Equiv.) - Apparent Consumption By Main Countries and Economic Regions

Countries/ Economies	Actual: Averages 1969-71	Actual: Averages 1979-81	Actual: 1990	Actual: 1991 b/	Projected: 1992	Projected: 1993	Projected: 1994	Projected: 1995	Projected: 2000	Projected: 2005	Growth Rates a/: 1961-90	Growth Rates a/: 1970-90	Growth Rates a/: 1991-2005
	('000 Tons)										(% p.a.)		
High-Income	372,269	379,625	379,101	354,277	346,394	347,138	357,562	358,452	374,409	390,565	0.9	-0.7	0.7
OECD	369,583	368,848	358,128	341,631	330,772	331,285	341,327	341,987	356,499	371,431	0.7	-0.9	0.6
United States	131,216	127,682	102,480	91,083	90,629	91,768	94,371	92,950	90,486	87,723	-0.5	-1.9	-0.3
Germany	56,418	51,532	39,550	38,536	37,548	37,938	38,671	39,137	40,612	42,652	-0.4	-2.1	0.7
France	22,252	19,449	18,076	16,775	16,038	16,025	15,990	15,981	16,441	16,811	-0.2	-2.3	0.0
United Kingdom	23,549	17,433	16,690	15,321	14,957	14,895	15,458	15,414	15,916	16,209	-1.4	-2.5	0.4
Italy	19,387	23,866	28,532	27,799	25,614	25,889	26,673	26,952	29,016	30,970	2.6	1.2	0.8
Japan	63,063	76,102	99,032	95,826	90,607	91,159	92,587	92,209	95,367	103,751	4.0	1.2	0.6
LMICs	220,807	355,436	403,565	379,457	377,161	385,411	394,932	404,595	453,866	505,027	4.3	3.0	2.0
Americas	19,755	34,117	27,313	27,774	29,846	30,522	30,928	31,038	31,977	32,856	4.3	1.3	1.2
Brazil	6,335	13,048	10,197	11,197	12,440	12,594	12,853	12,946	13,509	14,047	5.8	2.2	1.6
Asia & Pacific	36,370	79,062	138,188	150,728	156,484	162,143	167,389	172,990	200,103	226,646	7.3	7.2	2.9
China, People's Rep.	21,422	42,356	68,832	77,688	81,373	84,386	86,090	88,989	102,192	115,863	7.4	6.9	2.9
Korea, Rep. of	1,287	7,027	21,650	22,999	24,421	25,791	27,105	28,359	33,677	37,490	17.7	14.1	3.5
India	6,714	12,677	21,700	23,019	23,672	24,344	25,036	25,747	29,616	34,066	4.4	5.6	2.8
Europe	149,983	210,848	207,656	175,090	169,068	170,253	173,345	176,494	193,115	211,301	3.1	1.6	1.3
FSU	110,145	150,970	156,403	134,134	128,875	128,232	130,561	132,932	145,451	159,149	3.0	1.6	1.2
World	593,076	735,061	782,666	733,734	723,555	732,549	752,494	763,048	828,274	895,592	2.4	1.0	1.4

a/ Least squares trend for historical periods (1961-90); end-point for projected periods (1991-2005).
b/ Estimate.

Sources: International Iron and Steel Institute (actual);
World Bank, International Economics Department (projected).

Lead and Zinc

Summary

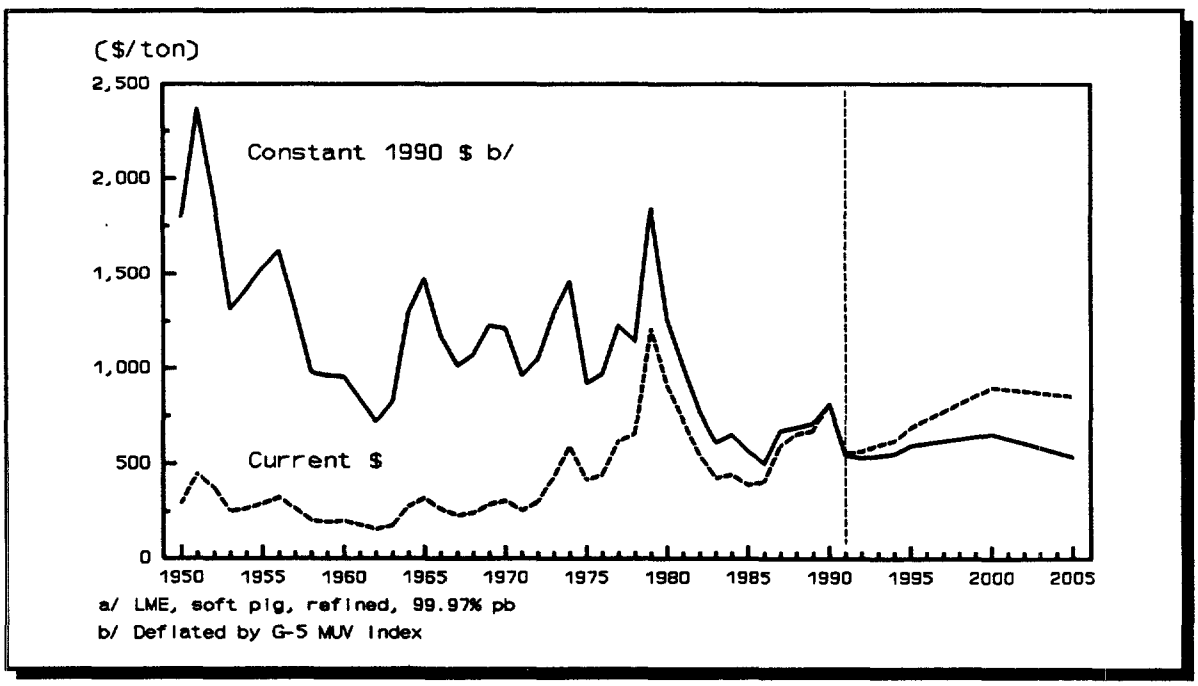
- Since lead prices troughed in the first quarter of 1992 they have recovered somewhat, but, barring major supply disruptions, the short-term outlook is for little or no increase because of the expectation of significant excess supplies.

- Zinc prices troughed in the third quarter of 1991 and have increased by about 32% since then, mostly because of speculative activity. Their short-term outlook is also flat.

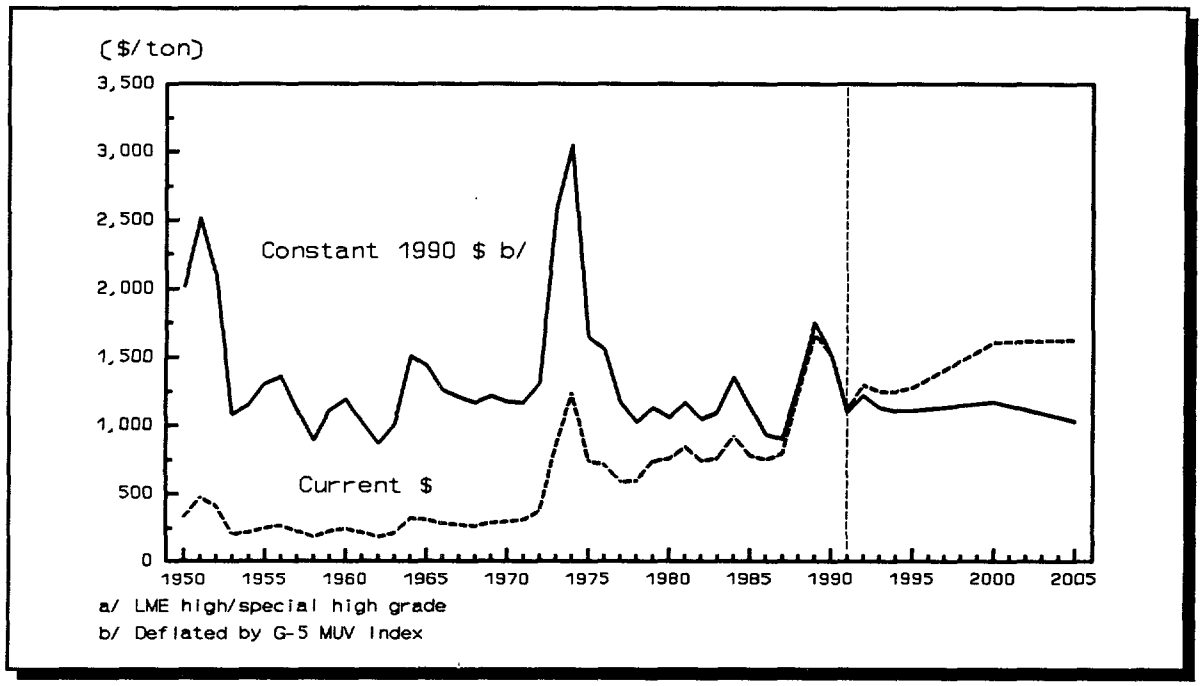
- Demand growth is likely to be constrained by the sluggish US economic recovery and recessions in Japan and Germany. Prices, however, are not likely to decline much from the current low levels.

- 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.

Lead Prices a/, 1950-2005



Zinc Prices a/, 1950-2005



Demand Outlook

New uses for lead boost demand. Since about two thirds of lead consumption is in automotive batteries, the demand outlook for lead depends critically on automobile production and the number of registered vehicles. However, promising new uses of lead have been found and their importance has been growing in the past several years. These include large-capacity industrial batteries for power storage and industrial vehicles and applications in nuclear safeguards. In major industrial and developing countries representing 70% of world consumption, lead consumption in batteries and shot/ammunition increased over the 1985-90 period at 4.7% p.a. All other uses (cable sheathing, rolled and extruded products, alloys, pigments and other compounds, and gasoline additives) experienced declines. Total lead consumption in these countries increased at 2.7% p.a. during this period.

Strong demand for zinc in galvanizing. Zinc's main market (47% in 1990) is in galvanizing steel products for corrosion protection; rolled zinc sheet and strip, brass, and zinc diecastings are also important uses. The galvanizing market increased the fastest over the 1985-90 period in the major industrial and developing countries, at 4.7% p.a. compared with 2.8% p.a. growth for total zinc consumption. Hence, the share of the galvanizing market increased, while shares of other uses either declined slightly or remained flat.

Automobile changes favor both lead and zinc demand. Between 1986 and 1991, world lead and zinc demand received moderate boosts from developments in the automobile industry. In the case of lead, downsizing of batteries had more or less run its course by the mid-1980s and therefore changes

in automobile production and stocks led to corresponding changes in lead demand for batteries. Furthermore, the trend to greater use of electronic equipment in cars required more powerful batteries. In the case of zinc, the greater quality competition among automobile manufacturers led to more corrosion protection and therefore greater demand for galvanized steel.

Modest growth in lead market expected. The industrial economies' demand for original equipment and replacement batteries for automobiles is expected to grow at a slightly lower rate in the 1991-2005 period than over the preceding 15 years. In most of the high-income countries, the automobile stock is reaching saturation level in terms of per capita ownership, pollution emission, and parking space. In most developing countries, however, automobile ownership is in its infancy and will increase quickly as per capita incomes grow. Lead consumption for batteries is expected to continue to increase at a robust pace in the forecast period, although not as fast as in the 1985-90 period. Environmental constraints will exert greater pressure on most other uses of lead, particularly for gasoline additives in LMICs. On the other hand, continued expansion of industrial applications and technological improvements in lead acid batteries are expected to allow total lead consumption to grow at moderate rates. We project that world lead consumption should grow at around 1.3% p.a. during the 1991-2005 period.

Intense research and development has been directed at improving batteries capacity and efficiency with a view to eventual use in electric motor vehicles. The latest development involves a battery which is a composite of different metals, use of which considerably shortens the recharging time and extends the peak output and range. This development may signal the introduction of viable electric cars earlier than previously expected.

Environmental concerns continue to restrict some lead uses. Restrictions on lead use for environmental reasons are intensifying in both the high-income and developing countries. Four bills relating to lead use are under consideration in the United States. These laws, if enacted, will further restrict lead use in soders, alloys, and chemicals, and encourage recycling of lead batteries. In many developing countries, the use of lead in gasoline, paints, and soders is still prevalent. These uses will come under strong pressure which will moderate demand growth rates in these countries.

Zinc outlook moderate but vulnerable. World zinc consumption is expected to increase at 1.4% p.a. in the 1991-2005 period, a rate slightly higher than in the 1970-91 period. Zinc demand is highly sensitive to fluctuations in industrial activity and vulnerable to substitution by other materials in the medium term. It should be kept in mind, therefore, that zinc consumption could experience wide fluctuations over the forecast period and its long-run consumption growth could be significantly lower if prices remain high over an extended period.

Supply Outlook

Lead and zinc are produced mostly as joint products; about 60% of the market economies' lead and zinc output is derived from ores containing both lead and zinc, often together with silver and copper, and sometimes gold. In 1987, for each ton of zinc produced, the market economies' lead and zinc mines produced as joint products 0.42 tons of lead, 1.20 kg of silver and 0.11 tons of copper. Because of this joint production, decisions about investment in lead and zinc mining are complicated by the different market outlooks for the various metals vis-a-vis the metal content of the deposits. With the poor market prospects for lead over the last 15 years, deposits consisting mostly of lead were rarely considered economic. However, lead deposits with significant silver content have been attractive, in which case lead

Table 1: Cash Production Costs for Lead and Zinc

	1987	1989	1990
	($/ton)		
Lead			
United States	412	340	423
Mexico	293	364	483
Peru	426	437	540
Australia	421	421	540
Canada	485	567	628
Zinc			
United States	745	1,131	946
Mexico	553	1,019	959
Peru	673	1,120	1,023
Australia	686	1,129	1,032
Canada	639	1,133	1,039

Source: Brook Hunt and Associates Ltd.

is treated as a by-product. It has, therefore, become rare to develop lead-only mines; they are confined mostly to Morocco, South Africa, and the United States. Over the years, lead and zinc mining has gradually shifted to deposits that contain more zinc relative to lead, unless otherwise justified by the presence of silver or gold. Lead production has been almost "involuntary."

Lead and zinc production costs have increased substantially since the mid-1980s largely due to exchange rate movements and increases in smelter charges. Table 1 shows estimates of cash production costs for primary lead and zinc for the major producing countries. The United States emerged as the lowest cost producer of lead and zinc, thanks to the depreciation of the US dollar and the start-up of the large low-cost Red Dog mine in Alaska. The changes in costs reveal their dependence on market prices, as mine costs of lead and zinc are often allocated between the two on the basis of their revenue shares.Furthermore, labor costs and smelter charges closely follow changes in product prices and hence in industry profits.

Costs expected to fall as prices remain low. Today's low market prices are expected to reverse the recent increases in lead and zinc costs. It is estimated that lead and zinc costs will decline by about 10% over the 1990-95 period, for the existing mines as well as for new mines expected to come on-stream during the period. On a total cost basis that includes capital charges, the average cost of production by 1995 for the operating and expected new mines is estimated at $600/ton for lead and $1,100/ton for zinc. About 90% of all lead and zinc production expected by that time will have total costs at or below $730/ton for lead and $1,320/ton for zinc.

Potential for new mine and smelting capacity. During the 1991-96 period, lead mine projects expected to be completed total 159,000 tons, most of it in conjunction with zinc. In 1991, there was a large gross addition to lead smelting capacity--93,000 tons in primary smelting and 119,500 tons

in secondary smelting. By the mid-1990s, ten lead smelters are expected to come on-stream, with a total capacity of 202,000 tons. World zinc mine capacity was pared down significantly in 1991--permanent and temporary closures exceeded additions by 141,500 tons. However, effective zinc mine capacity as of the end of 1991 stood at 13% above actual 1991 production. During the period 1991-96, zinc mine projects that are considered firm add up to 628,000 tons. Zinc smelter capacity increased by a wide margin in 1991; net smelter capacity additions amounted to 175,000 tons in 1991, and the largest for a single year since 1984. New zinc smelters and expansions to existing ones expected to come on-stream by 1996 total 328,000 tons, including a 100,000 ton smelter in China. Over the long term, to the year 2000 and beyond, the lead and zinc industry has no shortage of potential new projects that could be developed and brought into production.

Price Outlook

Market depressed by recession. Lead and zinc prices dropped to record low levels in constant dollar terms in the recent past. The decline was caused by weak demand, particularly in the automobile sector, and increased supplies. The excess of supplies over demand was exacerbated by increased exports from the FSU and Eastern Europe, estimated at 128,000 tons for lead metal and 143,000 tons for zinc over a two-year period (1990-91). Prior to 1990, the FSU and Eastern Europe had been net importers of these metals. Over the same two-year period, total commercial stocks of lead in the market economies increased by 81,000 tons and zinc by 65,000 tons. At 5.5 to 6.5 weeks' consumption, the current stock levels are high compared with those in 1987-88, but not unusually high. However, most of the increased stock converged on the LME warehouses. Fluctuations in the exchange stocks have immediate market impact.

Over the short term, lead and zinc prices are not likely to deviate much from the low levels of the recent past. This expectation is based on the assessment that the current market imbalance (excess supplies over demand) is likely to persist for the next two to three years. Net exports from the FSU and Eastern Europe are likely to continue at levels only slightly lower than in 1991. The likelihood of demand increases absorbing the anticipated increases in supplies is small.

Real gains from mid-1990s. The market balance is expected to improve by the mid-1990s, as demand increases catch up with production capacity. Lead and zinc prices, therefore, are projected to gain in real terms by 1995. Assuming that net exports of lead and zinc from the FSU and Eastern Europe will decline to zero by 1996 and that the anticipated increases in smelter capacities all materialize without any closures of existing ones, the market will achieve exact supply/demand balance if demand grows at 1% p.a. for lead and at 1.9% p.a. for zinc over the 1991-96 period. If one half of the gross additions to smelter capacities are offset by closures of old smelters, the anticipated smelter capacity increases can support demand increases of 0.6% p.a. for lead and 1.3% for zinc. We expect lead and zinc demand to grow at 1.0-1.5% p.a. during the 1990s. Thus, based on the available information, one must conclude that market balance will be restored by or before 1996, probably earlier for lead than for zinc.

Production costs to fall in long term. For the long term, lead and zinc prices are on average expected to closely reflect the costs of production. Although new greenfield lead and zinc projects have gradually moved to more hostile environments in recent years (e.g., the Red Dog mine in Alaska), their total costs of production have tended to be lower than the existing facilities. For example, the total production cost of the Red Dog mine in 1991 is estimated at $840/ton for zinc and $570/ton for lead. The

Cayeli copper/zinc project in Turkey is expected to have total costs in the neighborhood of $950/ton for zinc in 1995. A similar cost structure is expected for the Iscaycruz project in Peru. Thus, new projects to come on-stream in the latter half of the 1990s should have favorable cost structures in relation to existing mines in order to justify project viability in a more competitive environment. We forecast that lead and zinc prices for the years 2000 and 2005 should average about $600/ton for lead and $1,100/ton for zinc in constant 1990 dollars.

Table A1: Lead - Prices, 1950-91 (Actual) and 1992-2005 (Projected)

	($/ton)					
			1990 Constant $			
	Current $		G-5 MUV a/		G-7 CPI b/	
	US c/	LME d/	US c/	LME d/	US c/	LME d/
Actual						
1950	293	293	1,794	1,794	2,363	2,363
1951	386	446	2,050	2,369	2,809	3,246
1952	363	372	1,839	1,885	2,533	2,596
1953	297	252	1,548	1,314	2,055	1,744
1954	310	265	1,653	1,413	2,113	1,806
1955	334	292	1,748	1,528	2,269	1,984
1956	353	321	1,783	1,621	2,347	2,134
1957	323	266	1,598	1,316	2,101	1,731
1958	267	201	1,299	978	1,705	1,284
1959	269	195	1,327	962	1,721	1,248
1960	263	198	1,271	957	1,651	1,243
1961	240	176	1,140	836	1,472	1,080
1962	212	154	987	717	1,265	919
1963	245	174	1,163	826	1,416	1,006
1964	300	278	1,400	1,297	1,690	1,566
1965	353	318	1,635	1,473	1,927	1,736
1966	333	262	1,490	1,173	1,758	1,383
1967	309	229	1,367	1,013	1,590	1,179
1968	291	240	1,300	1,072	1,457	1,202
1969	328	289	1,390	1,225	1,574	1,387
1970	344	304	1,372	1,212	1,556	1,375
1971	305	254	1,154	961	1,292	1,076
1972	331	302	1,149	1,048	1,271	1,160
1973	359	430	1,076	1,289	1,206	1,445
1974	497	593	1,222	1,458	1,508	1,799
1975	474	417	1,048	923	1,280	1,126
1976	509	445	1,111	971	1,330	1,163
1977	677	617	1,345	1,226	1,601	1,459
1978	742	661	1,281	1,141	1,432	1,276
1979	1,160	1,208	1,768	1,841	2,115	2,203
1980	936	906	1,301	1,259	1,526	1,477
1981	805	727	1,114	1,006	1,302	1,176
1982	562	546	790	767	921	894
1983	478	425	687	612	771	686
1984	563	444	827	652	910	718
1985	420	391	612	570	666	620
1986	486	406	601	502	638	533
1987	792	597	891	672	921	694
1988	819	656	859	688	884	708
1989	868	673	917	711	942	730
1990	1,015	811	1,015	811	1,015	811
1991	738	558	723	546	702	530
Projected						
1992		565		530		506
1993		600		543		519
1994		620		551		524
1995		690		597		567
2000		900		656		613
2005		850		539		484

a/ Deflated by G-5 Manufacturing Unit Value (MUV) Index.
b/ Deflated by G-7 Consumer Price Index (CPI).
c/ Pig, common grade, domestic producer price, New York.
d/ Soft pig, refined, 99.97% pb, London Metal Exchange.

Sources: Engineering and Mining Journal, Metallgesellschaft, Metal Statistics, and Metals Week (actual); World Bank, International Economics Department (projected).

Table A2: Zinc - Prices, 1950-91 (Actual) and 1992-2005 (Projected)

	($/ton)					
			1990 Constant $			
	Current $		G-5 MUV a/		G-7 CPI b/	
	US c/	LME d/	US c/	LME d/	US c/	LME d/
Actual						
1950	317	328	1,941	2,009	2,556	2,645
1951	408	473	2,167	2,512	2,969	3,443
1952	369	412	1,870	2,088	2,575	2,875
1953	250	207	1,303	1,079	1,730	1,433
1954	247	216	1,317	1,152	1,684	1,472
1955	282	250	1,476	1,308	1,916	1,698
1956	308	269	1,556	1,359	2,048	1,789
1957	262	225	1,296	1,113	1,705	1,464
1958	238	182	1,158	885	1,520	1,162
1959	263	226	1,297	1,115	1,683	1,446
1960	297	247	1,435	1,193	1,864	1,551
1961	265	214	1,259	1,017	1,626	1,313
1962	267	185	1,244	862	1,593	1,104
1963	276	212	1,311	1,007	1,595	1,225
1964	310	324	1,446	1,512	1,746	1,825
1965	331	311	1,533	1,440	1,807	1,698
1966	331	282	1,481	1,262	1,748	1,489
1967	316	273	1,398	1,208	1,626	1,405
1968	309	262	1,380	1,170	1,547	1,312
1969	333	287	1,411	1,216	1,598	1,377
1970	349	295	1,391	1,176	1,578	1,334
1971	356	309	1,347	1,169	1,508	1,309
1972	391	377	1,357	1,309	1,502	1,448
1973	455	851	1,363	2,550	1,529	2,860
1974	793	1,239	1,950	3,047	2,406	3,759
1975	859	743	1,900	1,643	2,320	2,006
1976	823	712	1,796	1,554	2,151	1,861
1977	758	591	1,506	1,174	1,792	1,397
1978	683	593	1,179	1,024	1,318	1,144
1979	822	742	1,253	1,131	1,499	1,353
1980	825	761	1,146	1,057	1,345	1,241
1981	982	846	1,359	1,171	1,588	1,368
1982	848	745	1,192	1,047	1,389	1,221
1983	912	764	1,312	1,099	1,471	1,233
1984	1,072	922	1,575	1,355	1,734	1,491
1985	890	783	1,297	1,141	1,410	1,241
1986	838	754	1,036	932	1,101	990
1987	924	799	1,040	899	1,074	929
1988	1,327	1,242	1,392	1,303	1,433	1,341
1989	1,808	1,659	1,910	1,753	1,961	1,800
1990	1,644	1,513	1,644	1,513	1,644	1,513
1991	1,163	1,117	1,139	1,094	1,106	1,063
Projected						
1992		1,300		1,220		1,164
1993		1,250		1,131		1,081
1994		1,250		1,110		1,056
1995		1,280		1,107		1,051
2000		1,610		1,173		1,097
2005		1,630		1,034		929

a/ Deflated by G-5 Manufacturing Unit Value (MUV) Index.

b/ Deflated by G-7 Consumer Price Index (CPI).

c/ Domestic producer price. Prior to January 1991, high grade/Prime Western, include small amount of other grades; thereafter special high grade.

d/ London Metal Exchange. For years up to 1984, Good Ordinary Brand, or standard grade for zinc content of 98% or better; 1985-89, high grade, minimum 99.95% zn; from 1990 onward, special high grade, minimum 99.995% zn.

Source: Metals Week, Metallgesellschaft, Metal Statistics, Engineering and Mining Journal (actual); World Bank, International Economics Department (projected).

Gold

Summary

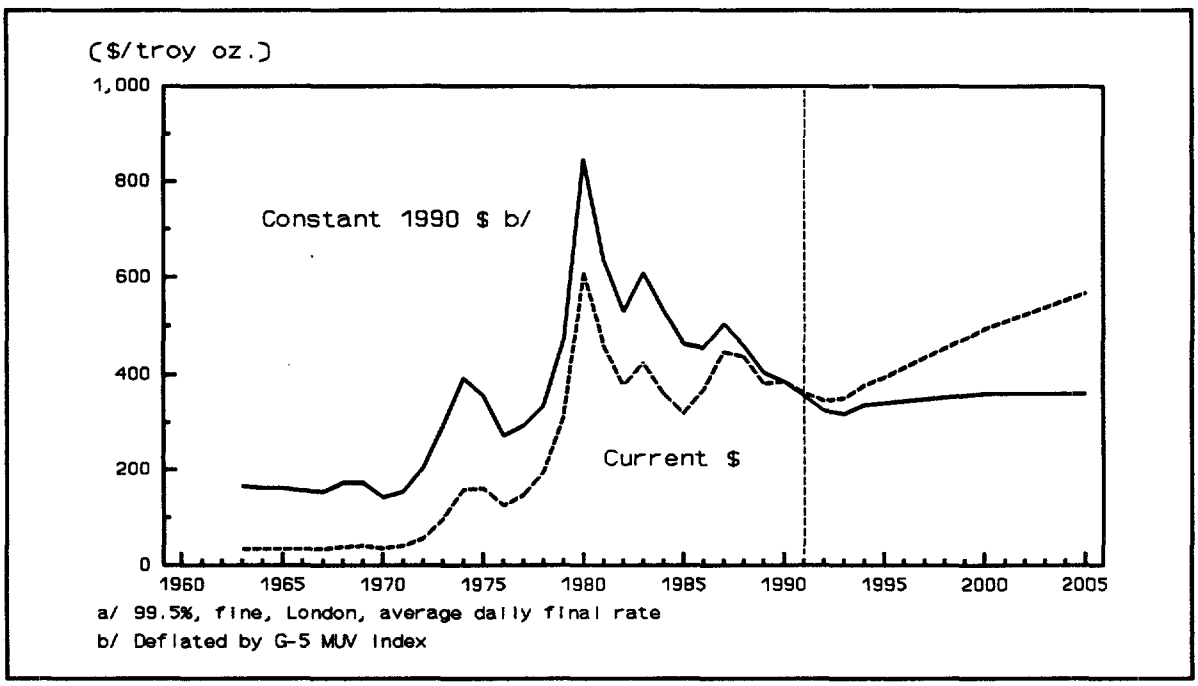
- After having fallen for five years, gold prices seem to be near their cyclical bottom and real price increases are expected in the medium term.

- Real price increases are expected to take place in a market where fabrication demand growth is around 1.5% p.a., the rate of expansion of supplies is projected to slow down, and Central Bank disposals are not expected to upset the market greatly.

- Gold mine production growth has slowed since 1989. Production is expected to stagnate in 1992 and 1993 before rising at a much slower pace. For the largest producer, South Africa, mine output is expected to recover only as prices rise and political instability diminishes.

- Gold fabrication demand, especially in jewelry, is projected to continue steadily during the forecast period, while investment demand is expected to increase markedly only in circumstances of political and economic disturbances which are largely unpredictable.

Gold Prices a/, 1960-2005



Price Outlook

Gold price at cyclical bottom in mid-1992. There are four key components in the gold market that collectively set price levels and trends: total new supply, fabrication demand, private investment demand, and official sector transactions. These variables in turn respond mainly to expected changes in inflation rates, financial market conditions, and interest rates.

Three of these four components have had a negative impact on gold prices in the late 1980s and early 1990s. First, total supply has been rising sharply, fueled by increasing mine production and higher exports from the FSU; second, there have been consistent net disposals by central banks; and finally, investors have had reduced enthusiasm for gold, given low inflation, high real interest rates, attractive alternative investments, and a perception that mine companies and the FSU were supplying too much metal to the market. The fourth factor, fabrication demand, generally rose throughout this period, a trend supportive of gold prices, but not sufficiently forceful to counter the negative price implications of the other three factors. Nominal prices consequently fell 32.5% from a peak of $497.10/oz in late 1987 to $335.30/oz in early 1992. There are reasons to believe that the price level of around $335/oz in mid-1992 is near a cyclical bottom, after five years of declining prices.

For the projection period, the outlook is more balanced. Fabrication demand should grow moderately. In the four decades after 1950, the compound growth rate of gold fabrication demand was 4.5% p.a., although in the 20 years from 1970 to 1990, fabrication demand grew at a 2.6% p.a. rate, as prices rose sharply in a post-Bretton Woods adjustment period. The rate of growth projected for fabrication demand for the next 13 years are below historical growth trends, at around 1.5% p.a.

Supply meanwhile has ceased increasing at the fast pace of the late 1980s. The growth rate of newly-refined gold supplies entering the market has slowed from a 5.4% p.a. average in 1988-89 to 2.6% p.a. in 1990 and 1991. A further reduction in the rate of expansion of gold supplies, including scrap recovery and exports from the FSU, is projected.

Real prices to increase in medium term as demand grows and supply stalls. These two factors alone would be sufficient to push real prices up moderately over the next five to ten years. But in addition, investment demand can be expected to increase at times during the forecast period in the event of political changes and economic disturbances such as high inflation and financial and currency market instability caused by cumulative fiscal and trade imbalances.

In order to stimulate sufficient supplies to meet projected fabrication and investment demand in the late 1990s, we expect real prices to increase. (These real price increases are unlikely to be greatly affected by possible higher central bank sales.) Higher real gold prices should stimulate higher secondary recovery of gold from scrap as well as keeping mine production near recent high levels. Mine production in Russia and the other FSU republics is expected to recover from the declines in recent years and possibly reach new highs by the end of the century, especially with an infusion of capital and technology from the market economies.

The projected rates of growth in mine production, total supply, and fabrication demand might appear low, but they are supported by a number of factors at work in the market. First, mine output growth is expected to be restrained by cutbacks and closures of existing mines, increased investor wariness towards major capital expenditures, and capital constraints for gold-mining ventures. Next, total

supply growth is likely to be restrained by the slow restructuring of mine production in the economies of South Africa, Eastern Europe, and the FSU and by the reduced profitability of recycling gold from redundant electronic equipment and other scrap. Finally, the rate of increase in fabrication demand is expected to be restrained by a combination of lower expectations of income growth in industrial countries, a shift away from heavy dependence on gold jewelry as a form of savings in some developing countries, and "portfolio saturation" among recent heavy buyers of gold jewelry in industrial countries. All of these factors have been present in the market during the early 1990s, and thus the projections here represent a continuation of trends currently unfolding, not a reversal. It should be noted that our projections for slower growth in mine production and total supply, are in contrast to some analysts' perceptions that supplies could decline over the forecast period--the information we have available does not support such a radical forecast.

Supply Outlook

The total supply of gold rose sharply in the past several years--from less than 50 million ounces per year in 1982-84 to 76.1 million ounces in 1991. Total supply consists of mine production (72% in 1991), secondary recovery from old scrap (15%), and net sales from the FSU, Eastern Europe, and centrally planned Asia (13%).

Over the period 1971-91, total supply rose at a 3% p.a. rate, while mine production rose at a 1.3% p.a. rate. However, since 1977, the compounded growth rate of total supply was 3.3% p.a., while that of mine production was 4.3% p.a.--illustrating the tremendous increase in gold mining stimulated by the sharp increase in gold prices in 1979-80, and the fact that prices have remained above $300/oz for most of the subsequent 12 years.

Over the forecast period, the rate of expansion of total gold supplies is projected to slow considerably. Between 1990 and 2005, total supply is projected to increase at a 1.2% p.a. rate, reaching 88.9 million ounces by the end of the forecast period. The growth in mine production is projected to slow even more dramatically, possibly to less than 1% p.a..

MINE PRODUCTION. ***Widespread restructuring causes fall in growth of mine production.*** In the late 1980s, mine production rose at a very fast pace, in excess of 6% p.a. This illustrates the considerable lag in production in response to a price increase--a number of major projects conceived in the early 1980s in response to higher gold prices, were brought into production only in the late 1980s. In 1988, mine production rose 12.8% to 47.4 million ounces, in 1989 the rate of increase was 8.6%, in 1990 it slowed to 3.7%, and in 1991 to 2.5%. In 1992, the rate of expansion may be no more than 0.3%, and in 1993 total gold mine output may be roughly unchanged from 1992 levels. Beyond 1993, mine production is projected to begin rising again, although at a much slower pace than was experienced in the 1980s.

South Africa remains the largest gold-producing country by a wide margin. In 1991, South African output totaled 19.3 million ounces. The United States has become the second largest producer, at 9.3 million ounces. While South African production has fallen in recent decades, it has stabilized in recent years and is much higher than market observers previously expected. It may decline in the middle of the 1990s as many of the mines in South Africa are experiencing severe cash-flow problems--more than one eighth of South Africa's present production capacity was operating at a loss as of the middle of 1992. Several mines have closed and cutbacks have occurred at others. Some mines

have redesigned their mining plan, raising their average head grade and thus increasing production in the short term. Other new projects, some designed as replacement capacity, have been postponed indefinitely, awaiting gold prices high enough to warrant the massive capital investments necessary, as well as of an improved political outlook for South Africa. Depending on the economic and political outcome of the current South African transition process, it is possible that South Africa could see a rejuvenation of its gold mining industry by the turn of this century, with total gold output rising again.

Another country where gold production had been expected to decline was Australia. Australia's gold production rose extremely rapidly in the 1980s, however, from 867,000 ounces in 1982 to 7.9 million ounces in 1990. In 1991, the government altered the tax regime, imposing income taxes on gold mining profits. As a result of this, and the simultaneous decline in gold prices, the Australian gold mining industry has been restructured. Even so, production has held up reasonably well and is expected to stabilize at around 7.4 million ounces per year. Initially, Australia's gold production was expected to decline precipitously as a result of these developments. There have been a few closures in the past two years, but the major trend has been the consolidation of mining interests, rather than the closure of mines. Thus, there remains a large base of gold-mining companies in Australia, in possession of established, profitable gold-mining operations and resources. These mines should continue to operate for at least the next eight years. Some are expected to face diminishing ore reserves, but new mines are being developed or planned to replace the depleted operations.

Given the extended period of relatively low gold prices, exploration and development efforts have fallen worldwide in recent years. One survey showed that there were 143 gold mine developments or expansion programs in progress in 1988, but by 1992 the total had fallen to 53 projects. While the pace of new developments has slowed, it nonetheless continues, indicating the continuation of incremental increases in gold production capacity for several years to come.

New projects are in progress in many countries. In Ghana, once a major producer, the gold mining industry is being revived. Production has risen from 287,000 ounces in 1984 to 845,000 ounces in 1991, with further increases projected for the next several years. Papua New Guinea has been the site of several major new mining projects, boosting output from 564,000 ounces in 1982 to nearly 2 million ounces in 1991. Indonesia also has seen some major developments, with production rising from 72,000 ounces in 1982 to 828,000 ounces in 1991. Further significant increases in Indonesia's output are projected for the mid-1990s. Other countries showing significant increases in output include Chile while numerous countries have reported smaller increases in production.

SECONDARY RECOVERY. ***Secondary recovery continues to be highly price-elastic.*** The recovery of gold from old electronic equipment, dental alloys, and, most important, jewelry and decorative items, increased sharply in the late 1970s, in line with the rise in gold prices. Scrap recovery totaled 4.5 million ounces in 1977, the first year for which such statistics are available. As gold prices doubled in 1979, so did secondary recovery, to 10.9 million ounces. Gold prices doubled again the following year, and secondary recovery once more doubled, to 21.2 million ounces. After that, gold prices and scrap recovery rates both subsided. Since 1981 secondary recovery of gold has ranged between 9 and 13 million ounces on an annual basis. Secondary recovery rates are expected to continue to be highly price-elastic so that when gold prices rise, as projected, secondary recovery of gold also would be expected to increase.

FSU PRODUCTION. ***FSU production expected to return to previous peak.*** FSU production is estimated to have fallen from more than 10 million ounces per year in the middle of the

1980s to around 7.2 million ounces in 1991. Russia is estimated to have accounted for nearly two thirds of this output, with Kazakhstan and Uzbekistan producing much of the remainder. Even as mine output was declining, however, exports rose. Some of these exports were drawn from government reserves of refined bullion.

Over the forecast period, gold mining in the FSU is expected to undergo a transformation to new levels of efficiency and output, aided by the introduction of capital and technology from the market economies. Already in 1992, several major joint-venture agreements have been announced, and many major mining companies are examining deposits and negotiating joint-venture programs. It is possible that by the end of the century mine production in the FSU will exceed the previous peak of 10 million ounces per year. Beyond the mid-1990s, increasing mine production from new projects can be expected to support an increase in total shipments.

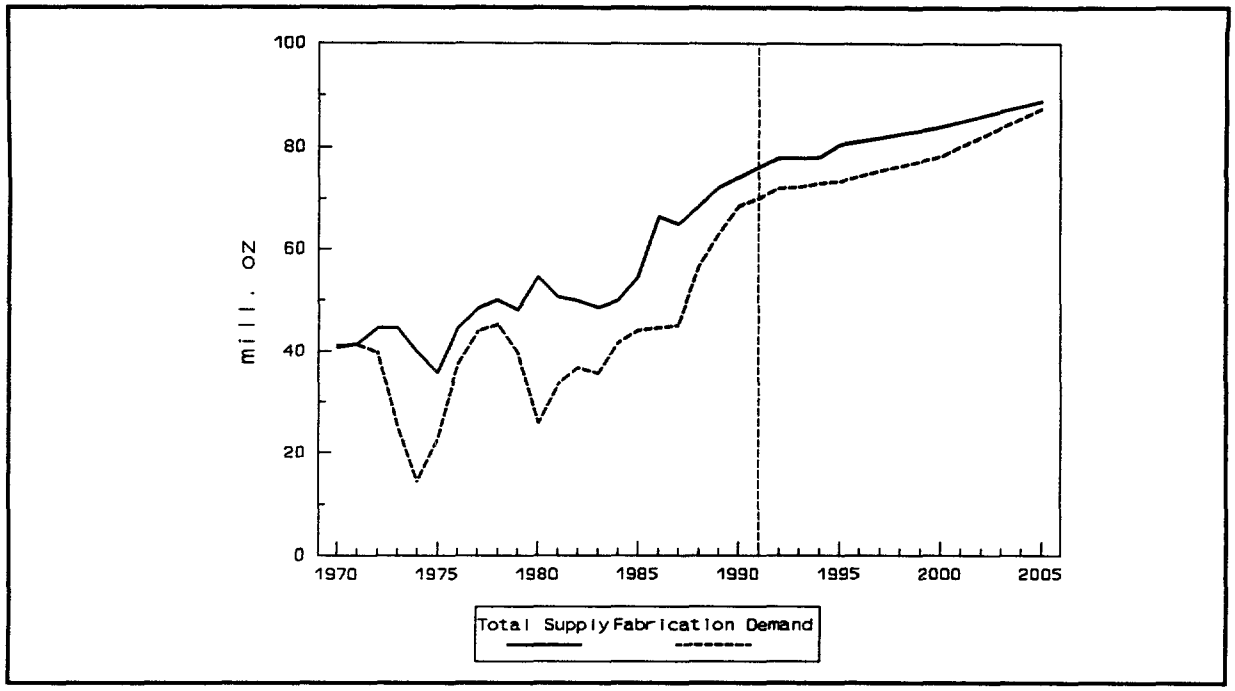
Demand Outlook

FABRICATION DEMAND. ***Steady growth in demand for gold jewelry to continue.*** Fabricators are projected to use 72 million ounces of gold in 1992. This is 60% higher than the 44.7 million ounces of gold used annually as recently as 1986-87. Of this total, 89%, or 64.3 million ounces, is projected to be used in the fabrication of jewelry--the bulk of the increase over the past several years has been in the jewelry sector. Gold jewelry consumption has risen most strongly in the newly industrializing countries of Asia, although gold jewelry consumption in the industrial countries has also been growing strongly, partly because of favorable economic conditions during most of this period. Changes in labor force participation rates have contributed to the rise in jewelry demand, too, especially through their effect of heightening the role of women as purchasers in industrial countries. Strong growth in gold jewelry consumption has also been recorded in the Middle Eastern countries, Eastern Europe, and the FSU.

During the next 13 years, fabrication demand for gold is expected to remain vibrant. Gold jewelry demand has not shown a high degree of price elasticity, so that demand would be expected to rise even in the event of moderately higher gold prices. Fabrication demand rose at a 2.6% p.a. rate from 1970 to 1991, although gold prices rose sharply during this time. From 1979 to 1990, as gold prices fell, fabrication demand rose at a compounded rate of 5.1%. The growth rate is projected to be 1.5% over the period 1990-2005. This would appear to be a conservative forecast. Market analysis does not point to a decline in consumer appetites for these products during the forecast period--market studies conducted by the World Gold Council and several other independent groups point to a continuation of strong, fashion-led demand growth for gold jewelry in the industrial countries. Additionally, demand growth in the newly industrializing countries is expected to continue apace, although economic and market studies in individual countries point to a slowing down in the growth rate from the fast rates seen in the late 1980s and early 1990s.

OFFICIAL TRANSACTIONS. ***Central bank disposals not expected to upset gold prices markedly.*** The official sector probably represents both the greatest threat to higher gold prices in the 1990s and the market's greatest enigma. Central banks and intergovernmental agencies hold more than 1.1 billion ounces of gold, equivalent to 15 years of total demand at current and projected rates. For the most part, these holdings are vestiges of the various gold currency standards employed prior to 1971. A trend toward reducing these holdings has emerged since the mid-1980s, a trend which has gathered momentum since 1990. Since 1987, central banks have been net sellers of 8.8 million ounces, after accounting for the 9.7 million ounces purchased by the Bank of China (Taiwan) from 1987 through 1989

Gold Supply and Demand, 1970-2005



as part of a dollar sterilization program. In 1989 alone, net disposals totaled 6.2 million ounces. Should monetary authorities more aggressively seek to reduce their gold holdings, as some have indicated they wish to do, the impact on gold prices could be significant.

Two aspects of the impact of potential official sales on gold prices need to be assessed. The first is the amount of supply which will be added to the market each year. Two or three million ounces of gold per year is not a large amount for the market to absorb, and sales at these levels would be expected to have only a slight effect on gold prices. However, should sales rise to around 10 million ounces per year, a significant decline in prices is likely to occur. The second aspect is the investment demand level. Annual investment demand levels are extremely volatile, fluctuating between 6 million ounces to as much as 26 million ounces. Should investment demand remain at the low levels of 1989-91 (below 10 million ounces per year), increased supplies from central banks could have a depressing effect on prices. But if investment demand were to rise to high levels and remain there during the forecast period, a major increase in net official disposals could readily be absorbed without substantial negative price consequences. Net official sales of 8.7 million ounces in 1977, 11.7 million ounces in 1978, and 17.5 million ounces in 1979 largely went unnoticed as the gold price rose from $127/oz in early 1977 to a peak of $825/oz in January 1980. In fact, gold prices would have risen sooner and higher were it not for these official sector gold sales, which at that time were the largest government gold disposals in history, and represented a 26% increase in new gold supplies during the three-year period 1977-79.

For the projections made here, combined fabrication and investment demand is expected to be sufficient to accommodate central bank net disposals of 7 million ounces per year without significantly reducing gold prices. As outlined elsewhere in this chapter, even with a significant decline in the growth rate of jewelry demand for gold, fabrication demand is projected to rise from around 72 million ounces in 1992 to 78.2 million ounces in 2000. Investment demand levels of between 8.4 million ounces and 15 million ounces per annum are projected--levels that are within the lower range of investment demand levels in the past 25 years. Even at these low levels of demand, fabrication and

investment demand would absorb the higher amounts of gold disposed of by central banks and other monetary authorities.

INVESTMENT DEMAND. ***Investment demand in 1990s faces mixed picture***. Investors buy gold for many reasons, among the most prominent being:

(a) as an inflation hedge;
(b) as a portfolio diversifier;
(c) as a currency hedge or surrogate;
(d) as a safe haven in times of financial, economic, or political uncertainty;
(e) as a commodity, when they perceive gold as having strong supply and demand fundamentals; and
(f) as a form of savings, both in industrial countries and in areas where banks and other financial institutions either do not exist or do not have a reputation for security and stability.

The interplay of these factors is crucial. In 1978-80, all of these factors stimulated investment demand for gold, which led to the massive rush on gold by investors worldwide. Conversely, for much of the 1980s these factors were not particularly stimulative of investor demand and prices fell.

There were, however, periods during the 1980s when one or more of these factors stimulated some investor interest in gold. For example, in 1986 when the US dollar fell sharply against most major currencies, investors interested in gold as a currency hedge increased purchases thus stimulating prices. At the time, inflation was very low--consumer prices in OECD countries rose only 2.8% in 1986, while US consumer price inflation, at 1.9%, was at a post-war low. Thus, investors who viewed gold as an inflation hedge were not buying gold, which restrained prices. The net result was that the annual average gold price rose 15.9% in 1986.

The nature of investment demand for gold in recent times has been that investors have been net buyers of 6.7-16.4 million ounces of gold annually in most years. Occasionally, investors have entered the market for greatly increased volumes of gold--in the range of 21 to 27 million ounces at an annual rate. This has occurred when investor interest in gold as a safe haven has been reinforced by expectations of attractive returns from gold relative to competing assets.

Despite some market commentary to the contrary, there has been no evidence that investors have changed their views toward gold, abandoning gold for exchange-traded assets. In contrast, there have been indications, on both national and international levels, that investors continue to view gold as a viable investment alternative, given the appropriate economic circumstances. But over the past ten years, those factors that stimulate investor gold "rushes" have been largely absent. Inflation has remained under control in most industrial countries, at least compared with the experiences of the 1970s; the performance of stocks, bonds, and other assets that compete with gold have generally been good, again when compared with the experience of the previous decade; and most importantly, real interest rates have remained high for most of the time, while gold's fundamental supply and demand conditions have been relatively unsupportive of higher prices. In this environment, investors have found gold of reduced interest. Net investment demand has been around 9 million ounces per year in 1991 and 1992.

The 1990s are likely to present a mixed picture for gold investors. Lower inflation is projected for the industrial countries during the 1990s compared with the 1980s, which would be a negative for gold investment demand. Interest rates are also projected to be significantly lower in the

1990s, which would be supportive of gold investment demand and higher prices. Our projection of lower real oil prices in the first part of the 1990s, followed by higher oil prices in the second half of the decade, suggests weaker gold prices to 1995, but higher prices later. However, the timing or occurrence of the kinds of economic events that lead to sharply increased investor demand for gold cannot be projected.

Table A1: Long-Term Gold Supply and Demand (Million Troy Ounces)

	Supply					Demand		
							Private Investment	
Year	Production in Market Economies	Flow from Transitional Economies	Secondary Recovery	Total Supply	Official Transactions Purchases (+) or Sales (-)	Jewelry and Industrial	Coins and Medallions	Bullion Purchases (+) or Sales (-)
Actual								
	24.3	-	N.A.	24.3	9.2	12.0	*	3.1
1950	33.5	5.7	N.A.	39.2	8.4	25.0	*	5.8
1960								
	40.9	-0.1	N.A.	40.8	7.6	41.1	3.2	-11.1
1970	39.7	1.7	N.A.	41.4	-3.1	41.3	3.4	-0.2
1971	37.8	6.8	N.A.	44.6	4.9	39.9	3.3	-3.5
1972	35.8	8.8	N.A.	44.6	-0.2	25.2	2.4	17.2
1973	32.8	7.1	N.A.	39.9	-0.6	14.3	9.0	17.2
1974								
	30.9	4.8	N.A.	35.7	-0.3	22.8	8.8	4.4
1975	31.2	13.2	N.A.	44.4	-1.9	37.2	7.5	1.6
1976	31.0	12.9	4.5	48.4	-8.7	43.9	6.3	6.9
1977	31.1	13.2	5.7	50.0	-11.7	45.2	10.8	5.7
1978	30.7	6.4	10.9	48.0	-17.5	39.7	10.4	15.4
1979								
	30.4	2.9	21.2	54.5	7.4	25.7	8.9	12.5
1980	31.1	9.0	10.5	50.6	4.5	33.4	8.2	4.5
1981	32.3	6.5	11.1	49.9	1.0	36.7	6.5	5.7
1982	34.1	2.7	11.7	48.5	-2.4	35.6	6.8	8.5
1983	35.6	3.9	10.4	49.9	-1.5	41.6	5.5	4.3
1984								
	37.8	7.6	9.0	54.4	1.5	44.1	5.2	3.6
1985	40.2	13.2	13.0	66.4	1.0	44.5	11.4	11.2
1986	42.0	10.1	12.8	64.9	-2.9	44.9	7.5	15.4
1987	47.4	10.1	11.1	68.6	5.3	56.6	5.2	1.5
1988	51.5	11.0	9.7	72.2	-6.2	63.0	5.7	9.7
1989								
	53.4	10.0	10.7	74.1	-2.0	68.6	4.6	2.9
1990	54.8	10.0	11.3	76.1	-3.0	70.1	4.0	5.0
1991								
Projected								
	54.9	11.0	12.0	77.9	-6.0	72.0	3.5	8.4
1992	54.9	11.0	12.0	77.9	-4.0	72.7		9.2
1993	55.1	10.0	13.0	78.1	-6.0	73.0		11.1
1994	55.4	11.0	14.0	80.4	-8.0	73.4		15.0
1995								
	57.0	12.8	14.0	83.8	-7.0	78.2		12.6
2000								
	58.9	1.40	16.0	88.9	7.0	87.4		8.5
2005								

Notes: N.A. = data on secondary supply is not available for years prior to 1977. Demand statistics for years prior to 1977 represent use of gold from mine production, transitional economy sales, and official sector sources, and exclude use of gold from scrap, while demand statistics beginning with 1977 reflect total gold use, including metal recovered from scrap. *Coins and medallions prior to 1968 are included in the jewelry and industrial column.

Source: CPM Group.

Table A2: Major Gold Producers 1982-91

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991e
					('000 troy ounces)					
South Africa	21,355	21,847	21,905	21,598	20,518	19,437	19,927	19,492	19,380	19,326
United States	1,466	1,956	2,059	2,475	3,739	4,947	6,460	8,537	9,330	9,300
Australia	867	1,035	1,257	1,833	2,508	3,533	5,048	6,752	7,877	7,555
Canada	2,081	2,223	2,491	2,815	3,308	3,724	4,334	5,128	5,284	5,624
Brazil	1,434	1,640	1,726	2,025	2,375	2,694	3,222	3,305	2,807	2,667
Philippines	830	812	773	810	1,139	1,048	1,044	964	940	800
Papua New Guinea	564	584	835	1,067	1,157	1,190	1,286	1,085	1,093	1,967
Colombia	460	439	800	1,143	1,285	853	972	871	956	946
Chile	546	571	541	554	588	548	663	713	735	922
Zimbabwe	426	453	478	472	475	473	481	515	543	572
Ghana	330	304	287	299	287	324	390	428	487	845
Mexico	196	223	244	257	267	289	344	385	322	286
Dominican Republic	379	361	338	337	246	246	186	177	139	130
Peru	165	166	137	135	145	150	150	139	111	121
Indonesia	72	77	79	300	320	440	500	515	600	828
Others	1,161	1,443	1,661	1,701	1,871	2,142	2,393	2,464	2,758	2,872
Total	32,332	34,134	35,611	37,821	40,228	42,038	47,400	51,480	53,362	54,761

Notes: Totals may not equal the sums of the columns due to rounding.
e = estimated.

Sources: Chamber of Mines of South Africa; U.S. Bureau of Mines; American Bureau of Metals Statistics; Gold Institute; Statistics Canada; industry sources; CPM Group.

Table A3: Gold - Prices, a/ 1963-91 (Actual) and 1992-2005 (Projected)

	($/troy oz.)		
	Current $	1990 Constant $	
		G-5 MUV b/	G-7 CPI c/
Actual			
1963	35	167	203
1964	35	163	197
1965	35	162	191
1966	35	157	185
1967	35	155	180
1968	39	173	193
1969	41	174	197
1970	36	143	163
1971	41	154	173
1972	58	202	223
1973	97	292	327
1974	159	392	483
1975	161	356	435
1976	125	272	326
1977	148	293	349
1978	193	334	373
1979	307	467	559
1980	608	845	991
1981	460	636	744
1982	376	528	616
1983	423	608	681
1984	360	530	583
1985	318	463	504
1986	368	455	483
1987	446	503	519
1988	437	459	472
1989	381	403	414
1990	384	384	384
1991	362	355	345
Projected			
1992	345	324	309
1993	350	317	303
1994	377	335	318
1995	393	340	323
2000	494	360	337
2005	567	360	323

a/ 99.5% fine, London, average of daily afternoon second fixing, or final rates.
b/ Deflated by G-5 Manufacturing Unit Value (MUV) Index.
c/ Deflated by G-7 Consumer Price Index (CPI).

Sources: International Monetary Fund, International Financial Statistics to 1983; Shearson Lehman Brothers Metal Market Weekly Review from 1984 to 1988; Metals Week from 1989 onwards (actual); World Bank, International Economics Department (projected).

Silver

Summary

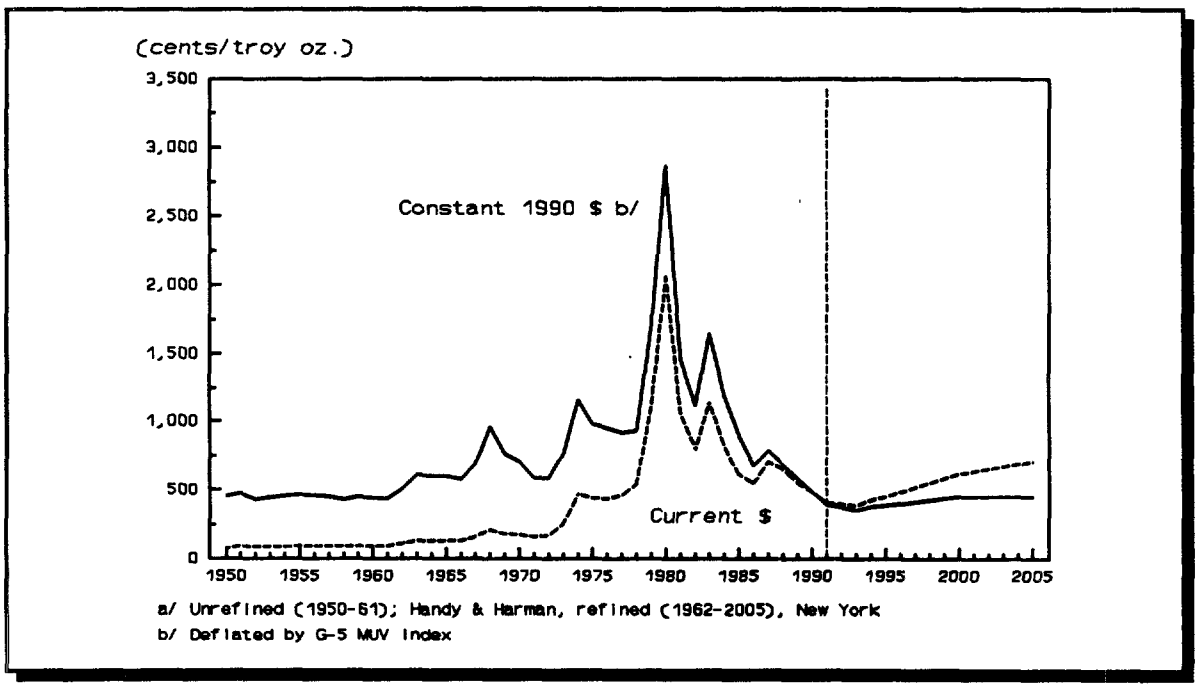
- Supplies of silver exceeded demand throughout the 1980s, but at the beginning of 1991 the market balance turned to deficit. So the long-term fall in silver prices may soon be reversed, although this will be greatly influenced by the extent of net sales from inventories. We forecast a slow recovery in real silver prices.

- Fabrication demand is projected to rise at 2.9% p.a. from 1990 through 2005, with photographic use of silver the strongest growth area.

- Investor demand for silver is likely to be weak during the forecast period, in line with silver's real price outlook.

- Silver supplies historically have been adequate to meet fabrication demand because supplies are easily augmented with inventories, increased mine production and secondary supplies. This ease of market supply is expected to continue, with disposals from inventories capable of satisfying a great deal of the projected growth in demand to 2005, and mine production also increasing, by a forecast of 1.4% p.a.

Silver Prices a/, 1950-2005



Price Outlook

The silver market has experienced substantial changes in market fundamentals over the past 40 years. A turning point was reached in 1979 and 1980, when speculative buying pushed up silver prices from $5/oz to $50/oz. The surge in prices led to the reversal of many of the long-term trends. First, production and secondary supply rose and have remained high. Second, fabrication demand fell sharply in the early 1980s; it was not until the second half of the decade that silver prices fell to levels that allowed sharp increases in fabrication demand for silver, although this trend is being offset at present by weak economic conditions that are limiting demand for silver-bearing products. Third, and most importantly, investors abandoned the metal. Established mines have been faced with the possibility of closure, some development plans have been deferred, and other producers have stockpiled silver to wait for higher prices.

Large inventories and investor sales likely to extend period of low prices. From a long-term perspective, silver production appears unsustainable at the current low price level. However, the large inventories and net investor sales are likely to extend the period of low silver prices for some time yet. The silver market historically has been well supplied; sharp increases in fabrication demand have been met easily with inventories, increased mine production, and secondary supplies. Any positive effect of increased silver use on silver prices has usually been minor. Typically, it has taken several years of high demand to tighten the silver market sufficiently to affect prices. For example, silver's supply/demand balance shifted into deficit in 1971, with the withdrawal of the US government as a major supplier of silver, yet it was not until 1979 that investor inventories had been drawn down sufficiently for the full impact of the shift in the market balance to be reflected in silver prices.

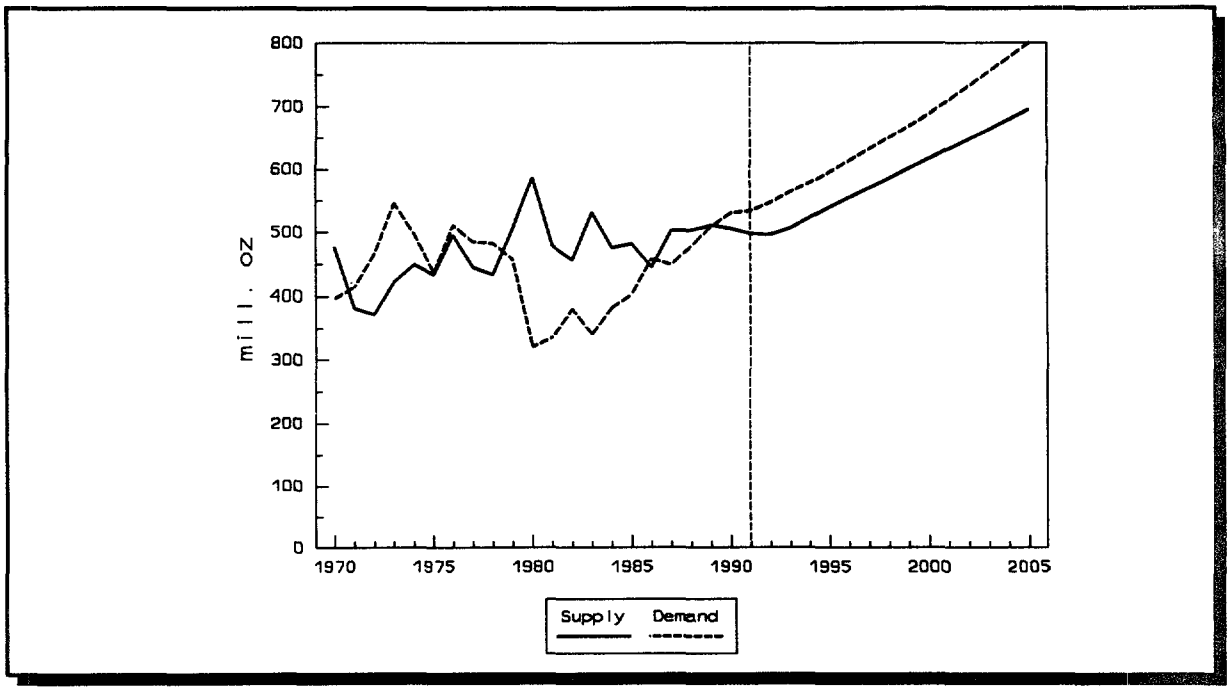
The silver market in the early 1990s is looking much the same as it did in the 1950s and 1970s. Fabrication demand is rising strongly, while new supplies coming into the market are relatively stable. These two factors are supportive of higher prices, but the presence of large inventories of refined silver and the recent sales by investors from their massive holdings have kept prices down. Since 1990, the amount of newly-refined silver entering the market from all sources (total supply) has been less than fabricators have required, but the deficit has been filled by investor sales.

Still, the silver market may have passed a turning point in 1990 and 1991. The surplus of total supplies over demand shrank consistently throughout the 1980s and turned to a deficit beginning in 1990 (see Figure 1). So silver prices may have stopped falling, reversing a trend that started in 1983; the low of $3.50/oz in early 1991 may well represent the cyclical bottom. Silver prices should strengthen in the years ahead, although the rise may be only mild and erratic. Real, inflation-adjusted silver prices are projected to rise from around $3.75/oz in 1992 (in 1990 dollars) to around $4.50/oz by the year 2000.

Demand Outlook

FABRICATION DEMAND. ***Fabrication demand to rise steadily with technological innovation and price competitiveness.*** Fabrication demand fell sharply in the early 1980s, following the high prices reached in 1979 and 1980. However, since silver prices have fallen to low levels in the latter half of the 1980s, fabrication demand has increased sharply (see the figures on industrial demand in Table A1). The weakening economic activity in the early 1990s seems to have slowed this growth.

Silver Supply and Demand, 1970-2005



Fabrication demand is projected to rise at least 2.9% p.a. from 1990 through 2005--from 500.5 million ounces in 1990 to 772.3 million ounces in the year 2005. Technological innovations appear likely to support the increased use of silver in the 1990s. Equally important, silver's low price--nominally, inflation-adjusted, and relative to the prices of substitute materials--makes silver appealing to industrial users. Growth is expected to exceed 2% p.a. in all of silver's established markets, except electronics. Photographic use of silver, growing at 3.5% p.a., is projected to rise at the fastest rate. By 2005, photography is expected to account for 40% of total industrial use of silver--up from 37% in 1990.

INVESTMENT DEMAND. ***Investor interest likely to remain low during forecast period.*** Investor buying of silver averaged 132 million ounces per year in the early 1980s, as buyers hoped for a repeat of the ten-fold increase in silver prices that occurred in 1979 and 1980. As the decade progressed and silver prices continually fell, investor disenchantment grew. By 1988, investors were buying less than 33 million ounces annually, while in 1989, investors sold an estimated 17 million ounces on a net basis. This was the first year of net investor disposals since 1978. The following year, 1990, net investor sales rose to an estimated 40.3 million ounces, and in both 1991 and in 1992, investor sales appear to be between 20 and 25 million ounces.

Two factors readily explain the decline in investor demand for silver. First, silver was not an attractive investment during the late 1980s. Inflation was under control in most industrial countries, stocks and other financial instruments offered attractive returns, and silver's supply/demand conditions were not supportive of higher prices. The second factor was that the channels for distribution of silver investment products had largely deteriorated. In the past, most major brokerage houses and many large commercial banks offered silver investment products, but few offer these services today.

Over the forecast period, the second factor is expected to negatively affect investment demand, limiting investors' interest in silver. However, the first factor, the investment environment, is more critical in determining investment demand levels for silver, and this is expected to be mixed: at times some elements, i.e., inflation, silver's supply/demand outlook, and silver's overall ability to offer competitive returns vis-a-vis other investment opportunities, are likely to stimulate increases in investment demand. But such periods may be relatively limited in duration. Thus, over the coming 13 years, investors may prove relatively disinterested in silver. That does not preclude major, short-lived interventions of investors, such as were seen in 1973-74, 1979-80, 1982-83, and 1987.

Supply Outlook

TOTAL SUPPLY. ***Most supplies unresponsive to small changes in price.*** Newly-refined silver supplies are not likely to exceed silver demand for most of the forecast period. About one half of new silver supplies are in the form of by-product production from gold, copper, zinc, and lead mines. This source of supply is not very responsive to silver price changes. Few base metal miners would expand production because the price of their silver by-product had risen.

Another quarter of supply derives from secondary recovery. Here, the production costs range from $1/oz to $3/oz, so that higher silver prices would have a relatively muted impact on the profitability of silver recovery efforts. In the 1970s and early 1980s, these sources were highly price-elastic, but in recent years, the price responsiveness has deteriorated. This new situation is likely to persist for much of the coming ten years. Indeed, a more compelling factor than price behind silver scrap recovery today and in the years ahead is likely to be environmental regulations related to protecting water supplies from silver-bearing discharges.

The sources of secondary silver should be considered in two distinct groups. The first group is spent photographic products, used industrial catalysts, and redundant electrical and electronic equipment. The costs of recovering silver from these materials range from ¢75/oz to around $3/oz, in 1992 dollars. Following the sharp increase in silver prices in 1979-80, many manufactures implemented thorough recovery operations, and since silver prices have remained sufficiently high to make these recovery programs profitable in the ensuing 12 years, most have remained in effect (a move aided by the introduction of more stringent environmental controls and legislation regarding the disposal of these materials). As long as silver prices remain above these costs of recovery, changes in silver prices should have a minimal effect on the recovery of these materials.

The second group of secondary silver sources is silver in old coins, jewelry, sterlingware, and decorative items. These items often have intrinsic value in excess of their silver content so that someone wishing to dispose of old jewelry, sterlingware, or decorative pieces would earn more by selling them into the antique market rather than into the silver scrap market. Similarly, old silver coins would usually fetch a better price in the numismatic coin market than in the silver scrap market. It is only when silver prices rise sharply that these materials appear in the silver secondary supply market. The one time in recent history when such materials constituted a significant flow of scrapped goods for refining into silver bullion was during the speculative binge of 1979-80, and then it was only when silver prices rose to levels above $20/oz (in nominal 1979 dollar terms). Given that silver prices are not projected to even approach these levels, such scrap flows are not anticipated.

Most of the remaining quarter of total new silver supplies comes from mining operations in which silver is either the main economic product or one of the major economic products. Mine

production costs at these operations range from around $2/oz, at a few extremely high-grade Mexican operations, to $7/oz at some of the older, unionized underground mines of North America. In 1992, as in 1986, low silver prices are leading to closure of some of these mines. Perhaps 10 million ounces of production capacity has been taken out of operation since 1990 due to low prices. Not all of this would come back into production were prices to rise. Numerous silver-producing mines are being developed or planned at present. Most of these are nonferrous metals or gold-mining operations, with silver as a by-product. The McArthur River deposit in Australia is expected to be producing more than 2.2 million ounces of silver per annum after it commences in 1996. Several other major lead and zinc mines are being considered in Australia that also would have significant silver by-product, including the Century, Benambra, and Lady Loretta deposits. In the United States and Canada, several developments are underway, each of which should be producing 300,000 ounces or more per year of silver as by-product by 1996. The Eskay Creek deposit in Canada would have by-product output of 1 million ounces of silver per annum, if it is developed. The Montanore deposit that Noranda Mines is considering in Montana is said by the company to have the potential to produce up to 20 million ounces of silver per annum.

The total silver supply is projected to rise at 2.2% p.a. between 1990 and 2005--from 505.1 million ounces in 1990 to 695.8 million ounces in 2005. The increase is expected to be equally divided between mine production and secondary recovery from scrap. Mine production is expected to rise at 1.4% p.a., especially in the form of by-product mine output. By-product silver output from major new mines is expected to peak in 1991-92 and then flatten out. Some of these new mines will experience a decline in by-product silver production by the mid-1990s. The 1990s also should see a continued decline in the recovery of silver from non-photographic scrap, although this trend will be more than offset by the projected increase in silver recovery from scrapped photographic products.

INVENTORIES. ***Inventory disposals expected to be high during forecast period.*** Market inventories are an important variable in determining silver prices. They may be grouped into two parts, reported and not reported. Reported stocks receive the most attention, since they are visible, but they are only a portion of the total silver stock available on relatively short notice. As of the middle of 1992, for example, reported market stocks were around 313 million ounces, while among those not publicly recorded were 200 million ounces or more held in Delaware and European inventories of 400 million ounces or more. It is estimated that total refined silver inventories in 1992 are of the order of 1.2 billion ounces.

Silver inventories are held primarily by investors and bullion dealers, both of which are highly price sensitive. Disposals from these large inventories could accommodate a great deal of the projected growth in fabrication demand for silver over the forecast period.

The outlook for the forecast period is that an extended period of deficits in annual supply flows are likely to be compensated for by large-scale disposals from inventories. The total worldwide inventories of refined silver bullion may fall by three quarters over the coming 13 years, with most of the inventory withdrawals projected to occur later in the forecast period. From 1992 through 1995, for example, the cumulative deficit is projected to be only 221 million ounces.

An interesting historical corollary to this projection exists. From 1964 through 1970, investors, primarily in the United States, absorbed 620.5 million ounces of silver in the expectation of higher silver prices. Between 1971 and 1978 they sold two thirds of this, 415.8 million ounces, back into the market.

Table A1: Long-Term Silver Supply and Demand, 1950-2005

Year	Supply				Demand			
	Mine Output	Secondary	Other	Total	Industrial	Coinage	Total	Surplus or Deficit
				(million troy ounces)				
Actual								
1950	169.5	N.A.	N.A.	169.5	157.4	44.1	201.5	-32.0
1960	201.8	52.0	90.0	343.8	235.3	103.9	339.2	4.6
1970	258.5	127.0	91.0	476.5	372.9	23.4	396.3	80.2
1971	247.3	127.0	7.0	381.3	386.6	27.8	414.4	-33.1
1972	248.9	112.0	12.0	372.9	427.4	38.1	465.5	-92.6
1973	254.0	122.0	46.0	422.0	516.5	28.5	545.0	-123.0
1974	236.6	192.0	21.0	449.6	466.3	31.6	497.9	-48.3
1975	239.0	177.0	18.0	434.0	404.5	33.4	437.9	-3.9
1976	242.9	235.0	18.0	495.9	481.0	30.0	511.0	-15.1
1977	263.3	169.0	13.0	445.3	451.0	34.5	485.5	-40.2
1978	266.8	152.0	16.0	434.8	444.4	39.5	483.9	-49.1
1979	272.0	216.0	17.0	505.0	426.0	31.0	457.0	48.0
1980	266.5	302.0	18.0	586.5	306.0	15.0	321.0	265.5
1981	283.2	184.0	12.0	479.2	326.2	9.5	335.7	143.5
1982	298.0	155.0	3.0	456.0	368.4	12.0	380.4	75.6
1983	313.6	197.5	20.0	531.1	330.3	10.2	340.5	190.6
1984	324.5	165.6	-14.0	476.1	368.3	13.7	382.0	94.1
1985	329.9	140.9	12.0	482.8	390.4	13.4	403.8	79.0
1986	320.3	129.3	-4.4	445.2	432.1	26.8	458.9	-13.7
1987	338.2	137.9	26.1	502.2	418.8	30.4	449.2	53.0
1988	344.0	143.9	14.2	502.1	453.0	25.3	478.3	23.8
1989	358.4	136.2	17.0	511.6	483.5	26.3	509.8	1.8
1990	370.1	118.0	17.0	505.1	500.5	29.8	530.3	-25.2
1991	366.6	111.2	19.8	497.6	503.9	29.9	533.8	-36.2
Projected								
1992	369.0	111.0	16.6	496.6	516.0	30.0	546.0	-49.4
1993	375.0	116.0	15.0	506.0	529.5	35.0	564.5	-58.5
1994	380.0	126.0	17.0	523.0	541.9	37.0	578.9	-55.9
1995	382.0	140.0	17.0	539.0	559.2	37.0	596.2	-57.2
2000	419.0	190.0	8.0	617.0	658.0	30.0	688.0	-71.0
2005	454.5	237.3	4.0	695.8	772.3	28.0	800.3	-104.5

Notes: *Compounded growth rate for secondary and other supply is for 1960-90.
N.A. = Not available.

Sources: CPM Group; industry sources.

Table A2: Silver Use, 1977-92

	Photography							
	Basic	X-Ray	Graphics	Total	Electronics	Jewelry and Silverware	Other	Total
				(million troy ounces)				
1977	N.A.	N.A.	N.A.	129.6	78.7	91.0	151.7	451.0
1978	N.A.	N.A.	N.A.	142.9	79.3	91.9	128.5	442.6
1979	N.A.	N.A.	N.A.	146.1	80.4	79.1	132.9	438.5
1980	N.A.	N.A.	N.A.	123.8	71.2	47.9	114.0	356.9
1981	N.A.	N.A.	N.A.	128.1	62.2	43.5	114.2	348.0
1982	N.A.	N.A.	N.A.	133.3	61.7	50.2	108.6	353.8
1983	N.A.	N.A.	N.A.	138.3	60.4	42.1	107.7	348.5
1984	N.A.	N.A.	N.A.	144.2	62.3	41.3	119.3	367.1
1985	N.A.	N.A.	N.A.	148.2	64.7	47.5	111.1	371.5
1986	N.A.	N.A.	N.A.	153.5	66.9	61.3	118.4	399.6
1987	N.A.	N.A.	N.A.	164.1	61.1	66.0	128.6	419.8
1988	N.A.	N.A.	N.A.	176.3	65.3	69.3	130.2	441.1
1989	87.0	50.0	40.1	177.1	70.6	75.8	142.5	466.0
1990	91.1	55.0	39.9	186.0	70.6	81.0	162.9	500.5
1991	84.2	61.7	41.1	187.0	65.2	85.4	166.3	503.9
Projected								
1992	86.0	63.8	42.2	192.0	65.0	87.0	172.0	516.0

Source: CPM Group.
June 29, 1992

Table A3: Silver - Prices, a/ 1950-91 (Actual), 1992-2005 (Projected)

	(¢/troy oz.)		
	Current $	1990 Constant $	
		G-5 MUV b/	G-7 CPI c/
Actual			
1950	74	454	598
1951	89	475	651
1952	85	430	592
1953	85	444	590
1954	85	455	581
1955	89	466	605
1956	91	459	604
1957	91	449	591
1958	89	433	568
1959	91	450	583
1960	91	442	574
1961	93	439	567
1962	109	505	647
1963	128	607	739
1964	129	603	728
1965	129	599	706
1966	129	579	683
1967	155	686	798
1968	215	958	1,074
1969	179	759	859
1970	177	706	801
1971	155	585	655
1972	169	585	647
1973	256	767	860
1974	471	1,158	1,428
1975	442	978	1,193
1976	435	950	1,138
1977	462	918	1,093
1978	540	932	1,042
1979	1,109	1,691	2,023
1980	2,064	2,867	3,365
1981	1,052	1,456	1,701
1982	795	1,117	1,302
1983	1,144	1,646	1,845
1984	814	1,196	1,316
1985	614	895	973
1986	547	676	718
1987	701	789	815
1988	654	686	706
1989	550	581	597
1990	482	482	482
1991	404	396	384
Projected			
1992	400	375	358
1993	390	353	337
1994	428	380	362
1995	450	389	370
2000	618	450	421
2005	709	450	404

a/ For 1950-61, unrefined, producer price; beginning 1962, Handy & Harman, refined, delivered New York.
b/ Deflated by G-5 Manufacturing Unit Value (MUV) Index.
c/ Deflated by G-7 Consumer Price Index (CPI).

Sources: Australian Mineral Economics Pty. Ltd., Silver, World Supply & Demand to 1979 and Metals Week from 1980 onwards (actual); World Bank, International Economics Department (projected).