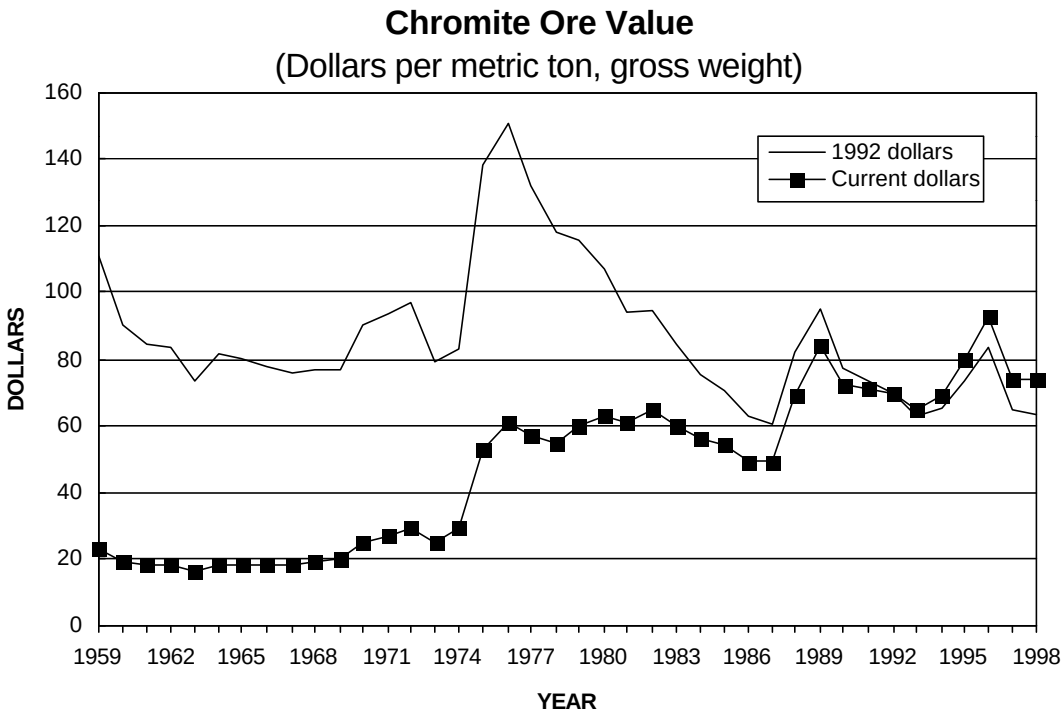
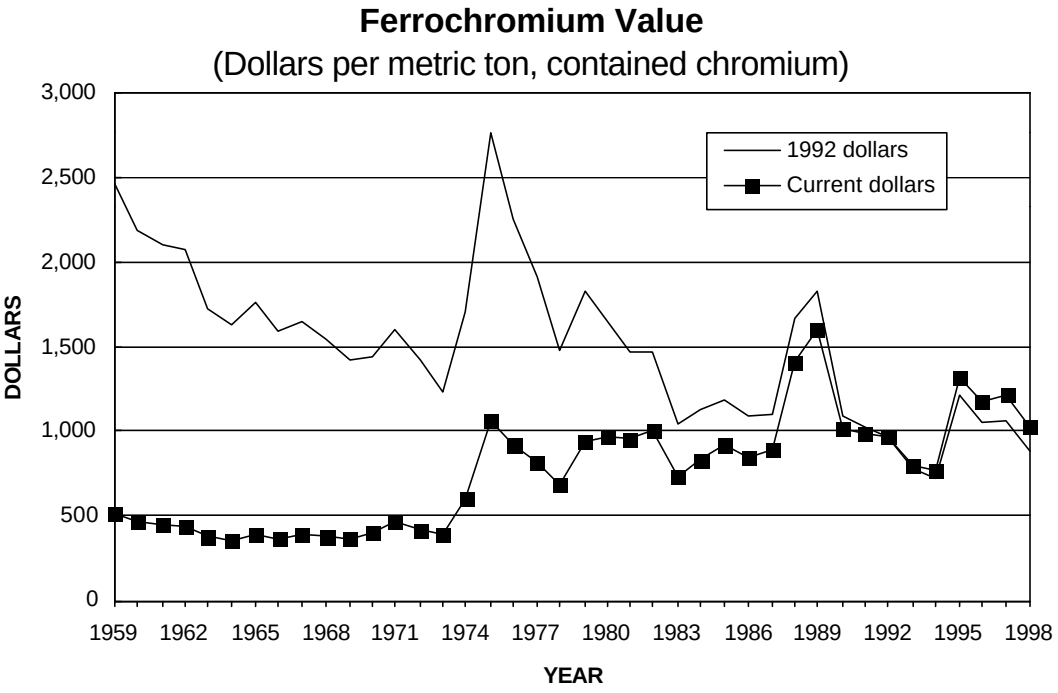
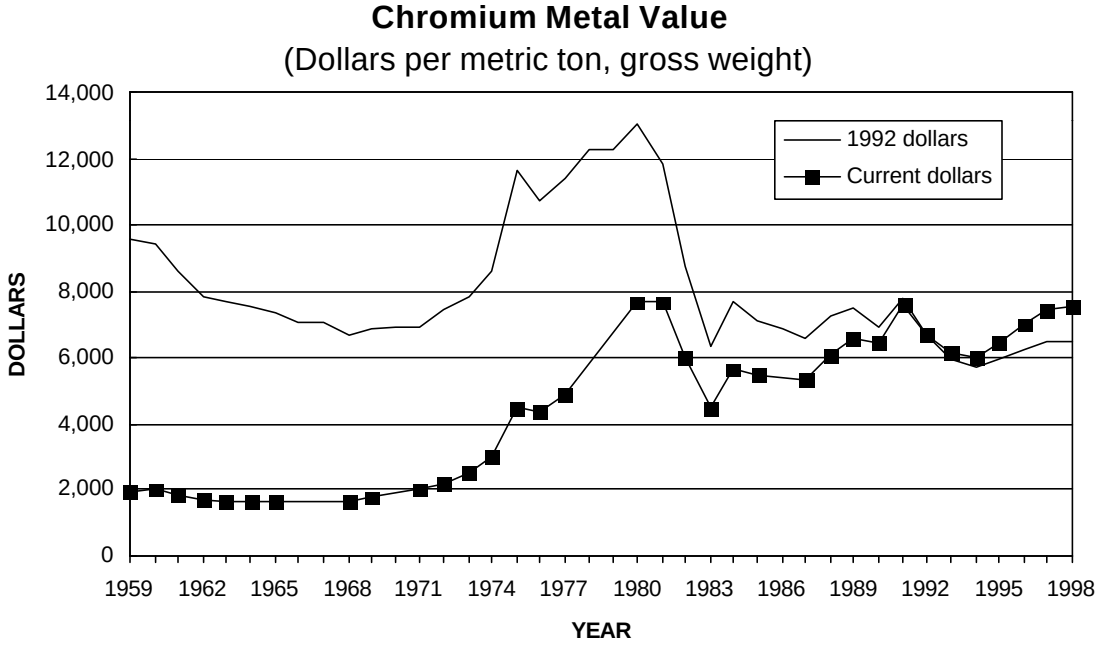
Chromium

by John F. Papp







Significant events affecting chromite ore prices since 1958

1987-89	Increased stainless steel production
1991	Dissolution of the Soviet Union
1997	Start of the Asian financial crisis

Chromium, the chemical element, was discovered in 1797 by Nicolas-Louis Vauquelin, a professor of chemistry at the Paris École des Mines, one of the new European technical universities established to bring science education to the mining industry (Weeks, 1968, p. 271-283). The chromite mineral, comprising primarily chromium, iron, and oxygen, was subsequently found to be useful as a refractory material. Chromite was first exploited for the production of pigments (Gray, 1988) and the manufacture of refractory materials. Today, the major use of chromium is in the metallurgical industry to make stainless steel; substantially less chromium is used in the refractory and chemical industries (Papp, 1994, p. 7, 17). The major chromium commodity materials are chromite ore, ferrochromium, and chromium metal. The major traded chromium commodity is now ferrochromium, which replaced chromite ore. Chromium metal prices apply to a relatively small amount of the chromium commodity materials. To meet the needs of different users of price information, all three price histories have been included.

An understanding of the structure of the chromium industry is important to understanding chromium material price structure. Ferrochromium was originally produced mainly near stainless steel producers but production has since moved to locations in proximity to chromite ore producers. The United States is not a chromite-ore-producing country; it is, however, a major world producer of stainless steel and of chromium chemicals. After World War II, the United States built a stockpile of chromium commodities for national security reasons. After the dissolution of the Soviet Union in 1991, the Federal Government started to sell its stockpile; the price of material was based on negotiated contract. Each month, the Defense Logistics Agency (DLA), the Federal agency responsible for stockpile management, accepted bids on chromium materials that had been authorized for sale by the U.S. Congress (U.S. Department of Defense, 1997). The DLA negotiated a price for the chromium material with the potential purchaser.

Imports of various forms of chromium are important because their value is a good indicator of price. Until the period from 1980 through 1990, the United States imported most of its chromium needs in the form of chromite ore because ferrochromium was domestically produced. As

domestic ferrochromium production capacity declined, imported ferrochromium surpassed chromite ore as the major commodity source of chromium for the United States. Markets for chromium metal developed along with the jet engine, many parts of which need alloys that require chromium metal.

The structure of the chromium industry has been changing, as has the role of the United States in that industry. Reported U.S. trade statistics (i.e., amount and value) for chromite ore date back to 1884; ferrochromium, 1910; and chromium metal, 1923. Trade journal prices for chromium metal go back only to 1964. Thus, chromite ore is the only chromium commodity for which the reported historical trade journal price and U.S. import value series is long. Since U.S. import data was first collected, technological changes have resulted in a change in the predominant grade of chromite ore and ferrochromium traded. The United States has been a consumer of a broad range of chromium materials, and to a large degree, prices of chromium-containing materials have been sustained by demand in the United States and other industrialized nations. As a chromium-chemical-manufacturing nation, the United States also imported chromite ore for chemical production. As a steel-producing nation, the United States imported chromite ore for refractory and alloy production. Between about 1970 and 1999, the United States made the transition from producing to importing ferrochromium for its steel industry. As a result, U.S. import statistics included declining amounts of metallurgical grade chromite ore over that time period. The United States is a major alloy- and stainless-steel-producing nation, and chromium ferroalloy imports, including a broad range of grades and sources, reflect that.

Chromite ore and other chromium materials are not traded on commodity or futures exchanges. Thus, the price for chromite ore or any other chromium material is not publicly negotiated or available. After surveying consumers and producers, some trade journals publish a composite price or price range based on their survey. Included among these are American Metal Market, Industrial Minerals, Metal Bulletin, Metals Price Report, Platt's Metals Week, and Ryan's Notes. Although the prices for chromium materials reported in such periodicals might, indeed, represent price in the market being surveyed, no representation of quantity of trade is made. Usually, more than one source and/or grade of material reported by the trade journals may have disparate characteristics. In this situation, price is an average and does not apply to any specific product. A broadly descriptive name like "chromite ore" covers many sources and grades of material. The U.S. import value reported to the U.S. Customs Service, the U.S. Department of the Treasury, and published by the U.S. Bureau of the Census, U.S. Department of Commerce, includes a declared value of the imported material estimated at the point of export. It excludes U.S. import duties, freight, insurance, and other charges incurred in shipping the merchandise to the United States (U.S. Bureau of the Census, 1992, p. 2-6). Chromite ore values are annual weighted-average values based on quantity, content, and customs value of imports as reported in U.S. customs statistics.

Chromite ore is graded by its chromic oxide (Cr_2O_3) content, and its price is reported in trade journals on a gross-weight basis (U.S. dollars per metric ton, gross weight). Commercially traded chromite ore grades range from 35% to 55% Cr_2O_3. Suppose, for example, that a particular chromite ore is graded at 42% to 45% and priced at $100 per metric ton. It contains 42% to 45% chromic oxide and costs $100 per ton, gross weight. To calculate the cost of the chromium contained in this material, remember that chromic oxide is 68.42% chromium. Consequently, 1 ton of this material then contains between 0.287 and 0.308 ton of chromium yielding a unit value of between $325 and $348 per ton of chromium. Ferrochromium typically contains between 50% and 65% chromium, and its price is reported in trade journals in dollars per pound of contained chromium. Chromium metal is typically in excess of 99% pure, and its price is reported in trade journals in dollars per pound, gross weight (Papp, 1995). A wide variety of chromium metal prices are reported in trade journals. The units of chromium material value are similar to those of chromium material price reported in trade journals—dollars per metric ton, gross weight, for chromite ore and chromium metal and dollars per metric ton of contained chromium for ferrochromium. (To convert from dollars per metric ton to dollars per pound, multiply by 4.536×10^{-4}.)

The unit value of chromium in each of its commodity forms is substantially different. In 1997, the unit value of chromium contained in its commodity forms was, in rounded numbers and in units of dollars per metric ton of contained chromium— chromite ore, $200; ferrochromium, $1,000; and chromium metal, $7,000.

The predominant influence on the price of chromite ore is the relation between supply and demand and general economic conditions. Stocks relative to anticipated consumption also affect material price. When supply does not meet demand or when stocks appear to be insufficient, price is expected to increase. Because stainless steel is the major end use for chromium, world stainless steel production or anticipated production plays a major role in determining chromium demand and is, therefore, a major influence on ferrochromium and chromite ore prices. Strong demand for chromium from the international stainless steel market resulted in price increases from 1987 through 1989. Chromium industry production capacity growth exceeded stainless steel industry chromium demand growth, which

continued but at a rate lower than that of ferrochromium production capacity. The result was excess production capacity in the chromium ferroalloy industry that resulted in lower ferrochromium prices. In 1991, the dissolution of the former Soviet Union (FSU) resulted in decreased demand for chromium from those markets and added chromium products from the FSU to world markets. Both of these events exacerbated the downward pressure on ferrochromium prices. In 1997, the Asian financial crisis resulted in a lower world demand for stainless steel that put more downward pressure on ferrochromium prices.

Of the 12.5 million metric tons of 1997 world chromite ore production, 85% went into the ferrochromium industry; 8% to the chemical industry; and 7% to the refractory industry (Toerien, 1997; Papp, 1998, p. 8). Because non-ferrochromium-grade chromite ore is often a byproduct of ferrochromium-grade ore, ferrochromium industry demand is the main driving force of chromite ore production (O'Driscoll, 1998). The relation is indicated by the lead sometimes shown by ferrochromium price over chromite ore price. The annually averaged price data show that price peaks for ferrochromium and chromite ore were coincident in 1982 and 1989, and ferrochromium price led chromite ore price in 1975-76 and 1995-96. In the first two cases, annual averaging hides the price change relation. In the second two cases, increased demand for ferrochromium drove up ferrochromium prices, but the chromite ore price increase lagged by 1 year. The most recent ferrochromium price peaks were in June 1989 and December 1995 (Warburg Dillon Read Securities (South Africa) (Pty) Ltd., 1998, p. 3).

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Chromite Ore Value[1]

(Dollars per metric ton, gross weight)

Year	Price	Year	Price	Year	Price	Year	Price
1940	13	1955	23	1970	25	1985	54
1941	12	1956	25	1971	27	1986	49
1942	16	1957	27	1972	29	1987	49
1943	20	1958	25	1973	25	1988	69
1944	21	1959	23	1974	29	1989	84
1945	21	1960	19	1975	53	1990	72
1946	17	1961	18	1976	61	1991	71
1947	19	1962	18	1977	57	1992	70
1948	24	1963	16	1978	55	1993	65
1949	22	1964	18	1979	60	1994	69
1950	20	1965	18	1980	63	1995	80
1951	20	1966	18	1981	61	1996	93
1952	25	1967	18	1982	65	1997	74
1953	28	1968	19	1983	60	1998	74
1954	26	1969	20	1984	56		

[1] Annual weighted-average chromite ore value based on quantity and declared free-on-board value of U.S. imports as reported in U.S. customs statistics, as reported by the U.S. Bureau of the Census, U.S. Department of Commerce. Based on U.S. chromite ore import statistics, 1940 through 1997, average chromic oxide content plus or minus average deviation is 43.8 ± 1.5 percent; and chromium content, 30.0 ± 1.0 percent.

Ferrochromium Value[1]

(Dollars per metric ton, contained chromium)

Year	Price	Year	Price	Year	Price	Year	Price
1947	295	1960	462	1973	392	1986	851
1948	344	1961	449	1974	600	1987	893
1949	352	1962	445	1975	1,061	1988	1,403
1950	363	1963	376	1976	916	1989	1,609
1951	411	1964	360	1977	826	1990	1,017
1952	442	1965	395	1978	686	1991	997
1953	556	1966	367	1979	945	1992	966
1954	NA	1967	394	1980	972	1993	801
1955	NA	1968	382	1981	952	1994	767
1956	484	1969	370	1982	1,008	1995	1,322
1957	516	1970	401	1983	737	1996	1,179
1958	540	1971	464	1984	833	1997	1,212
1959	512	1972	422	1985	914	1998	1,027

NA Not available

[1] Weighted-average ferrochromium value based on content quantity and declared free-on-board value of U.S. imports as reported in U.S. customs statistics, as reported by the U.S. Bureau of the Census, U.S. Department of Commerce. Based on U.S. ferrochromium import statistics, 1947 through 1997, average chromium content plus or minus average deviation is 61.4 ± 3.7 percent.

Chromium Metal Value[1]

(Dollars per metric ton, gross weight)

Year	Price	Year	Price	Year	Price	Year	Price
1956	1,852	1967	NA	1978	NA	1989	6,597
1957	2,237	1968	1,656	1979	NA	1990	6,460
1958	2,234	1969	1,800	1980	7,682	1991	7,584
1959	1,993	1970	NA	1981	7,662	1992	6,671
1960	1,998	1971	2,003	1982	6,018	1993	6,137
1961	1,832	1972	2,206	1983	4,491	1994	6,031
1962	1,689	1973	2,491	1984	5,674	1995	6,455
1963	1,677	1974	3,030	1985	5,468	1996	7,018
1964	1,670	1975	4,486	1986	NA	1997	7,419
1965	1,661	1976	4,350	1987	5,320	1998	7,576
1966	NA	1977	4,938	1988	6,097		

NA Not available

[1] Weighted-average chromium metal value based on quantity and declared free-on-board value of U.S. imports as reported in U.S. customs statistics, as reported by the U.S. Bureau of the Census, U.S. Department of Commerce. Chromium metal is typically in excess of 99% pure.