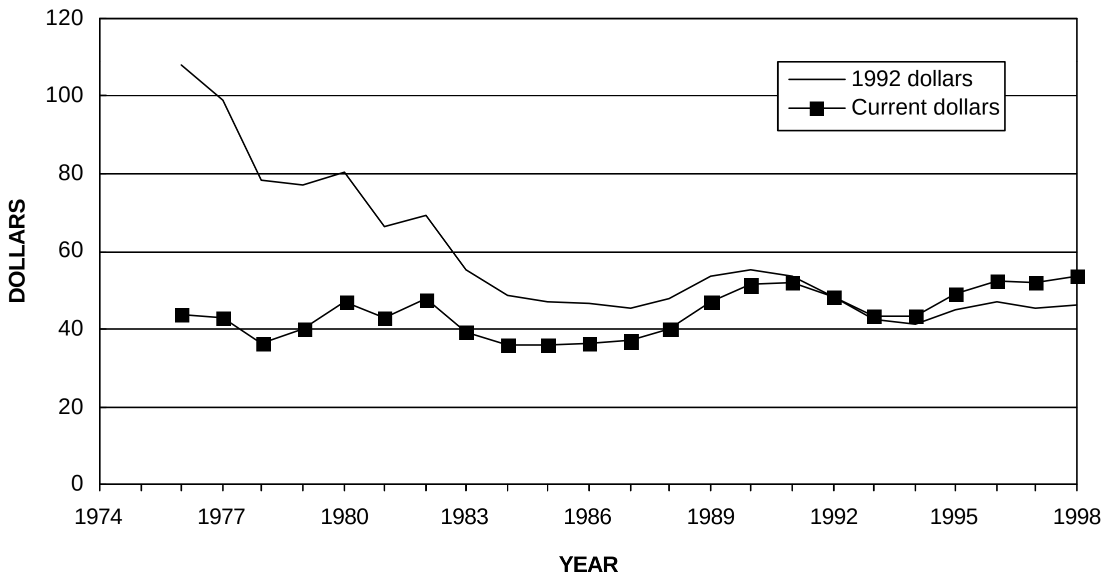
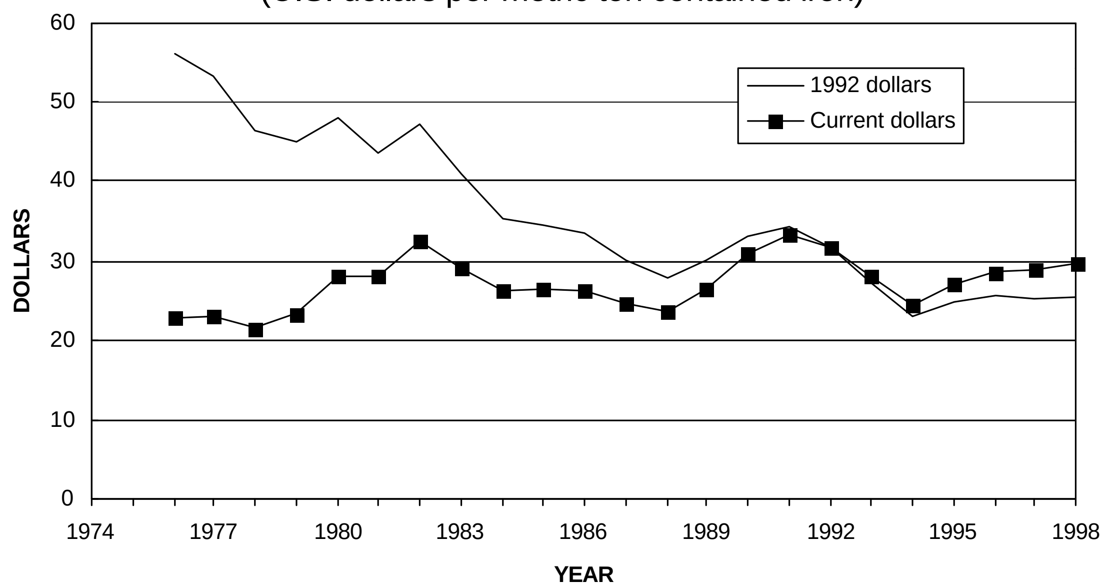
Iron Ore

by William S. Kirk

Annual Brazilian Iron Ore Pellet Price
(U.S. dollars per metric ton contained iron)



Annual Brazilian Iron Ore Fines Price
(U.S. dollars per metric ton contained iron)



Significant events affecting iron ore prices since 1958

1973-75	Organization of Petroleum Exporting Countries (OPEC) oil embargo and sharp recession
1981-82	Sharp recession
1997	Beginning of the Asian financial crisis

Iron ore is used to make iron and steel. Iron is the most useful, abundant, and cheapest of the metallic elements. In metallurgical terms, "iron" refers to alloys that contain too much carbon to be formable by forging or rolling. The term "steel" refers to an alloy of iron that is malleable at some temperature ranges and contains carbon, manganese, and often some other alloying elements. Steel is made by using the blast furnace/basic oxygen furnace (BF/BOF) process or the electric arc furnace (EAF) process. The BF/BOF process first makes iron by smelting iron ore in a blast furnace and then using that iron to make steel in a BOF. In the EAF process, iron and steel scrap and often direct reduced iron are melted to produce steel.

Almost all (98%) iron ore is used to make iron and steel so its price is determined by what steelmakers are willing to pay for it and that is based on how the ore behaves in the iron-making process—whether it raises or lowers the costs of producing steel. The behavior of iron ore in the iron-making process is determined by its chemical composition and by its structure or form, both of which affect blast furnace productivity. The chemical constituents that affect the productivity of a blast furnace are iron content, levels of the undesirable substances silica and alumina, moisture and impurities, and levels of the desirable substances limestone and dolomite.

The forms that affect blast furnace productivity—fines (fine ores), lump, and pellets—are also the primary market products. Minor quantities of iron ore concentrate are also sold. Fines are defined as iron ore with the majority of individual particles measuring less than 4.75 millimeters (3/16 inch) diameter. Conversely, lump is iron ore with the majority of individual particles measuring more than 4.75 millimeters diameter. Fines and lump are produced from the same ore and are separated by screening and sorting. Neither product is concentrated. Pellets, the third product type (form), begin as a fined-grained concentrate. A binder, often clay, is added to the concentrate, which is then rolled into balls. The balls then pass through a furnace where they are indurated and become pellets, usually measuring from 9.55 to 16.0 millimeters (3/8-5/8 inch).

Although fines and lump ores cost about the same to produce, fines fetch lower prices than lump because they must be sintered by the steel mill before they can be charged to the blast furnace. This is done to improve permeability of the furnace burden and to prevent loss of fines up the stack. Pellets can be charged directly into the blast furnace as can lump ore, but the latter can decrepitate in the furnace, thereby lowering its value to the steel mill operator. Pellets are usually the most desirable form of iron ore because they contribute the most to the productivity of the blast furnace. Lump ore is the next most desirable ore in terms of blast furnace productivity. The least desirable form is fines, which must be agglomerated (sintered), usually by the steelmaker, before being charged to the blast furnace.

If the chemistry and structure of an iron ore are favorable, then iron- and steel-making costs are reduced, and the steelmaker is willing to pay a higher per-unit price for this ore than for one with less favorable properties. Although an ore with a high iron content and good structure is desirable for increasing productivity in a blast furnace, preference may be given to a lower quality ore if the price is low enough to compensate for its less favorable characteristics. No such flexibility occurs in direct reduction, where ore-quality parameters are very stringent. The direct reduction process uses pellets and lump with chemical characteristics that have historically supported a price premium over blast furnace grades. Fines-based direct reduction processes are now under development.

A steelmaker's preference for pellets over fines is reflected in the prices. From 1976 through 1998, the average price for Brazilian fines was $27.03 per metric ton; and the average for Brazilian pellets was $44.31 per metric ton. Although iron ore prices rose during the 1976 to 1998 period, when adjusted for inflation, they fell considerably. The price for fines in constant dollars declined by 53.2% and the price for pellets in constant dollars dropped by 56.2%. The inflation adjustment factor used was the Consumer Price Index for All Urban Consumers (CPI) from the U.S. Bureau of Labor Statistics. The CPI was rebased to 1992.

Another factor that affects which form of iron ore used is steel demand. When demand is low, European and Japanese steelmakers switch to fines because they do not have to be concerned with productivity targets. In a tight market, more pellets and lump are consumed.

Until the 1980's, there were two international iron ore price structures, each related to a specific geographic area: North America and the other market economy countries (Franz, Stenberg, and Strongman, 1986). In North America, more than three-quarters of iron ore production capacity was owned directly by its consumers, the integrated steel companies. These equity ownership conditions led to stable "cost-plus" pricing, meaning the iron ore producers were paid what it cost them to produce the ore, plus royalty and management fees. Prior to this, there was very little need to be competitive (Marcus, Kirsis, and Kakela,1996). Demand was high, and the North American iron ore industry was growing, as it had for 25 years. Pellet capacity expanded steadily from its first commercialization in 1955 to a peak capacity of 127 million metric tons in 1980.

In 1982, major structural changes occurred in the domestic iron ore industry, one of which was the development of a U.S. spot market for pellets. Most spot sales are individually negotiated, one-time contracts made directly between buyer and seller. The spot market led to the beginning of price competition and a winding down of the Lower Lakes pricing system, which had served the iron ore industry for 100 years. Previously, only annual sales, multiyear contracts, or equity ownership transactions existed. The North American iron ore industry had to cut capacity and lower prices to make domestic ore competitive with imported material. This meant that the industry had to lower production costs to stay in business, which was done by greatly improving labor productivity, reducing wages, negotiating lower cost power contracts and royalty agreements, pressing suppliers to reduce prices for materials, lobbying legislators for tax breaks, and paying off debt. The results were dramatic. Domestic mines cut costs by 30%, reduced capacity by one-third, and lowered prices by 42%. Domestic producers are continuing their efforts to reduce costs. The spot market has persisted and, with the reduction of steel mill ownership of iron ore mines to about 63%, has grown stronger.

Exported iron ore is traded in the seaborne market, and prices are determined by market forces. Two iron ore price lists, one for prices of ore to Europe and the other for prices to Japan are widely published. All iron ore is priced in U.S. dollars, which facilitates comparison. The unit pricing system is used with iron ore to accommodate variations in iron content. Prices are quoted in U.S. cents per ton unit of iron. A unit is 1/100, or 1%, of the weight of a ton of iron so that 1 metric ton unit corresponds to 1/100th of a metric ton. This means that a steelmaker that buys 1 ton of ore that is about 65% iron is paying for 1 ton of iron contained in that ore and will receive about 1½ tons of ore.

These prices are usually set during lengthy negotiations between Brazilian iron ore producers and German steelmakers and between Australian producers and Japanese steelmakers. Australia and Brazil with roughly equal shares dominate the export market, have a combined share of world iron ore exports of 62%; the next largest exporter has only a 6% share. Europe and Japan, with roughly equal shares, have a combined share of world imports of 57%; the next largest importer has 12%. The price agreed on for ore to Europe is applicable for the calendar year effective January 1st of that year. For ore sold to Japan, prices are set for the Japanese fiscal year, which begins on April 1st and ends on March 31st. The price for iron ore fines is usually settled first because it is the predominant type of ore used in Europe and Japan. Prices for pellets and lump ore are then set based on the fines prices.

The steel recession that was the result of the OPEC oil embargo created downward pressure on iron ore prices that can be seen in the Brazilian fines price for 1978, the lowest level of the 1976- through-1998 period (See price tables). As the world economy recovered, iron ore prices peaked in 1982. Prices then dropped as the 1981-82 recession combined with major increases in iron ore production capacity in Australia, Brazil, and Venezuela created a situation of oversupply. During this period, one U.S. steelmaker permanently closed 16% of its production capacity. U.S. iron ore production fell from 73.4 million tons in 1981 to 36.0 million tons in 1982.

Prices continued to fall until 1989, when economic conditions began to improve. Decreasing steel production caused prices to fall until 1994 when they began rising as the world steel industry enjoyed a number of years of increased production. In 1997, domestic steelmakers increased shipments for the sixth consecutive year, the longest consecutive increase ever.

During the second half of 1998, the U.S. steel industry became a victim of the world's growing financial crisis (Hogan, 1999). With the spread of the Asian economic recession, steel demand and export opportunities were curtailed within the region and Asian steel producers, particularly in Japan and the Republic of Korea, started to divert more of their products for export, much of it aimed at the United States. Despite high demand for steel, U.S. steel shipments declined by about 3%. Lower steel production in the United States and the rest of the world in 1998 caused the Brazilian fines price for 1999 to fall to $26.96, a decrease of 9.2%.

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Annual Brazilian Iron Ore Pellet Price[1]
(U.S. dollars per metric ton contained iron)

Year	Price	Year	Price	Year	Price	Year	Price
1976	43.80	1982	47.50	1988	40.35	1994	43.64
1977	42.80	1983	39.00	1989	47.33	1995	49.14
1978	36.40	1984	36.00	1990	51.60	1996	52.40
1979	39.96	1985	36.00	1991	52.15	1997	52.10
1980	47.05	1986	36.60	1992	48.47	1998	53.56
1981	43.05	1987	36.70	1993	43.64		

[1] Prices are for Brazilian iron ore pellets sold to Europe, f.o.b. Tubaro terminal, Southern System, Cia. Vale do Rio Doce.

Source: TEX Report Co. Ltd., Iron ore manual, [various years].

Annual Brazilian Iron Ore Fines Price[1]
(U.S. dollars per metric ton contained iron)

Year	Price	Year	Price	Year	Price	Year	Price
1976	22.70	1982	32.50	1988	23.50	1994	24.47
1977	23.00	1983	29.00	1989	26.56	1995	26.95
1978	21.50	1984	26.15	1990	30.80	1996	28.57
1979	23.30	1985	26.56	1991	33.25	1997	28.88
1980	28.10	1986	26.26	1992	31.62	1998	29.69
1981	28.10	1987	24.50	1993	28.14		

[1] Prices are for Brazilian iron ore fines sold to Europe, f.o.b. Tubaro terminal, Southern System, Cia. Vale do Rio Doce.

Source: TEX Report Co. Ltd., Iron ore manual, [various years].