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The Status of the Ferroalloy Industry with Special Reference to South Africa

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This paper analyses the vital link of the global ferroalloy industry in a variety of critical production chains, as well as its interaction with market forces.

The impact of the cyclical nature of demand and unit prices on the industry is analysed and discussed.

Closer cooperation between producer and consumer is proposed, and one possible avenue, stock management, is analysed.

South Africa's current and future role is portrayed against the background of its mineral wealth and its advantages in regard to infrastructure and other resources.

Introduction

The ferroalloy industry on a global basis forms a vital link in a great variety of critical production chains. The industry is subjected to a large variation in market forces. World economic conditions in general, and more specifically the production levels of carbon, stainless, and speciality steels, are the most significant variables.

Over the past few decades South Africa has made an ever-increasing contribution to the servicing of the Western World's needs for ferroalloys. This is mainly due to its vast and readily accessible mineral resources, a well-established infrastructure, and competitive energy costs. In addition to the general market forces mentioned above, the South African ferroalloy industry has to contend with internal and international political pressures and the high inflation rates typical of a developing country.

One of the most significant results of the various market forces that are brought to bear on the ferroalloy industry is the cyclical nature of the demand and the unit prices of the various alloys. Here, I address this important aspect and its influence on the status of the ferroalloy industry.

Production of Crude and Stainless Steel in the Western World

The production of crude steel in the Western World has shown tremendous fluctuation over the past two decades or so. Production reached its lowest level in 1982, and peaked again in 1985 and 1989, after which it plummeted. The slump of 13 per cent in 1982 was to a great extent due to the oil-price crisis in 1979–1980.

The recovery that followed in 1983–1985 was curbed by the implementation of tight monetary and fiscal policies, which were required to counteract the inflationary impact of rising oil prices. The dramatic recovery in the 1980's can largely be ascribed to an improvement in the world economy, as well as an improvement in net steel consumption *per capita* in Latin America and the Far East.

The production of crude steel is highly correlated with growth in the gross domestic product (GDP), as is shown in Figure 1 and Table I. It is clear from the graph that relatively small changes in world GDP have an enormous impact on the steel market, which emphasizes the sensitivity of the latter to economic market forces. The expected growth in the world economy in 1992 is reflected in an expected growth in steel production.

A further important macro-variable that has an impact on world steel markets is the relatively low intensity of steel usage in developed countries. Over the period 1981 to 1990, for example, developed or advanced countries

TABLE I
STEEL PRODUCTION VERSUS GDP FOR THE WESTERN WORLD[1]

Year	Steel production % change	GDP % change
1976	6,8	4,7
1977	–2,1	3,8
1978	5,7	4,1
1979	6,1	3,1
1980	–6,8	1,2
1981	–0,8	1,8
1982	–13,4	–0,3
1983	2,2	2,8
1984	9,5	4,9
1985	1,2	3,5
1986	–4,1	3,0
1987	3,7	3,5
1988	9,1	4,4
1989	1,7	3,3
1990	–1,1	2,6
1991	–5,0	1,1

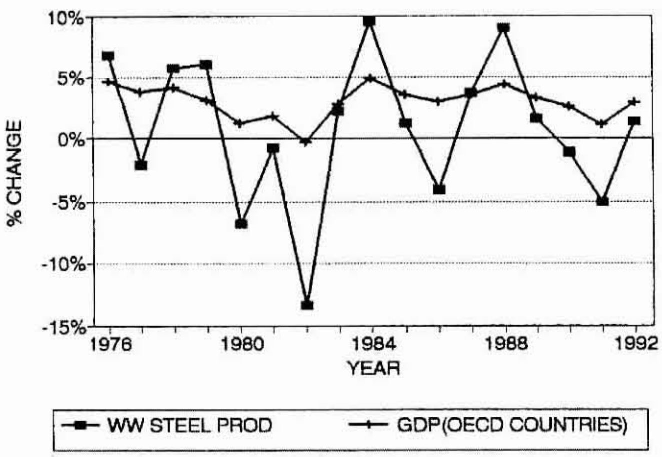

FIGURE 1. Steel production versus GDP for the Western World[1]

showed an average steel-intensity factor of 39,1 t per 1000 $US GDP, while developing countries averaged 45,3 t per 1000 $US GDP. Developing countries show a relatively high intensity of steel usage as the different economic stages of industrialization are accomplished. Industrially mature countries, on the other hand, tend to have higher activity in services than in the manufacturing industries, resulting in a flat or declining intensity of steel usage.

The production of stainless steel in the Western World to a certain extent followed a similar cyclical pattern to the production of crude steel. The production bottomed in 1982 and peaked again in 1988. The subsequent decline was, however, not as severe as in the case of crude steel. In fact, a moderate recovery was already starting in 1990, reflecting a prognosis of higher long-term growth for stainless steel.

For its part, the world steel market dictates the ferroalloy industries to a large extent. The ensuing paragraphs will discuss the impact of steel on the ferroalloy industries on an international level, as well as for South Africa.

Production: Steel versus Ferroalloys in the Western World

The production of steel correlates with that of high-carbon ferromanganese (HCFeMn), silicomanganese (SiMn), and ferrosilicon (FeSi) to a large extent. Figures 2 to 4 show these three commodities to have reached record production levels in 1989, after which there was a strong reaction to the decline in steel production. The production of SiMn suffered a larger

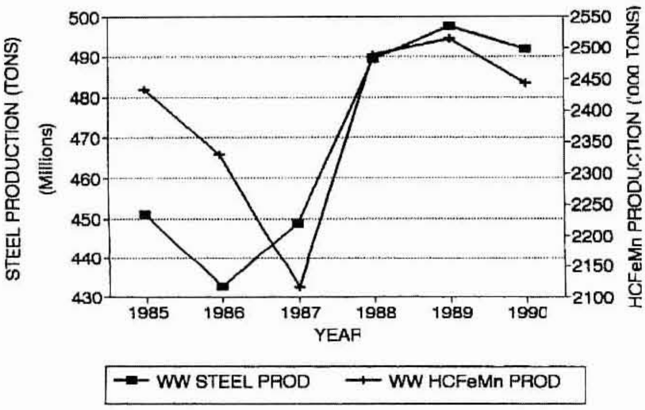

FIGURE 2. Steel production versus HCFeMn production in the Western World[2]

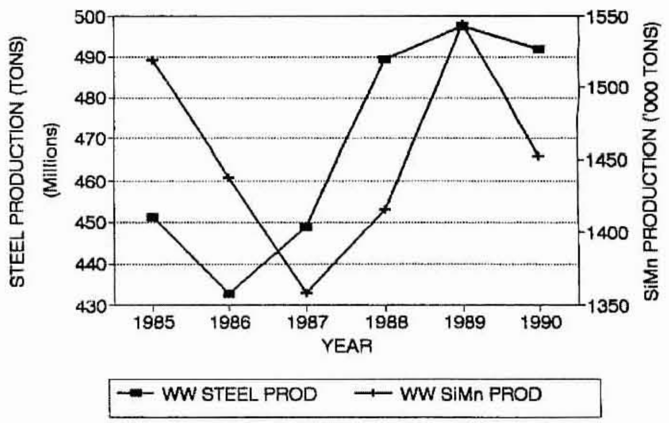

FIGURE 3. Steel production versus SiMn production in the Western World[2]

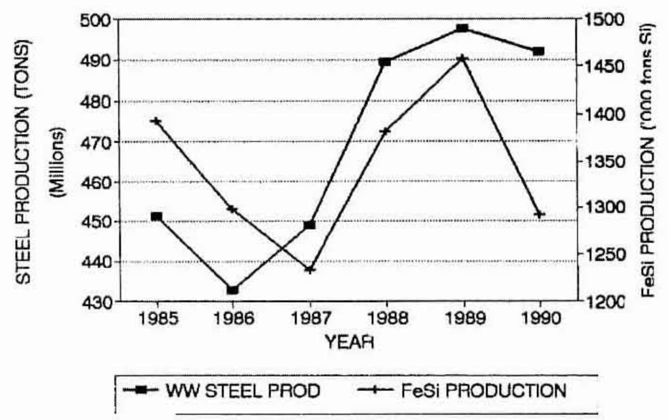

FIGURE 4. Steel production versus FeSi production in the Western World[2]

decline than that of HCFeMn in 1990, 6 per cent compared with 3 per cent. This can be ascribed to the fact that a number of producers changed their product mix in favour of HCFeMn owing to the sharp decline in SiMn prices during 1990.

FeSi production suffered a decline of 11 per cent during 1990, which was mainly induced by a sharp drop in prices. FeSi and SiMn seem to be more sensitive to fluctuations in the steel market than HCFeMn. The lag between steel and ferroalloy production appears to be approximately one year.

It is interesting to note that, in 1989, the Mn ferroalloy production was 4 per cent below the 1979 production levels, while the steel output was 5 per cent higher in 1989 than in 1979. Mn ferroalloy production therefore shows a declining trend over the long term. This is mainly the result of the falling consumption of Mn units per ton of steel produced. The total Mn consumption per ton of steel produced in Japan dropped from 8,8 kg in 1979 to 6,9 kg in 1990. The trend to use Mn ore directly in steelmaking, as is done in Japan, has also affected the Mn-alloy market. However, the rising cost of Mn ore since 1987 has resulted in a swing towards the use of HCFeMn in Japan.

The strong growth in the production of stainless steel and of high-carbon ferrochromium/charge chrome (HCFeCr/ChCr) during the eighties is depicted in Figure 5. The production of both stainless steel and HCFeCr/ChCr has increased at an average rate of around 5 per cent per year since 1981. A strong correlation between changes in growth is evident from the diagram, particularly during the first half of the eighties.

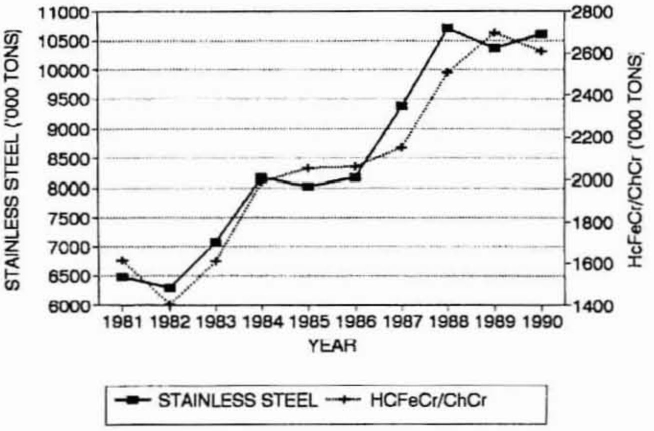

FIGURE 5. Stainless-steel production versus ferrochromium production in the Western World[3]

A pattern, in which the production of HCFeCr/ChCr lagged that of stainless steel by approximately one year developed later in the decade. Despite an increase in the production of stainless steel in the Western World to over 10,5 Mt in 1990, an over-supply of HCFeCr/ChCr and consequent low prices forced producers to reduce the production of HCFeCr/ChCr. In fact, certain producers in countries such as Sweden, Italy, Yugoslavia, and the Philippines were forced to close down their production facilities during 1990 and 1991.

South Africa's ferroalloy production is shown against the Western World's steel production in Figures 6 to 8. The South African ferroalloy industry is highly integrated. Production-wise, South Africa's market share in the Western World ranges between 15 and 20 per cent for HCFeMn and SiMn, and approximately 6 per cent for FeSi. The country's share for HCFeCr/ChCr reached over 40 per cent in 1990. Peak production ranged from 1987 through to 1989. The local production of HCFeMn and FeSi appears to lag the world steel market by one year, while the production of SiMn is lagging by approximately two years.

A comparison between local ferroalloy production and that in the Western World is shown in Figures 9 to 12. The production of HCFeMn and FeSi appears to be fairly in phase with the Western World's production, while SiMn seems to lag trends in the Western World by two years.

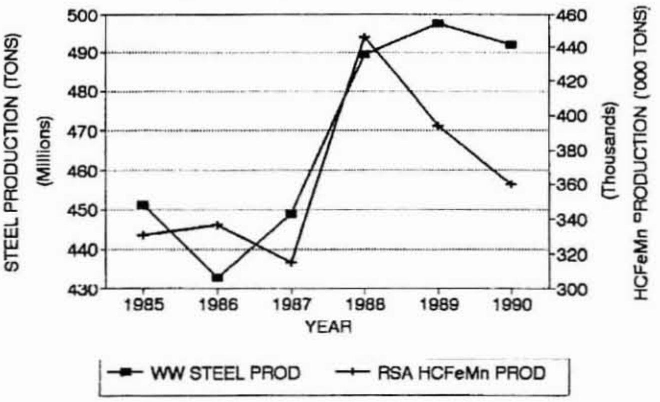

FIGURE 6. Steel production in the Western World versus high-carbon ferromanganese production in South Africa[4]

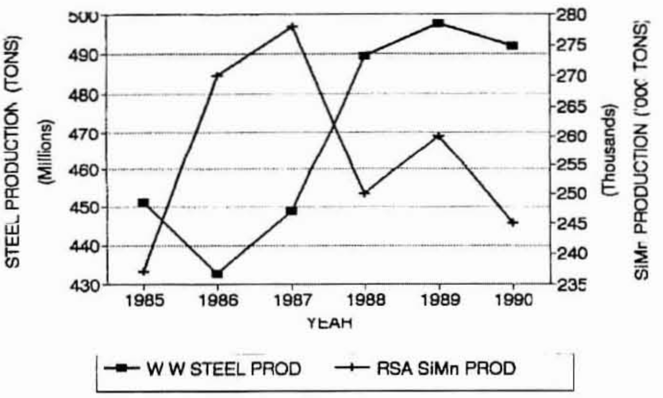

FIGURE 7. Steel production in the Western World versus silicomanganese production in South Africa[4]

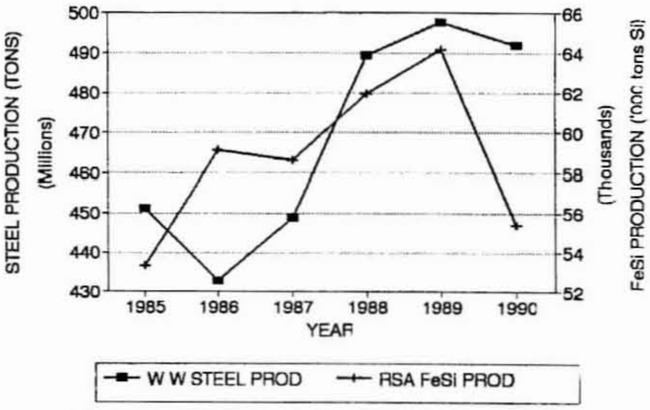

FIGURE 8. Steel production in the Western World versus ferrosilicon production in South Africa[4]

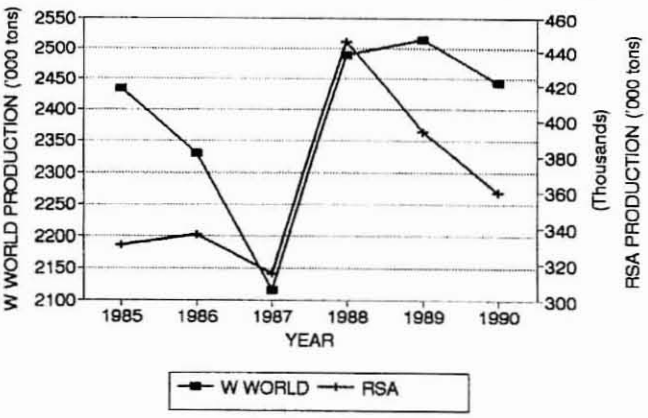

FIGURE 9. High-carbon ferromanganese production in the Western World versus that in South Africa[5]

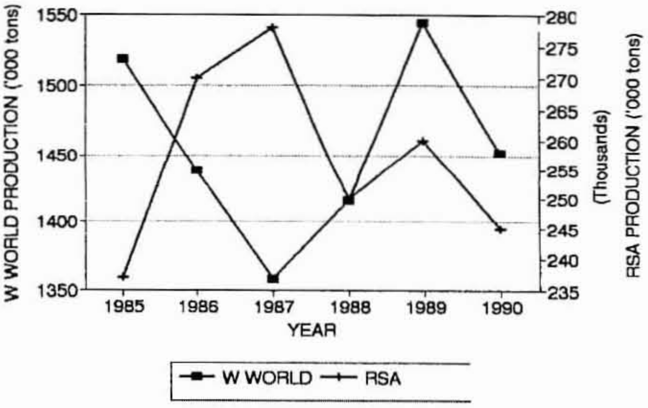

FIGURE 10. Silicomanganese production in the Western World versus that in South Africa[5]

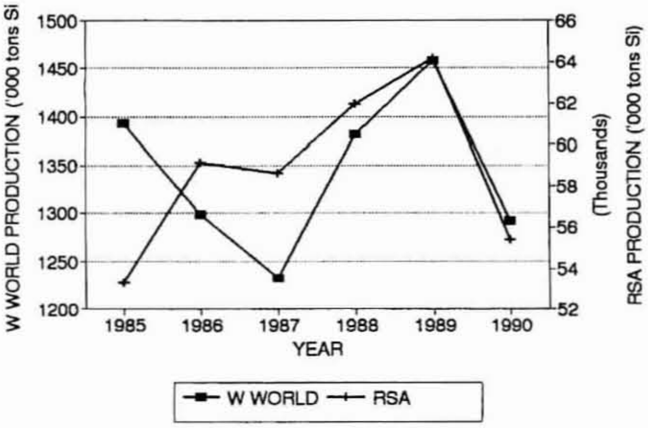

FIGURE 11. Ferrosilicon production in the Western World versus that in South Africa[5]

Local and Western World production of HCFeCr/ChCr seems to be in phase, with the exception of 1990, when the total Western World production decreased despite a further increase in the South African production.

Although temporarily slowed down by a two-year pause in the growth of stainless-steel production subsequent to 1984, South Africa has experienced uninterrupted growth in the production of HCFeCr/ChCr since 1982, as depicted in Figure 13. This can be attributed to the utilization of new production capacity in South Africa, which came on stream during the latter half of the decade.

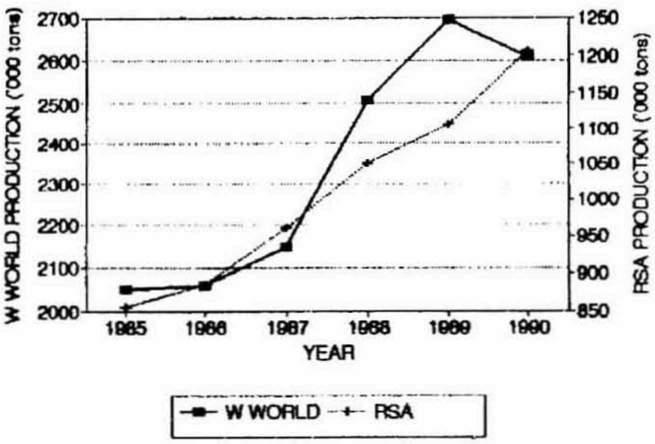

FIGURE 12. Production of HCFeCr/ChCr in the Western World compared with that in South Africa[5]

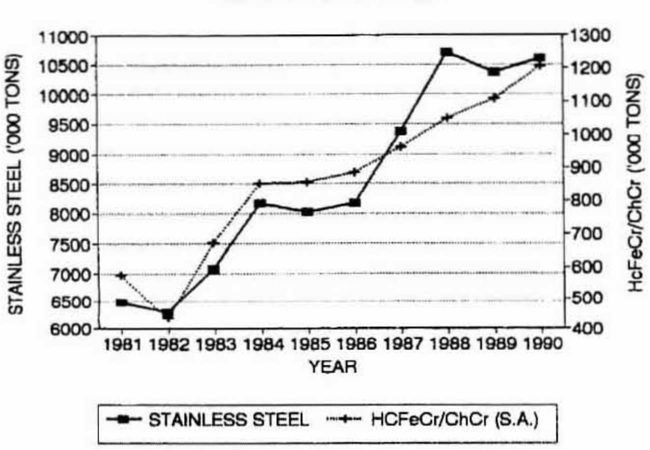

FIGURE 13. Stainless-steel production in the Western World versus ferrochromium production in South Africa[6]

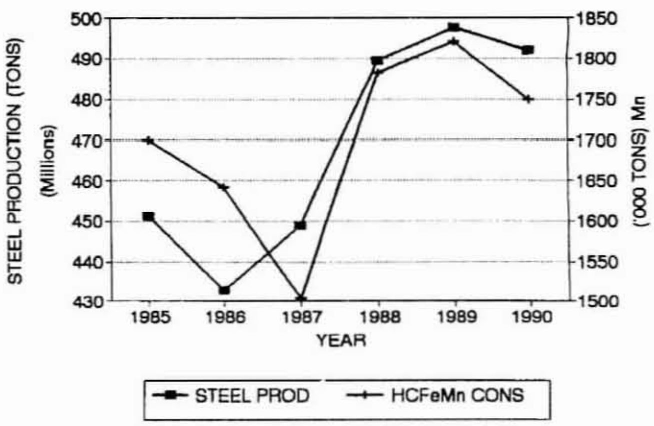

FIGURE 14. Steel production versus high-carbon ferromanganese consumption in the Western World[7]

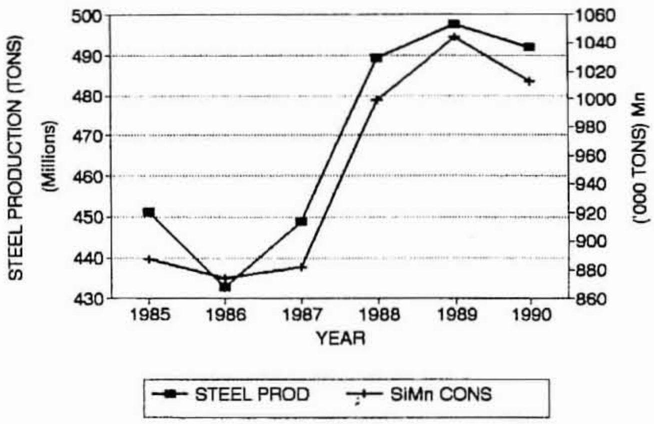

FIGURE 15. Steel production versus silicomanganese consumption in the Western World[7]

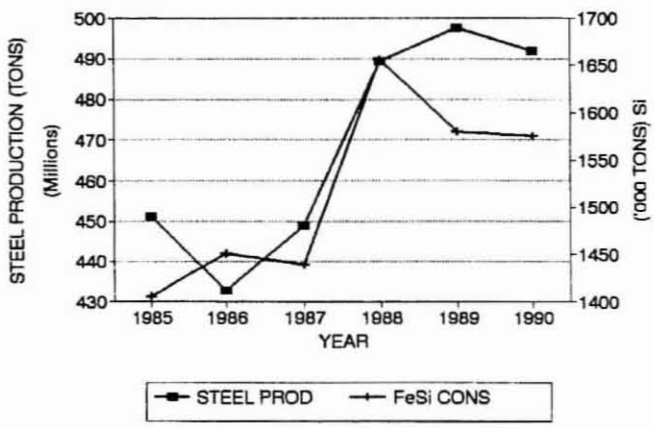

FIGURE 16. Steel production versus ferrosilicon consumption in the Western World[7]

Production/Consumption: Steel versus Ferroalloys in the Western World

Steel production in the Western World is a good indicator of ferroalloy consumption. The slump in steel production in 1986 caused ferroalloy consumption to suffer a decline in 1987, with HCFeMn showing the largest drop. The consumption of both HCFeMn and SiMn peaked in 1989, with FeSi consumption reaching record levels in 1988. This is also the period in which steel production was at its highest.

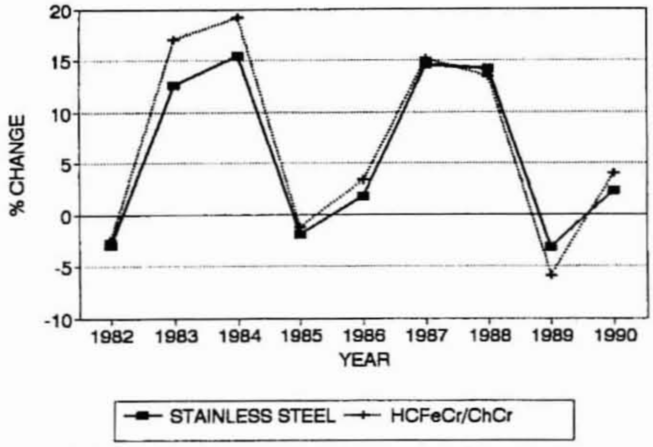

FIGURE 17. Stainless-steel production versus ferrochromium consumption in the Western World[8]

The move to SiMn in favour of HCFeMn and FeSi over the past year or two was mainly induced by price movements. However, the overall shift in consumption from HCFeMn to SiMn has been relatively moderate, with variations from country to country.

Figures 14 to 16 show a comparison between steel production and ferroalloy consumption in the Western World.

As depicted in Figure 17, a close relationship exists between the consumption of HCFeCr/ChCr and the production of stainless steel. The tendency of HCFeCr/ChCr consumption to be exaggerated by changes in stainless-steel production is a function of the complex relationships between HCFeCr/ChCr, nickel, and scrap.

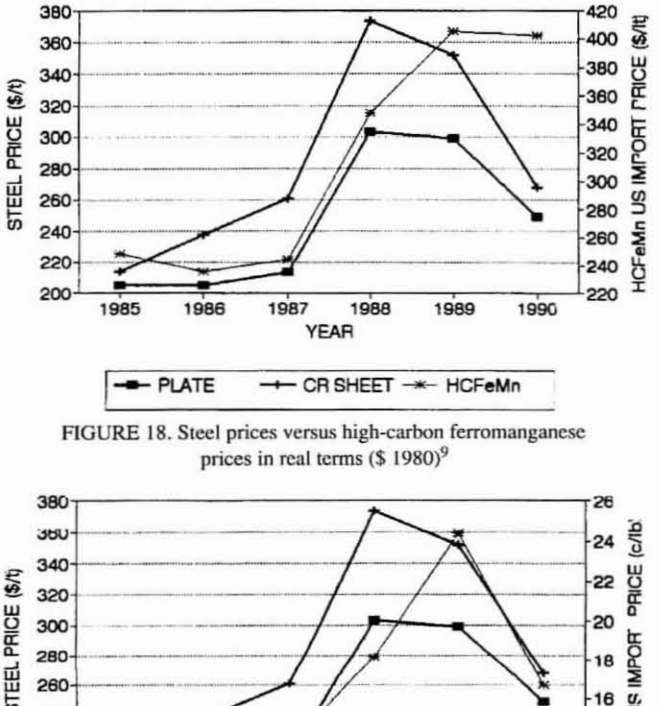

FIGURE 18. Steel prices versus high-carbon ferromanganese prices in real terms ($ 1980)[9]

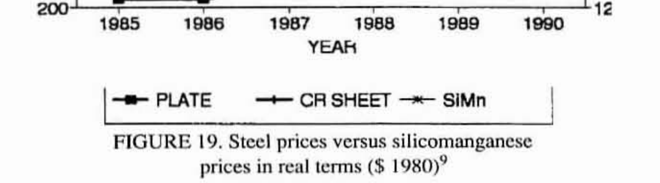

FIGURE 19. Steel prices versus silicomanganese prices in real terms ($ 1980)[9]

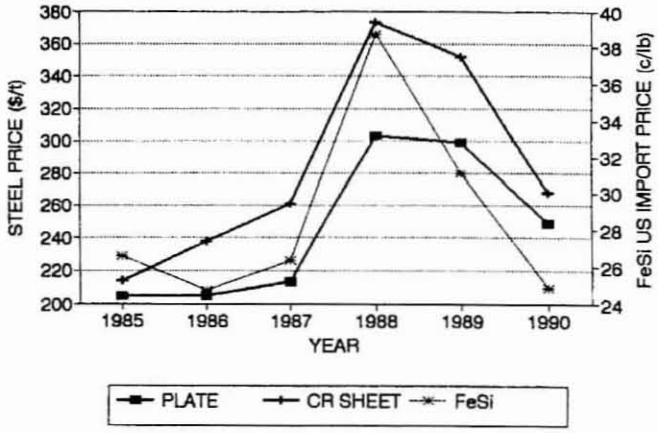

FIGURE 20. Steel prices versus ferrosilicon prices in real terms ($ 1980)[9]

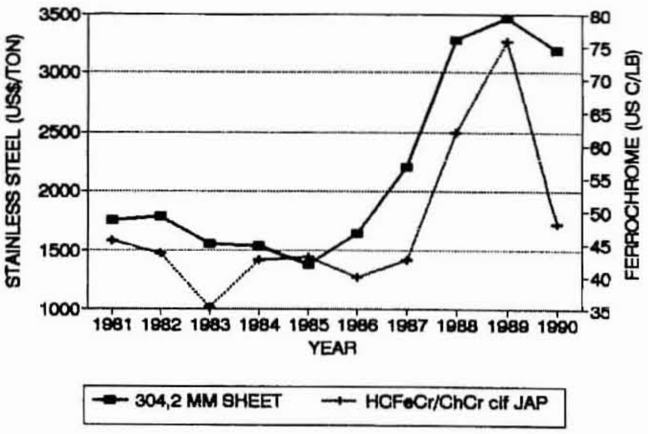

FIGURE 21. Average realized stainless-steel prices versus contract ferrochromium prices[10]

Prices: Steel versus Ferroalloys in the Western World

Steel prices seem to lead ferroalloy prices, although these two indicators are fairly well correlated. HCFeMn and SiMn prices peaked in 1989, and FeSi in 1988. On the chromium side, HCFeCr/ChCr prices peaked in 1989. The lag between steel and ferroalloy prices appears to be about one year, although the drop in steel prices since 1989 seems to have had an immediate effect on ferroalloy prices. This is especially true for SiMn, FeSi, and HCFeCr/ChCr. Figures 18 to 21 depict a comparison between the prices of ferroalloys and of representative steel products.

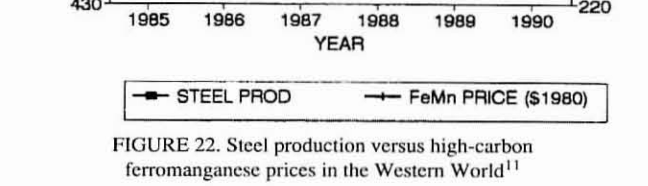

FIGURE 22. Steel production versus high-carbon ferromanganese prices in the Western World[11]

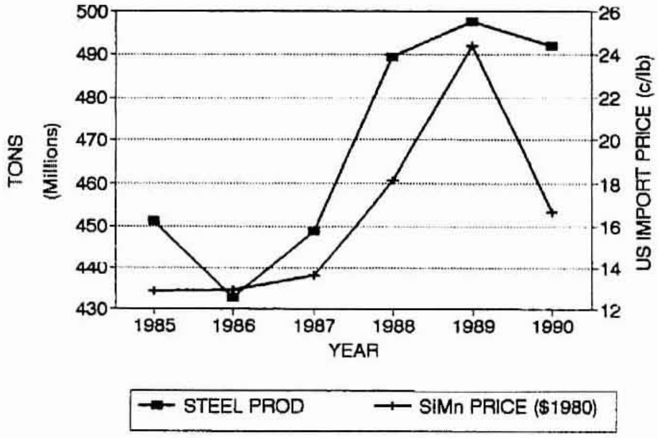

FIGURE 23. Steel production versus silicomanganese prices in the Western World[11]

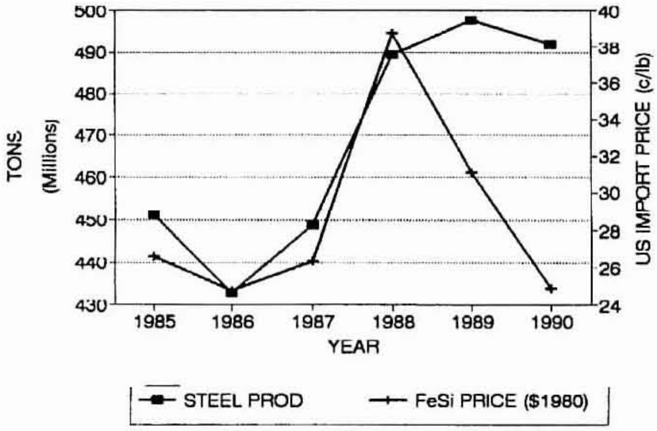

FIGURE 24. Steel production versus ferrosilicon prices in the Western World[11]

Steel production correlates well with ferroalloy prices. SiMn and FeSi prices appear to be more sensitive to swings in steel production than HCFeMn prices. These relationships are shown in Figures 22 to 24.

In general, the ferroalloy consumption dictates prices. It is evident from Figures 25 to 27 that a decline in consumption forces prices down, and *vice versa*. These two market indicators are in phase for both HCFeMn and SiMn, which reflects the immediate reaction of the market to changes. Producers, for example, cut down when a decline in consumption occurs, resulting in shortages when consumption picks up. This inevitably leads to an increase in prices. FeSi

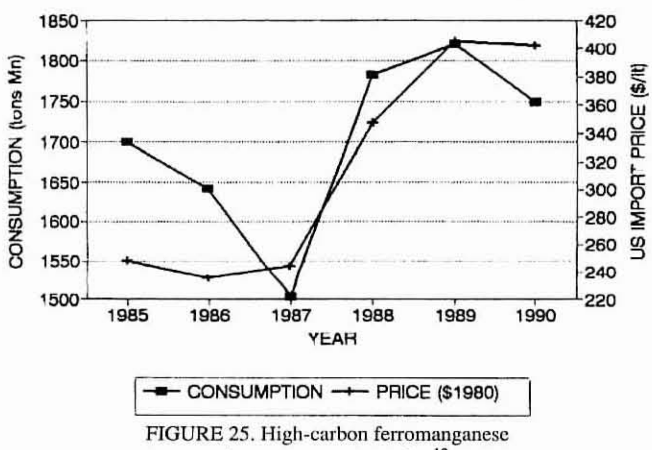

FIGURE 25. High-carbon ferromanganese prices versus consumption[12]

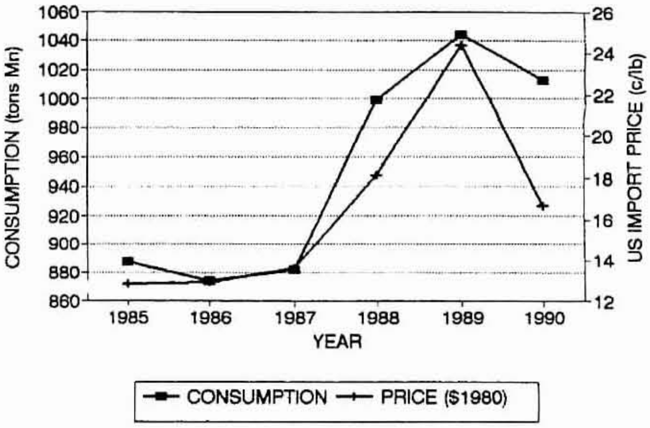

FIGURE 26. Silicomanganese prices versus consumption[12]

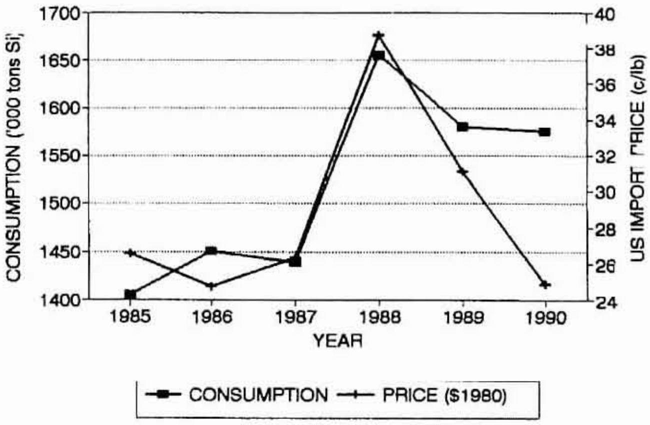

FIGURE 27. Ferrosilicon prices versus consumption[12]

prices seem to lag consumption by about one year.

It is interesting to note that FeSi prices followed the same trend as HCFeMn and SiMn prices, but FeSi consumption started a declining trend one year before that of HCFeMn and SiMn. This is possibly due to a relatively large increase in FeSi prices in 1988 compared with those of SiMn, for example.

Market Volatility

In general terms, the steel and ferroalloy industries are very volatile and sensitive to market fluctuations. Steel production dictates the ferroalloy industry, and relatively small changes in the steel industry have significant impact on the ferroalloy industry. In 1988, for example, a 9 per cent increase in steel production in the Western World resulted in an 18 per cent increase in HCFeMn production, and 42 per cent, 33 per cent, and 47 per cent increases in the prices in real terms of HCFeMn, SiMn, and FeSi respectively. This went hand in hand with a 1 per cent increase in Mn-alloy capacity in the Western World, and a 3 per cent increase in FeSi capacity in the Western World, during 1988.

In 1990, a drop of 1 per cent in steel production in the Western World resulted in sharp decreases in ferroalloy production, as well as in prices. SiMn and FeSi prices, for example, dropped by 32 per cent and 20 per cent (real terms) respectively over that period.

Figures 28 and 29 and Table II compare relative changes in the steel and ferroalloy industries. From Figures 30 and 31 and Table III, it is clear that ferroalloy production and prices peak and drop at much wider ranges than steel production. This emphasizes the tremendous impact made by

TABLE II
RELATIVE PERCENTAGE CHANGES IN STEEL AND FERROALLOY MARKETS[15]

Year	Steel production W. World	Steel price (plate)	HCFeMn production W. World	SiMn production W. World	FeSi production W. World	HCFeMn price	SiMn price	FeSi price
1985	1	–7	1	3	–4	–4	–15	–19
1986	–4	0	–4	–5	–7	–5	0	–7
1987	4	4	–9	–6	–5	4	5	7
1988	9	42	18	4	12	42	33	47
1989	2	–1	1	9	6	17	35	–20
1990	–1	–17	–3	–6	–11	–1	-32	–20

TABLE III
RELATIVE CHANGES IN STEEL PRODUCTION VERSUS FERROALLOY PRODUCTION AND PRICES[18]

Year	Steel production % change	Ferroalloy production % change	Ferroalloy prices % change
1985	1,2	0,2	–14,4
1986	–4,1	–5,2	–5,1
1987	3,7	–7,1	6,1
1988	9,1	12,3	41,6
1989	1,7	4,4	4,6
1990	–1,1	–6,0	–17,0

steel on these industries. From Figure 28, the production of HCFeMn seems to be hardest hit and boosted by steel production compared with FeSi and SiMn. However, from Figure 29 it appears that HCFeMn prices are at a more stable level than the prices of the other two commodities, which show very high volatility.

In terms of volume, swings in the Western World's production have been enormous over the past decade. The trough in 1982, for example, represented a drop of about 61 Mt compared with 1981, while in 1988 40 Mt more steel was produced than in 1987.

On the ferroalloy side, lows and highs for HCFeMn, FeSi, and SiMn range from a decline of about 200 kt to an increase of about 400 kt on previous years.

It is clear from the above analyses that fluctuations in world GDP have a multiplicative effect on the ferroalloy industries. The volatility of these markets complicates long-

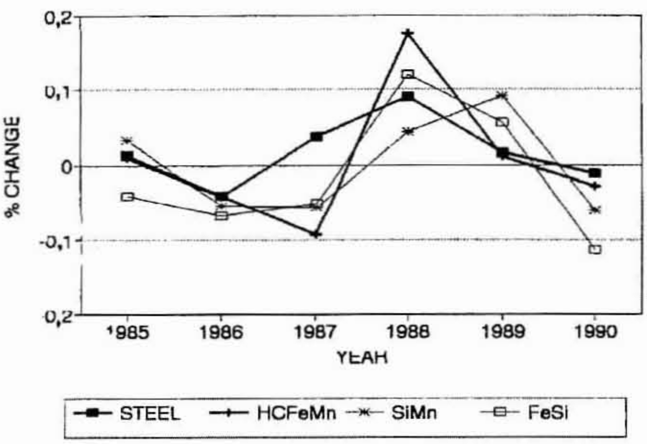

FIGURE 28. Percentage change in steel and ferroalloy production in the Western World[13]

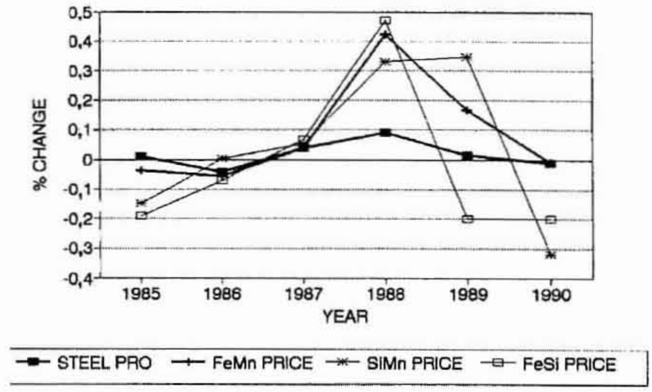

FIGURE 29. Percentage change in steel production and ferroalloy prices[14]

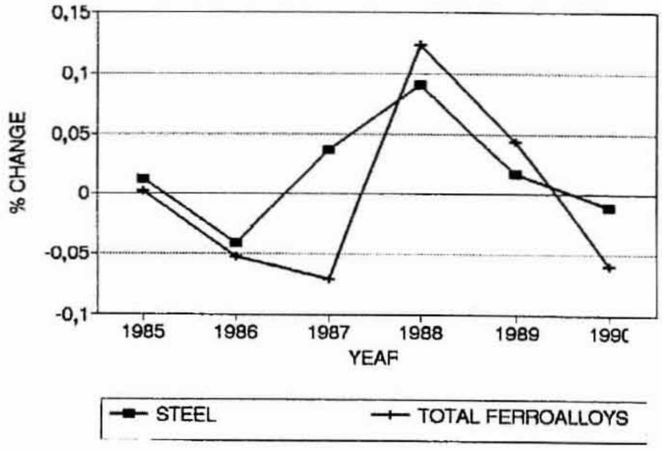

FIGURE 30. Percentage change in steel and ferroalloy production[16]

term planning in terms of producers, as well as consumers. Both these parties bear the risks of over- or under-stocking, which makes it critical for a mutual understanding of their market situation, and of existing and potential problems.

In view of the low growth expected in the world's steel economic environment in the 1990's, a similar scenario can be anticipated for steel production. A steady base of demand for steel products can be expected from industries such as construction and capital/consumer goods over the next decade or so. However, there are substitution threats, which add risks to an already volatile market.

The cyclical nature of the ferrochromium industry is depicted in Figure 32. Capacity constraints inhibited a

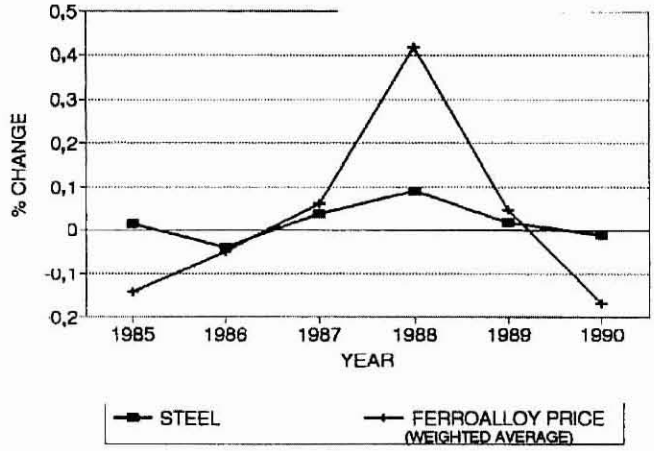

FIGURE 31. Percentage change in steel production and ferroalloy prices[17]

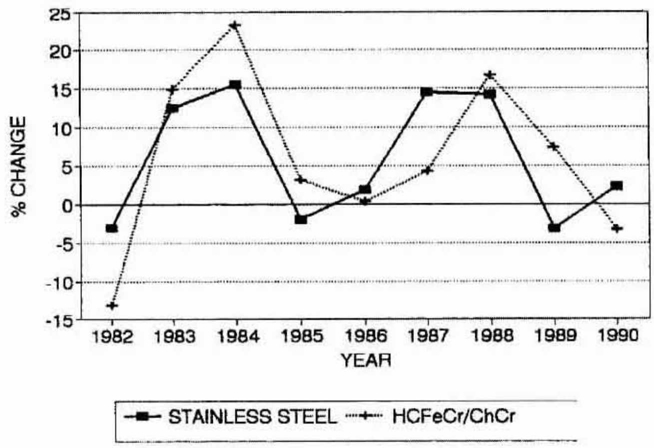

FIGURE 32. Percentage change in stainless-steel and ferrochromium production in the Western World[19]

cyclical upturn in the industry in 1987, when the production of stainless steel surged by almost 15 per cent. Subsequent years saw huge increases in HCFeCr/ChCr production capacity. In South Africa alone, the production capacity was increased by more than 50 per cent. The total world capacity surged by more than 1,1 Mt per annum in the late eighties, which led to a considerable surplus in supply.

As mentioned, the inevitable rationalization process has already started. However, the current over-capacity in the ferrochromium industry will most probably result in larger production swings to accommodate future changes in demand.

The Ferroalloy Pipeline

The exceptionally large amplitudes of swings from one year to another create enormous pressure on the performance of alloy producers in regard both to servicing the market and to financing the business.

For many industries, the just-in-time (JIT) delivery system has created a competitive edge and, particularly in regard to the manufacturing of components, this has worked well. Manufacturing industries that are more raw-material oriented, such as the pulp and paper industry, are adopting this approach.

Most of the product flows are between, or even within, the industrialized countries of the Northern Hemisphere, which have well-developed transportation infrastructures. Distribution problems have been solved, the products being delivered in time at a realistic cost. Completely new systems have been created to accommodate these needs.

The development in regard to handling, transportation, etc. has not shown the same progress for ores and alloys as for components for the manufacturing industry. The higher-quality service demanded by consumers of ores and alloys has been accomplished, but there has not been an equivalent improvement in distribution and cost efficiency. For the ore and alloy company, maintaining a high-quality service has resulted in particularly higher stocks for the whole production chain from the producer's mine to the warehouse in the customer's countryby the feroalloy industry.

A great endeavour is currently being made by the ferroalloy industry to reduce costs wherever possible, but this is tricky since it is important not to reduce the quality of service to the customers. Stockpiling at various stages in the mining, manufacturing, and distribution processes seems to be the main culprit. A look at the complete pipeline shows that substantial quantities of material are locked into it at many different stages.

Samancor recently completed an exercise in which they broke down the flow of materials from mining up to final delivery to the customer, including receipt of payment. The time that elapsed between the various stages raised grave concern. The time for mining, processing, and transportation accounted for less than 15 per cent of the total time, with minimal opportunities for major improvements. Total stockpiling, basically dead time, represented around 70 per cent of the pipeline or, measured in time, about eight months.

Stocks at the mine seems to be the lowest of all the stocks, at least for Samancor. Increases at the alloy works are inevitable since both raw materials and finished stocks have to be carried. Stockpiling during the transportation process seems to be reduced to a minimum. Very little can be done with today's equipment and procedures to reduce this part of the chain, which constitutes a very small part of the total pipeline at present.

Stocks carried in warehouses close to the customers add up to the longest period of time. In regard to Samancor, an average of three months is the norm, and not the exception. Keeping stocks for that length of time in warehouses in the consuming countries is expensive.

Payment terms accounted for the rest of the pipeline, at 15 per cent. There seems to be some possibility of reducing this part of the cycle.

It is clear from the above that, for ore and alloy producers to provide an excellent service, unduly large stocks for no return at all have to be carried.

For Samancor, the total pipeline is close to one year, which seems to be an eternity, particularly when it comes to financing the working capital involved. The total of stocks and debtors is currently almost 50 per cent of turnover. Samancor, as a single ferroalloy producer, is therefore financing consumer services, mostly clients in first-world countries, to the extent of R1 billion per annum. When it is considered that current prime rates are about 20 per cent, and that South Africa is in desperate need of development capital, the situation has become untenable and drastic improvements are required.

For the industry to survive and prosper, changes have to be made. The producers of alloys and ore have to get their act together and, wherever possible, reduce working capital to keep the costs down and prices competitive. However, this is not sufficient, and a closer cooperation has to be achieved with customers, so that stocks move faster and do not get stacked in warehouses for several months. The JIT principle and a commitment to its success have worked for the manufacturing industry. A similar commitment is needed for the ore and alloy business. The producers will ensure delivery in time with certain guarantees in regard to stock levels, but the customer has equally to fulfil his obligation and maintain a regular off-take to keep costs to a minimum. The cost and benefit for JIT must lie in the hands of both the supplier and the consumer, and not entirely in the hands of one party, the supplier.

It is important to remember that all ferroalloy producers are working for the same goal to satisfy needs. To be able to achieve this at the lowest possible cost, there has to be cooperation. Dialogue in regard to the shortening of the pipeline has to start between producers and consumers to reduce stocks and payment terms. The ultimate objective must be to cut unnecessary costs.

Furthermore, closer cooperation can only strengthen the trust between producer and consumer, and ensure the long-term viability of the ore, alloy, and steel industries.

South Africa's Future Role in the World's Ferroalloy Industry

Total world reserves of manganese ore are in the region of 4,9 billion tons of contained manganese, with South Africa having about 81 per cent of this total. These deposits are located predominantly in the Kalahari manganese field, in the northwestern part of the country. The time to the depletion of world reserves is in the region of 130 years, while South Africa's manganese ore should be depleted in another 220 years.

The average grade of manganese ore currently mined is at the high level of 43 per cent manganese. In addition, impurities such as phosphorus contained by the South African ore are at highly competitive levels.

The world's reserves of chromium ore are estimated at 4,3 billion tons, with 75 per cent of the reserves occurring in South Africa, and 17 per cent in neighbouring Zimbabwe. At current production levels, the reserves in South Africa and Zimbabwe have a lifetime of more than 100 years. If production from South Africa is stopped, the remaining world reserves could be depleted within 40 years.

The South African ferroalloy industry is highly integrated. This places the country in a very favourable position with respect to the availability and cost of raw materials. Technology-wise, the local ferroalloy industry is on a highly competitive level, with the potential to adopt new technology fairly effortlessly. It also enjoys the back-up of facilities such as those at Mintek and the CSIR, which are involved in extensive research-and-development work into the minerals industry.

The future of the ferroalloy industries around the world is greatly dependent on developments in production costs. South Africa is in the fortunate position that the four major production-cost components, *viz* those of raw materials, internal transportation, labour, and power, compare very favourably with those of other countries. With the devaluation of the rand, wages have increased in constant 1990 rand terms by about 25 per cent, which means that labour has become more expensive in absolute terms. However, in real terms, labour costs have shown relative stability.

South African rail tariffs are highly competitive in relation to those of other countries. From 1975 to 1985, the unit cost (constant US cents per ton per kilometre) declined for high-value products like ferroalloys and steel. After 1985, the trend remained flat but still at a lower average rate than in other countries.

Electricity in South Africa is abundantly available, and relatively cheap compared with other developed countries. In real dollar terms, Eskom's tariffs are at present at the same level as they were in 1960. However, in constant rand terms, electricity rates have increased by almost 20 per cent, underscoring the weak value of the rand. In spite of the latter, South Africa's electricity tariffs are still lower than in the major developed countries.

The strategy in which power is priced as a function of alloy prices has been adopted with a great measure of success in one-quarter of the world's aluminium-refining industry. This is being investigated by the ferroalloy industry in South Africa, since it could significantly assist the industry in managing the severe cyclical swings of the market.

South Africa's infrastructure is unsurpassed by African standards, and compares favourably with those of many highly industrialized countries. Internal transportation is channelled through a well-established rail network, which is largely electrified. The transport chain is then extended by the two alloy-exporting harbours of Durban and Richards Bay, where the facilities are of world standard.

The combination of the country's vast high-quality mineral reserves, well-established infrastructure, cost competitiveness, and advanced technology places South Africa in a very favourable position with regard to the expansion and improvement of its ferroalloy industry.

South Africa's position in international markets has also improved drastically with the loosening of sanctions. There is still tremendous potential for development and for strengthening its position as an international market force in a post-sanctions, post-apartheid era. The country's political and socio-economic situations are improving slowly but stably towards a positive future.

As the leading market economy in Africa, South Africa has vast opportunities for expanding and strengthening trade with its neighbouring countries. General trade between this country and neighbours such as Zimbabwe, Zambia, Malawi, Mozambique, and Namibia is already flowing on a well-established basis, with a fairly well-developed infrastructure to facilitate these initiatives.

However, the existing relationships could be strengthened by the development of the region's natural resources through the integration of mineral resources and the exploitation of existing hydro-electric potential. Schemes, such as Cahora Bassa in the catchment area of the Zambezi River, are largely under-utilized. Vast potential for the generation of electricity is also still undeveloped – in the catchment area of the Zaire River, for example. The Lesotho Highlands Water Scheme in the high-lying mountains of Lesotho boasts the establishment of large water and energy resources for South Africa. The project is due for completion in the next few years, and will greatly strengthen South Africa's existing infrastructure.

Recent political developments in Africa have paved the way for the extension of trade between South Africa and its neighbours. It therefore seems clear that, within the right political and economic environment, South Africa is in a very strong position to extend its leading role as a market force in Africa, as well as internationally.

From the foregoing discussion, it is clear that excellent opportunities exist for the expansion of South Africa's ferroalloy industry. The accessibility of natural mineral resources, as well as the presence of other important key components, are all accommodating factors to improve this country's role in the international ferroalloy industry.

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