FERRO-ALLOYS IN A GLOBAL CONTEXT-- AN ECONOMIC VIEW OF THE FUTURE

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ABSTRACT

The ferro-alloy industry is passing through a period of rapid technical evolution and geographical change away from many of the large steel producing nations towards sources of raw material supply.

This has arisen largely as a result of changing economic conditions set in motion by the energy price escalations triggered by Opec in 1973.

Ferro-Alloy consumption is inevitably tied to the steelmaking industry which itself is undergoing a traumatic process of adaption to new conditions. Future growth patterns for carbon steels favour certain developing countries and are unlikely to match the growth rates which have sofar prevailed through this century. To enable economies of scale to be achieved, new plants are likely to be at least partially export orientated. Special steels, on the other hand, are expected to show a much higher growth rate with production concentrated in the major industrialised countries.

The ferro-alloy industry will adapt to the ever increasing sophistication of the steelmaker with the accent on the cheapest possible raw materials and energy efficiency.

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INTRODUCTION

The rapid evolution of ferro-alloy production technology to the sophisticated levels of today has perhaps been the most remarkable feature of all modern pyrometallurgical developments. The small, relatively inefficient, 5 to 15 MVA furnaces that characterised production facilities two decades ago have given way to the 24,48, 75 and even 98 MVA giants of today. The small units still in operation are used almost exclusively for the production of low volume special alloys and alloys such as low carbon ferrochromium and low and medium carbon ferromanganese, and the silicon containing alloys of manganese and chromium.

For the large tonnage chromium, manganese and silicon alloys, the technological evolution will inevitably continue, initially towards large computer controlled units emphasising cost reduction through optimum manpower utilisation, electric power conservation, heat recycling, maximum transfer of valuable components from the ore to the alloy and not least, environmental controls that meet the demands of the latest breed of environmentalist which is all too frequently able to dictate to the authorities.

In the case of ferromanganese attempts to keep the blast furnace in operation by exploiting the concept of the low-shaft variety have not succeeded in preventing this mode of manufacture from yielding to the greater versatility of the large submerged arc furnace. A prime factor is no doubt the increased demand for ferrosilicomanganese and the diversity of alloy that can be produced through a mix of large and small electric furnaces and slag recycling. The high price of metallurgical coke and the difficulties of grade control are major contributing factors in the phasing out of the blast furnace production of ferromanganese.

Plant closures embracing all types of ferro-alloys have resulted from many changing factors, not the least of which is the failure on the part of management to give timely recognition to changing economic conditions thereby updating obsolete equipment during times of prosperity to enable subsequent cyclical downturns to be endured.

Power and labour intensive operations requiring an individualised specialisation of expertise in the production of low and medium carbon and silicon containing manganese and chromium alloys, the output of which has declined over the past decade, are likely to find a new lease of life in meeting the demand of the highly specialised steelmaker of future years. This demand

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will be dictated through his end user, becoming increasingly particular about the composition of alloys required to meet the highly sophisticated demands of modern day requirements of such industries as defence and space travel.

HISTORICAL TRENDS IN WORLD STEEL

The fortunes of ferro-alloys inevitably follow those of steel; no steel production is possible without manganese added through the medium of manganese containing ores and alloys. Silicon is a vital component of almost every steel and such alloying elements as chromium, vanadium, molybdenum, niobium and titanium are becoming even more essential to the specialised steels of today. Hence, the future of ferro-alloys is inevitably linked to the destiny of steel and a study of the future of steel is paramount to any meaningful forecast on ferro-alloys.

Figures 1 and 2 illustrate the growth of steel production over the past three decades. In a similar way, Table 1 reflects the growth in stainless steel production. It will be observed that in recent years, the growth rate of stainless steel outstripped the growth of the general steel industry.

Table 2 divides the world steel production into countries and thus identifies the growth pattern in the various countries and regions.

Figures 3 and 4 illustrate that the main producing countries are also the main consuming countries. Figure 5 shows the ratio of exports to imports in leading producing countries; Japan, Western Germany, Belgium/Luxembourg and France, were net exporters, while the USSR and the USA were net importers. Through the development of competitive production plants in the developing areas of the world, this pattern is changing.

In trying to identify economic cycles of an industry in a given country, "intensity" trends are an all important guide to the future. Steel intensity measures the relationship between consumption and real GNP/GDP. A developing nation with a rapidly growing economy needs a large steel import during its early years of infrastructural development, but as the society becomes more affluent, steel consumption falls off relative to GNP/GDP per capita growth. This is illustrated in Figures 6 to 10 from which the interpretation may be drawn that future carbon steel development is unlikely to take place in the industrialised nations. Figure 10 decisively shows that the converse holds true for stainless steels.

TABLE 1

WORLD PRODUCTION OF STAINLESS STEEL INGOTS (EXCLUDING COMECON COUNTRIES AND CHINA)
AND FERROCHROMIUM CONSUMPTION

'000 M TONS

Country	1960	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982 E	1983 E
France	180	460	394	480	521	570	419	497	572	538	613	594	508	525	
Germany	259	504	370	518	620	688	437	673	636	761	821	816	753	680	
Italy	58	238	216	260	288	311	267	366	418	440	502	493	393	450	
Spain	*	*	*	*	*	76	77	110	142	156	156	161	165	185	
Sweden	176	354	340	382	467	519	419	418	325	360	418	379	330	328	
U K	224	257	164	196	240	226	148	222	194	233	266	144	242	220	
Other Europe (a)	57	117	136	174	214	180	163	174	203	232	304	293	282	295	
Total - Europe	960	1 970	1 620	2 010	2 350	2 570	1 930	2 460	2 490	2 725	3 080	2 880	2 673	2 683	
U S A	908	1 158	1 141	1 413	1 716	1 950	1 008	1 528	1 696	1 763	1 913	1 537	1 582	1 125	
Japan (b)	238	1 643	1 404	1 421	1 995	1 910	1 543	2 066	2 032	1 944	2 136	2 157	1 900	2 255	
Other (a)	44	179	125	156	189	220	149	196	212	248	237	251	290	307	
Grand Total	2 150	4 950	4 290	5 000	6 250	6 650	4 630	6 250	6 430	6 680	7 365	6 825	6 525	6 380	6 300 - 6 500
+Ferrochromium	470	1 275	1 065	1 245	1 560	1 660	1 150	1 560	1 610	1 820	2 010	1 850	1 695	1 655	1 700
As % of Steel	22	26	25	25	25	25	25	25	25	27	27	27	26	26	27

(a) Includes Estimates
(b) HR production converted on a 75% basis up to 1972
HR production converted on a 80% basis for 1973-1978
HR production converted on a 85% basis for 1979-1980
* Included in "Other Europe" prior to 1974
\+ Includes high carbon, low carbon and ferrosilicochromium
E = Estimated

Sources: World Stainless Steel Statistics - Inco Europe 1981.
Ferrochrome Consumption Figures by Samancor and MS and A.

TABLE 2

WORLD STEEL PRODUCTION, 1959-1982)

(Millions of Metric Tons, Raw Steel Equivalent)

Region and Country	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Western Europe																								
Austria	2,5	3,1	3,1	3,0	2,9	3,2	3,2	3,2	3,0	3,5	3,9	4,1	4,0	4,1	4,2	4,7	4,1	4,5	4,1	4,3	4,9	4,6	4,7	4,3
Belgium/Luxombourg	10,1	11,3	11,1	11,4	11,6	13,3	13,7	13,3	14,2	16,4	18,4	18,1	17,7	20,0	21,5	22,7	16,2	16,7	15,6	17,4	18,4	16,9	15,8	13,4
France	15,2	17,3	17,6	17,2	17,6	19,8	19,6	19,6	19,7	20,4	22,5	23,8	22,8	24,1	25,3	27,0	21,5	23,2	22,1	22,8	23,4	23,2	21,3	18,4
Germany, Federal Rep.	29,4	34,1	33,5	32,6	31,6	37,3	36,8	35,3	36,7	41,2	45,3	45,0	40,3	43,7	49,5	53,2	40,4	42,4	39,0	41,3	46,0	43,8	41,6	35,9
Italy	6,8	8,2	9,1	9,8	10,2	9,8	12,7	13,6	15,9	17,0	16,4	17,3	17,5	19,8	21,0	23,8	21,9	23,5	23,3	24,3	24,3	26,5	24,8	24,0
The Netherlands	1,7	1,9	2,0	2,1	2,3	2,6	3,1	3,3	3,4	3,7	4,7	5,0	5,1	5,6	5,6	5,8	4,8	5,2	4,9	5,6	5,8	5,3	5,5	4,3
Spain	1,8	1,9	2,3	2,3	2,5	3,1	3,5	3,8	4,5	5,1	6,0	7,4	8,0	9,5	10,8	11,5	11,1	11,0	11,2	11,3	12,2	12,6	12,9	13,2
Sweden	2,8	3,2	3,6	3,6	3,9	4,5	4,7	4,8	4,8	5,1	5,3	5,5	5,3	5,3	5,7	6,0	5,6	5,1	4,0	4,3	4,7	4,2	3,8	3,9
United Kingdom	20,5	24,7	22,4	20,8	22,9	26,7	27,5	24,8	24,3	26,4	26,9	27,8	24,2	25,4	26,7	22,4	19,8	22,4	20,5	20,3	21,5	11,3	15,6	13,8
All other	2,7	3,1	3,4	3,7	3,8	4,3	4,7	5,2	5,5	6,2	7,1	7,5	7,6	8,8	9,3	9,6	9,3	9,8	10,9	12,3	12,8	12,9	12,9	12,5
Sub Total	93,5	108,9	108,0	106,4	109,4	124,7	129,6	126,8	132,0	144,9	156,6	161,5	152,4	166,2	179,7	186,7	154,7	163,8	155,5	163,9	174,0	161,3	158,9	143,7
Eastern Europe																								
USSR	59,9	65,3	70,8	76,3	80,2	85,0	91,0	96,9	102,2	106,5	110,3	115,9	120,6	125,6	131,5	136,2	141,3	144,8	146,7	151,4	149,1	147,9	148,5	147,5
All other	18,9	21,2	22,7	24,6	25,2	27,2	28,5	30,5	33,1	35,0	37,3	140,1	42,4	45,0	46,8	48,9	51,3	54,1	57,5	59,5	60,4	61,3	57,6	56,5
Sub Total	78,8	86,5	93,4	100,9	105,4	112,1	119,6	127,5	135,4	141,5	147,6	156,0	163,0	170,6	178,3	185,1	192,6	199,0	204,2	210,9	209,5	209,2	206,1	204,0
North America																								
Canada	5,4	5,3	5,9	6,5	7,4	8,3	9,1	9,1	8,8	10,2	9,4	11,2	11,0	11,9	13,4	13,6	13,0	13,3	13,6	14,9	16,1	15,9	14,8	11,9
United States	84,8	90,1	88,9	89,2	99,1	115,3	119,0	121,6	115,1	119,3	128,2	119,3	109,3	120,9	136,8	132,2	105,8	116,1	113,7	124,0	123,3	101,5	109,6	65,7
Sub Total	90,2	95,4	94,8	95,7	106,5	123,6	128,1	130,7	123,9	129,5	137,6	130,5	120,3	132,8	150,2	145,8	118,8	129,4	127,3	138,9	139,4	117,4	124,4	77,6
Latin America																								
Brazil	1,5	2,3	2,4	2,6	2,8	3,0	3,0	3,7	3,7	4,5	4,9	5,4	6,0	6,5	7,2	7,5	8,4	9,3	11,3	12,2	13,9	15,3	13,2	13,0
Mexico	1,0	1,5	1,7	1,9	2,0	2,3	2,5	2,8	3,0	3,3	3,5	3,9	3,8	4,4	4,8	5,1	5,3	5,3	5,6	6,7	7,0	7,1	7,6	7,1
All other	0,8	1,0	1,1	1,6	2,0	2,5	2,9	2,8	3,1	3,5	3,8	3,9	4,2	4,7	4,8	5,1	4,9	4,9	5,1	5,4	6,6	6,7	6,6	7,3
Sub Total	3,4	4,8	5,2	6,1	6,8	7,8	8,4	9,3	9,8	11,3	12,2	13,2	14,0	15,6	16,8	17,7	18,6	19,5	22,0	24,3	27,5	29,1	27,4	27,4
Africa & Middle East																								
South Africa	1,9	2,1	2,5	2,6	2,8	3,1	3,3	3,3	3,7	4,1	4,6	4,8	4,9	5,3	5,7	5,8	6,8	7,1	7,3	7,9	8,9	9,0	9,0	8,3
All other	0,0	0,3	0,3	0,4	0,4	0,4	0,7	0,8	0,8	0,9	1,0	1,1	1,2	1,3	1,8	2,1	2,1	2,2	2,4	3,0	4,3	4,4	4,4	4,5
Sub Total	1,9	2,4	2,8	3,0	3,2	3,5	3,9	4,0	4,5	4,9	5,7	5,8	6,1	6,7	7,5	7,9	8,9	9,3	9,7	10,9	13,2	13,4	13,4	12,8
Asia and Far East																								
Australia	3,4	3,8	3,9	4,2	4,7	5,1	5,6	6,0	6,4	6,6	7,0	6,8	6,8	6,8	7,7	7,8	7,9	7,8	7,3	7,6	8,1	7,6	7,6	6,4
China, People's Rep.	13,3	18,4	9,5	10,0	12,0	14,0	12,0	12,0	14,0	15,0	16,0	18,0	21,0	23,0	26,0	26,0	26,0	21,0	23,7	31,8	34,5	37,1	35,6	37,0
India	2,5	3,3	4,1	5,1	5,9	6,0	6,4	6,6	6,3	6,4	6,6	6,3	6,1	6,9	6,9	7,1	8,0	9,4	10,0	10,1	10,1	9,5	10,8	11,0
Japan	16,6	22,1	28,3	27,5	31,5	39,8	41,2	47,8	62,2	66,9	82,2	93,3	88,6	96,9	119,3	117,1	102,3	107,4	102,4	102,1	111,7	111,4	101,7	99,5
Korea, Rep. of	0,0	0,0	0,1	0,1	0,2	0,1	0,1	0,2	0,3	0,4	0,4	0,5	0,5	0,6	1,2	1,9	2,0	3,5	4,4	5,0	7,6	8,5	10,8	11,8
Taiwan	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,3	0,4	0,5	0,5	0,4	0,5	0,5	0,5	0,9	1,0	1,6	1,8	3,4	3,2	3,4	3,1	4,1
All other	0,5	0,6	0,8	1,2	1,2	1,1	1,5	1,6	1,8	2,1	2,6	3,3	3,6	4,1	4,8	4,9	4,8	5,1	6,3	7,6	7,8	8,2	7,9	8,3
Sub Total	36,5	48,4	46,8	48,3	55,6	66,4	67,1	74,5	91,5	97,9	115,2	128,5	127,0	138,8	166,4	165,7	152,0	155,8	155,9	167,5	183,0	165,8	177,5	179,6
World Total	304,3	346,5	351,0	360,4	386,9	438,1	455,7	472,8	497,1	530,0	574,9	595,5	582,8	630,7	698,9	708,9	645,6	676,8	674,6	716,4	746,4	716,0	707,7	643,6

Source: 1959-64 UN Yearbooks (1961 and 1969 issues)
1965-81 IISI tables)

Totals may not add up due to rounding.

FIGURE 1

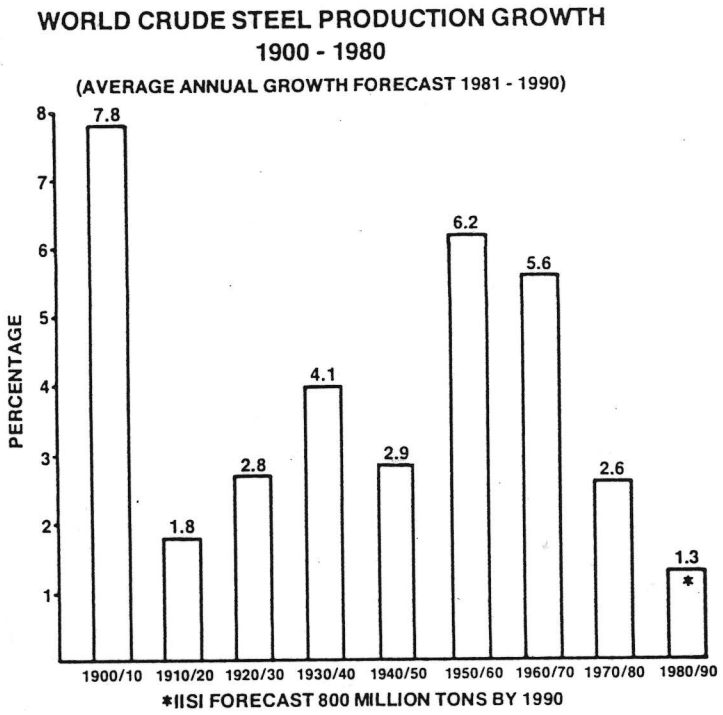


FIGURE 2

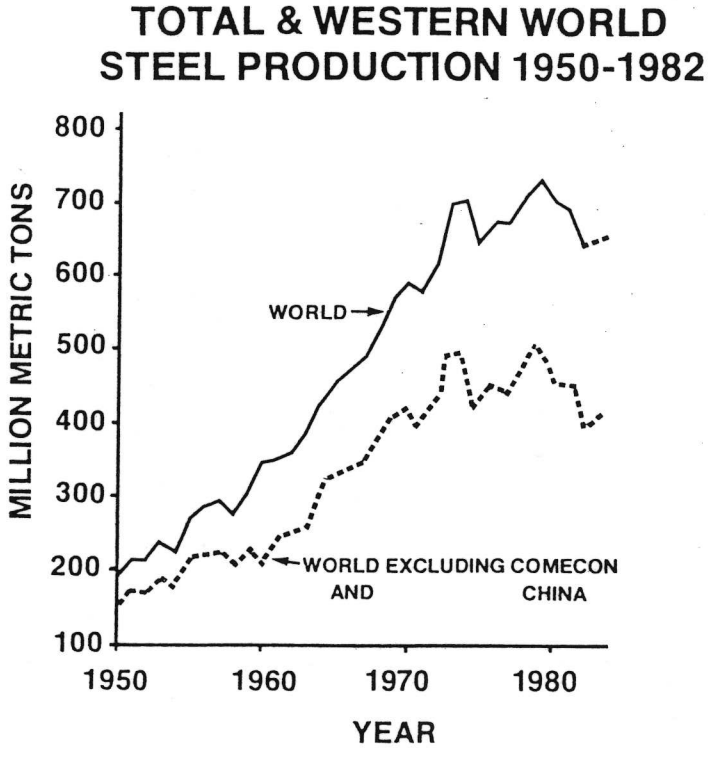
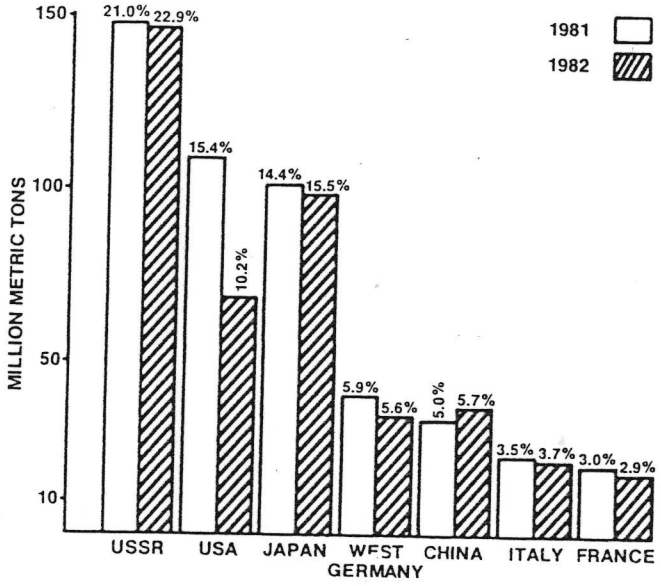


FIGURE 3

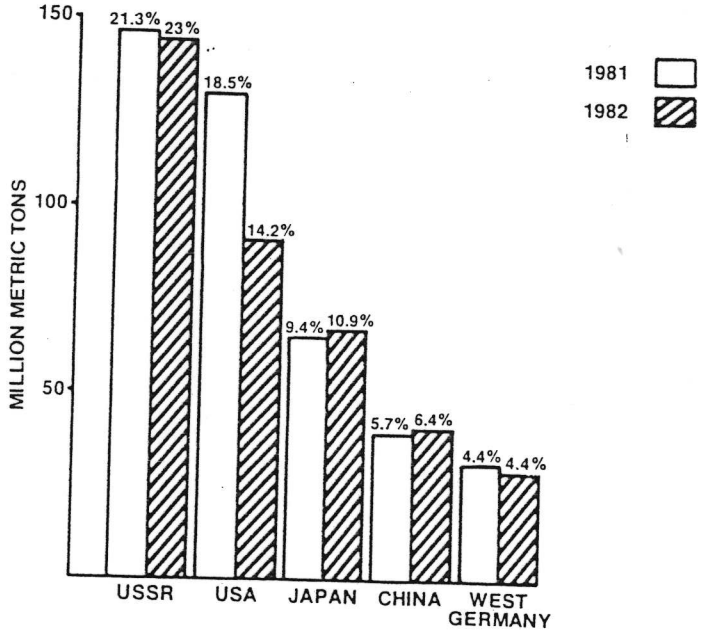
PRINCIPAL CRUDE STEEL PRODUCERS 1981 / 1982
IN EXCESS OF 15 MILLION TONS/ANNUM IN 1982



WORLD CRUDE STEEL PRODUCTION TOTALLED 707.7 MILLION METRIC TONS IN 1981 and 643.6 MILLION METRIC TONS IN 1982

FIGURE 4

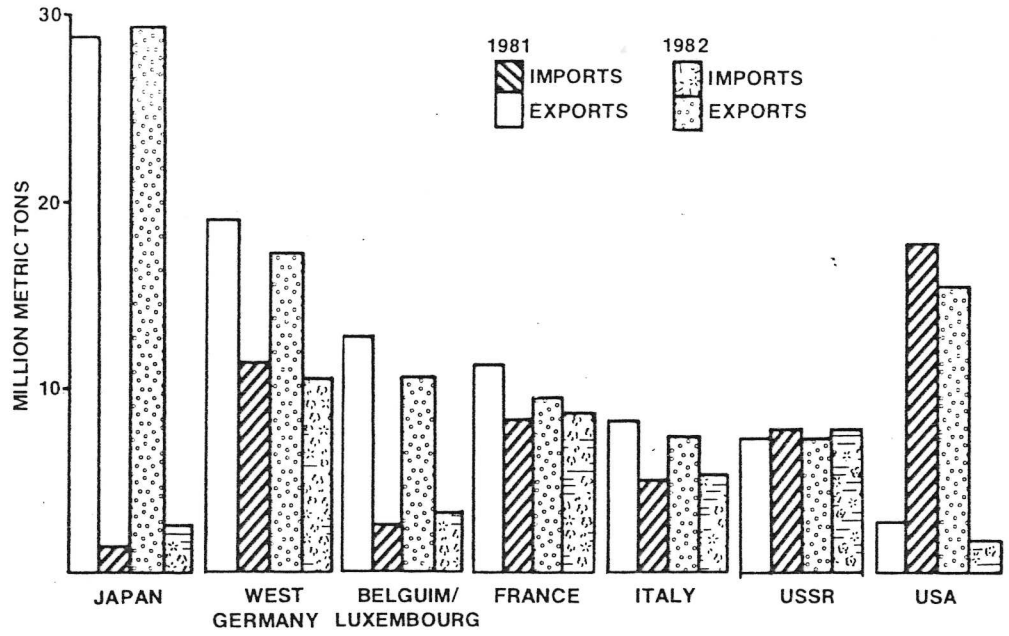
PRINCIPAL CRUDE STEEL CONSUMERS 1981 / 1982



1982 ARE ESTIMATED FOR USSR AND CHINA

FIGURE 5

PRINCIPAL STEEL TRADING NATIONS 1981/1982



CHINA IS EXPECTED TO IMPORT > 6 MILLION TONS FROM JAPAN IN 1983

FIGURE 6

The development of Steel intensity in the U.S.A. 1888 - 1982

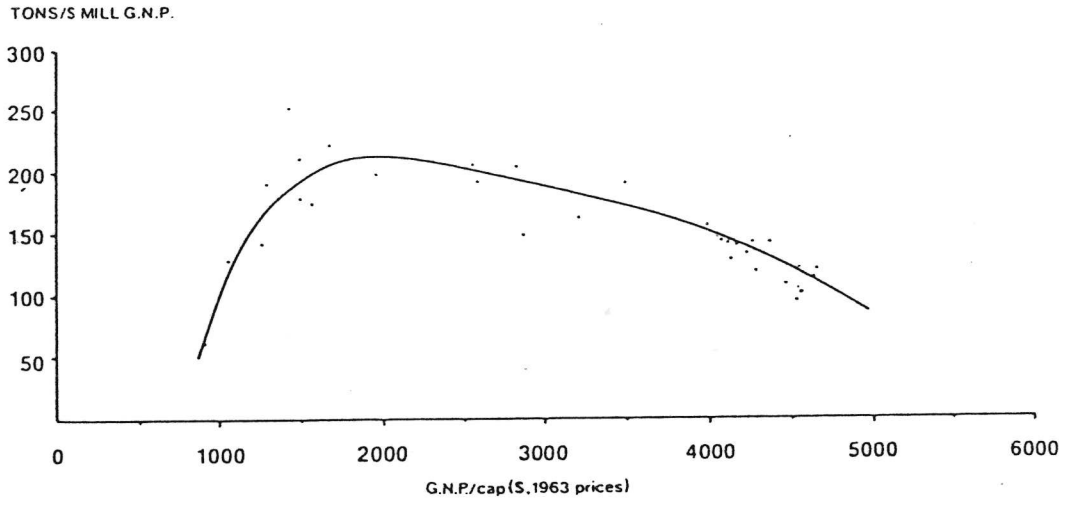


FIGURE 7

The development of Crude Steel Intensity
Europe Four, W.Germany, France, Italy, U.K.
as a function of GDP/CAP (1900-1982)

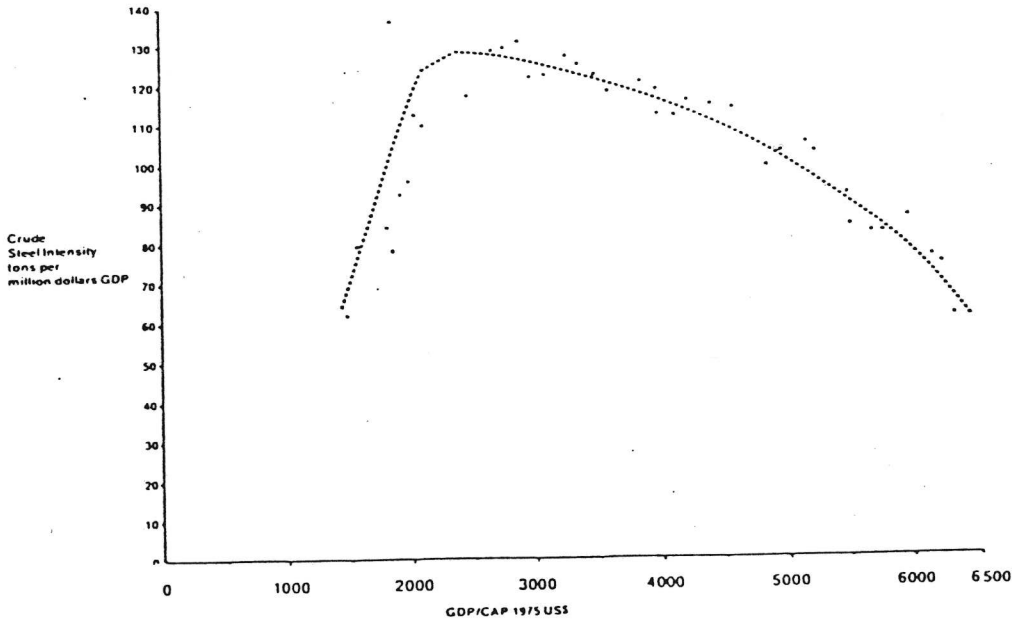


FIGURE 8

The development of Crude Steel Intensity (Japan) as a function of GDP/CAP (1900 - 1982)

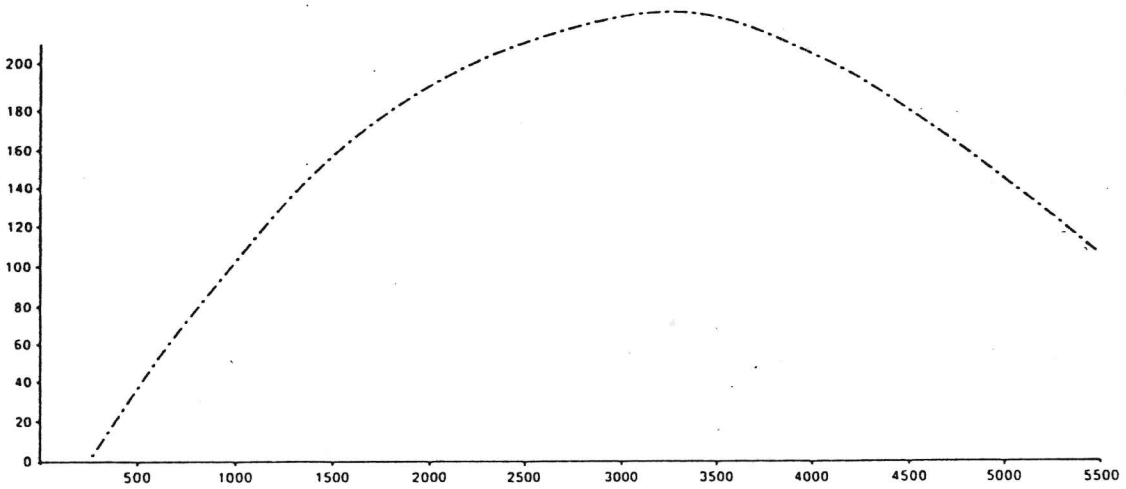


FIGURE 9

The development of Crude Steel Intensity (World) as a function of GDP/CAP (1900-1982)

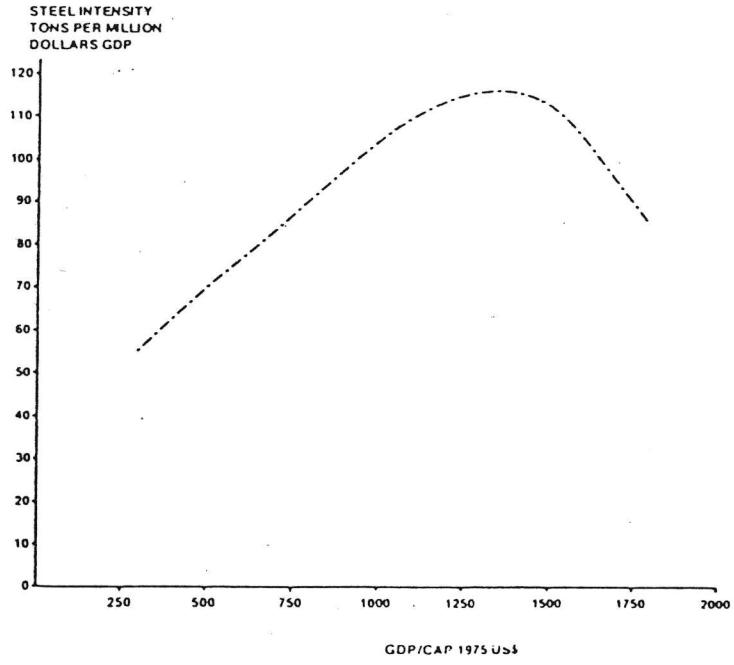


FIGURE 10

The development of Stainless Steel Intensity (Western World) as a function of GDP/CAP (1950-1982)

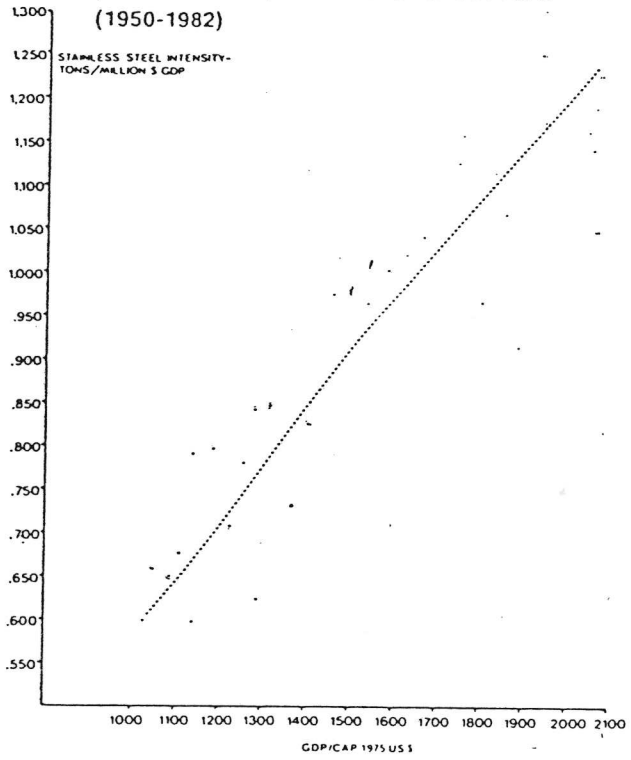


FIGURE 11

CRUDE STEEL PRODUCTION AREA GROWTHS 1982/1981

	PERCENT
WORLD DECLINE	-9.1
GROWTH AREAS	
CHINA	3.9
SPAIN	1.9
SOUTH KOREA	9.3
INDIA	2.1
NORTH KOREA	5.5
TAIWAN	29.8
SWEDEN	3.4
HUNGARY	4.3
ARGENTINA	14.9
TURKEY	15.2
BULGARIA	4.7
FINLAND	0.3
VENEZUELA	13.1
EGYPT	11.1

ALL OTHER PRODUCING NATIONS DECLINED IN 1982 COMPARED TO 1981

From the foregoing it is evident that future growth can be expected in newly developing areas and hence meaningful forecasts of both steel and ferro-alloy consumption depend on the identification of these world growth points.

MAJOR FACTORS AFFECTING WORLD STEEL GROWTH

In the early years of steel development, Western Europe and the USA dominated the industry, but over the past few decades the picture has changed quite dramatically and the identification of the causes behind these trends could give important indications to the future.

Prime causes may be identified as follows in order of their occurrence :

1 The rise of the USSR as an industrialised nation and hence a large steel producer. (Figure 11)

2 Japan's astronomic rise as a large producer and highly competitive exporter of steel. (Figure 12)

3 The emergence of the Third World as a steel consumer thus creating opportunities for potential exports and the emergence of certain member countries as producers.

4 The increase in the volume of world steel trade.

5 The oil price increase, the new economic order, the economic recession and world debt escalation.

These aspects are illustrated in Figures 11 to 17. Figure 12 shows the steady growth to a near trebling of USSR steel production over two decades. In view of this past performance the downturn since 1978 is significant indicating either that the Soviet Union is not immune to western economic recessions or that economic and industrail development has reached its peak and could enter a period of decline.

Japan's sensational 653 per cent growth from a production of 17 million tons of steel in 1959 to 111 million tons in 1980 is illustrated in Figure 13. Over the same period exports increased from 1,5 to 34 million tons having reached a peak of 42 million tons in 1976. This quantity of metal had a profound effect on world markets and the pattern of new production. Table 3, taken from Metal Bulletin, illustrates that four of the seven top steel producing companies are located in Japan.

Several Third World nations exampled by Taiwan, Korea, China and Brazil avidly established themselves as highly competitive steel producers encouraged by strong government support (Figure 11). With the

FIGURE 12

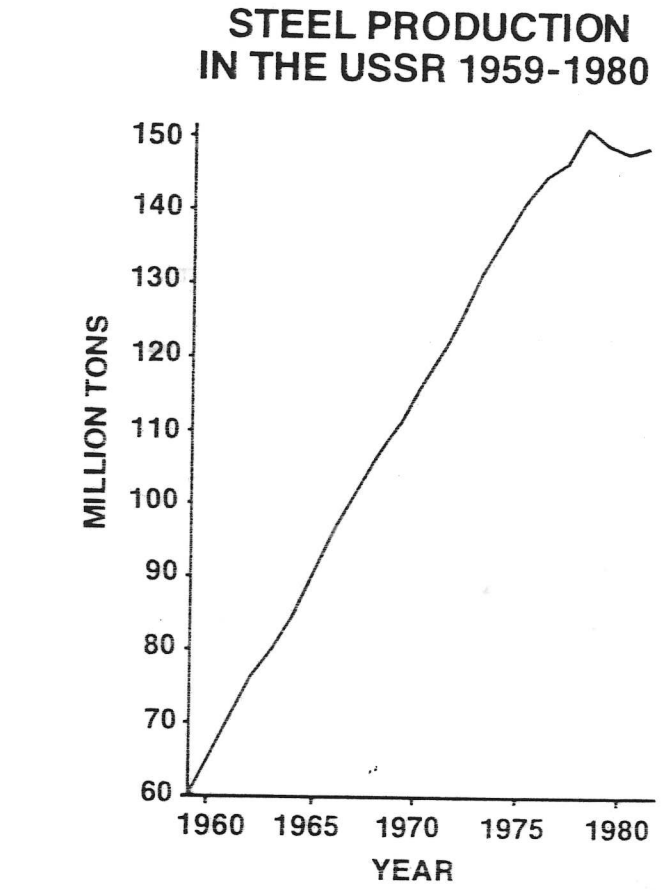
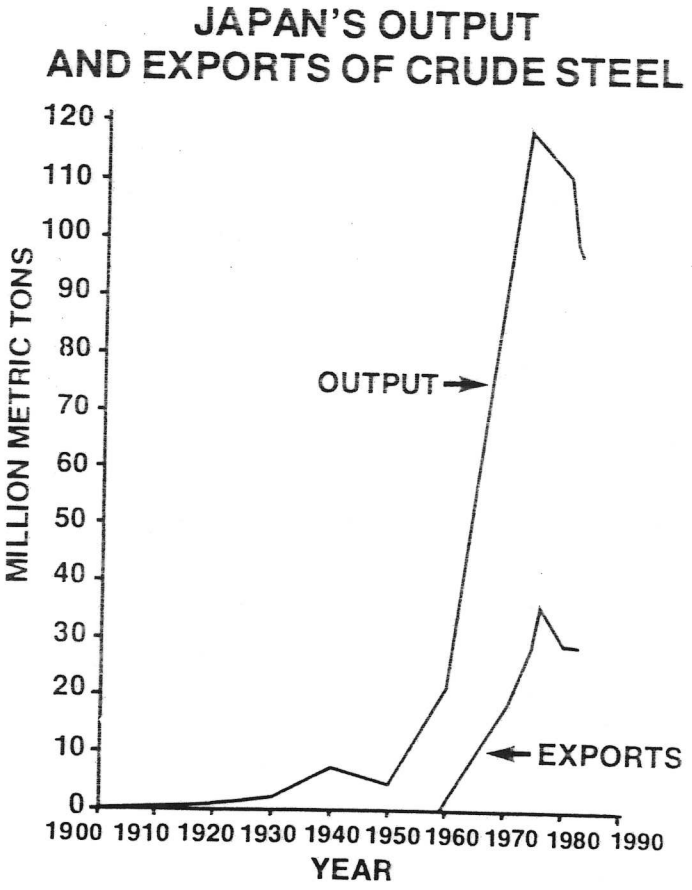


FIGURE 13



exception of China, economies of scale demanded the creation of export industries. Changing patterns of distribution are shown in Figure 14 while Figure 15 shows the rapid increase in steel exports in proportion to production.

Figures 16 and 17 vividly illustrate the effect of the oil price increase on steel production in W. European countries and the susceptibility of steel to economic downturns; it showed twice the variation displayed by industrial production. The 1975 troughs, for example, were substantially a result of large inventories built up in anticipation of escalating prices caused by the oil price.

Throughout the 1950's and 1960's the steel industries of the major western powers flourished along with the steady demand generated by the industrial boom. In the early 1970's money was over-optimistically invested in carbon steel production facilities. This continual expansion was cut short by the actions of OPEC in 1973 when the harsh realities of higher oil prices were gradually but progressively translated into stagnation in the industrialised world and a falling off in the demand for all ferrous metals, steel and steel related commodities.

PROJECTED PATTERNS OF FUTURE STEEL AND FERRO-ALLOY PRODUCTION

As illustrated earlier,(see Figures 6 to 9, 12 and 13) carbon steel production declines as a country reaches an advanced stage of development, a phenomenon which is equally apparent for ferro-alloys. Most significant is the converse pattern for special steels. Steel and ferro-alloys were traditionally produced in the same countries, but the past decade has increasingly illustrated that this is no longer the case although with future technological breakthrough the cycle could be reversed. Nevertheless, in spite of certain similarities, very different geographical patterns are projected for the future growth of the two industries with ferro-alloys becoming an essential import of major western steel producers. The USSR and China are likely to retain integrated steel industries based on abundant resources of ferrous minerals in these countries.

In other words, new steel capacity is projected to migrate towards developing countries with growing economies. Ferrochromium and ferromanganese should establish themselves at sources of raw material, ferrosilicon is likely to favour centres of low cost power where other favourable economic parameters also prevail. In essence ferro-alloys will almost certainly become wedded to areas of abundant raw material and low cost power.

FIGURE 14

CHANGING DISTRIBUTION OF STEEL PRODUCTION BY AREA

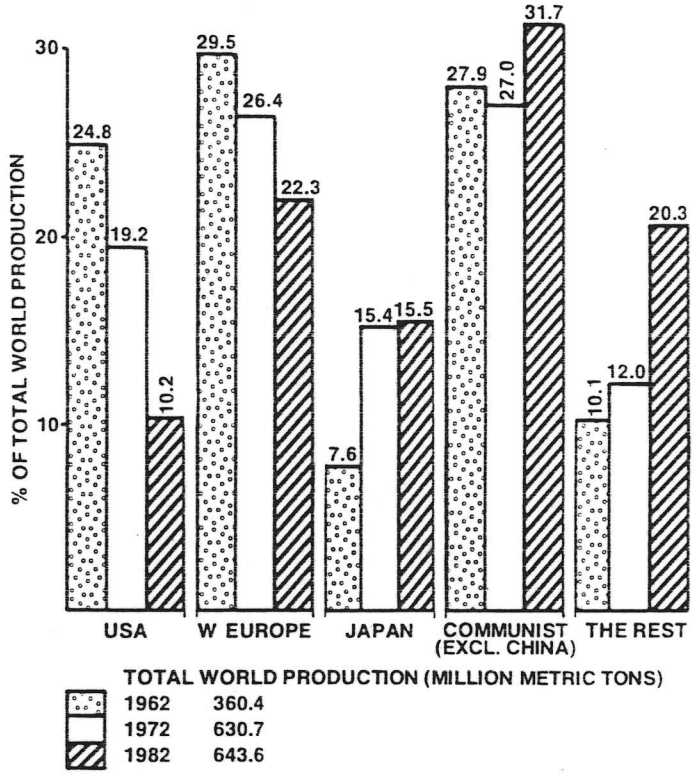


FIGURE 15

WORLD STEEL EXPORTS AS A PROPORTION OF WORLD STEEL PRODUCTION 1950 - 1982

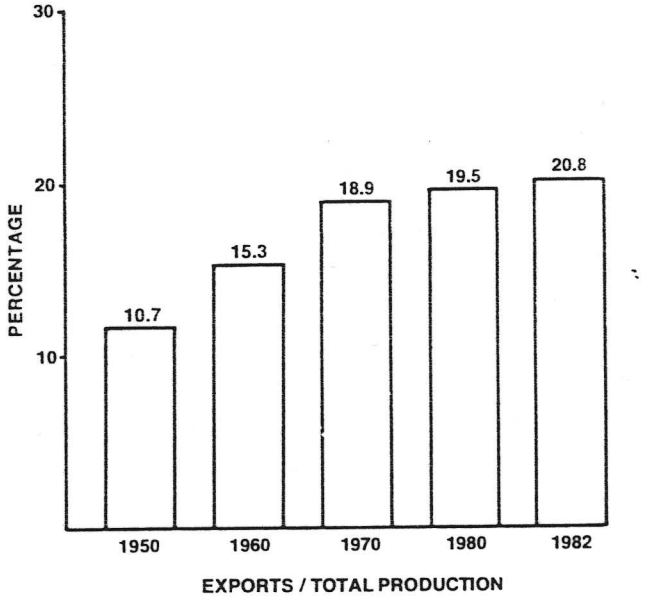


FIGURE 16

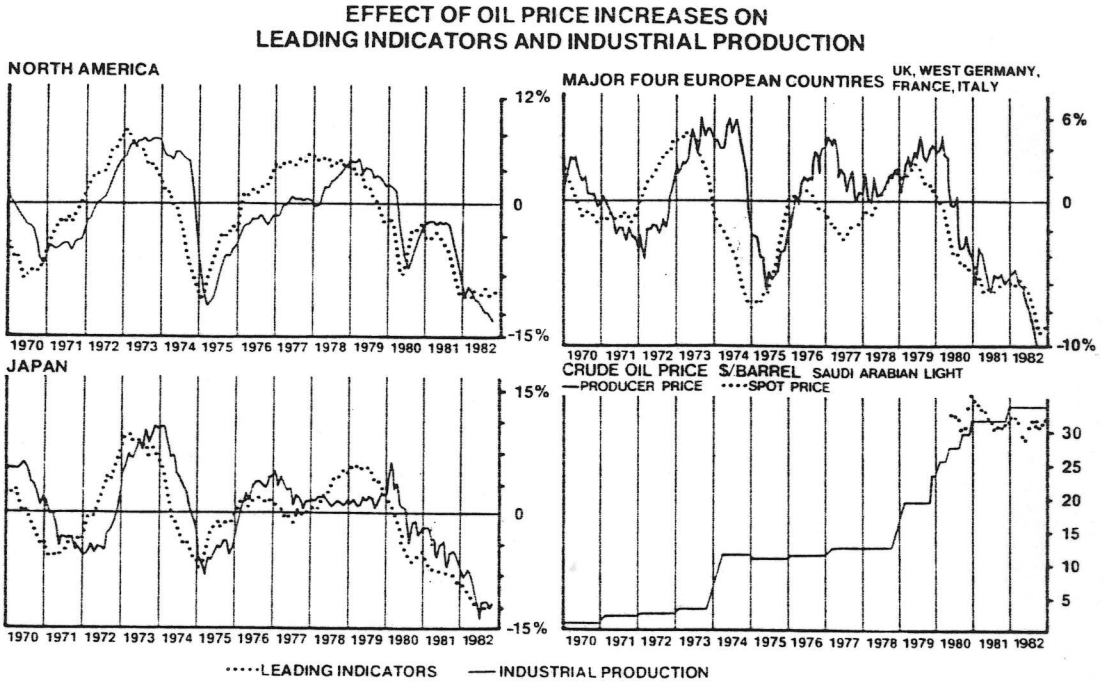
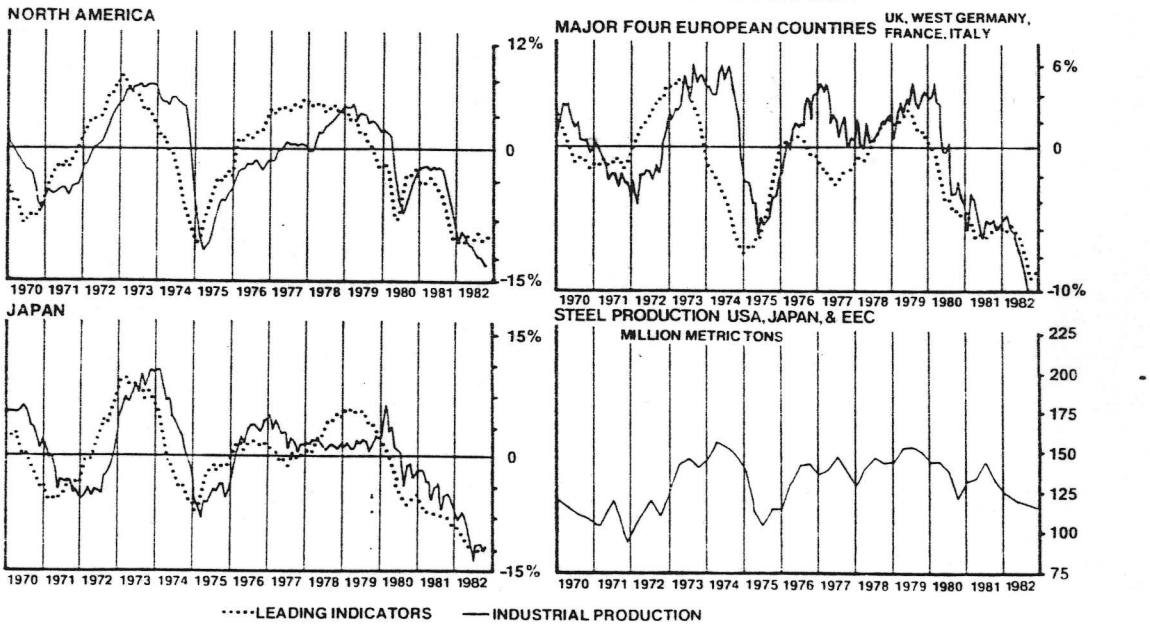


FIGURE 17



Carbon Steel's rapid growth rate of the past is unlikely to be repeated in future years although certain specialised categories of steel are expected to show exceptional development. The vital question is what will future growth in steel be and where will it be geogrpahically located? On this hangs the future of ferro-alloy markets.

It is expected that Latin America will show the most rapid growth in steel consumption until the turn of the century - this is anticipated by many to exceed 5 per cent. With the exception of oil rich Venezuela, however, financial constraints are likely to inhibit capital expenditure on additional capacity which will inevitably give rise to progressively increasing imports.

On the African continent, rapid growth rates are projected for the Republic of South Africa - this will occur both as primary steel production and steel produced as a co-product of vanadium and titanium - exports should also increase. No significant growth is foreseen in the stagnant Third World economies which comprise much of the rest of Africa although some development could emerge in Nigeria and the Arab States to the north.

The Middle East with its lucrative oil incomes should, if political instability does not escalate, show very substantial growth both in production and consumption, albeit from a very low base. We are not, however, as optimistic as a member of the Arab Iron and Steel Union who predicted in March 1980 that the 15 Arab States would together consume and produce 24,5 million tons of steel by 1985.

Australia, like Canada, is blessed with many ingredients needed for an expanding steel industry, but huge distances between mineable iron ore and coal deposits, combined with labour problems, tend to mitigate against a large economically viable steel industry. Local consumption should maintain a growth rate of at least 2 per cent.

Although capacity is at present being expanded beyond its current 32 million ton capacity, China's steel production is certain to fall far short of the projected 60 million tons by 1985. Substantial imports must therefore be the scenario for the short to medium term.

A region with considerable potential is the South East Asian basin where a number of states are likely to follow the example of Japan, Korea, Taiwan and India and will bludgeon forth with substantial steel industries of their own. Probably foremost amongst these is Indonesia which has shown considerable initiative in other spheres.

World steel production amounted to 644 million tons in 1982, a significant reduction on the 748 million tons in 1979. Forecasts for the remainder of the century are as numerous as forecasters themselves, but the rapid growth that has characterised the century to date seems unlikely to continue. Information from the International Iron and Steel Institute shows the apparent steel consumption (in terms of crude steel equivalent) to be 708 million tons in 1981 and 644 million tons in 1982. Their forecast for 1983 is 689 million tons.

It is interesting to note from Table 3 that forecasts for world steel growth from 1985 to 1990 are only 1,3 per cent per annum.

With mean steel plant costs currently running in excess of US$ 1 500 per annual ton of production capacity, a new steel works of a minimum economic size can be expected to cost at least US$ 500 million, while a modern integrated works capable of a large product mix would run into several billion dollars. The equivalent cost for a modern technology ferrochromium plant is estimated at US$ 1 000/annual ton. With the smaller scale of operation than is the case with steel, US$ 100 million allows for a good size plant.

Factors which are seen as mitigating against expansions of the steel industries of established major Western World producers are:

1 Decreased growth rates created by the energy price increases of the past and projected for the future

2 Greatly reduced population growth rates which have and are expected to continue to stifle growth in demand for consumer goods

3 Ever increasing use of high strength low alloy and other special steels whereby increased strength is achieved with reduced mass

4 Fuel costs forcing economies through weight reductions in such major steel consuming items as motor vehicles

5 Scrap for recycling increasing substantially in proportion to virgin steel production

TABLE 3

COMPARATIVE RATING OF TOP STEEL PRODUCING COMPANIES IN 1981 and 1982

OUTPUT IN MILLION TONS OF RAW STEEL

	1981		1982	
	RANKING	OUTPUT	RANKING	OUTPUT
NIPPON STEEL*	1	29.64	1	28.32
FINSIDER	5	13.90	2	13.30
NKK	4	12.63	3	11.99
BSC	6	13.24	4	11.38
US STEEL	2	21.22	5	10.97
SUMITOMO METAL	9	11.20	6	10.88
KAWASAKI	8	11.40	7	10.86
THYSSEN *	7	11.81	8	10.06
ARBED GROUP	10	11.02	9	9.93
BETHLEHEM	3	15.17	10	9.54
SACILOR	-	9.95†	11	8.91
USINO	13	9.82	12	8.80
POSCO	14	8.69	13	8.78
SIDERBRAS	17	7.73	14	7.70
SAIL	25	5.50	15	6.72
KOBE	23	6.70	16	6.43
ISCOR	22	6.88	17	6.37

* ESTIMATE

† INCLUDING COMPANIES REQUIRED DURING 1982

TABLE 4

WORLD APPARENT STEEL CONSUMPTION

(MILLION METRIC TONS CRUDE STEEL)

	1985		1990		1985-1990
COUNTRY/REGION	TREND	(PEAK)	TREND	(PEAK)	% ANNUAL GROWTH RATE
WESTERN EUROPE	135	(144)	135	(135)	0
NORTH AMERICA	135	(147)	137	(150)	+0,3
JAPAN	74	(80)	79	(85)	+1,3
OTHER INDUSTRIALISED	17	(20)	21	(24)	+4,3
INDUSTRIALISED COUNTRIES	361	(391)	372	(403)	+0,6
LATIN AMERICA	43	(46)	50	(55)	+3,1
ASIA (EXC. JAPAN)	52	(54)	65	(67)	+4,5
AFRICA (EXC. RSA)	11	(12)	13	(15)	+3,4
MIDDLE EAST	20	(21)	23	(24)	+2,8
DEVELOPING COUNTRIES	126	(133)	151	(161)	+3,7
WESTERN WORLD TOTAL	487	(524)	523	(564)	+1,4
EASTERN BLOC	207	(210)	212	(215)	+0,5
CHINA & NORTH KOREA	55	(57)	65	(68)	+3,4
CPEs	262	(267)	277	(283)	+1,1
WORLD TOTAL	749	(791)	800	(847)	+1,3

6 Selected developing countries establishing steel industries and, to obtain economies of scale, incurring a need for substantial export promotion.

7 Substitution of steel particularly by concrete, plastics and aluminium.

Although substitution is not a dominant factor in the decline of steel as yet, such materials as concrete; aluminium and plastic in the construction industry and aluminium and plastic in the automotive, machinery, mining, chemical and agricultural industries are making an impact. The development of lower cost corrosion resistant steels such as 3CR12 could go a long way to countering this trend. The cost of corrosion in the Western World alone has been estimated at US$ 200 - 250 billion per annum.

A feature of steel over the last decade has been the remarkable growth in trade from 11 per cent of production in 1950 to some 26 per cent in 1980. The effect of this is vividly illustrated by the US steel capacity utilisation falling from over 90 per cent in 1973 to an estimated 37 per cent in October 1982. This has placed the US steel industry in a virtual state of siege with imports competing heavily with local production. The industry has endeavoured to protect itself by filing dumping suits against foreign exporters.

In Europe the steel situation reached such a crisis that the EEC introduced mandatory production controls, but in spite of this, prices have decreased steadily, suffering declines of some 10 per cent in 1981 and 1982. The USSR and China have substantially maintained their position, the USSR steadily increasing production each year until 1978 after which a levelling off has become apparent for the first time.

TRENDS IN FERRO-ALLOY PRODUCTION

Ferro-alloy demand and hence production and consumption is intimately tied to the fortunes of steel. Consumption of manganese and silicon ferro-alloys follow closely the patterns of overall steel production whereas chrome, vanadium and other more specialised alloys follow developments in the special steels in which they feature as alloying elements.

Recent events in ferro-alloy production which are affecting so profoundly the geographical re-orientation of the industry have their roots in the energy cost escalations which have plagued the past decade. The magnitude of these effects are thus related to the energy consumed in the production of each individual alloy. These consumptions are listed in Table 5.

It is perhaps not surprising that production capacity for the higher energy consuming materials has tended to migrate away from areas with high energy costs, with ferromanganese being the last of the major alloys to have maintained a substantial presence in these areas.

FERROCHROMIUM

Perhaps the most pronounced shift in geographical emphasis of all ferro-alloys has occurred in ferrochromium with the dominance of production moving from the major alloy consuming countries to those which are endowed with the basic raw material-chrome ore. As early as 1975, the Union Carbide Group in the USA announced it would not invest a single additional dollar in ferrochrome in the US and immediately proceeded with the replacement of its domestic capacity with plants in South Africa and Rhodesia (now Zimbabwe).

A number of plants have since been built in South Africa, Greece, the Philippines, Turkey, India and Albania, all sited close to chrome resources. Meanwhile, US production has dropped to token levels and only Italy remains as a significant exporter within the EEC - Greece is expected to enter the market in 1983. Production levels in Japan have fallen from nearly 600 000 tpa in 1974 to a basic strategic support level of some 300 000 today. Toll smelting of the U S chrome ore stock pile could give the industry in that country a new lease of life albeit at a substantially reduced level.

The Comecon countries and China meet their domestic requirements with insignificant imbalances being satisfied by small imports or exports as conditions dictate. The future trend for the alloy is thus firmly established and as world economic conditions revive, production is sure to consolidate in the newly established areas.

Future expansion lies in special steels such as stainless and other chrome based steels. With growth in this field expected to outstrip that of carbon steels by at least 2:1, it is here that the dominant expansion in ferrochromium demand is anticipated. The future successful development of the alloy thus lies with the countries able to maintain energy costs, utilise the latest technology to maximum effect, provide reliable marketing, reduce labour requirements, operate in politically stable and enlightened climates and avoid labour unrest.

Established exporters have amply demonstrated this ability in the past and are expected to continue to play a major supply role in the future.

TABLE 5

APPROXIMATE POWER CONSUMED DURING PRODUCTION OF MAJOR FERRO-ALLOYS

COMMODITY	POWER CONSUMED PER TON kWh
CHROMIUM ALLOYS	
FERROCHROMIUM HIGH CARBON - DIRECT SMELTING	4 200
- WITH PREREDUCTION	2 800
LOW CARBON	9 100
FERROSILICOCHROMIUM	11 300
MANGANESE ALLOYS	
FERROMANGANESE HC	3 200
MC	6 600
FERROSILICOMANGANESE	5 500
ELECTROLYTIC MANGANESE	12 500
SILICON ALLOYS	
FERROSILICON-METALLURGICAL	10 200
ELEMENTAL SILICON	13 900
OTHER COMMODITIES	
ALUMINIUM	16 700
CALCIUM CARBIDE	3 800
PHOSPHORUS	19 000
TITANIUM SLAG	2 400

TABLE 6

EXAMPLE OF FORMATION OF THE MANGANESE UNIT CONSUMPTION - PRODUCT MIX ON A 1980 BASIS -

	% IN PRODUCT MIX		Mn Kg /TON		Mn USED	
STEEL GRADE	PAST	FUTURE	PAST	FUTURE	PAST	FUTURE
L C STEEL	40	26	2,5	0,1	1,00	0,26
HSLA STEEL		4	-	5,0	-	0,20
CONT. ANNEALED STEEL		10	-	0	-	0
ALLOY STEEL	12	12	10	10,0	1,20	1,20
HEAVY PLATES	5	5	10	12,0	0,50	0,60
C STEEL	43	43	8	7,0	3,44	3,01
UNIT CONSUMPTION Kg/T CRUDE STEEL					6,14	5,27

Newcomers to the scene must yet prove themselves.

Table 1 illustrates the close correlation between stainless steel production and estimated ferrochromium consumption, a similarity which is unlikely to alter in the future.

FERROMANGANESE

High carbon ferromanganese consumes less energy during electric furnace production than any other major ferro-alloy and it is perhaps this fact and the frequent use of blast furnace smelting that has enabled the producing industry to maintain a substantial presence in the major developed countries of the world. Hence, geographical shift has to date been small when compared to ferrochromium. It is significant that the USSR and Japan continue to be the largest producers with South Africa the largest exporter. As the world emerges from the current prolonged recession, the extent of the industry's survival in developed countries will be determined. Inevitably, as with chromium alloys, increasing production capacity will emerge at the major sources of raw material with nearly all established steel works being fed increasingly by imported raw materials.

Technological advances have moved predominantly towards larger furnaces with the computer controlled 75 MVA giants proving the most efficient - blast furnace smelting is on the decline. New processes such as pre-reduction and plasma are smelting have been slow to develop - perhaps the greatest need is an economically attractive procedure for the utilisation of the vast stock-piles of ore fines.

The greatest threat to the manganese industry has been, and still is, the ability of the steel producer, through the use of modern technology such as the Q-BOP process, to use less manganese in the production of steel. This has largely been achieved by retaining more of the original blast furnace charge in the final product thus permitting reduced ferromanganese additions.

This trend varies from country to country and depends on the process used and the extent to which the plant has been modernised. Table 5 illustrates trends from 1973 to 1981 for the main manganese alloys for each of the dominant classes of steel produced as published by the USBM and compiled by the Manganese

In the case of low carbon steels, which represent some 50 per cent of all carbon steels, the tendency is towards the reduction of manganese content whereas with other carbon steels the manganese level is expected to increase. Hence, the trend in total unit manganese consumption is not firmly established. With full alloy steels, after a tendency to reduce manganese additions in 1978 - 1979, consumption is now again increasing. In the case of HSLA and stainless steels, manganese consumption appears to have stabilised after declining for several years.

Trends towards the combined blowing process in steelmaking is expected to give rise to a yield of 30 to 35 per cent of residual manganese as opposed to 20 per cent in the past. Hence, in spite of a move towards higher manganese content in steels, overall consumption per unit will certainly drop reaching a level of stabilisation of some 5,3 kg per ton in 1985/1986 in contrast to 6,14 in 1981.

Although the amount of manganese added to steels seems destined to decline, new steel production capacity should compensate for the losses incurred, with the result that a small but significant overall growth in manganese ore and alloy consumption is projected. New alloy production capacity is likely to evolve at ore sources, while existing efficient production facilities in the consumer countries could possibly be maintained albeit at a steadily declining rate when plants beomce obsolete. It is unlikely that new plants will be built in these areas. It is possible, however, that the development of new less energy and capital intensive processes might influence this trend.

FERROSILICON

As the highest energy consumer of all the major ferro-alloys and being mainly independent of scarce raw materials, the ferrosilicon industry has established itself either in regions of inexpensive, often hydro-electric, power such as Norway, Iceland, and South Africa, or close to major steel plants such as in Japan and the USSR. The latter has remained the largest producer with Japan second, but their industries are essentially orientated towards domestic requirements. Technological advances have tended towards larger furnaces and better control but the alloy appears unlikely to be readily amenable to such processes as pre-reduction and plasma arc smelting. The industry currently appears well rooted in its traditional environments and it could be hazardous to project future geographical shifts in focus.

Consumption per unit of steel seems well stablised, hence growth is entirely dependent on increased steel output.

MINOR FERRO-ALLOYS

The so-called minor ferro-alloys - those of vanadium, niobium, molybdenum, titanium, nickel and the rare earth metals, are all highly priced commodities for which power costs constitute a relatively minor proportion of overall production costs. Production facilities are located close to tradional outlets for the products and likely to remain so. Hence, no significant change in geographical location or profound technological developments are expected to affect the industry in the foreseeable future.

With HSLA and stainless steels expected to show renewed growth over the ensuing decade, demand for specialised alloys should grow faster than overall steel production with rates of increase in line with those of chromium alloys. Substitution of one alloy for another seems to be a well set pattern as prices and supply fluctuations favour one alloy over and above competitors which yield similar metallurgical characteristics.

CONCLUSION

After a traumatic period during which Western World economies have suffered their deepest and most prolonged recession since the 1930's the steel industry, and with it ferro-alloys, are showing positive signs that a recovery has commenced.

Economies in steel usage brought about substantially as a result of the new economic order created through excalation in energy costs is likely to mitigate against the growth rates experienced so far this century continuing into the future -a gradual change in geographical production focus is also visualised. HSLA, high chromium and other special steels on the other hand are projected to show substantial growth in the years ahead with production continuing to be concentrated in the major industrialised nations. This augers well for the chromium, vanadium, molybdenum, niobium, titanium and rare earth alloys. To a lesser extent this also applies to manganese alloys, but these and ferrosilicon are fundamentally tied to crude steel output for their future growth.

Technologically, the longer term trend in ferro-alloys must be increasingly towards lower cost reductants, increasing popularity of such techniques as pre-reduction, careful sizing of furnace burden, more efficient energy utilisation and, the introduction of plasma arc smelting and other novel techniques many of which are still limited to the pilot

plant or pyrometallurgical laboratory. There is little doubt that the future will be dictated by economics embodied in a fight for survival on a hitherto unprecedented scale, while the ever more exacting demands of the end consumer will force the ferro-alloy producer and steelmaker into previously unconceived spheres of technological development.