STEEL

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Summary
Both steel production and consumption grew strongly in 2000. Global crude steel production reached an all-time high of 843.7 Mt, an increase of 7.1% over 1999. All regions shared in this growth, and double digit gains were recorded by the Former Soviet Union, South America and the Middle East. Asia was the largest steel producing region with 330 Mt, equivalent to nearly 40% of the world total, and at 44%, has an even larger percentage of world steel consumption.

Despite 2000 being a boom year for steel production, steel prices were less than healthy, particularly in North America, and many steel companies in that region made losses or were barely profitable. As the year wore on, prices moved lower and trade friction increased. Currency mis-alignments played a significant role in this theatre.

Economic Environment
World economic growth has averaged about 3.6% per year from 1970-2000. The most recent "slowdown" occurred in 1998, the year of the "Asian Crisis", when world economic growth fell to 2.6%, primarily due to sharp recessions in Japan, South Korea and Russia.

Economic activity bounced back to 3.4% in 1999 as the Asian economies recovered, with the exception of Japan which continued to experience severe structural problems. The recovery of World economic activity continued apace, led by a buoyant US, and achieved a growth rate of 4.7% in 2000.

The outlook for 2001 is much more problematic, with slowdowns in the major industrialised economies, and growth will probably drop below the long run average rate of 3.6%. Higher oil and gas prices in 2000 and rising inventories, particularly in the high technology sector, have had a dampening effect on economic activity. Forecasts made (or, more accurately, published) by the OECD and the IMF at the end of 2000 would almost certainly be downgraded if made again at the end of Q1, 2001.

World Economic Indicators - Growth Rates %			
	1998	**1999**	**2000**
World GP	2.6	3.4	4.7
USA	4.4	4.2	5.2
Japan	(2.5)	0.2	1.4
EU 15	2.7	2.4	3.4
South Korea	(6.7)	10.7	8.9
China	7.8	7.1	7.5
Russia	(4.9)	3.2	7.0
Brazil	(0.1)	1.0	4.0
World Trade	***4.3***	***5.1***	***10.0***

Sources: IMF, OECD

Steel Demand
Steel demand is dependent upon economic activity, but it does not have a linear relationship. Initially a country's demand for steel products is limited until such time that "economic take-off" is achieved, the point when industrialisation commences. As the infrastructure of a country is developed, steel is needed for the construction of bridges, roads, railways, trains, buildings, sewerage systems, etc. Infrastructure developments are steel intensive, as are transportation systems, plant and equipment, engineering and energy developments, and as economies develop, white goods (appliances), utensils and aesthetic decoration, the latter categories usually being alloy steels.

As the service sector in an economy develops, the steel intensity (consumption of

steel per unit of GDP) in the overall economy tends to decline, giving steel intensity a bell-shaped curve. But, just when steel forecasters think they understand steel consumption, steel intensity can increase, as it has in the US, partly due to marketing innovations such as sports utility vehicles (SUVs).

World apparent steel consumption grew by 5.8% in 2000, the highest level ever achieved heretofore. Apart from Oceania, all regions enjoyed higher steel consumption. Asia is the world's powerhouse in steel consumption, growing by 6.9% in 2000, and responsible for over 44% of total consumption, outstripping that of Western Europe, North America and South America combined.

The US enjoyed strong economic growth in 2000, and steel consumption increased by 4.6%, largely because of consumer sentiment and a strong automotive sector. The US dollar remains strong, and the US continues to run a substantial deficit, a proportion of which is steel imports.

The European Union enjoyed steady growth in economic activity, helped by export-led growth on the back of the euro, which has shown weakness against the US dollar, and steel consumption rose by 4.5%.

The former Soviet Union continued to recover and looks as if it has left the worst of the economic implosion over the last few years behind it. Apparent steel consumption rose by 3.5% in the region as a whole and by 4.7% in Russia.

Apparent steel consumption in South America grew by 11.1%, led by its biggest economy, Brazil, with 12.1%. The devaluation of the Real in Brazil helped boost economic activity but Argentina, whose currency is linked to the US dollar, fared poorly by comparison.

Apparent Steel Consumption (Mt of steel products) [1]

Region	1999	2000	% Change
EU 15	138.0	144.2	4.5
Other Europe	31.8	33.7	6.1
FSU	31.3	32.4	3.5
Russia	16.9	17.7	4.7
North America[(2)]	137.8	144.2	4.6
United States	110.7	114.9	3.8
South America	24.7	27.4	11.1
Africa	14.8	15.3	3.1
Middle East	15.1	16.2	7.3
Asia	310.6	332.2	6.9
China	130.8	137.0	4.8
Japan	68.9	73.8	7.1
South Korea	34.0	38.6	13.5
Oceania	6.7	6.3	(5.9)
World Total	***710.9***	***752.0***	***5.8***

[1] Note that these data are in steel product tonnes and are not directly comparable with crude steel data quoted elsewhere

[2] Includes Mexico and Central American Countries

Source: IISI

Iron and Steel Production

World output of blast furnace iron was 572 Mt in 2000, a 5.8% increase over 1999. Asia was the biggest regional producer with 269 Mt, up 6.1% from the previous year. China's production increased steadily through the year to reach 131 Mt, which was more than the combined total in the European Union or in North America. Japan had a strong year with 81 Mt, up 8.8%, and production also increased in India by 5.9%, in South Korea by 6.9%, and in Taiwan by 8.5%. Production edged ahead in the European Union by 2.5%, surprisingly fell by 1.0% in Other Europe (essentially Eastern Europe), but was up by a substantial 13.5% in the former Soviet Union. South America also had a good year, up 12.9%, largely due to Brazil where blast furnace iron output increased by 13.3% over 1999.

The blast furnace iron to crude steel production ratio fell slightly from 68.6 in 1999 to 67.8 in 2000. This ratio tends to decline slightly in strong steel production years and vice versa, but has remained remarkably constant over time.

World Blast Furnace Iron Production (Mt)				
Country/Region	**1998**	**1999**	**2000**	**%00/99**
European Union (15)	96.0	92.9	95.2	2.5
Other Europe	27.4	23.2	22.6	(1.0)
FSU	58.1	65.4	74.2	13.5
North America[(1)]	61.7	59.9	61.2	2.1
South America	28.9	28.1	31.7	12.9
Africa	8.8	8.1	8.2	1.4
Middle East	2.1	2.1	2.2	4.2
Asia	247.7	253.5	269.1	6.1
China	118.5	125.3	130.8	4.4
Japan	75.0	74.5	81.1	8.8
Oceania	8.3	7.7	7.5	(2.5)
World Total	***539.0***	***540.9***	***572.3***	***5.8***

[1] Includes Mexico and Central American Countries
Source: IISI

Steel production closely follows blast furnace iron production and was up 7.1%, to reach a new record output of 844 Mt, the first time that World crude steel production has exceeded 800 Mt. All regions were part of this record production, with notable increases of 12.6% in the former Soviet Union, 12.7% in South America, 10.2% in the Middle East, and 13.0% in Japan.

Crude steel production in the former Soviet Union has increased sharply over the past two years and reached 97 Mt in 2000. Growth in apparent steel consumption has not kept pace and the result has been increased steel exports, which has caused trade friction. If this region is to recover economically it will have to remain a major exporter of steel and other metals. Ironically, the collapse of the centrally planned economies has had a much bigger negative economic impact on the metal industries in the "West" than the Cold War ever did.

Crude steel production in Asia in 2000 reached 330 Mt, clearly outpacing any other region in the World. China is the world's largest steel producer, one more in a long list of China firsts. Japan had a very good year, with production outpacing apparent steel consumption, indicating relatively strong steel export demand.

Crude steel production in the US was strong in the first half of 2000 but weakened considerably in the second half. Comparing crude steel production and apparent steel consumption, and factoring in the difference between the data, shows a significant level of imports in 2000, but not that much different from 1999.

Comparing blast furnace iron and crude steel outputs highlights some anomalies. Crude steel production in Other Europe grew at 8.5% in 2000 and yet blast furnace iron production was down by 1.0%. A similar situation is observable for Oceania, and other regions such as the European Union, North America and Japan show similar trends. Presumably, at higher levels of output, the proportion of solid metallics used in steel production increases. China is an interesting exception in that reported blast furnace iron output exceeds crude steel production. Reasons for this anomaly could be a relatively large iron foundry sector, exports of pig iron, a shortage of steel scrap, steel-

World Crude Steel Production (Mt)				
Country/Region	**1998**	**1999**	**2000**	**%00/99**
European Union (15)	159.9	155.3	163.2	5.1
Other Europe	47.5	42.6	46.3	8.5
FSU	73.9	85.7	96.5	12.6
North America[(1)]	129.9	130.1	135.2	3.9
South America	36.1	34.6	39.0	12.7
Africa	12.8	12.1	12.6	4.2
Middle East	9.1	9.8	10.8	10.2
Asia	297.8	308.3	330.4	7.2
China	114.6	124.0	126.3	1.9
Japan	93.5	94.2	106.4	13.0
Oceania	9.7	8.9	9.3	3.7
World Total	**777.2**	**787.8**	**843.7**	**7.1**

[1] Includes Mexico and central America
Source: IISI

making inefficiencies, or a different method of reporting.

Production of direct reduced iron (DRI) and hot-briquetted iron (HBI) in 2000 reached 43.2 Mt, an increase of 11.9% over 1999. The major producing countries were Venezuela with 6.7 Mt, Mexico 5.8 Mt, India 5.4 Mt, and Iran 4.7 Mt.

Gas-based direct reduction systems dominated production, almost entirely Midrex and HYL, producing 93% of the total. Gas-based systems have proved to be more reliable and productive than coal-based systems. However, a cheap and reliable source of natural gas is a prerequisite, It is no coincidence that gas-based direct reduction processes thrive in regions where natural gas is plentiful, particularly when it is a byproduct of oil production and if not used would be flared off, ie, its opportunity cost is close to zero. High gas prices have halted direct reduction plants belonging to Hylsamex in Mexico, and the Anglo-Dutch Corus Group has closed its plant in the US because of high energy costs.

Direct reduction plants that are integrated with electric arc furnaces (EAF) are insulated to some extent from the vagaries of the scrap market, but merchant hot briquetted iron (HBI) plants have suffered at the hands of low scrap prices.

Direct reduction processes are fed with iron ore pellets or lump. These forms of iron ore demand a sizeable premium in price over iron ore fines, and this has led to a concerted effort to introduce technology that can use these fines in direct reduction. Several such plants have been built but none of them operates as well as they were supposed to. This technology remains to be proven.

The Steel Market

Steel price indices for Asia, North America and Europe, hit a five-year low in February 1999, corresponding to a trough in monthly world crude steel production. From that time, monthly steel production rose to a peak in April 2000 and the price indices for the three major regions followed suit, with European prices particularly strong. Monthly crude steel production weakened only slightly from April 2000 to the end of the year, but the steel price indices fell sharply, with the North American index dropping below the earlier trough of February 1999.

Steel production in the US in 2000 was a very respectable 101 Mt, the highest for a decade, but the first half of the year was significantly stronger than the second, i.e., production and prices fell in unison. This is a good example of steel production as a leading indicator of economic activity since the economic slowdown was only visible generally towards the end of the year.

Falling steel production and prices in the US during the second half of 2000 led to friction over steel imports and moves were made towards submitting anti-dumping law suits. The domestic iron ore producers in the US were strong proponents of anti-dumping suits against steel imports as the fall in domestic steel production adversely impacted them. The iron ore producers, however, realised that part of the problem was the importation of semi-finished steel slabs by the US steel industry, a trade that is likely to be enhanced in the future.

Steel prices appear to be on a long-term downward trend. Steel industry productivity has increased markedly over the past 30 years and the quality of steels produced has consistently improved, and competition has ensured that these benefits have been passed on to the steel consumer.

Falling steel prices have made steel production an unprofitable business for many steel companies. Some companies in the US have claimed bankruptcy protection, a legal manoeuvre that allows them time to put their business on a creditable footing. While this is beneficial to those particular companies, their

continued existence adversely impacts the healthier companies.

Consolidation was a feature of 2000 and is often proposed as a panacea for the industry's woes. Some international consolidations or mergers have a definite logic, but consolidation on its own is not enough, albeit an often necessary first step. In a steel market where consumers have learnt the benefits of bulk purchasing, a splintered steel industry is at their mercy.

The world's largest steel producer is now "Newco", the company formed in early 2001 by the merger of Arbed of Luxembourg, Usinor of France and Aceralia of Spain. Production capacity will be about 40 Mt/y, considerably more than the 27 Mt/y of the second biggest, Pohang Iron and Steel of South Korea, and the 26 Mt of Nippon Steel of Japan in third position. However, Newco's production capacity is less than 5% of World crude steel production in 2000, and its market is almost totally within Western Europe.

Other consolidations that have taken place in Western Europe include the merger between Thyssen and Krupp of Germany, and that between British Steel and Hoogovens of the Netherlands to produce the Corus Group. US Steel wandered further afield and bought VSZ of Slovakia, thereby getting a toe-hold in Europe. Ispat is the only sizeable truly international steelmaker, with facilities in Europe, Asia, the US and the Caribbean. There has also been some sharing of technology between, for example, Nippon and Pohang, and Nippon and Usinor.

For an individual steel company, to maintain or expand production capacity may be completely rational, but it can have a debilitating effect on the global scene. It is not easy to align production capacity with demand because the business is cyclical and capacity changes much more slowly than demand. Economies of scale drive individual producers to increase output, especially at times when reduced production would better serve the industry as a whole.

The steel companies must stick their heads over the top of the trenches from time to time and scan the economic landscape in general and their own market in particular. The prices of the various grades of steel scrap, for example, are together one of the most prescient indicators of what is happening and what will happen in the steel market.

Locational Aspects of Steelmaking

The location of steel production is still a national rather than an international enterprise, ie, steel is largely produced where it is consumed. Steadily, over the last 20 years, steel trade has increased as a proportion of production, from 23.9% in 1980 to 39.8% in 1999, and this trend is likely to continue. However, most of the trade is intra-regional and stays within Western Europe, North America or Asia, ie, inter-regional trade is significantly less than half the total. Interestingly, the share of production that is exported does not appear to be influenced one way or the other by slowdowns in economic activity.

Other than local demand, there are secondary drivers behind the location of steel production. Essentially, steel can be made anywhere as long as a physical and financial infrastructure is in place. Steel production needs access to raw materials and these are

World Steel Production and Trade

Year	Production	Exports	% Share
1980	588.8	140.6	23.9
1982	542.7	135.5	25.0
1984	605.9	58.8	26.2
1986	616.9	162.3	26.3
1988	680.4	171.1	25.1
1990	677.6	171.0	25.2
1992	636.2	196.1	30.8
1994	644.4	238.5	37.0
1996	669.3	247.0	36.9
1998	695.5	273.1	39.3
1999	703.2	279.6	39.8

Source: IISI

either local or near to deep water ports which enable raw materials to be shipped in and product to be shipped out. Electricity, transport facilities and a willing workforce are other necessities. With these factors in place, and the necessary permits, capital will be made available.

In the building of integrated (BF/BOF) steel production facilities, developing countries have an advantage in the siting of such facilities because of significantly lower labour costs compared to Western Europe, North America or Japan, and because environmental legislation in those three regions is likely to be more severe than that in developing countries. The sort of impact that environmental legislation is having is observable in the US, where domestic coke-making capacity is now insufficient to meet potential demand, despite a sharp fall in coke rates due to the introduction of pulverised coal injection (PCI) and other injectants - the gap is filled by imports - and steel semis are imported for further processing. In a slightly different vein, some sinter plants are being closed in Western Europe and iron ore pellets used instead of sinter. It is considered unlikely that a new integrated steel plant (BF/BOF) will be built in the foreseeable future, if ever, in Japan, Western Europe or North America. These types of plant are being built in China, South Korea, Taiwan, and Brazil.

Because the industrialised countries have a history of steel consumption, they have built up steel scrap “banks” and this, along with technology such as thin strip casting which allows a much wider range of steel products to be produced, will tend to push steelmaking towards metallics-based furnaces. This option is not so readily available to the developing countries, who anyway need quite large increases in production capacity, for which the classical integrated production plant is more appropriate.

The direct reduction/electric arc furnace (DR/EAF) system is another type of integrated production facility, with a much smaller minimum economic scale than the classical route. DRI can be added to a scrap charge to dilute deleterious elements, or a 100% DRI charge can be used if necessary. Most DRI production is dedicated, but there are a number of merchant plants. These merchant plants are at the mercy of scrap prices, which at times can make them uneconomic.

Steel Uses

Steel is a generic term that is an umbrella for hundreds of different types of steels. Iron is obviously the main constituent of steels, but the properties of the steels can vary widely with carbon content, alloy additions, heat treatment and cold working. Within certain limitations, such as weight, opacity and rigidity, it is possible to produce a steel with almost any property that a consumer would desire. Production costs, of course, may make that statement entirely academic.

One property that is invariable is weight; it is a misnomer to talk of “lighter steels”, and yet such a term is often used. Steels generally have the same specific gravity, but alloy steels, for instance, which can be stronger than ordinary carbon steels, allow steel products to be made of thinner sections, and therefore the steel product is lighter. An often quoted example is the Eiffel Tower in Paris; if built today using modern alloy steels, the same type of structure could be built at half the weight.

As economies develop, they increasingly use the more sophisticated alloy steels. These steels are often several time more expensive to produce than ordinary carbon steels, and are used for those purposes where specific properties are required at a competitive cost/price with other materials. These steels are used in the developing countries, but to a much lesser extent than used in the advanced economies.

Total production of alloy steels in the World in 2000 was almost 80 Mt, less than 10% of

total World crude steel production. Of this total, more than 75% was produced by the advanced economies, with Western Europe producing about 40%, Japan 22%, and the US 15%. In 1989, total alloy steel production was over 100 Mt, of which 45% was produced in the former Soviet Union (FSU). Following the political and economic collapse in that region, alloy steel output dropped in the FSU by around 80% over the following decade.

As the name suggests, alloy steels contain metallic alloying elements that, in combination with the more usual elements present in plain carbon steels, such as carbon and manganese, radically affect the microstructure and, thus, the properties of the final steel.

Most of the generic alloy steel production is of the low alloy type, and this is where stronger steel products are required without increasing weight, ie, strength to weight characteristics are superior than those of ordinary carbon steels. Low alloy steel output constitutes about two-thirds of alloy steel production.

Stainless steels, which are usually defined as those steels containing a minimum of 12% chromium, and whose properties can be enhanced by increasing the amount of chromium and/or by the presence of other alloying elements such as nickel and molybdenum, are a sub-group of alloy steels. These steels have superior corrosion resistance because of the presence of chromium and that effect is enhanced at elevated temperatures by the presence of between 1-3% molybdenum. The key alloying element in stainless steels is chromium and the others are mere handmaidens by comparison, although there is some degree of substitutability with all alloying elements.

Stainless steels are used in chemical plant and equipment, particularly in extreme environments, exhaust pipes, that will last the life of the vehicle, kitchen utensils, sinks, and in many aesthetic environments. World production of stainless steels in 2000 was approximately 18 Mt, of which Western Europe produced 44%, Japan 19%, and North America 16%. Growth in stainless steel production over the past ten years has been at a 3% per year average, well above that of total steel production, and this strong growth is expected to continue.

Substitution of Steel

At critical periods, such as times of war, some elements may be substituted because their availability is called into question. This type of substitution could be called strategic and is different from the techno-economic substitution that is in progress at all times in all countries.

For techno-economic substitution, the alternate material must exhibit acceptable properties at a lower cost or improved properties at a cost that can be justified in terms of higher price, ie, would the consumer be willing to pay for those improvements? It is important to factor in the total cost of substitution, not only the cost of innovation and development, but also life-cycle costs, including disposal and recycling costs.

Iron has a certain specific gravity and steel products have a determinate weight. In certain products, such as automobiles, weight increases fuel costs, and efforts have been made to substitute lighter parts for steel in these functions. Examples include plastic hub caps and aluminium engine blocks and panels. There are a small number of “aluminium” cars, but these are expensive and still require a steel frame. The key properties of steel, strength and rigidity, are essential for safety, and allied to relatively low cost, make steel the material of choice for most cars. Where steels are substituted, the new material is, more often than not, a stronger steel, which allows a thinner gauge to be used without sacrificing steel’s key properties. Steel products were once susceptible to corrosion, particularly in automobiles, but again higher quality steels

and better finishing and design have largely eliminated that problem.

Steel has a distinct advantage in the recycling process because of its magnetic properties. Automobiles, for instance, are shredded and the steel fragments extracted magnetically, leaving the dross behind. Steel scrap currently supplies over 40% of the iron units going into steel production.

The real cost and price of steel has declined relative to other materials and the competitive position of steel has improved accordingly. This may be a mixed blessing for steel companies, but it is music to the ears of steel consumers. Recent energy-price increases also tend to reinforce steel's competitive position relative to energy-intensive aluminium and oil-based polymers.

Steel Outlook

Most forecasts made towards the end of 2000 expected steel consumption and production to continue to grow in 2001. These forecasts were bolstered by strong steel production in January 2001, compared with the same month in 2000. However, the economic slowdown in the US (it is still too early to call it a recession) has taken hold, and the old adage that says "If America sneezes, the world catches a cold", almost certainly still applies. Certainly, if the stock markets are any indication at all, world economic growth will be significantly slower in 2001 than in 2000. Steel scrap prices, usually a good indicator, remain depressed and the steel industry is exhibiting weaker consumer demand, falling production and depressed prices.

All the indications are that steel consumption/production in 2001 will be somewhat less than the record year of 2000, possibly a 3-4% decline.