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CONSULTANCY REPORTS

ZIMBABWE INSTITUTE OF DEVELOPMENT STUDIES

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The Iron and Steel Industry in Zimbabwe And Regional Co-operation in the SADCC Context.

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ZIDS
P.O. Box 880 HARARE

CONSULTANCY REPORT

Number 22

THE IRON AND STEEL INDUSTRY IN ZIMBABWE AND REGIONAL CO-OPERATION IN THE SADCC CONTEXT

by

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HARARE, 1991

P.O. Box 880
Harare

First Printing 1991

Printed and published in Zimbabwe

This paper was originally written for the Southern African Social Science Universities Conference on Regional Co-operation in Development held in Lusaka, Zambia, in July 1982.

The author, J.W.G. Kaliyati, is a Senior Research Fellow with the Zimbabwe Institute of Development Studies. However, the views and opinions expressed in this paper are those of the author and do not necessarily reflect those of the Institute.

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INTRODUCTION

Zimbabwe owns the largest and only integrated iron and steel plant in Africa south of the equator excluding South Africa. The plant has a capacity to produce just over one million tonnes of steel per annum. Because of breakdowns and routine stoppages for servicing, the plant has so far produced a maximum output of just over 800 000 tonnes per annum. Production normally averages 700 000 tonnes. The Zimbabwe Iron and Steel Company (ZISCO), based in the Midlands town of Redcliff, is the sole steel producer. It produces a wide range of products which include pig iron, billets, blooms, slabs, sections, bars, flats, rounds, squares, angles, hoops and strips, rails and railway track material, rods and plough beams (see also Table 1 in the Appendix for the full range of products and their specifications).

About 80% of ZISCO's output is exported in the form of billets, blooms and pig iron, earning the country about Z$65 million in foreign currency per annum. The 20% used in the domestic economy finds its way into the various engineering and foundry firms where it is used in the production of various iron and steel products. These include agricultural implements like groundnut shellers, hoes, axes, ploughs, harrows, etc, and tools like shovels, picks, etc., pipes, tubes, nails, bolts, etc.

Despite its possession of a large iron and steel industry, Zimbabwe still imports a lot of iron and steel products, some of which can be produced locally using the existing facilities with probably minor adjustments. The capital goods sector is not that highly developed in Zimbabwe. This means that the country is technologically dependent on the developed economies.

This paper looks at the Zimbabwean iron and steel industry with the aim of answering the following questions:

- Why the economy is highly dependent on imported steel when there is a large iron and steel plant;
- Why the iron and steel industry in Zimbabwe is an export enclave industry;
- Why there has been little or no progress in the development of a capital goods sector in Zimbabwe despite the existence of an iron and steel industry since 1948.

The paper aims at coming up with policy prescriptions as to how the iron and steel industry can best be utilised to benefit the Zimbabwean economy more.

The paper is made up of a literature review of how the iron and steel industry can affect the economic growth of other sectors, a historical review of the development of the Zimbabwean iron and steel industry, a look at the current availability of the raw materials used in the production of iron and steel products, a brief discussion on production, shipment and trade in iron and steel, and the role played by Government, and finally a summary and conclusion.

LITERATURE REVIEW

There is a common belief among most developing countries that, in order to develop, a country should develop its own iron and steel industry.

G. Manners [1] has observed that:

> ...The steel industry should certainly not be thought of as a national status symbol. Nor should it be regarded as the developing world's economic salvation, nor as inevitably bringing wide-ranging economic growth in its wake... It should be seen for what it is - viz. a possible but dispensable element within a broad economic strategy of national development. In many developing countries, the market is simply not large enough to justify local iron and steel production even with substantial tariffs. Particularly is this true in the case of products such as sheets and plates whose production costs respond dramatically to economies of scale. It is for this reason that a good deal of attention has been given in recent years to the possibility of enlarging the markets of LDCs through common market agreements. The major problems in such an agreement are the location of the industry, unsuitable currencies, and varying tax arrangements.....

Yuan-Li Wu [2] also noted that there are two substantial reasons that decisions on the rate of expansion of the steel industry and its product mix are of crucial importance to the rate of economic development:

- Steel is a principal input in construction and machine manufacture, both of which are of crucial importance to the formation of fixed capital in the course of development; and
- Iron smelting and steelmaking are activities requiring large initial capital outlays and must be carried out on a substantial scale.

The first observation is a fact of life, but the second can be disputed on the grounds that certain developing countries, notably India, have developed small mills which are reportedly operating efficiently. Wu [3] also noted that the development of the iron and steel industry by most developing countries seems to be in emulation of developed countries most of which have one. This point is probably supported by the fact that even when the Economic Commission for Africa (ECA) proposed in 1964 that the whole of the West African region should be associated economically as a common market, the question of the location of the proposed regional iron and steel industry was problematic. All the member states wanted the proposed plant to be situated within their territorial boundaries. Whilst some countries gave legitimate reasons why this was to be so, others merely vowed that come what may the industry was to be located within their territorial boundaries. This was mainly because of the economic impact which these countries visualised the iron and steel industry to have on their domestic economies.

It is important, however, to note that there is a high correlation between industrial production and iron and steel production. The correlation is greater between iron and

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1 Manners. G., The Changing World Market for Iron Ore 1950-80, Johns Hopkins Press, 1971.
2 Wu, Yuan-Li, The Iron and Steel Industry in Communist China, Frederick A. Praeger, New York, 1965.
3 Ibid.

steel consumption and industrial production. (See Figures 1 and 5 in the Appendix). This tallies very well with Wu's assertion of fixed capital formation.

It is, however, possible to give an answer to the high positive correlation between the two variables if one thinks carefully through the linkages between the iron and steel industry and other sectors in an economy. (See Figure 6 in the Appendix). From Figure 6 it can be seen that the iron and steel industry is directly linked with sectors that provide it with inputs and those that use its output as inputs. Indirect links also exist with service industries such as transport, water supply, housing, hospitals, power supply, etc.

These links with the other sectors of the economy, especially the link between primary, secondary and tertiary industries, gives the iron and steel industry its importance as an industry capable of generating industrial activities in an economy. However, its ability to generate industrial activities depends on the degree of interlinkage in any one particular economy. The ability is greater if the iron and steel industry has strong links with the capital goods sector whose output is instrumental in increasing productivity in other sectors. It should be noted, however, that for the iron and steel industry to spearhead industrial activity in an economy, its products must be of high quality and low in cost since the products will inevitably compete with similar imported products. This brings us to the question of economies of scale and plant sizes.

Table 2 in the Appendix gives a cost comparison for different steelmaking processes at different operating levels. From the table it can be seen that as the level of production increases, the relative importance of labour, capital and processing costs per unit diminish in each type of steelmaking technology. An additional advantage for increasing the level of production is the ability to fully utilise by-products like coal tar, coke, oven gas, etc.

It is also important to note the point where diseconomies of scale start to operate as this will assist management or the government on the question of how many plants to set up, and what plant sizes to install. Table 3 in the Appendix shows the different optimal plant sizes for the different mills.

It is interesting to note that the optimal scale of output is achieved at different levels of output for different mills. From this it would follow that it is impossible to set up an integrated plant in which optimum size equipment is used throughout; a fact which has led most integrated plants to be multi-product plants. At this point let us turn to the Zimbabwean case.

THE HISTORICAL DEVELOPMENT OF THE ZIMBABWEAN IRON AND STEEL INDUSTRY

Iron and steel production on a commercial scale in Zimbabwe started in 1938 when an electric arc furnace of capacity 12 000 tonnes was imported by a few individuals in Bulawayo. The furnace used steel scrap to produce steel castings and rolled sections.[4] In 1942, the colonial government established the Rhodesian Iron and Steel Commission (RISCOM) to take over all iron and steel production in the country and to develop the huge iron and limestone deposits at Redcliff. Production at Redcliff commenced in 1948 when the first blast furnace was commissioned. At that point in time the plant at Redcliff comprised No. 1 blast furnace, one 25- tonne open-hearth furnace and a rod mill capable of producing 10-inch, 12-inch, and 21-inch rods.[5]

During the first seven years of operation RISCOM experienced a lot of financial problems. These problems were mainly a result of lack of experienced personnel and low level of production which meant high unit costs. In the hope of reducing costs and improving the financial position, No. 2 blast furnace was installed in 1954.[6] The continuation of the loss-making situation, despite increases in the plant capacity and the recruitment of experienced personnel abroad, led government to seriously consider the possibility of denationalising the industry. It is worthwhile to note that by 1954 a total of 1,7 million pounds sterling had been written off as irrecoverable.[7] In 1956 when the loss-making situation was turned into a profit-making situation, mainly as a result of an increase in the market with the formation of the Federation of Rhodesia and Nyasaland, moves to denationalise the industry were taken. In 1957, a consortium of local and overseas interests formed the Rhodesian Iron and Steel Company (RISCO) which took over iron and steel production from RISCOM. The Government's shareholding in RISCO was 10,7%.

The other shareholders in RISCO were Messina Transvaal (SA) with 24,2%, Anglo American Corporation with 22,6%, Stewarts and Lloyds (SA) with 14,5%, Lancashire Steel (UK) also with 14,5%, Roan Select Trust (UK) with 7%, and Tanganyika Concession holding the rest.[8] The Government retained the distribution side of the undertaking through the Rhodesian Steel Sales Corporation (Rhosales) in which the South African Iron and Steel Corporation (ISCOR) had shares.[9]

Soon after its formation, RISCO embarked on a 10 million pounds sterling development programme which involved the building of No. 3 blast furnace, two open-hearth furnaces, a 24-batch coking oven and improvement of the already existing mills.[10] This was RISCO's first development programme in a series which was intended to give RISCO a steelmaking capacity of one million tonnes per annum.

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4 Schedule of products produced by ZISCO, Redcliff, 1982.
5 Ibid.
6 Ibid.
7 Parliamentary Debates, Vol. 35, page 878, Harare.
8 Parliamentary Debates, Vol. 36, Harare.
9 Parliamentary Debates, Vol. 35, page 81, Harare.
10 Parliamentary Debates, Vol. 37, Page 1086, Harare.

No. 3 blast furnace was installed in 1961 by the Kawasaki Steel Corporation of Japan. As payment, 360 000 tons of pig iron and 600 000 tons of iron ore were to be shipped to Japan per annum as from 1963 until a total of 50 million tonnes had been shipped.[11] Another major investment was the installation of a second-hand sheet and plate mill, which was imported from Scotland, in 1961.

It was, however, scrapped in 1965 because of the poor quality of output and stiff competition from ISCOR, which by this time was using more advanced technology than RISCO.[12] By 1965 RISCO was employing about 2 900 people of whom 2 104 were Africans. At that point in time RISCO was producing a wide range of products which included light rods, window sections, fencing standards and droppers, light and heavy flats and angles, ploughshares and rounds.[13] Pig iron production was about 1 000 tons per day of which 700 tons (70%) was exported to Britain, Italy, Egypt, Japan and the Philippines.[14]

In 1965 economic sanctions were imposed against Rhodesia following the Unilateral Declaration of Independence (UDI) by Ian Smith and his followers. This coincided with the launching of the second development programme by RISCO. This expansion programme was estimated to cost about 14 million pounds and it was scheduled to be completed in 1972. It involved the installation of No. 4 blast furnace, a sinter plant, coke ovens and electrical infrastructure, a 500-tonne hot metal mixer and a teeming crane capable of lifting a load of 160 tons. Diesel locomotives of between 5-380 horsepower were also ordered to replace existing steam locomotives.[15] In 1966, however, the programme was shelved and Nos. 1 and 2 blast furnaces and one open-hearth furnace had to be closed, reducing steel output by 50% and pig iron output by 30%. This was probably due to the effects of sanctions and the slump on the world steel market, but according to the then chairman of RISCO this was because of "the necessity to maintain the company's financial stability".[16] Some of the major investments undertaken in this phase included the construction of a coke crushing plant in 1965 that allowed for greater control of the quality of coke fed into the blast furnace, at a cost of R$50 000;[17] the construction of an underground pipe to carry oxygen from Sable Chemicals (17 miles away) to Redcliff in 1969; and the installation of a 720-tonne hot-metal mixer in 1972.[18]

The third expansion programme at the Redcliff works was drawn up in 1972 and this was aimed at boosting the steelmaking capacity of RISCO from 410 000 tonnes to just over one million tonnes per annum.[19] This plan was drawn up at a meeting in Paris on 18th August, 1972 in defiance of the United Nations mandatory sanctions against Rhodesia. Attending this meeting were representatives of 13 international organisations. These organisations included financial institutions and countries from the Federal Republic of Germany, South Africa, Austria, Switzerland and Rhodesia (including representatives from RISCO). At this meeting plans were drawn up on ways

11 The Sunday Mail, 26/11/61, Head Office, Harare.
12 The Sunday Mail, 16/5/65, Herald Office, Harare.
13 The Rhodesia Herald, 23/7/63, Herald Office, Harare.
14 The Rhodesia Herald, 6/3/63, Herald Office, Harare.
15 The Rhodesia Herald, 25/6/65, Herald Office, Harare.
16 The Rhodesia Herld, 3/2/66, and the Sunday Mail, 23/11/75, Herald Office, Harare.
17 The Rhodesia Herald, 25/4/74, Herald Office, Harare.
18 The Rhodesia Herald, 19/3/72, Herald Office, Harare.
19 United Nations Security Council Official Records, Thirtieth year, Special Supplement No. 3, New York, 1975.

and means of funding and implementing a R$63,5 million expansion programme at Redcliff, Zimbabwe. As payment for the project steel was to be shipped to the countries concerned. To the Smith government this was a welcome programme since it boosted the foreign currency earning capacity of RISCO as most of the increased output was to be exported. However, in the agreement was a political risk clause which stated that in the event of revelation of the plan, the Rhodesian government would pay for any partial implementation of the project thereof. The plan was exposed by Mr Kenneth McIntosh in 1974, resulting in the Rhodesian government paying for the partial implementation of the plan.[20] This led the government's shareholding to rise from 10,7% to 49,73%.

Other developments at the Redcliff works included:

- The installation of the fourth hot-air stove and the modification of two others;
- The inauguration of the Planning and Projects Department which turned the workshop, which had hitherto performed a servicing role, into an innovative workshop;
- The widening of a No. 3 blast furnace hearth from 5,18 m to 5,5 m, which allowed for greater charge of raw materials;
- The addition of tar and oxygen injection systems to blast furnace No. 3 which greatly increased furnace heat and reduced coke consumption;
- The construction of a second benzol refining plant at a cost of R$750 000;
- The building of three new soaking pits at a cost of R$150 000 each;
- The installation of an ingot roller table, at a cost of R$250 000, to replace an ingot buggy which carried ingots from the soaking pits to the mills;
- The building of a gas precipitator which greatly increased the utilisation of blast furnace gases and reduced pollution.[21]
- The construction of a R$75 000 Production Control Centre in 1975 which centralised production planning and quality control. (The main control room is sound-proof, and the staff have TV, radio and telephone links with the main production centres). In the same year, a second-hand hot-metal mixer bought from a South African company was installed at a cost of R$400 000;[22]
- Further modifications were made to blast furnace No. 3 at a cost of R$80 000 in 1976;
- In the same year, a 20-tonne overhead crane for the billet mill was constructed to cope with increased production;
- The construction of a bloom transfer bank at the heavy mill and a plant to prepare the clay-tar mixture used to plug the tap holes of the blast furnace at a cost of R$110 000 and R$25 000 respectively in 1976;[23]

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20 Ibid.
21 For more details on developments at the Redcliff works, see The Rhodesia Herald, 23/3/73, 25/4/74, Herald Office, Harare.
22 The Rhodesia Herald, 25/4/75, Herald Office, Harare.
23 The Rhodesia Herald, 22.4.76, Herald Office, Harare.

- The building of a cogging mill in 1977 and the installation of a hydraulically operated role change rig, designed and manufactured by RISCO, which led to a reduction in roll change time from 8 hours to 1,5 hours;[24]
- Finally, in 1979, a new coke plant was installed.[25]

Other projects in the pipeline included the proposed R$60 million sinter plant which would recycle wasted fines of ore and coke accumulated over the years. The process converts the fines into lumpy material before being fed into the blast furnace. There are also plans to increase the general production levels in all the mills.

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24 The Rhodesia Herald, 8/12/76, Herald Office, Harare.
25 The Rhodesia Herald, 6/9/79, Herald Office, Harare.

EXISTING IRON AND STEEL FACILITIES AT ZISCO

The Sinter Plant

The plant has a capacity to produce 800 tonnes per day. The plant screens inputs into the blast furnace to ensure that properly sized ores and coke are charged to the blast furnace. The iron ore size is 10 mm; limestone 6 mm; and coke 20 mm. ZISCO has iron ore and coal storage beds of capacity 152 000 tonnes and 56 000 tonnes respectively.

The Coke Plant

There are 110 coke ovens at ZISCO, of dimensions 400 mm in width and 4 000 mm in height each. A maximum of 2 530 tonnes of coal can be charged into the coke ovens to produce a maximum of about 1 640 tonnes of coke daily. Coal is converted to coke by the process of destructive distillation at temperatures of about 1 300°C. The minimum coking time is 15,9 hours.

The Blast Furnace

ZISCO has two blast furnaces in operation, namely No. 3 and No. 4, which together have a capacity of about 3 000 tonnes per day. Currently, production is restricted to about 2 500 tonnes per day. The output from these furnaces is low sulphur iron of 1,1% Si, 0,025 S, 1,2% Mn, 0,08% P. Table 1 below gives the specifications of the two blast furnaces currently in operation.

Table 1
BLAST FURNACE SPECIFICATIONS

Blast Furnace	No. 3	No. 4
Year Commissioned	1961	1975
Hearth Diameter	5,5 m	8,75 m
Height	58,5 m	75,0 m
Working Volume	563 M^3	1 348 M^3
Annual Production Capacity	300 000 tonnes	730 000 tonnes
Tuyeres (Singles Chamber)	12	208
Tap Holes	1	1
Slag Notches	1	2
Stack Cooling	Copper Flat Coolers and external sprays	Copper Flat Coolers on an enclosed Rohde system plus external sprays.
Charging	Scalecar Skips with McKee Distributor	Automatic Proportioning system with pre-skip screening.
Gas Cleaning	Dustcatcher, cyclone Electrostatic Pre-cipitators	,Dustcatcher, triple cone Venturi scrubber axial separator.
Stoves	3 Cowper	3 External combustion chamber type, with fully automatic operations.

The Lime Kiln

Limestone, mined just outside the plant, is crushed to a size greater than 50 mm but less than 115 mm, burnt in two identical kilns and screened before it is fed to the steel plant. Below are the dimensions of the two lime kilns.

Table 2

LIME KILN DIMENSIONS

Shell Diameter	5 300 mm
Shell Height	27 450 mm
Inner Diameter (After Brick Lining)	4 150 mm
Height of Brick Lining	26 999 mm
Pre-Heat Zone	7 000 mm
Burning Zone	9 500 mm
Cooling Zone	9 500 mm
Maximum Daily Output	150 tonnes
Normal Daily Output	100 tonnes

Hot-Metal Mixers

There are three hot-metal mixers at Redcliff. These are comprised of:

- 2 x 720 tonnes capacity
- 1 x 500 tonnes capacity.

These mixers keep the molten iron (hot metal) at a temperature of about 1 250°C, and, as their name suggests, ensure a uniform composition of the hot metal. At this point the hot metal contains:

- 4,4% C
- 1,2% Mn
- 1,1% Si
- 0,04% S
- 0,08% P.

The Steelmaking Bay

This consists of two 50-tonne LD convertors, an 80-tonne and 50-tonne overhead crane. The two LD vessels are similar and each has a steel output of 58 tonnes.

The Ingot Casting Bay

This consists of one 160-tonne, one 100-tonne teeming crane, 10 teeming aisles and three ladle tilting devices. The moulds are fairly standard with inside dimensions of 560 x 560 mm at the top and 620 x 620 mm at the bottom, and 2 266 mm in height. Each ingot weighs approximately 5,5 tonnes.

The Continuous Casting Machine

This consists of two strands casting 160 mm^2 blooms with in-line reduction to 110mm^2.

The Primary Mill

This consists of all soaking pits, each with a capacity of 12 ingots, three stripper cranes and a 38-inch blooming mill.

The Billet Mill

This mill has a capacity of about 700 000 tonnes per annum.

The Medium Mill

This mill was commissioned in 1948. It has a capacity of 8 000 tonnes per month. The mill uses billets and blooms from the respective mills as input. The mill consists of a bloom bay, a reheating furnace, a three-stand mill, a cutting and cooling bank, and a finishing section.

The Light Mill

The mill capacity is about 200 000 tonnes per annum. It uses billets from the billet mill to produce rounds of between 5 mm-34 mm in diameter, coils of up to 16 mm in diameter and bars of up to 34 mm in diameter.

The Scrap Handling Bay

This consists of reinforced concrete bins for separate storage of heavy scrap, light scrap, pig iron and iron scrap; a 10-tonne and a 15-tonne overhead magnetic crane; four electronic scales, four cross-transfer systems, four 12 m^3 and four 3,5 m^3 scrap chutes and one hydraulic scrap charging machine.

AVAILABILITY OF RAW MATERIALS

Zimbabwe is well endowed with the basic raw materials used in the production of iron and steel, namely iron ore, limestone and coal.

Iron Ore

Known reserves of iron ore in Zimbabwe are estimated at 3 700 million tonnes, of iron content of between 40% and 62%. The reserves are found around the Zvishavane, Kwekwe and Harare areas. Currently, iron ore is being mined at Buchwa and Ripple Creek. Measured reserves at Buchwa and Ripple Creek are estimated at 20 million and 70 million tonnes respectively. The iron contents of the two deposits are 61% (Buchwa) and 54% (Ripple Creek). Considering the fact that in some European countries ores of about 38% iron content are currently being mined, it would follow that the iron ores in Zimbabwe still have a long way to go before depletion. Table 3 below provides an analysis of representative samples from the two deposits.

Table 3

CHEMICAL ANALYSIS OF IRON ORE CONTENT

Element or Compound	PERCENTAGES CONTAINED	
	Buchwa	Ripple Creek
Fe (Total)	61,6%	53,6%
Mn	0,2%	1,06%
P	0,04%	0,04%
S	0,02%	0,06%
$Fe0$	N/A	N/A
Fe_20_3	N/A	N/A
$A1_20_3$	2,5%	1,36%
$Si0_2$	6,0%	8,8%
Ca^0	0,5%	1,64%
Mg^0	0,4%	0,63%
$Ti0_2$	N/A	N/A
H_20	1,5%	9,9%

Note: N/A = Not available

Limestone

Zimbabwe has about 200 million tonnes of limestone. The biggest deposits are just a few hundred metres from the Redcliff works. These deposits are so large that the management are confident they will not be exhausted in the near future.

Coal/Coke

Zimbabwe boasts about 22 billion tonnes of coal of which about 6,9 billion is commercially exploitable. At the current rate of production the reserves are estimated to last another 1 760 years. Table 4 below gives an analysis of Wankie coal delivered at Redcliff:

Table 4

CHEMICAL ANALYSIS OF WANKIE COAL

Composition	Percentage
Fixed carbon	59,1%
Volatile Matter	26,3%
Ash	2,0%
Moisture	4,5%
Sulphur	1,1%
Bulk density	800 kg m^3

Other Raw Materials

Fluxing materials like manganese, fluorspar, corundum and dolomite are known to exist in Zimbabwe in fairly large amounts although the exact quantities are not known. Clays to produce refractory materials are also in abundance in Zimbabwe. A narrow range of refractories is being manufactured locally. A wide range of refractory bricks is imported from South Africa and Europe. This, however, does not mean that such bricks cannot be manufactured locally. Production is not done locally simply because a subsidiary of the company which produces refractories in South Africa is currently operating in Zimbabwe and the two sister companies do not want to compete against each other.

IRON AND STEEL PRODUCTION, SHIPMENT, TRADE AND THE DEVELOPMENT OF THE ZIMBABWEAN ECONOMY

Iron and steel production and trade in Zimbabwe have to a large extent been influenced by Government policy, external influence and the ownership of the iron and steel plant at Redcliff.

At the formation of RISCOM, the iron and steel industry was wholly owned by government. Production was aimed at supplying the country with cheap iron and steel products so as to stimulate metal fabrication industries.

An analysis of the shipment of iron and steel between 1939 and 1949 shows that about 81% of the steel sold, in value terms, was within the domestic economy, 16,8% went to Zambia, with the rest going to Tanzania, Botswana, Zaire, Mozambique, Malawi, Kenya and South Africa (see Table 5 below).

Table 5

STEEL SOLD BY ZIMBABWE TO OTHER COUNTRIES BY COUNTRY OF DESTINATION (1939 to 1949)

Country	Value (pounds)	Percentage
Tanganyika (Tanzania)	13 459	0,60
PEA (Mozambique)	10 538	0,48
Belgian Congo (Zaire)	7 485	0,34
Bechuanaland (Botswana)	19 678	0,89
South Africa	11	0,00
Kenya	474	0,02
Northern Rhodesia (Zambia)	370 036	16,79
Nyasaland (Malawi)	2 635	0,12
Southern Rhodesia (Zimbabwe)	1 779 672	80,75
TOTAL	2 203 988	100,00

Source: Parliamentary Debates

In the early stages of the development of the iron and steel industry, one can therefore say the industry was inward-looking. This was, however, in line with the government's import substitution strategy adopted soon after World War II in an effort to counter the shortages caused by the war.

The inward-looking policy did not last long. The financial problems faced by RISCOM led to the expansion of the plant which was not matched by increases in demand. The only way to cope with increased output was to export the excess over domestic needs. A deliberate move to make the industry an export enclave was taken during UDI when the government was in desperate need of foreign currency to sustain the war effort and to save the economy from total collapse. The iron and steel industry was ideal for this purpose as it was the biggest industry whose products were easily marketable on international markets as long as they were not highly processed. Apart from the need to earn foreign currency, the type of contracts entered into in expanding the plant assisted in transforming iron and steel into an export-oriented industry (refer to the earlier discussion on the historical development of ZISCO).

Table 4 in the Appendix shows a totally different picture in the pattern of distribution of the iron and steel output in the later stages of the development of ZISCO. The table shows that, on average, between 1977 and 1980, there was a 769% increase in the sales of pig iron; a 97% increase for the products from the bar-rod mill; a 12% increase in the sales of output from the medium mill. During the same period sales of the products from the blooms and billet mill, and the large mill decreased by 17% and 3% respectively. Overall, there was a 9% increase in sales between 1977 and 1980. (Note: All comparisons are of quantities and not value.)

The table also shows that, of the total quantity of iron and steel sold between 1977 and 1980, 57,8% were billets and blooms, 20,8% were bars and rods, 3,5% was pig iron, 10,9% came from the medium mill and 7,1% from the large mill.

The table further reveals that on average about 80% of the total sales were earmarked for the export market. A breakdown of the figures to show exports from the different mills reveals that 36% was pig iron, 48% blooms and billets; 70% of the products came from the medium mill, 42% from the large mill, and that about 86% from the rod mill were destined for the export market. Compared to the data in Table 5 showing the situation between 1939 and 1949, the above figures seem to suggest a reversal in policy.

Table 5 in the Appendix gives Zimbabwean iron and steel exports by product for the period 1959 to 1981. From the table it can be seen that the major exports were pig iron, ingots, billets and blooms. There seems to have been a shift in policy from the exportation of pig iron to the exportation of billets and blooms over the period 1959 to 1981. In 1959 about 100% of the exports were pig iron. In 1965 of the total exports 80% were pig iron, 9% were angles, shapes and sections, and 7% were made up of billets and blooms. By 1981 the share of pig iron on the export market had been reduced to 40%, while billets and blooms had gone up to 55%. Angles and sections were down to 4%.

The export orientation of the steel industry in Zimbabwe meant that the linkage effects between the iron and steel industry and the rest of the economy were very weak. From this it also follows that the ability of the industry to spearhead industrial development was greatly reduced. Tables 6 and 7 in the Appendix give an inter-industry analysis between the iron and steel industry and other sectors of the Zimbabwean economy. The analysis is based on the 1965 input-output tables. This is mainly because more recent tables were not available.

Table 7 shows that in 1965 a total of Z$21,2 million worth of iron and steel was produced domestically, Z$10 million was imported, giving a total steel supply of Z$31,2 in the domestic economy. Of this, 52% was used by the manufacturing sector, 44% was exported; private consumption, agriculture, and mining each accounted for 0,64%, whilst services consumed about 1,3%. Within the manufacturing sector itself, 17%, 13%, 9,6%, 6,4% and 3% of the total steel supply were consumed by metal products, other manufactures, electrical and non-electrical machinery, the iron and steel industry itself, and transport (motor vehicle bodies, repairs, etc.) respectively. Of the total steel consumed by the manufacturing sector, 58% was imported. Going down the list, almost all the iron and steel requirements of the agricultural, mining and the wood and furniture sectors were met from domestic sources. The chemical industry's iron and steel requirements were met largely from imports. The iron and steel industry itself imported 30% of its requirements, 55,6% metal products, 60% electrical and non-electrical machinery, 20% transport; 85% other manufactures; 50% services, and 7% of the total of the iron and steel exported were re-exports.

From this analysis it is quite clear that there was a heavy dependence on imported material. With the exception of the manufacture of small agricultural and mining equipment and the refurbishing of machinery, there was little development in the capital goods sector.

Table 6 shows the major sectors supplying the iron and steel industry with inputs, and how much of it was imported. Thus all the mineral inputs were sourced from the domestic economy and these constituted 23,7% of the total input requirements; 62% of the manufactured input requirements were imported. Overall, about 24% of the total input requirements were imported. Table 8 in the Appendix gives a whole range of iron and steel products imported for the period 1959 to 1981.

THE ROLE OF GOVERNMENT

The role played by Government in the development of ZISCO has been mainly political rather than economical. ZISCO employs about 5 500 people. Indirect employment created by the very existence of ZISCO is claimed to be about 50 000 by ZISCO officials. If this is true, it means that the industry alone accounts for about 5,5% of the total employment. As mentioned earlier in the paper, ZISCO earns about Z$65 million in foreign currency per annum. In a country so dependent on the availability of foreign currency for its development like Zimbabwe, ZISCO obviously plays an important role as a foreign currency earner as well as a generator of employment.

The Zimbabwe Iron and Steel Company sustains a large number of small firms in both the formal and informal sectors by providing them with inputs. The Government is conscious of the role played by ZISCO in this regard; especially in the informal sector in Zimbabwe which is known to employ quite a large number of people although the exact number is not known. The major activities in the informal sector include the production of metal door and window frames, cooking grates, burglar bars, gates, hoes, axes, wire trays and a host of other small items using steel from ZISCO. These products are fairly cheap but up to standard, hence the informal sector draws most of its customers from the low-income urban areas and the rural areas which house about 80% of the population. We also have firms in Zimbabwe like Zimplow which uses 100% ZISCO steel to produce items like axe-heads, hoes, ox-drawn ploughs, groundnut shellers and grinding mills. All these products are geared for the rural population.

Apart from these small operators, we have companies like RESSCO which refurbishes railway locomotives; Bolt Manufacturers which produces a wide range of components, like bolts, etc, for the imported plants. All these firms and several others use steel from ZISCO in conjunction with imported steel in some, if not all, cases.

From the above discussion it can be seen that politically the Government was and still is obliged to keep ZISCO going. Economically, ZISCO has survived through Government grants, loans and subsidies. To give an example of this, by 1979 government loans to ZISCO totalled about Z$92 million. Subsidies to ZISCO's products were stopped in 1980. This resulted in heavy cash flow problems. In the period 1981/82 ZISCO was reportedly operating at a loss of Z$1,25 million per day; and the management claimed that it required about Z$25 million to keep it in operation.

Having briefly discussed why the Government has an interest in ZISCO, let us now look at its role *vis-a-vis* ZISCO. The main activities in which Government is involved are:

- Monitoring the overall performance of the industry;
- Setting prices of the products produced by ZISCO for the domestic economy;
- Allocation of foreign currency to maintain existing plant and machinery through committees in the Ministry of Industry and Energy Development;
- Assisting in the exploration of new markets for the industry;
- Giving grant aid to the industry in the event of financial problems;

- Acting as a guarantor for loans secured from financial institutions; and
- Reviewing all new development plans to expand the industry as well as improving the quality of products.

Talking about reviewing new development plans, below is a table showing a development plan currently under consideration.

Table 6

ZISCO DEVELOPMENT PLAN

	INSTALLED CAPACITY (Tonnes per Year)	PRODUCTION (1980) (Tonnes/Year)	PROPOSED EXPANSION (Tonnes/Year)
Production Facilities Based On:			
Scrap-Based			
Electric Furnace	-	-	108 000
Conticast Billets	168 000	115 000	360 000
Ingot Cast Billets	648 000	531 000	-
Rolling Programme			
Merchant Bars & Rods	N/A	110 837	-
Angles, Shapes & Sections	N/A	98 056	240 000
Wire Rod N/A		40 122	85 000

	CAPACITY (Tonnes/Year)
Planned Production Facilities	
Sinter Plant	1 200 000
Electric Steel Making	108 000
Conticast	552 000
Rolling Mills	276 000
Planned Rolling Programme	
Blooms	461 000
Billets	557 000
Slabs	204 000
Merchant Products	400 000
Flat Products	192 000

An analysis of the above figures shows that the proposed expansion programme does not increase output to a point where economies of scale are fully exploited (compare with Table 3 in the Appendix). Production of plate and sheetmetal which is in great demand in Zimbabwe is not included in the plan. With the exception of these flat products, the proposed expansion is merely expanding existing production lines. This means that products which are currently being imported will continue to be imported. Reductions in foreign currency expenditure will therefore be minimal.

THE IRON AND STEEL INDUSTRY IN A REGIONAL PERSPECTIVE

Introduction

As already pointed out, the major setbacks in the development of the iron and steel industry in developing countries include:

- The small size of the domestic market which tends to limit not only the size of domestic production but also its range;
- Production in most developing countries tends to be sub-optimal, leading to high production costs and therefore uncompetitiveness of the products on the international market;
- The narrow range of output means that quite a large proportion of the iron and steel requirements of developing countries have to be met from imports, leading to unnecessarily high foreign currency expenditures.

One way of overcoming these problems is through regional co-operation. Through regional co-operation human, raw material and financial resources would be greatly increased, not to mention the increase in the size of the market. A further increase in the size of the domestic market could be envisaged if deliberate moves such as using similar vehicles, equipment and machinery are taken. This would make the establishment of a plant producing spare parts for the entire region more profitable. The setting up of such a plant would just be the first step in the establishment of the capital goods sector. Inevitably, this type of arrangement would lead to an increased demand for primary iron and steel products and the raw materials used in the manufacture of iron and steel products. A great deal of groundwork is, however, necessary to establish the type of co-operation, demand, supply and consumption pattern in the region.

Type of co-operation/specialisation

The types of co-operation envisaged can take several forms, e.g.co-operation in production and distribution and co-operation in dealing with third parties.

Co-operation in production and distribution

Co-operation in production would have to be looked at in conjunction with current and potential distribution patterns of both raw materials and the final output. The distribution of different plant would also have to take the current installed capacities into consideration, and whether it is cheaper to locate a plant close to the mining site or near the market.

Two types of specialisation can be envisaged. The first one is where a country well endowed with the raw materials to produce a particular product is given the responsibility of supplying the whole region with that particular product. Thus if, say, Zimbabwe is responsible for the production of iron and steel products, Zambia would be given the responsibility to supply the whole region with copper and copper products, etc. The other form of specialisation which one can envisage is one where a country is responsible for the production of one type of iron and steel product whilst another concentrates on the production of a different iron and steel product.

This is the kind of co-operation which requires answers to the question of which is cheaper to transport finished products or to transport the raw material to the market either for consumption or further processing before consumption. An example of this would be, say, Mozambique is given the responsibility of supplying the whole region with bearings, Zimbabwe is given the responsibility of supplying gear units and so on. In both these cases trade would have to be based on commodity trade agreements with cash transactions taking place only to balance the figures at financial year ends. A common stand would have to be taken when dealing with third parties in order to avoid a situation where member states would take advantage of regional co-operation for their own individual benefit.

Possibility of Setting Up a Regional-Based Iron and Steel Industry Within the SADCC Region

Raw Material Base

The SADCC region is well endowed with the raw materials required for the production of iron and steel, namely iron, limestone, coal and refractory materials.

IRON ORE

Proved and potential iron ore reserves in the SADCC region are estimated at about 8 000 billion tonnes. Compared to the estimate for the whole of Africa of about 20 000 billion tonnes, the SADCC region accounts for about 40% of Africa's total. The average iron content of these ores ranges from about 35% to 69%.

Zimbabwe has about 378 million tonnes of proven reserves and about 3 300 million tonnes potential reserves of iron content ranging from 40% to 63%. Most of these deposits are found in the Kwekwe and Buchwa areas. The major impurities in these ores are silicon dioxide, sulphur and manganese.

Angola has proven reserves of about 3 000 million tonnes of iron content of between 40% and 60%. The deposits are mainly of the Lake Superior type. The major impurities include silicon dioxide, sulphur, phosphorus and titanium oxide. Most of the deposits are in the Villa Salazar and Mossamedes districts. Production was about 5 million tonnes in 1975 before it was interrupted by the war. Mozambique has reserves estimated at 309 million tonnes situated mainly in the Tete region. The reserves average 45% to 67% in iron content. The major impurities in the ores are silicon dioxide, sulphur, phosphorus, aluminium oxide and magnesium oxide. No iron ore extraction has been reported.

Zambia has extensive deposits of iron ore in the north-western region of the country. The deposits are estimated at about 300 million tonnes of iron content of between 40% and 69%. The deposits are of the Lake Superior type. The Zambian officials are currently considering setting up an iron and steel plant based on these deposits.

For more details on the occurrences of iron ore deposits in the SADCC region, see Table 9 in the Appendix.

COAL

The SADCC region has about 270 billion tonnes of known reserves of coal. Botswana, Namibia, Lesotho and Swaziland together have estimated reserves of about 80 billion tonnes of coal. In 1978 these countries produced about 89 million tonnes of coal, representing about 95% of Africa's total production that year. Known coal reserves in Zimbabwe are estimated at about 22 billion tonnes, 7 million of which are commercially exploitable. Mozambique's deposits are estimated at about 200 billion tonnes, of which about 700 million tonnes are under exploitation. About 1,5 billion tonnes of coal are known to exist in Tanzania, and about 500 million tonnes and 38 million tonnes are also known to exist in Malawi and Zambia respectively. (See also Table 10 in the Appendix).

Fluxing and Refractory Materials

The major fluxing materials in the iron and steel industry, namely limestone, dolomite, fluorspar, corundum and manganese are known to exist in the region although estimates are not available. In Zimbabwe, about 200 million tonnes of limestone are, however, known to exist.

Different types of clays which are good for the manufacture of refractory materials are also known to exist in the region. In Zimbabwe, a narrow range of refractory materials is currently being manufactured. Zimbabwe has, however, probably the largest known deposits of kyanite. Studies are currently underway on the possibility of developing these deposits and the huge lithium deposits into refractories and porcelain earthenware.

Current Iron and Steel Production Facilities in the SADCC Region

The only countries in the SADCC region which have iron and steel production facilities are Zimbabwe, Angola, Mozambique, Tanzania and Zambia. With the exception of Zimbabwe, the plants are based on imported scrap and billets to produce a very narrow range of iron and steel products, mainly reinforcing bars for the building industry and light sections. The capacities of these mills are relatively small for viable operation. The Tanzanian mill, for example, has an annual capacity of only 70 000 tonnes. For efficient production and to fully benefit from economies of scale, the iron and steel production facilities in the SADCC region will have to be expanded tremendously. This also goes for Zimbabwe despite the fact that its annual production capacity currently stands at about one million tonnes.

The metal fabricating, foundry and engineering firms are also still relatively small and limited in the range of output. The narrow range of output in the iron and steel industry, in the case of Zimbabwe, forces these firms to depend on imports for quite a large proportion of their iron and steel requirements. On the other hand, the smallness of these firms restricts output in the iron and steel industry and the scope of expanding existing facilities and even setting up new ones.

The nature of the iron and steel industry in the SADCC region, therefore, makes the question of regional co-operation more obvious than otherwise.

Advantages of Regional Co-operation

The advantages of regional co-operation have been highlighted in previous sections of this paper. But to emphasise their importance we shall summarise them below.

The main advantages, in brief, include foreign currency saving, increased employment, accelerated growth, improved standard of living and a general increase in the level of industrialisation.

As mentioned earlier, regional co-operation allows optimal plants to be established. This means that production will be at its least cost, and therefore iron and steel products which are inputs in the foundry, fabricating and engineering firms would be relatively cheap. This fact alone might lead to new industries to come on stream. The widening of the product range would result in less foreign currency being used in the purchasing of such commodities, since trade between member countries in the region would be based on commodity trade agreements. Both these factors would mean increased employment within the region.

If increased production in the iron and steel industry is synchronised with increased development of the capital goods sector, then this kind of development would lead to increased productivity, since the output of the capital goods sector is instrumental in the increases in productivity. Increased productivity would mean increases in the general level of wages and salaries and therefore an increase in the monetary base for further development. As wages and salaries go up, so does the demand for all commodities, including the output in the capital goods sector. Thus production and productivity in almost all other sectors would also rise.

This argument applies to all countries engaged in regional co-operation despite the form of specialisation adopted. The only problems which one envisages are those related to different levels of development and political affiliation. Differences in the level of development might lead to one country failing to identify areas of mutual benefit, simply because that country produces most, if not all, the products produced by the other country. By political affiliation here one is referring to whether a nation is pro-West or pro-East. Such political differences might lead to misunderstandings which would inevitably affect economic relations.

SUMMARY AND CONCLUSION

From this paper the following observations can be made about the Zimbabwean iron and steel industry:

- The industry was initially inward-looking and later became an export enclave industry. This state of affairs seems to have arisen from (a) an unsynchronised development of the iron and steel industry *vis-a-vis* that of engineering, foundry and fabricating firms; (b) the drive to make ZISCO a viable economic enterprise via increased production; (c) the deliberate use of the industry by the Smith regime as a foreign currency generating apparatus.
- The product mix seems to have hardly changed since 1965 despite changes in the demand pattern. As a result, the country has depended so much on imported iron and steel products, despite the fact that an iron and steel plant the size of ZISCO exists in the country.
- The use of the iron and steel industry as a source of foreign currency by the Smith regime has been mentioned elsewhere in this paper. But what is not immediately apparent is the fact that such exports did not fetch a high price. This is not surprising since the majority of the importers were developed countries, most of which had excess capacity for the production of processed steel, but lacked the basic raw materials.
- A point which might have escaped mention is the heavy reliance on expatriate skilled manpower soon after independence, leaving a big vacuum in the smooth operation of ZISCO.
- The size of the capital goods sector within Zimbabwe seems to have significantly hampered the development of the iron and steel industry and, indeed, other sectors of the economy. This arises from the fact that the output of the capital goods sector would lead to increased productivity in other sectors. This, in turn, leads to higher salaries and wages and therefore a higher and stronger demand base for any future development. One argument put forward against the establishment of the capital goods sector in developing countries has been its impact on employment and lack of big enough markets. It still has to be proved that African states can co-operate in such organisations as SADCC and PTA and overcome the problems of the smallness of their individual domestic markets.

On the question of mechanisation versus labour opportunities, it goes without saying that those that propound the idea that Third World countries should not mechanise in order to create employment, have themselves gone through a process of mechanisation amidst high unemployment rates. The idea, then, seems to be a strategic piece of advice given by countries desperate to secure or sustain markets for their products. One can take an example of Japan which, until the end of World War II, was not mechanised. Since that time it has made deliberate moves to mechanise. It has made giant strides in this direction, and today it is one of the leading industrialised nations of the world. One astonishing thing about developing countries is how much our leaders succumb to such ideas.

In the case of Zimbabwe, the country is well positioned, for example, to start a regional capital goods industry. Co-operation in this respect can take the form of inter-product specialisation. Inter-product specialisation would involve, say, Zimbabwe producing an agreed range of iron and steel products for the region, depending on their resource endowment. Inter-industry co-operation refers to a situation where, say, Zambia produces copper and copper products whilst Zimbabwe specialises in iron and steel for the whole region.

Policy Implications

From what has been said so far it looks commendable that:

- The Government of Zimbabwe seriously thinks of an expansion programme for ZISCO in conjunction with ZISCO's management of expanding the range of products produced. There is an immediate need to look into the possibility of producing steel plate and sheet, and various steel alloys. This can be done through consultations between ZISCO, the Ministry of Industry and Energy Development, and the Ministry of Mines.
- Concurrent to the above is the need to seriously consider the development of a capital goods industry, and a sound engineering base capable of reproducing imported technology and possibly improving it.
- It goes without saying that whilst the two recommendations made above are underway, the Ministry of Manpower Planning and Development ought to initiate a training programme so as to equip the nation with the people of the right calibre to man the projects as they materialise.
- From both the discussions on the smallness of domestic markets and on economies of scale, it also probably goes without saying that it is necessary to incite the whole SADCC region in this regard.

APPENDICES

LIST OF TABLES AND FIGURES IN APPENDIX

TABLE 1

ISCOSTEEL — ROLLED STEEL SECTIONS : STANDARD MASSES PER METRE

ROD MILL

Size mm	kg/m
Rounds	
Coils Only	
5,5	0,187
6,0	0,222
6,5	0,260
7,3	0,328
8,0	0,395
Coils & Bars	
9,5	0,556
10,0	0,616
10,5	0,680
12,0	0,887
12,5	0,963
14,0	1,210
15,0	1,39
16,0	1,58
16,5	1,68
Bars Only	
18,0	2,00
19,0	2,23
20,0	2,47
20,5	2,58
22,0	2,98
22,5	3,12
24,0	3,55
24,5	3,70
25,0	3,85
26,0	4,17
28,0	4,83
30,0	5,55
30,5	5,73
32,0	6,31
34,0	7,13
36,0	7,99
38,0	8,90
40,0	9,86

Size mm	kg/m
Squares	
10,0	0,773
12,0	1,10
14,0	1,51
16,0	1,98
20,0	3,05
22,0	3,71
25,0	4,88
30,0	6,95
35,0	9,61
40,0	12,55

LIGHT MILL SECTIONS

Size mm	kg/m
Plate Not Export	
15x5	0,589
x8	0,942
20x4	0,630
x5	0,784
25x4	0,784
x5	0,98
x6	1,18
x8	1,57
x10	1,96
x12	2,35
30x5	1,18
x6	1,41
x8	1,88
x10	2,34
x12	2,82
40x5	1,57
x6	1,88
x8	2,51
x10	3,14
x12	3,77
x16	5,02
50x5	1,96
x6	2,35
x8	3,14
x10	3,92
x12	4,71
x16	6,28
x20	7,84
65x6	3,06
x10	5,10
x12	6,12
x16	8,16
80x6	3,77
x10	6,28

Size mm	kg/m
Plate Not Export	
80x12	7,53
x16	10,84
x20	12,55
x25	15,7
x30	18,8
Window Sections	
P.7	1,443
Y X 7	1,830
Fencing	
D.V.	2,00
Angles	
25x25x4	1,45
x5	1,77
30x30x4	1,78
x5	2,18
40x40x3,5	2,15
x4	2,42
x5	2,97
x6	3,52
50x50x4	3,06
x5	3,77
x6	4,47
x8	5,82
Plough Beam Straining Post Section	
9,5 Web	9,56
13 "	20,08

MEDIUM MILL SECTIONS

Size mm	kg/m
Rounds	
47,0	13,6
52,0	16,7
57,0	20,0
60,0	22,2
62,0	23,7
66,5	27,3
75,0	34,7
90,0	49,9
100,0	61,6
Plate	
100 x 6	4,71
x 8	6,28
x 10	7,84
x 12	9,41
x 16	12,55
x 20	15,7
x 25	19,6
130 x 8	9,16
x 10	10,2
x 12	12,24
x 16	16,3
x 20	20,4
x 25	25,5
150 x 8	9,4
x 10	11,8
x 12	14,1
x 16	18,8
x 20	23,5
x 25	29,4
160 x 10	14,1
x 12	16,9
x 16	22,6
x 20	28,2

Size mm	kg/m
Plate	
180 x 25	35,3
200 x 10	15,7
x 12	18,8
x 20	31,4
x 25	39,2
230 x 10	18,0
x 12	21,7
x 16	28,9
x 20	36,1
x 25	45,1
Angles	
60x60x6	5,42
x8	7,09
x10	8,69
80x80x6	7,34
x8	9,63
x10	11,9
x12	14,0
90x90x8	10,9
x10	13,4
x12	15,9
100x100x8	12,2
x10	15,0
x12	17,8
Unequal Angles	
75x50x6	5,65
x8	7,39
90x65x6	7,07
x8	9,29
x10	11,4
100x75x8	10,6
x10	13,0

Size mm	kg/m
Channels	
3 x 1½	6,70
4 x 2	10,42
5 x 2½	14,90
6 x 3	18,00
Rails	
20lb/yd	9,92
30lb/yd	14,9
45lb/yd	22,3
I-Beams	
100,0	8,34
120,0	11,1
140,0	14,3
Miscellaneous	
Fist 'G'	14,3
Plough Share	6,1
Grader blade	16,2

OTHER

Size mm	kg/m
Billets	
48 x 48	17,7
55 x 55	23,2
60 x 60	27,7
63,5x63,5	31,0
70 x 70	37,7
80 x 80	49,2
85 x 85	55,6
92 x 92	65,0
100x100	76,9
Blooms	
180x180	249,1
200x200	307,4
Concast	
110x110	93,1
150x150	173,0
160x160	196,8

Table 2

COST COMPARISONS OF THE VARIOUS STEELMAKING PROCESSES FOR OPERATIONS OF DIFFERENT ANNUAL CAPACITIES (All Figures at Constant 1962 Dollars)

	ANNUAL PRODUCTION IN THOUSANDS OF INGOT TONNES						
PROCESS AND COST ITEM	100	200	400	500	800	1 000	1 500
Open-Hearth Process							
Molten pig iron	36.99	33.35	30.64	29.55	28.76	28.23	27.47
Scrap	14.26	12.82	11.82	11.48	11.09	10.89	10.23
Iron ore	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Iron and ferro-alloys	55.61	50.43	46.82	45.59	44.21	43.48	42.42
Salaries and wages	8.07	6.98	4.10	3.73	3.28	3.08	2.56
Other conversion cost	14.46	14.21	13.41	13.09	12.75	12.61	12.41
TOTAL DIRECT COSTS	78.14	71.62	64.30	62.41	60.41	59.17	57.39
Capital charges	6.74	6.24	5.34	4.80	3.86	3.37	2.75
TOTAL COSTS	84.88	77.86	69.67	67.21	64.10	62.54	60.14
Electric Arc Furnace							
Molten pig iron	35.71	32.09	29.57	28.72	27.76	27.25	26.51
Scrap	13.77	12.38	11.41	11.08	10.71	10.51	10.23
Iron ore	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Iron and ferro-alloys	52.88	47.87	44.38	43.20	41.87	41.16	40.14
Salaries and wages	6.50	5.23	3.06	2.78	2.42	2.26	1.97
Other conversion cost	12.75	12.55	11.75	11.45	11.15	11.05	10.95
TOTAL DIRECT COSTS	71.73	65.65	59.09	57.43	55.44	54.77	53.06
Capital charges	5.78	5.34	4.73	4.26	3.54	3.21	2.71
TOTAL COSTS	77.51	70.99	63.92	61.69	58.89	57.68	55.77
The LD Process							
Molten pig iron	38.92	34.98	32.24	31.29	30.25	29.70	28.90
Scrap	15.11	13.26	12.51	12.49	11.75	11.53	11.22
Iron and ferro-alloys	57.18	51.39	47.90	46.93	45.15	44.38	43.27
Salaries and wages	25.38	4.26	2.84	2.54	2.20	2.07	1.75
Other conversion cost	8.53	8.30	7.46	7.14	6.77	6.61	6.36
Capital charges	4.52	4.10	3.44	3.12	2.58	2.26	2.00
TOTAL COSTS	75.61	68.41	61.64	59.73	56.70	55.26	53.38

Table 3

OPTIMAL PLANT SIZE

Mill	Optimal Size
Strip mill (200 cm continuous Wide - strip)	4 million tonnes
Billet Mill	1.25 million tonnes
Semi-continuous light-plate mill	0.75 million tonnes
Four-strand wire-rod mill	0.55 million tonnes
Heavy-section mill	0.60 million tonnes
Rail mill	0.50 million tonnes
Light section or Bar mill	0.35 million tonnes

Table 4

SUMMARY OF STEEL SALES 1977-80

	Average % Export	Average % Sales	Increase in Sales 1977-80 (No. of Times)	Increase in 1977-80 (%)
Pig Iron	36.10	3.50	8.70	769
Blooms and Billets	48.50	57.80	0.83	-17
Medium Mill	70.10	10.90	1.12	12
Large Mill	41.80	7.10	0.97	-3
Rod Mill	85.80	20.80	1.97	97
TOTAL	79.70	100	1.09	9

TABLE 5

ZIMBABWE'S IRON AND STEEL EXPORTS (1959-1981)
(000'S TONNES)

YEAR	PIG IRON AND FERROALLOYS	TUBES, PIPES AND FITTINGS	INGOTS, BILLETS BLOOMS, BARS AND RODS	ANGLES, SHAPES AND SECTIONS	PLATE AND SHEET			WYRE	RAILWAY TRACK MATERIAL		OTHER	TOTAL IRON AND STEEL
					GALVANISED	UNCOATED SHEET	OTHER COATED		RAILS	OTHER		
1959	45.0	.3	-	.50	-	-	-	-	-	-	-	45.80
1960	54.0	.1	13.70	2.60	-	-	-	-	-	-	-	70.40
1961	127.0	.1	29.40	3.20	-	-	-	-	-	-	.10	159.80
1962	210.0	.1	9.20	2.10	-	-	-	-	-	-	.20	221.60
1963	227.0	.1	.20	.80	-	-	-	-	-	-	.50	228.60
1964	237.0	2.9	32.40	15.50	-	-	-	-	-	-	6.30	295.10
1965	232.0	3.8	22.80	25.70	-	-	-	-	-	-	3.30	287.60
1966	197.0	4.2	42.00	1.70	.03	.38	.03	.80	.20	.30	-	246.60
1967	231.0	2.3	70.00	1.20	.05	.08	.02	.80	.02	.30	-	305.80
1968	257.0	.7	91.00	1.30	.05	.01	.01	.60	.04	.40	-	351.10
1969	162.0	.6	101.00	2.60	.12	.03	.04	.70	.15	.90	-	268.10
1970	177.0	.6	142.00	3.90	.75	-	.15	1.00	.01	.90	-	326.30
1971	81.0	.8	203.00	9.50	1.40	-	.15	1.60	1.50	.40	-	299.80
1972	121.0	.7	223.00	4.20	.60	-	.70	2.70	2.00	1.30	-	355.20
1973	299.0	2.0	244.00	40.00	.40	-	1.20	2.50	1.50	2.20	-	593.20
1974	157.0	3.1	218.00	43.60	.50	-	.80	4.20	1.00	.40	-	428.60
1975	230.0	1.4	185.00	26.00	.20	.05	.20	2.60	1.90	3.30	-	450.70
1976	325.0	.6	304.00	37.30	.10	.04	.01	6.00	.70	1.20	-	676.00
1977	107.0	.5	490.00	53.00	-	.00	.01	1.60	.70	.50	-	653.30
1978	101.0	-	981.00	63.00	-	-	.01	.10	.20	1.30	-	1146.60
1979	179.0	.3	405.00	56.00	-	-	.10	5.40	.20	1.40	.20	647.60
1980	293.0	.8	441.00	80.00	-	-	.10	4.70	1.70	1.10	.30	822.70
1981	221.0	.9	306.00	20.00	-	-	.10	3.40	.60	.80	.12	552.90

SOURCE: STATISTICAL YEARBOOK, BRITISH IRON AND STEEL FEDERATION, LONDON 1962,63,64, AND

STATEMENT OF EXTERNAL TRADE, 1978,79,80,81

TABLE 6

INPUTS INTO THE IRON AND STEEL INDUSTRY BY THE VARIOUS SECTORS IN 1965 (All Figures in Z$m; Original Figures were given in Rhodesian Pounds and were converted into Z$ using the rate: One Rhodesian Pound = Two Rhodesian Dollars)

Industry	Domestic Inputs (DI)	Imported Inputs (II)	Total Inputs (TI)	DI(100%) Total TI	II(100%) TI	II(100%) Total II
Mining	2.80	-	2.80	23.70	0.00	-
Manufacturing	1.60	2.60	4.20	35.60	61.90	22.00
Printing & Publishing	0.2	-	1.70	0.00	0.00	-
Non-Metallic Minerals & Structural Clay	-	0.6	0.60	5.00	100.00	5.10
Iron & Steel	1.40	0.6	2.00	17.00	30.00	5.10
Metal Products	-	0.2	1.00	8.50	100.00	0.50
Transport: Motor Vehicle Bodies and Repair	-	0.20	0.20	1.70	100.00	1.70
Other Manufactures	-	-	0.20	1.70	100.00	1.70
Electricity Water & Sanitary Services	1.40	-	1.40	11.90	0.00	-
Transport & Communication	0.20	-	0.20	1.70	0.00	-
Distribution	2.40	-	2.40	20.30	-	-
Banking, Insurance & Finance	0.20	-	0.20	1.70	0.00	-
Government Services	0.20	-	0.20	0.70	0.00	-
Other Services	0.20	-	0.20	1.70	0.00	-
TOTAL	9.0	2.80	11.80	98.40	23.70	23.70

Source: National Accounts and Balance of Payments of Rhodesia, 1965 and 1966, CSO, Harare.

Table 7

USE OF IRON AND STEEL PRODUCTS BY THE DIFFERENT SECTORS IN ZIMBABWE IN 1965

(All Figures are in Z$ million except %)

Industry	Domestic Supply (DS)	Imports (M)	Total Steel Supply (TSS)	M(100)% TSS	TSS(100)% Total TSS	TSS(100)% Total DC
1. Agriculture	0.20	-	0.20	0.00	0.64	1.10
2. Mining	0.20	-	0.20	0.00	0.64	1.10
3. Manufacturing	6.80	9.40	16.20	58.00	51.92	93.10
(a) Food & Beverages	-	-	-	-	-	-
(b) Textiles, Clothing & Footwear	-	-	-		-	-
(c) Wood & Furn.	0.40	-	0.40	0.00	1.28	2.30
(d) Printing & Publishing	-	-	-	-	-	-
(e) Rubber Products	-	-	-	-	-	-
(f) Chemicals	-	0.20	0.20	100.00	0.64	1.10
(g) Non-Metallic Minerals	-	-	-	-	-	-
(h) Iron & Steel	1.4	0.60	2.00	30.00	6.40	11.50
(i) Non-Ferrous Basic Metals	-	-	-	-	-	-
(j) Metal Products	2.40	3.00	5.40	55.60	17.30	31.00
(k) Electrical & Non-Electrical Machinery	1.20	1.80	3.00	60.00	9.64	17.20
(l) Transport: Motor Vehicles Bodies, Repairs, etc	0.80	0.20	1.00	20.00	3.20	5.70
(m) Other Manufactures	0.60	3.40	4.00	85.00	12.80	23.00
4. Construction	-	-	-	-	-	-
5. Electricity, Water & Sanitary Services	-	-	-	-	-	-
6. Transport & Communication	0.20	-	-	-	-	-
7. Other Services	12.80	0.20	0.40	50.00	1.28	2.30
8. Exports (ex)	0.20	1.00	13.80	7.20	44.20	79.30
9. Private Consumption	0.80	-	0.20	-	0.64	1.10
10. Increase in Stocks	21. 20	0.80	0.00	-	-	0.00
TOTAL	49.20	10.00	31.20	32.10	100.00	179.30

Source: National Accounts and Balance of Payments of Rhodesia, 1965, 1966, CSO, Harare.

TABLE 8

ZIMBABWE'S IRON AND STEEL IMPORTS (1959-1981)
(000'S TONNES)

YEAR	PIG IRON AND FERROALLOYS	TUBES, PIPES AND FITTINGS	INGOTS, BILLETS BLOOMS, BARS AND RODS	ANGLES, SHAPES AND SECTIONS	HOOPS AND STRIPS	PLATE AND SHEET					WIRE	RAILWAY TRACK MATERIAL		TOTAL IRON AND STEEL
						GALVANISED	UNCOATED			OTHER		RAILS	OTHER	
							PLATE	SHEET	STAINLESS					
1959	1.2	19.4	5.20	7.20	.60	12.10	-	-	-	-	3.30	6.20	7.40	84.00
1960	2.8	22.9	13.10	9.50	.80	17.70	12.20	15.50	1.10	2.30	6.70	23.60	5.00	129.40
1961	1.8	23.2	9.30	9.00	.90	18.70	17.20	14.00	1.50	2.70	7.40	20.70	3.40	127.60
1962	1.9	15.6	8.50	9.10	.90	17.70	7.70	12.70	.20	3.10	2.60	18.90	3.60	100.30
1963	1.9	14.2	7.70	6.90	1.10	13.00	11.40	16.20	.30	8.00	2.00	15.20	1.00	96.70
1964	1.5	9.9	5.80	8.10	.50	9.30	12.60	15.50	.20	7.10	2.40	21.90	5.20	98.30
1965	1.6	7.8	6.30	7.80	.60	6.70	14.30	16.20	.40	10.40	2.50	7.50	1.50	81.80
1966	1.1	6.7	5.00	4.30	1.50	8.20	10.70	13.80	.40	8.00	2.00	10.90	.50	74.80
1967	1.8	6.7	4.10	6.30	1.50	10.10	14.80	19.20	.40	7.70	2.60	18.70	.70	95.10
1968	1.5	10.8	4.80	9.00	1.20	12.60	15.50	16.50	.50	5.80	2.70	20.00	3.00	105.00
1969	1.3	11.5	4.10	6.60	.80	10.10	14.70	21.50	.40	9.20	3.30	11.40	1.60	97.10
1970	2.3	12.2	5.30	7.30	1.00	12.80	20.80	26.90	.70	14.80	3.80	9.60	.40	118.70
1971	2.4	13.2	20.20	13.00	3.70	11.80	36.30	40.80	.50	12.30	4.20	9.20	.20	169.10
1972	3.8	8.8	12.20	11.30	4.60	11.60	44.10	31.80	.50	12.40	2.40	15.90	.30	160.90
1973	3.4	8.8	62.60	10.30	10.40	19.30	29.50	47.50	.50	15.90	2.60	13.80	.30	225.90
1974	3.0	6.9	38.70	9.50	3.20	11.20	33.80	54.50	.70	19.30	2.30	22.40	8.40	215.60
1975	3.7	4.6	12.40	9.30	1.40	3.60	32.90	37.90	.50	10.60	.80	12.40	2.80	134.20
1976	5.2	3.0	7.60	5.30	.70	8.30	24.10	31.10	.80	10.50	1.10	11.30	3.90	113.80
1977	4.1	2.1	3.30	4.30	.50	5.10	16.60	19.10	.60	19.60	.40	6.10	.10	83.80
1978	3.0	N/A	2.40	2.20	.50	-	6.30	18.70	.40	17.00	-	3.80	.01	55.20
1979	5.1	1.8	3.10	2.60	.50	4.90	N/A	N/A	.60	8.00	.40	0.30	.50	84.70
1980	4.6	2.8	4.20	5.00	.50	5.80	25.50	39.00	1.10	9.90	.40	7.30	.10	107.50
1981	4.7	2.9	6.40	7.30	.50	9.50	25.00	42.60	.90	12.90	.30	17.60	1.00	132.90

SOURCE: STATISTICAL YEARBOOK, BRITISH IRON AND STEEL FEDERATION, LONDON 1962,63,64, AND

STATEMENT OF EXTERNAL TRADE, 1978,79,80,81

Table 9

IRON ORE DEPOSITS IN THE SADCC REGION

Country	Measured Reserves (M tonnes)	Potential Reserves (M tonnes)	Iron Content %	Impurities Production	Estimated Annual Common	Type of Mostly Found & Ores	Region Mostly
Angola	3 192	N/A	40-60	Si02,S, P and Ti02	5m Tonnes (1975)	Lake Supe-rior Haema-tite	Villa Salazar, Mossame-des)
Botswana	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Malawi	40	N/A	N/A	N/A	N/A	N/A	N/A
Mozambique	48	261	45-67	Si02,S, P and Ti02	None	Taberg (Haema-tite)	Tete Region
Swaziland	186	100	About 35	Mn	About 1m Tonnes	Lake Superior (Haema-tite, (Magnetite)	Gege, Malona and Ngwenya
Tanzania	49	76	About 50	Si02, Ti02, Mn, V	None	Taberg (Magnetite)	Hanyoro and Libanga
Zambia	26	230	40-69	S, Mn	None	Lake Superior (Haematite Magnetite)	North-West Region
Zimbabwe	378	3 300	40-63	Si02, Mn, S	1.2m Tonnes (1983)	Lake Superior (Haematite)	Kwekwe, Buchwa, &Ripple Creek
TOTAL	3 919	3 967					

Sources:

(a) *A Preliminary Report on the Development of the Iron and Steel Industry and Related Metallurgical Facilities in the Lusaka MULPOC Countries, ECA/MULPOC/ Lusaka/IV,26th November, 1980.*

(b) *Problems and Opportunities in the World's Iron and Steel Industry, UNIDO/10D.50, 22nd November, 1976.*

(c) *Mineral Raw Materials in Africa - Iron Ore, UN/ECA Economic and Social Council, E/CN.14/MIN.80/3.1, 15th August, 1980.*

Table 10

COAL DEPOSITS WITHIN THE SADCC REGION

Country	Known Reserves (million tonnes)	Ash Content (%)	Coking or Not Coking
Angola	8	Not Available	Not Available
Botswana	41 500	19-25	Not Coking
Malawi	500	Not Available	Not Available
Mozambique	200 000	Not Available	Coking
Swaziland	5 022	9-23	Coking
Tanzania	1 511	25	Coking
Zambia	38	16.8	Not Available
Zimbabwe	22 500	98-36	Coking

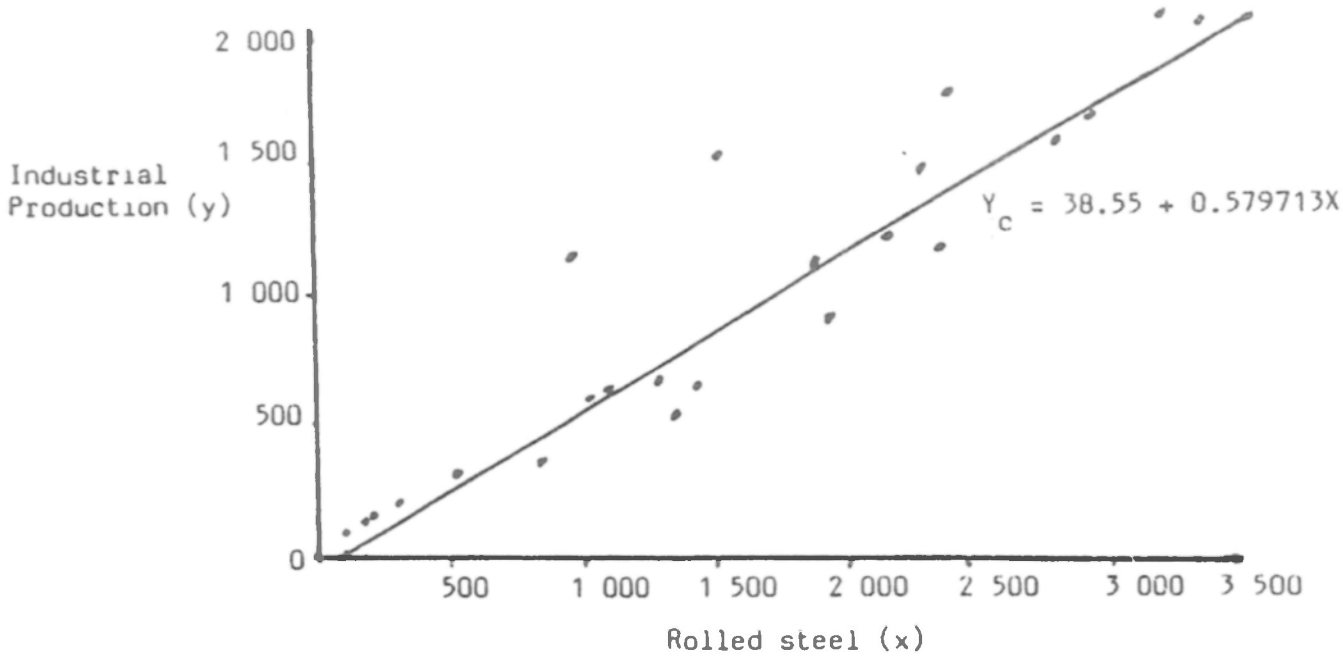
Sources:

(1) *Report on the Development of the Iron and Steel Industry and Related Metallurgical Facilities in the Lusaka MULPOC Countries, ECA/MULPOC/Lusaka/IV, 26th November 1980.*

(2) *Problems and Opportunities in the World's Iron and Steel Industry, UNIDO/IDO.50, 22nd November, 1976.*

FIGURE 2

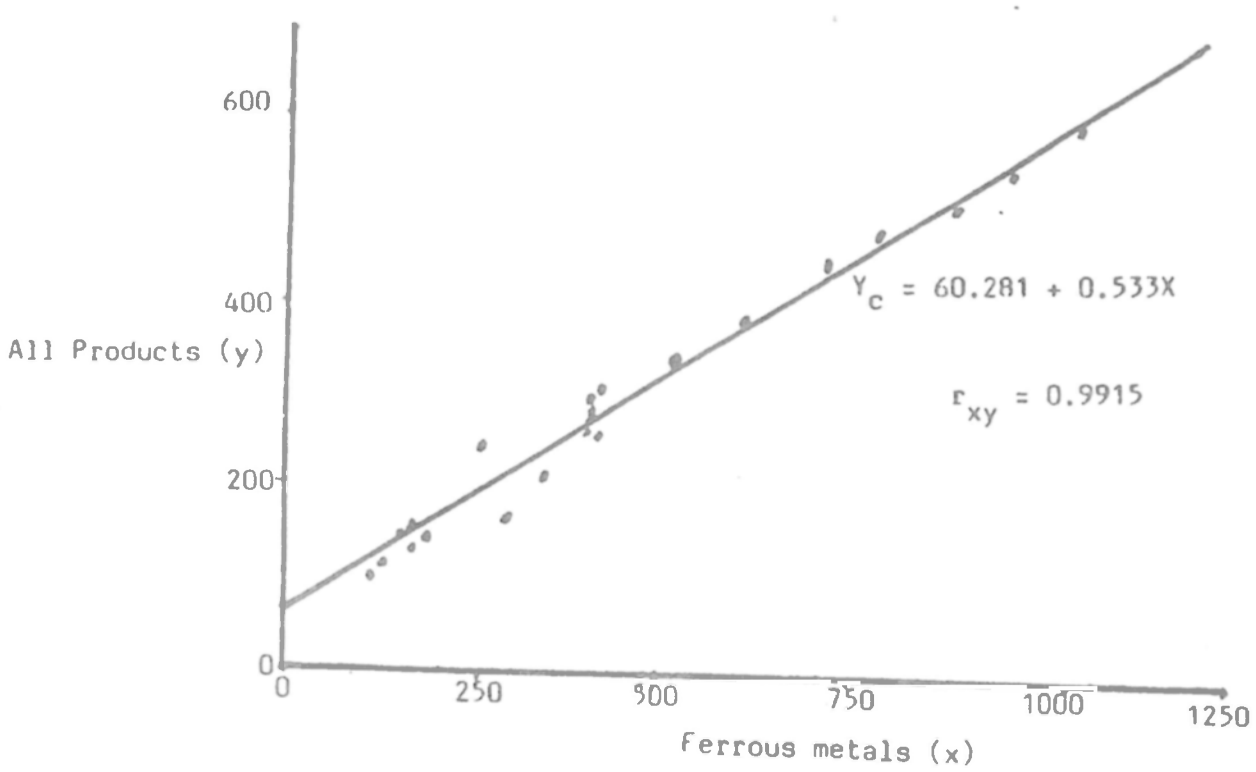
Scatter Diagram of Indices of Industrial Production and Rolled Steel, United States, 1885-1955 (1885 = 100)



Source: G. Nutter, Growth of Industrial Production in The Soviet Union, Princeton University Press, Princeton, New Jersey, 1962.

FIGURE 1

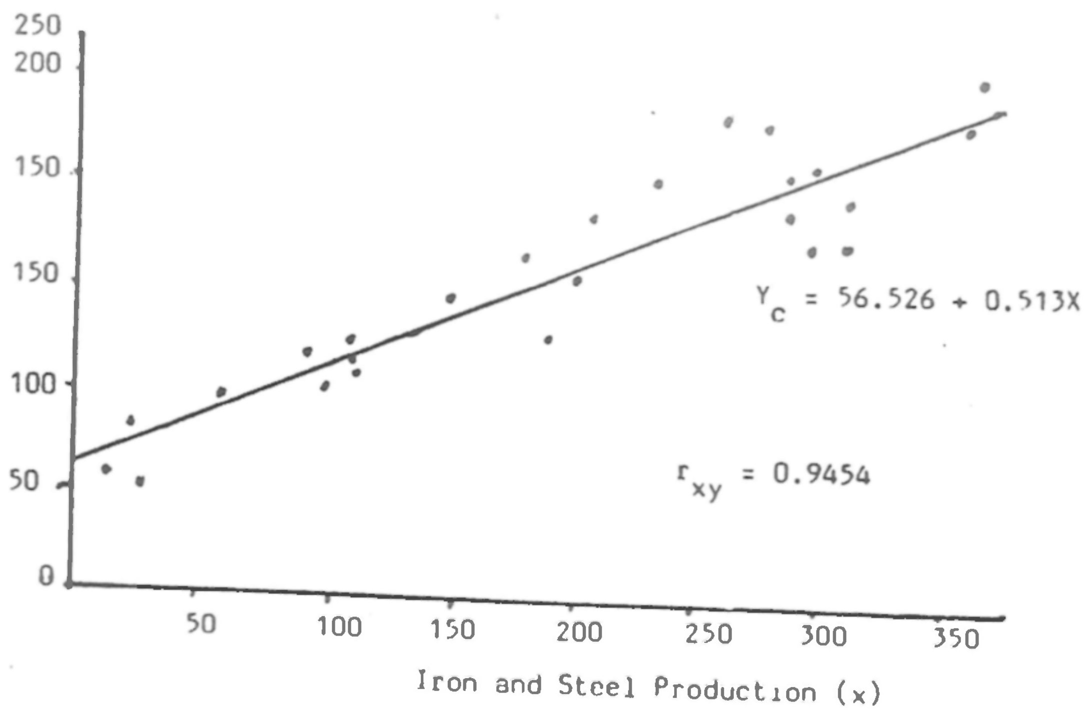
SCATTER DIAGRAM OF INDICES OF INDUSTRIAL PRODUCTION AND FERROUS-METAL OUTPUT, SOVIET UNION 1928-1955 (1928=100)



Source: Wu, Yuan-Li, The Iron and Steel Industry in Communist China, Frederick A. Praeger, New York, 1965.

FIGURE 3

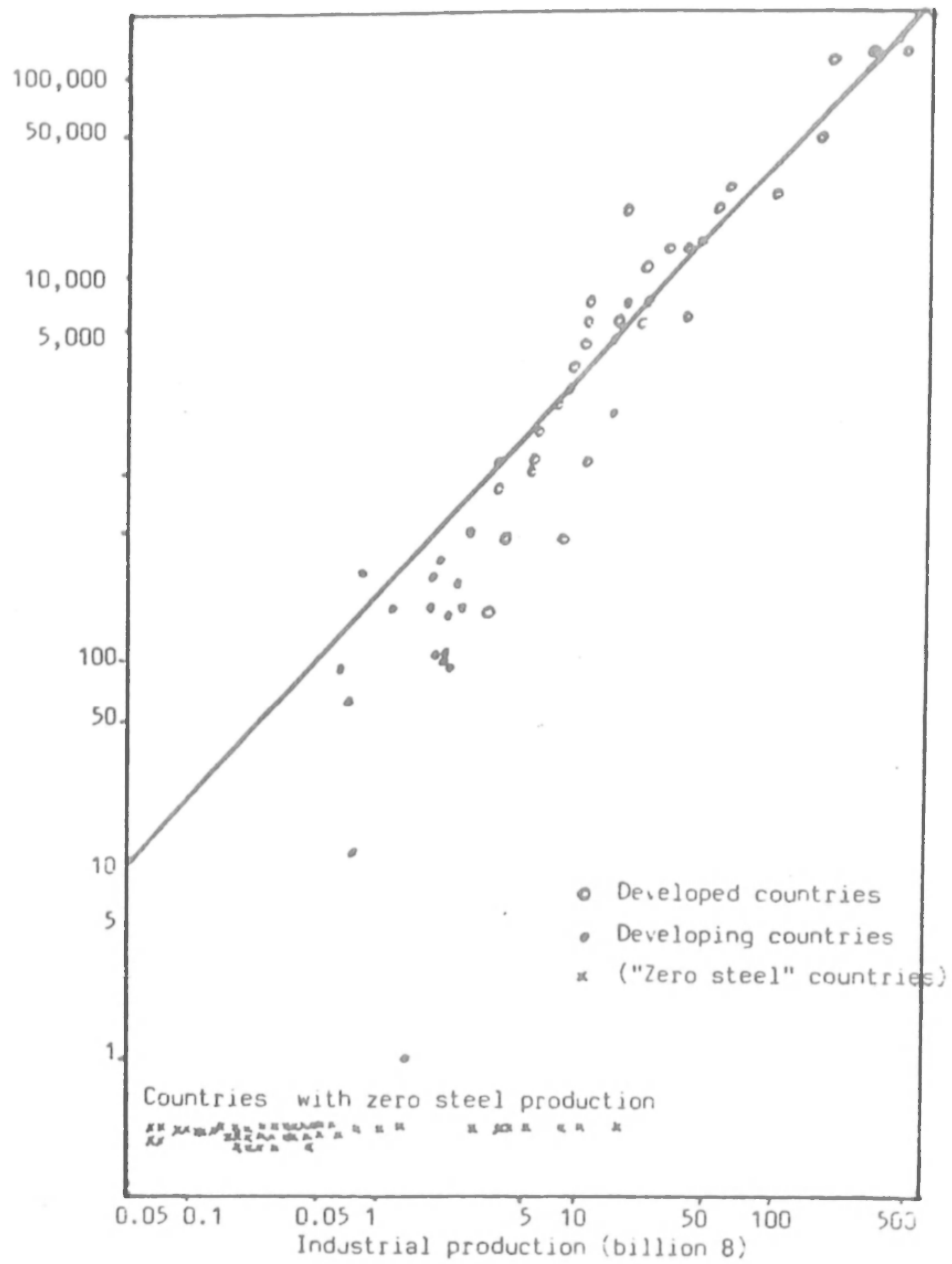
Scatter Diagram of Indices of Industrial Production and Iron and Steel Production, Japan, 1928-1954 (1928=100)



Source: Wu, Yuan-Li, The Iron and Steel Industry in Communist China, Frederick A. Praeger, New York, 1965.

FIGURE 4

Relationship between steel production and industrial production (1977)

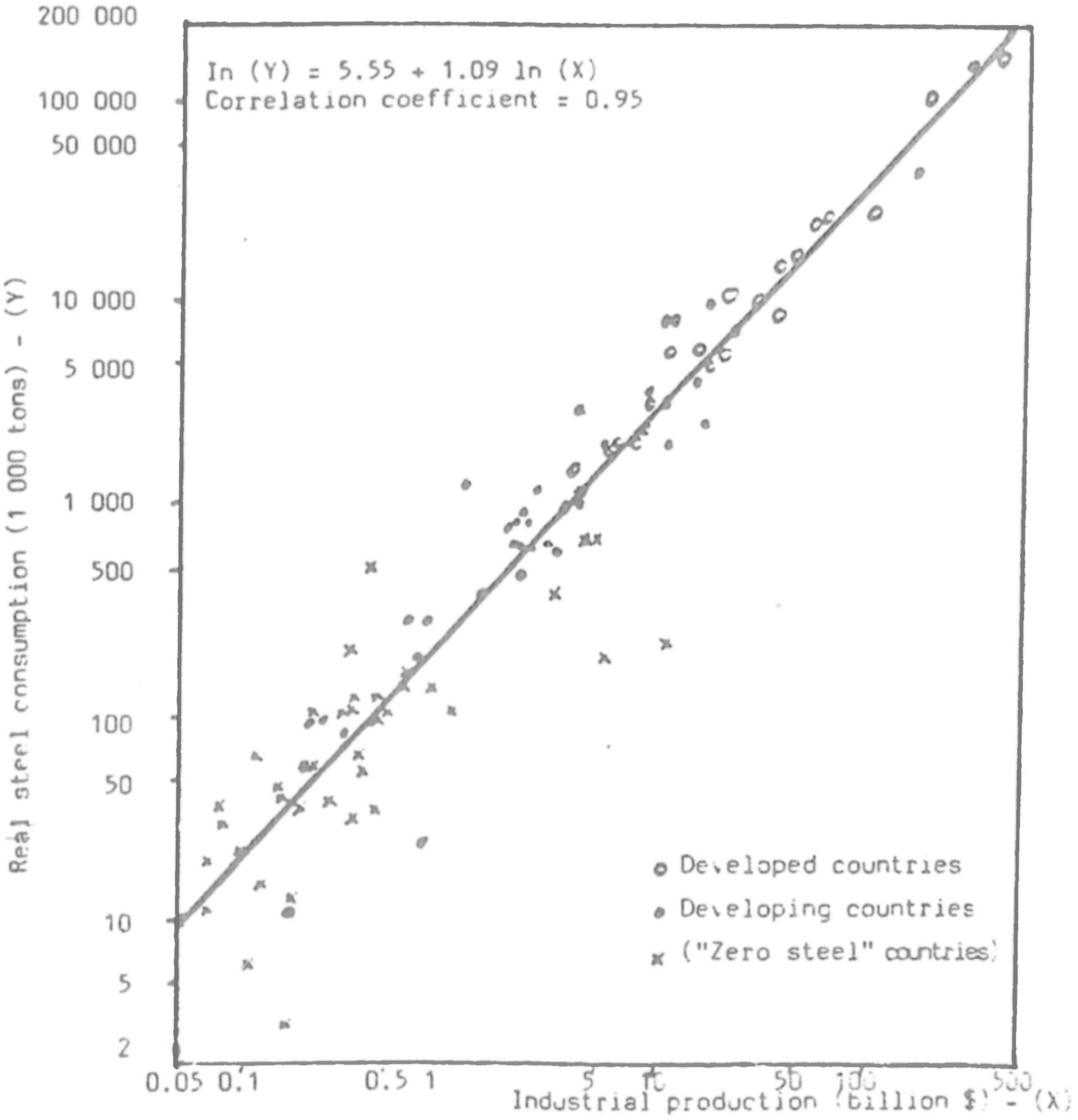


Note: The line is the one for the relationship between steel consumption and industrial production.

Source: UNIDO/IOD.50. 'Problems And Opportunities in the World Steel'.

FIGURE 5

RELATIONSHIP BETWEEN STEEL CONSUMPTION AND INDUSTRIAL PRODUCTION (in 1973)



Source: UNIDO/IOD.50, "Problems and opportunities in The World Iron and Steel"

FIGURE 6

VERTICAL INTEGRATION IN THE IRON AND STEEL INDUSTRY