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THE DIRECT AND INDIRECT EFFECTS
OF AN IRON AND STEEL INDUSTRY
ON THE OVERALL ECONOMY^{1/}

by

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SUMMARY

1. It is now widely accepted in the developing world that steel plants are not mere 'status symbols' but vital instruments of industrial development, particularly because steel is the principal input for construction and machine manufacture which are the main sources of capital formation. Unless adequate steel inputs are pumped into the economy, agriculture and industrial development, mass transport and communications and other amenities required to sustain the expanding population in developing countries and to raise its living standards would be difficult, if not impossible.

2. In the transformation of a predominantly agricultural country into a modern industrial country, two types of constraints can limit the pace of industrialisation, namely the consumption goods bottleneck and investment goods bottleneck. The latter is particularly important because, even if a higher pace of industrialisation were attainable through adequate availability of consumption goods, this is not, in fact, realisable in practice due to the limited capacity of the investment goods sector. It is against this background that rapid industrialisation and development of a range of basic industries assume high priority in the strategy of development.

3. The iron and steel industry creates the necessary conditions for sustained capital formation at a rapid rate, and assumes the role of a 'key industry'. For example, the input-output table for India indicates that the capital goods sector whose principal raw material steel is the principal source of capital formation. Any shortfall in steel will, therefore, have a first order impact upon the investment programme and the process of import substitution.

4. The degree of change in industrial activity is determined by the intensity of interdependence (backward and forward linkage) of the various sectors, that is, the magnitude of the total linkages. It has been observed that the steel industry has a very high combined linkage score. However, in the early stages of development, the various sectors within the economy are relatively independent of each other. In course of development, as Indian experience has shown, these linkages continue to grow.

5. The establishment of a local steel industry is expected to lead not only to a reduction in steel imports, but also to import substitution and later, to the exports of steel and engineering goods. The beneficial effects of setting up an iron and steel industry on the various sectors of the economy are employment generation, skill formation, development of backward regions etc. Though the industry's capital/labour ratio is very high, the multiplier effect it has on indirect employment generation makes the installation of a steel plant attractive. It is estimated that in developing countries, for every steel plant job, 50 indirect job opportunities are created in other industries and service sectors. Steel industry also provides greater opportunities for the formation of technical skill in a wide range of disciplines.

6. In developing countries, the economic rationale for the speedy development of the iron and steel industry is thus provided by the 'forward and backward linkage effects' and the social benefits that flow from it. However, in some developing countries, the backward linkages may be weak, depending on the raw material endowments and other factors. In such cases, the forward linkages assume even greater importance. Where the forward and backward linkages are the highest, the contribution of the iron and steel industry to the overall growth of the economy would be the maximum.

I. INTRODUCTION

1. It is now widely accepted in the developing world that steel plants are not mere 'status symbols' but vital instruments of industrial development. This growing awareness has been reflected in the growth of the indigenous steel production in many countries, particularly because steel is the principal input for construction and machine manufacture, which is the main source of capital formation required for accelerating the rate of growth.

2. The role of steel is equally important in raising agricultural output. Increase in agricultural productivity demands larger inputs of fertilizers and pesticides, improved agricultural machinery and implements, irrigation etc, which in turn would require larger quantities of steel. Again, there is the urgent need for increased housing, schools, hospitals, and transport facilities for the masses which also consume large quantities of steel. It would be obvious, therefore, that unless adequate steel inputs are pumped into the economy, agriculture, and industrial development, mass transport and communications and other amenities required to sustain the expanding population and to raise its living standards would be difficult, if not impossible.

3. In this paper, an attempt is made to find out the likely implications on the overall economy of the installation of the steel plant as a supplier of inputs to various industries and also as a consumer of the outputs of other industries like mining, refractories, power and services. Some guidelines are also mentioned for the balanced development of the linked industries.

11. ROLE OF BASIC INDUSTRIES IN ECONOMIC DEVELOPMENT AND INDUSTRIALIZATION IN INDIA

4. In analysing the broad process associated with the transformation of a predominantly agricultural, developing country into a modern, industrial country, usually two major types of constraints on the pace of industrialization may be identified. On the one hand, this limit may be set by insufficient availability of agricultural surplus, which in turn determines the extent of availability of 'base goods' for industrial workers. In this case, the limited availability of agricultural output in the form of marketable surplus required to sustain urban industrial workers, determines the maximum pace at which industrialization can proceed over time. The essence of this type of economic situation, stylised in several models of economic development, can be briefly described as the 'consumption goods bottleneck' situation, where the lack of sufficient consumption goods is the operative constraint. As opposed to this, one can also visualize a second type of situation, where the limited capacity of the investment goods sector itself operates as the constraint on the pace of industrialization. In such a situation, even if a higher pace of industrialization were attainable by means of adequate availability of consumer goods, this is not, in fact, realizable in practice due to the limited capacity of the investment goods sector. In brief, there simply is not enough 'machines' or capacity in the industrial sector to employ all the labour who could otherwise be employed by mobilising the maximum agricultural surplus.

5. It is evident that no real-life situation is so simple as to correspond exactly to the idealized picture of a 'consumption goods bottleneck' - or an 'investment goods bottleneck' situation discussed above. Nevertheless, they are significant simplifications because they indicate the broad character of the development strategy and the process of industrialization of a developing country. Within these limits

or abstraction, other types of models can provide some relevant direction of thinking on these and other issues. But in order to understand their relevance to the formulation of actual economic strategies for industrialization, the simplifying assumptions underlying such abstractions need to be made explicit.

6. It will be evident that a situation of 'consumption goods bottleneck' arises only when the real wage rate is insufficiently flexible. This means that the same amount of consumption goods cannot be spread out sufficiently over a larger number of employed workers to carry out a more rapid pace of industrialization. In the planning practice of centrally controlled economies it is generally believed that some degree of flexibility exists in the setting of the real wage rate, at least in the initial stages of development, which can bring about a certain degree of redistribution of consumption from the employed workers to those unemployed workers who are now being drawn into the work-force. This enabled countries like China, Cuba, or the Soviet Union of the 1950s to draw on the reserve army of unemployed labour for labour intensive irrigation and other construction work (which could be carried out with relatively little capital equipment) without hitting the 'consumption goods bottleneck' setting. But, it is only within limits that the real wage rate can be made flexible even in a completely centrally planned economy, and such an option is clearly more limited in the context of social democratic planning of a country like India. Consequently, the relevance of a 'consumption goods bottleneck' situation is probably greater for a developing country.

7. On the other hand, if a developing country could sell its primary export products in an international market with fixed price, the problem of an 'investment goods bottleneck' situation would be less severe. For, without even building up its whole range of basic industries, the country could

simply import the necessary range of goods and pay for it through its export earnings. But, given the limited prospects for such export earnings for most developing countries (whose exports are confined to a few primary products), a strategy of setting up heavy industries at home was its obvious rationale, in particular for countries like India which already has a huge domestic market.

8. Thus, the two problems mentioned earlier tend to reinforce each other in emphasizing the role of a range of basic or heavy industries in economic development. It is against this background that the rapid development of a range of basic industries assume high priority in the strategy of development. Such a strategy was given explicit recognition in India during the Second Five Year Plan (1956-61). Its intellectual base was provided by a planning model developed by Professor P. C. Mahalanobis. This model advocated the development of a range of basic industries by continuously devoting a significant proportion of basic investment fund to their development, which in turn tends to relax the constraint of an 'investment goods bottleneck' situation and thus creates a domestic base for further industrialisation. It was also shown that such a strategy would generate a faster rate of growth of national income. The enormous domestic market in India, coupled with the limited export prospect in the short-run, made such a development strategy particularly attractive. And, of these basic industries, iron and steel has played a leading role since the beginning of the Second Five Year Plan.

11. VELOCITY OF CAPITAL ACCUMULATION
IN CAPITAL CONSUMPTION
(with special reference to India)

9. The foregoing discussion makes it clear that the importance assigned to the iron and steel industry in general, and to the iron and steel industry in particular, will tend to increase in the process of planning, if the specific situation of a country resembles more closely an 'investment goods bottleneck' situation. This simple observation has some special relevance for the Indian planning experience in this respect for at least two reasons. First, the Mahalanobis model did work on the basis of the assumption of an 'investment goods bottleneck' situation. Indeed, in their mathematical formulation of the problem, Professor Mahalanobis did not introduce any explicit constraint relating to insufficient availability of foodgrains. (Probably, the Indian planners at that time were influenced by three successive years of good harvest (1953-55) preceding the commencement of the second Five Year Plan). Secondly, the pattern of industrial administration and control visualized during that period and as reflected in the Industrial Policy Resolution of 1956, was based on the theme of 'commanding heights in industry' as the method of development in a partially planned economy. According to this Resolution, most of the basic industries were earmarked for development more or less exclusively in the public sector, and this was expected to arm the government with adequate powers of control to steer the economy along the planned path of development.

10. It was against this background that the three new integrated steel plants were constructed in the public sector during this period, to strengthen the foundations of the industrial structure. With the strategy of heavy industrialization underway, steel consumption during the late 1950's rose at an average compound rate of about 15 per cent per year (it was around 12 per cent for the whole decade), while industrial production during the same period rose at a rate of about

8 per cent per year. The steel consumption during these relatively early years of industrialisation, steel consumption is about 15 per cent of total industrial production. This could be accounted for by the following factors:

- a) low efficiency of industrial output, and
- b) the absorption of a relatively complementary investment.

11. Table 1 shows a decrease in the production of steel input per unit of output in the country's capital goods sector, for a slightly later period.

TABLE 1 - STEEL INPUT PER UNIT OF OUTPUT
IN THE CAPITAL GOODS SECTOR IN INDIA
(in terms of value)

1960-61	14.7
1964-65	13.0
1970-71	12.7

Source: Ministry of Planning, *India: 1964-65, 1970-71 and 1980-85 - Perspective Planning Division, Planning Commission, Government of India, New Delhi, September, 1966.*

12. It will be observed that the effect of changing output-mix (including probably the influence of changing relative prices), which leads to a gradual and moderate fall in the coefficient of steel required per unit of output in the capital goods sector, is relatively mild. This probably the more important reason underlying the pattern of a faster rate of growth in the apparent steel consumption compared to industrial production is to be found in the complementary investments, particularly in the economic infrastructure, needed during the early years of industrialisation. This also indicates to some extent the special role of steel during the early years of industrialisation. It is more than just an important industrial input; almost on par with power and electricity, it is often a

basic requirements for industrial development in India, which provide the pre-condition for rapid industrialization.

13. In the transformation of the economy to a relatively advanced stage of industrialization, the iron and steel industry plays the role of a key industry in the sense that it is well integrated into the rest of the industrial structure, with high forward and backward linkageages. Indian data on inter-industry transactions indicate that the iron and steel industry in India during the 1950s had the highest combined backward and forward linkages, showing its dynamic role in the development of the rest of the industrial structure of the country.

14. An analysis of the 1950-51 inter-industry table for India reveals some special features of the inter-dependence of the steel sector and the rest of the economy. It would appear that, in India's economy, the current account transactions in respect of the three major sectors of the economy, namely (i) food and fibre or agriculture (FA), (ii) mining and metals, machinery, and construction (MM), and (iii) universal intermediaries such as fuel, power, transport, and chemicals (BI), present an almost closed triangular structure; that is to say, none of the three sectors has significant transactions outside itself.

15. Table 2 presents in summary form the inter-industry transactions in 1950-51, which show the extent of the inter-dependence of the sectors. It may be noted that the bulk of the transactions takes place within two independent sectors, namely FA and MM. The third sector BI, the output of which is consumed by all the sectors, is relatively small. MM is the source of investment goods and steel constitutes the core of this sector. The current account flow in Table 2 from MM into FA and BI are virtually negligible.

TABLE 2 - SUMMARY OF INTER-INDUSTRIAL TRANSACTIONS IN INDIA
 (at 1959-60 Indian producer's prices)
 (in billion US dollars)

Absorbing sector						
Producing sector	MM	AG	MI	Other total	Final demand	Gross output
MM	2,215	56	92	2,363	4,455	6,313
AG	22	1,286	99	4,387	16,133	20,541
MI	285	257	700	1,342	1,358	3,292
Value added	4,296	15,342	2,130			
Gross output	6,818	20,541	2,222			29,681

Source: A consistency model of India's Fourth Plan, Sankhya, Series B, Vol. 27, 1965.

15. One could perhaps draw two important conclusions from the above analysis of a block-triangular structure of inter-industrial transactions in India. First, purely from the point of view of inter-industrial balance (that is, rolling out problems of final demand), the process of capital formation^{a/}, which is largely carried out by the MM sector, is more or less self-sustaining because this sector is the biggest consumer of its own product as well as supplier to itself. It is really the pattern of final demand which largely brings up the question of balanced growth between industry and agriculture, as well as the problem of maximum realizable rate of investment expenditure. Secondly, within the MM sector itself, iron and steel plays a leading role - it is both a major supplier as well as a consumer. In brief, insofar as the Indian experience goes, the iron and steel industry creates a necessary condition for sustained capital formation at a high tempo.

a/ Total capital formation at any given point of time is that part of the output which is not consumed and carried forward into the next year's stock. Since land is limited, fixed capital formation is necessarily composed of current production of machinery and equipment. Steel constitutes the major element in the modern construction and machine building. Given the capital/output ratio of some sort, the capital formation increases the GNP which in turn makes possible further capital formation.

IV. POSITION OF IRON AND STEEL INDUSTRY IN AN INTER-INDUSTRIAL FRAMEWORK

17. In modern economic society, specialisation had led to a high degree of mutual dependence. This is true of international and intra-economy operations.

Backward and forward linkage

18. It has been observed that in the early stages of development the various sectors within an economy are relatively independent of each other, that is, their demand for critical inputs such as steel, power, transport, cement etc. is free of inter-sectoral considerations. However, at a later stage of development, the interdependence on other sectors, either as consumers or as competitors for scarce resources, grows considerably. Dependence of an industry on feeder industries is termed its 'backward linkage', while dependence of purchasing industries on this industry is its 'forward linkage'. Thus, a given change in the output of one industry inevitably leads to repercussions in all vertically linked industries. The degree of change in industrial activity is determined by the intensity of interdependence, that is, the magnitude of the total linkages.

19. An input-output matrix table would make it possible to trace the impact of any given change in deliveries to find the demand on all inter-industry flows on current account and hence on all industrial output. If more steel is to be produced, then the economy will have to deliver more iron ore, coking coal, limestone, power etc. To supply these additional inputs to the steel industry, the mining industries will require more steel. The transport network needed for the movement of bulk materials such as iron ore, coal, and limestone will call for additional facilities in the form of new rail-links, locomotives, wagons, and trucks. Again, additional power generation will involve the erection of more transmission towers and electric substations. For all these rounds of additional inputs, more steel will be needed.

20. A pioneering study carried out by two authorities on the inter-industry linkages in four countries, namely USA, Japan, Italy, and Norway, by Chenery and Watanabe highlights the sectors with strong linkages. The inter-industry linkages for the four countries taken together are presented in Table 3.

TABLE 3 - DEGREE OF INTERDEPENDENCE OF PRODUCTION IN THE FOUR SELECTED COUNTRIES

<u>Sector</u>	<u>Backward linkage^{a/}</u>	<u>Forward linkage^{b/}</u>	<u>Combined linkage score</u>
Iron and steel ..	66	78	144
Non-ferrous metals ..	61	81	142
Paper and paper products ..	57	78	135
Petroleum products ..	65	68	133
Coal products ..	63	67	130
Chemicals ..	60	69	129
Textiles ..	67	57	124
Rubber products ..	51	48	99
Printing and publishing ..	49	46	95

a/ Percentage ratio of inter-industry purchases to total production.

b/ Percentage ratio of inter-industry sales to total demand.

Source: 1. A.C. Hirschman - Strategy of economic development, Yale University Press, New Haven, 1958.

2. H.B. Chenery and T. Watanabe - International comparisons of the structure of production, Econometrica, Vol. 26, pp 487-521.

21. It would be clear from the table that, in the countries under review, the sector with the highest combined linkage score is iron and steel. This is specially significant in Japan even with no indigenous supplies of major raw materials.

22. The inter-industry linkages in developing countries are weaker than in developed countries. The forward linkages are especially weak since the economies are often based on primary agricultural commodities or primary raw materials such as mineral ores, oil etc. Table 4 gives the linkages in selected sectors in some developing countries.

TABLE 4 - COMPARISON OF LINKAGES IN DEVELOPING AND DEVELOPED COUNTRIES

Industry	Developing country	Year	Developing countries		Developed countries	
			Backward linkage ^{a/}	Forward linkage ^{b/}	Backward linkage ^{c/}	Forward linkage ^{b/}
Metal manufacturing	Cameroon	1959	11.5	2.0	66 ^{d/}	78 ^{d/}
					(51)	(81)
Metal mining	Morocco	1964	30.4 ^{a/}	13.1	21	93
	Rhodesia	1964	43.4	10.4		
Quarrying and mining of non-metallic minerals	Zambia	1964	10.8	1.2	17	52
Petroleum and natural gas	Algeria	1963	7.3	1.2	15	97

a/ Percentage of output purchased from domestic industries.

b/ Percentage of output sold to domestic industries.

c/ Average of linkages for USA, Italy and Japan during mid-fifties.

d/ Upper set of figures is for iron and steel and the lower set of figures within brackets is for non-ferrous metals, taken from Table 3.

e/ Taking the form of mainly inputs of energy and transport.

Sources: 1. Statistical Bulletin for Africa, March 1967.

2. Economic Commission for Africa.

23. It is important to note, however, that there are significant variations within the group of developing countries. Whereas in a country like Cameroon the linkages may be startlingly low, a relatively developed country such as India exhibits linkages similar in magnitude to those of some developed countries of the West.

24. The input-output matrix of the Perspective Planning Division of the Planner Commission of India details the forward and backward linkages of the steel industry in the country. Table 5 shows the backward and forward linkages of the iron and steel industry for 1964-65.

TABLE 5 - BACKWARD AND FORWARD LINKAGES OF THE IRON AND STEEL INDUSTRY IN INDIA, 1964-65

<u>Industries/sectors</u>	<u>Backward linkage</u>		<u>Forward linkage</u>	
	<u>Purchases^{a/}</u>	<u>Percentage share^{b/}</u>	<u>Sales^{a/}</u>	<u>Percentage share^{b/}</u>
Construction	-	-	486.0	39.6
Electrical equipment	-	-	28.0	2.2
Non-electrical equipment	-	-	79.0	6.5
Metal products	1.5	0.3	230.0	17.2
Iron and steel	228.0	46.0	228.0	18.6
Iron ore	13.0	2.6	-	-
Non-ferrous metals	18.0	3.7	4.0	0.3
Other minerals	10.5	2.2	-	-
Jute textiles	0.3	0.1	-	-
Petroleum products	3.2	0.6	-	-
Timber	0.2	Negligible	-	-
Paints and varnishes	0.2	Negligible	-	-
Chemicals (miscellaneous)	2.0	0.4	-	-
Railways	118.0	23.9	-	-
Electricity	32.0	6.5	-	-
Coal and coke	51.0	10.4	-	-
Transport equipment	-	-	131.0	10.7
Cement	-	-	1.0	0.1
Cotton yarn	-	-	0.4	Negligible
Cotton textiles	-	-	0.8	0.1
Man-made fibres	-	-	0.2	Negligible
Tyres and tubes	-	-	0.5	Negligible
Other rubber products	-	-	5.0	0.4
Plastics	-	-	0.2	Negligible
Government consumption	-	-	41.0	3.3
Others	16.0	3.3	-	-
Total	494.2	100.0	1235.2	100.0

a/ All 'purchases' and 'sales' values are in million US dollars at 1960-61 Indian producers' prices.

b/ Percentage share relates to sales/purchases as percentage of total steel output.

Source: Material and Financial Balances 1964-65, 1970-71 and 1975-76, Perspective Planning Division, Planning Commission, Government of India, New Delhi, September 1966.

... (the cost of transport services, the cost of freight services), electric power plants, cooling coils and iron ore sinter, non-ferrous metal industries and other metal industries. The industry also manufactures a significant amount of its own output, in the form of capital equipment, and the country's ability to produce plant and machinery improved. These inter-industry purchases of steel also increase. The major industries from which the iron and steel industry obtains its inputs are

- i) iron and steel
- ii) railways
- iii) coal and coke
- iv) electricity
- v) non-ferrous metals and
- vi) others such as minerals, refractories etc.

26. Going to the forward linkages, it will be seen that the construction industry accounts for the highest consumption of steel. This reflects the trend in developing countries in the early stages of development to provide the necessary infrastructure in the form of roads, bridges, buildings, housing etc. in the early stages of development. The crucial role played by steel in capital formation in the construction sector (which accounts for typically 60 per cent of the total capital formation in developing economies) gradually declines at higher stages of development, when the role of capital formation itself declines. This is largely due to the fact that the basic infrastructural refinements have already been completed at that stage of development. This phenomenon is typical of all developing countries, as is evident from Table 6.

TABLE 6 - ANNUAL RATES OF GROWTH OF CONSTRUCTION IN GDP IN DEVELOPED AND DEVELOPING COUNTRIES
(in percentage, at constant prices)

<u>Developed countries</u>	<u>Period</u>	<u>Growth rate</u>	<u>Developing countries</u>	<u>Period</u>	<u>Growth rate</u>
Austria	1965-69	3.9	Argentina	1965-69	11.9
U.K.	1965-69	1.3	Burma	1965-67	13.7
U.S.A.	1965-70	0.4	Sri Lanka	1965-69	10.2
U.S.S.R.	1960-65	3.8	India	1960-70	5.1
			Iran	1965-69	7.7
			Libya	1965-69	22.5
			Morocco	1965-69	7.2
			Pakistan	1965-69	11.8
			Syrian Arab Republic	1965-70	9.0

Sources: Data derived from Statistical Year Book, United Nations, New York, 1970-71.

27. Various other iron and steel consuming industries like iron and steel industry itself, heavy machinery and equipment, including steel plant equipment, is included in this group.

Briefly, the industries which exhibit a strong dependence on the iron and steel industry are

- i) construction
- ii) iron and steel
- iii) metal products and
- iv) equipment manufacture.

Break-down of forward linkage demand

28. So far the demand by the chief consuming industries for iron and steel as a broad group has been discussed. The pattern of demand by main products and shifts in demand reflect the level of industrial activity in the country.

29. In the early stages of development, the demand for certain steel products is closely related to the existing predominant sectors which enjoy priority in a developing economy. Thus, initially, steel rails and other railway material are required in the development of the railway system; tubes and pipes are required by the oil-producing industry; tin-plate is used by the canning industry which may be providing the bulk of the country's exports; wire products are required by animal husbandry and agrarian reform programmes. The construction industry, which is usually a major consuming sector in a developing country, stimulates the production of bars, light and medium sections, galvanised roofing material etc.

30. The growth in demand for flat products, especially cold-rolled sheet, occurs at a later stage, when assembly and manufacture of durable household goods and automobiles is undertaken. The demand for flat products shows a tendency to grow faster than that for non-flat products after the initial stage of development. In Latin America, for instance, local production of flat products rose by more than 500 per cent compared to an increase of 250 per cent for non-flat products during 1954-65.

V. IMPLICATIONS OF AN IRON AND STEEL INDUSTRY
ON A COUNTRY'S BALANCE OF TRADE POSITION

31. A large majority of developing countries are extremely export-conscious. Their chief items of export are usually a primary agricultural commodities such as tea, jute, cotton, sugar-cane, natural rubber, tobacco etc. or an industrial raw material such as iron ore, copper, tin etc. and commodities of universal application such as crude oil. These exports are comparatively inelastic, with a few exceptions like crude oil or copper. Further, most of these export items take the form of relatively unprocessed goods, while the main benefit of the value added is reaped by the importing country at higher stages of processing. This generates a pattern of trade where the developing country largely imports highly processed goods and finished products while exporting unprocessed goods. Thus industrial goods, including machinery and heavy capital equipment, figure prominently in the import composition of developing countries.

32. The establishment of a local steel industry in a developing economy is expected to lead to a reduction in imports of steel, import substitution in other sectors of the economy, and later, in exports of finished steel/engineering goods. This would have a beneficial effect on the balance of payments position.

33. In the fifteen-year period 1950-1965 the apparent consumption of steel in developing countries has increased from about 10 million to 32 million ingot tons. While their share of imports in total apparent consumption decreased from 70 per cent in 1950 to 46 per cent in 1965, the actual imports increased by 115 per cent in the review period and the corresponding increase in local production was 500 per cent.^{a/} These countries were thus able to effect substantial savings in foreign exchange.

^{a/} Based on ECA: World Trade in Steel and Steel Demand in Developing Countries, United Nations, New York, 1968.

34. It must be noted that the cost of steel production in developing countries is higher in comparison with the cost of production in the advanced countries despite certain advantages of raw materials and cheap labour supplies. This is due either to the establishment of plants of less than optimum size or to the lower utilisation of installed capacity. The causes underlying such low-capacity utilisation can be manifold: the limited size of the market, lack of availability of crucial inputs, or inexperience in management in the early stages of production. Despite these disadvantages, developing countries establish local steel-production facilities with a view to reducing the imports and to enable import substitution in various sectors of the economy. Thus, almost all developing countries with existing steel-production facilities are planning expansion in capacity in the present decade. Several new entrants in steel production are expected, too. By 1975, the total production in all developing countries is estimated to rise to about 70 million tons. If, by then, the consumption rises to the estimated level of 100 million tons, local production will cover about 70 per cent of consumption, thereby reducing the contribution of imports from 40 per cent in 1965 to 30 per cent in 1975.

35. Among the industrialised developing countries, India provides evidence of saving of foreign exchange through domestic production of steel. Indigenous steel production received an impetus in the period 1958-61, with the construction of three new integrated steel plants in the public sector and the expanding of the two existing private sector plants resulting in an increase in domestic output from 1.20 million tons of finished steel in 1954-56 to 3.80 million tons in 1962-63. In this period, though the imports remained steady at about 0.85 million tons, their share in the total supply of finished steel fell from 40 per cent to 18 per cent.

36. Despite the production problems that have beset the steel industry, indigenous production has saved the country a considerable amount of foreign exchange in direct imports. During the decade ending in 1956, the total indigenous production of steel was 29 million tons of finished steel, of which 15 million tons may be attributed to plants already in existence in 1956. Additional capacity of about 5 million ingot tons was created during the decade, at a foreign exchange cost of approximately £ 800 million. This additional capacity produced about 16 million tons of finished steel, which would have cost India at least £ 120 per ton of ingot steel c.i.f. if imported. Thus, the country has been able to effect foreign exchange savings to the tune of about £ 1,920 million during the decade or more than twice the amount of foreign exchange invested in the additional capacity.

37. Again, due to a spurt in industrial activity since 1970-71, there has been a phenomenal increase in demand for steel, resulting in imports worth £ 317 million in 1971-72 alone.

VI. SOCIAL BENEFITS OF A LOCAL IRON AND STEEL INDUSTRY

38. The arguments usually advanced in favor of establishing a steel industry in a developing country are well known. Some of the indirect benefits are discussed below. Before detailing the social benefits that accrue from a local iron and steel industry, it is important to study a phenomenon which has diluted these benefits to a large degree in actual experience.

39. In developing countries the government exercises controls over steel production with a view to channelizing the indigenous supply to priority uses compatible with social objectives. In India, for instance, the ideal utilization of domestic steel production has been spelt out often in official declarations and academic treatises. To quote the Report of Steel Control^{B/} published in 1963, the 'four important' social objectives that needed to be fulfilled were:

- i) availability, on priority basis, of steel for 'essential' capital projects and for current production requirements of 'essential' units;
- ii) the availability of intermediate products, e.g. pig iron and billets to processes other than the producers of these products (who are likely to prefer processing the whole or most of the available supply in their own plants);
- iii) the availability of a 'fair share' of the supply to the 'small man'; and
- iv) a 'fair' regional distribution of scarce supplies.

40. In recognition of the fact that unregulated market allocation would not lead to the ideal pattern of steel utilization, the Government of India attempted to regulate demand by imposing control over certain 'unrelaxed' categories of steel and priorities were allocated. It is emphasized that ideal

^{B/} Report of Steel Control - October 1963. Government of India, Ministry of Steel and Heavy Industries (Department of Iron and Steel).

utilization of resources. Production of steel is a pre-condition of modernization, which means that its role is a local iron and steel industry. The local steel industry can feel far short of the optimum value. The pattern of steel allocation conforms to the role is desirable.

Employment ~~and~~ 1966

41. The capital/labour ratio, or in other words, the investment per job, in steel is exceedingly high as compared to some industries such as textiles. It is estimated that, in a developing country, a two million ton steel plant with a capital cost of more than \$ 1,000 million creates direct employment for about 15,000 people. It can be readily observed that capital/labour ratio in steel industry is very high. But this apparent high investment cost per worker is not the true indicator of the employment potential, when it is considered that the installation of a steel plant has a multiplier effect on the employment generation in the industries linked with steel, both directly and indirectly. According to a study by the American Iron and Steel Institute, every worker in the steel industry creates factory jobs for another eight in plants which could not come into existence without an assured supply of steel. Corresponding data on developing countries is not available, but on the basis of conditions obtaining in India, it is estimated that a steel plant creates indirect job opportunity 10 times more than the direct employment in the plant itself.

42. Excepting a few industries like cement, the employment potential of steel industry is much higher than that of many basic industries, as revealed by an input-output analysis of 32 industries in August, in 1957. From this study, the Institute of Economic Studies had reached the conclusion that the iron and steel industry has the highest employment potential among major industries. The results of this study are reproduced in the following table.

TABLE 7 - EMPLOYMENT POTENTIAL OF MAJOR INDUSTRIES

<u>Industrial sector</u>	<u>Industrial^{a/} employment</u>
Iron and steel	24.9
Non-electrical machinery	24.2
Electricity	19.8
Heavy chemicals	11.9
Cotton textiles	6.3
Petroleum refining	3.4
Food products	3.6

a/ Coefficient of total direct and backward linkage per million forints of output.

Source: Project Evaluation and the Consistency of the Plan by G. Sukor, Institute of Economics, Budapest. Evaluation of Industrial Projects, United Nations, New York, 1968.

Technical skill formation as a prerequisite for economic growth

43. The importance of skill in the national economy is an old concept in economics. A remarkable correlation can be found between the creation of skills and the process of economic growth. Skills, like capital, are produced means of production which are required for further growth and are considered as direct result of investment in industries requiring high technology. These are, therefore, essential inputs as well as by-products of economic growth. It has been observed that the steel industry provides greater opportunities for the formation of technical skill in a wide range of disciplines. Benefits of skill formation from the establishment of a steel industry have a special relevance to most developing countries, because this aspect is not reflected in the direct advantages of steel industry.

44. Skills originate at three levels, namely, 1) managerial, 2) technical, and 3) operative. Within the industrial labour, the principal field of interest, particularly in respect of skill formation, is at the operative's level which is composed

of skilled, semi-skilled, and unskilled workers. Managerial and technical skills are formed at higher levels composed of engineers, scientists, and technicians. As economic development progresses, there occurs a structural change in the composition of the labour force. The economy will migrate from subsistence agriculture to industry. The levels of skills will rise continually in the course of economic development.

45. Since the steel industry is highly technology-oriented, the skill requirement is also high and the technical absorptive capacity also increases. In India, for instance, the experience gained and skills developed in the operation of the two steel plants installed in the early part of this century stood in good stead not only for the running of the new steel plants which were installed in the Tenth Five Year Plan (1950-61) but also provided the personnel for the other engineering industries. The technological experience also provided the nucleus for the creation and development of local steel plant design and engineering services.

Other social benefits

46. The demand for civil and structural steelwork involved in comparison with the capital investment is more massive in the installation of a steel plant than that in most industries. Construction of such a magnitude stimulates the development of construction industries such as the fabrication and erection of steel structures, concrete construction etc. and develops expertise in the execution of complicated civil engineering works, apart from augmenting the employment opportunities during the construction phase.

VII. SEQUENCE OF INDUSTRIES RELATED TO IRON AND STEEL INDUSTRY

47. Two groups of industries receive stimulus from the iron and steel industry - the 'feeder' industries that provide it with critical inputs, and the consuming industries that provide the market for its output. Unless supported by one or both of these industry-groups, the iron and steel industry has slim chances of working at a reasonable degree of capacity utilization.

48. Upon investigation, it is clear that in each case where a local iron and steel industry has been established, at least one of the above industry-groups exists, while the other does not present a 'problem'. Excellent illustrations are: Japan with no indigenous raw material resources, but with a strong forward linkage with engineering industries and export markets; and India and Mexico in the early stages of steel production, with a strong feeder base but relatively less developed forward linkage.

49. The establishment of a local steel industry is thus necessarily related to an examination of the industries supplying to and purchasing from the steel industry. It is possible that, in the balance, economic factors might in fact point to the establishment/reinforcement of the feeder/consumer industries. Nevertheless, the importance which should be attached to the prior existence of a group of related industries has to be decided on the circumstances in each case, because questions like the time-horizon of planning are intimately connected with it.

50. Typical feeder industries and consuming industries that are vertically linked to the iron and steel industry in a developing economy in the early stages of development which has no local supplies of coking coal or adequate skilled labour force are given in Tables 8 and 9.

TABLE 8 TYPICAL FEEDER INDUSTRIES

<u>A. Metallic materials</u>	<u>Non-metallic materials</u>
Ore mining Ore beneficiation Sintering and pelletisation Production of ferro-alloys Scrap processing	Mining of dolomite, fluxing and refractory raw materials Beneficiation of raw materials
<u>C. Consumable materials</u>	<u>D. Repair and maintenance material</u>
Graphite electrodes, electrode paste Pickling chemicals	Rolling-mill rolls Welding electrodes Steel, grey iron, and other castings Steel forgings Refractories

TABLE 9 - TYPICAL STEEL CONSUMING INDUSTRIES

	<u>Slabs</u>	<u>Finished Products</u>	
		<u>Non-flat</u>	<u>Flat</u>
A. <u>Tonnage steel</u>	Re-rolling mills	Fabricated structural materials Fasteners Agricultural implements Forgings	Welded pipes, tubes, and profile sections Steel furniture Expanded metal Tank Gas cylinders Drums and containers Builders' hardware Enamelware Equipment manufacturing
B. <u>Alloy tool and special steels</u>		Roller and link chains High-tensile and precision fasteners Metal cutting and forming tools Hand tools Coil and laminated spring Cutlery and surgical instruments	Stainless-steel utensils Hacksaw and bandsaw blades Razor blades Equipment manufacturing

The existence/absence of some of these industries can affect the establishment of a local steel industry. The feeder industries determine the cost of the raw materials; the consuming industries determine the size of the market. In the cost-benefit analysis of a steel plant, therefore, the feeder industries determine a large proportion of direct costs, while consuming industries dictate overhead costs (the size of the plant) and the profit levels.

51. Industries based on steel by-products, though exerting only a mild influence on the decision to establish a local steel industry, are important in influencing the size and technology of the plant. A list of the 'basic' by-product industries that have generally grown around steel plants in developing countries is given in Table 10.

TABLE 10 - TYPICAL STEEL BY-PRODUCTS BASED INDUSTRIES

<u>A. Metallic by-product</u>	<u>B. Non-metallic by-product</u>
Scrap re-rolling	Blast-furnace slag cement
Plants for scrap recovery from slag	Fertilisers (ammonium sulphate)
	Tar chemicals

52. To sum up, the establishment of a steel plant is determined to a large extent by the feeder base in the country and the size of the local market. However, the deficiency with regard to the size of the local market can be overcome if an economic union of smaller countries can be formed. The economic rationale for the development of the raw material base or the purchasing industries receives the justification from the establishment of the iron and steel industry. The question of setting up all these industries is one of optimal timing.

VIII. CONCLUDING REMARKS

53. The direct and indirect effects of iron and steel industry on the economy are far-reaching and all-pervading. So much so, that for the developing countries, if the growth has to be self-sustaining, it becomes imperative to increase the production of steel as well as the fabrication of that steel into the component parts of machinery. Under-provision of steel, as we have seen, creates idle capacity in the industries dependent on it, which ultimately retards development. Increased production of steel demands increased iron ore, coking coal, rail transport, and engineering services. But this increased demand for steel and steel products does not spring from the development of engineering industries alone. Steel is required for the wide range of activities from consumer goods like tin cans to durables like bicycles, and construction work.

54. In order to increase the foreign exchange earnings, the developing countries must develop their own production of all types of intermediate products and components etc, for which an export market is developing though the job of importing components and assembling them may appear to be easier. In recent times, however, the industrially advanced countries are finding it uneconomical to produce a number of steel intermediate products and components because of the high-cost labour and other technological considerations. It would be advantageous for the developing countries to exploit this situation. The steel intermediates that have a decided export potential in the developing countries are:

- Wagons and coaches
- Structural fabrication including
trusses, for-line towers
- Steel pipes and tubes
- Ferrous castings
- Wire rods

Hand tools
Bicycles and components
Automobile ancillaries and components
Railway track materials
Bolts, nuts, rivets, and washers
Sewing-machine parts

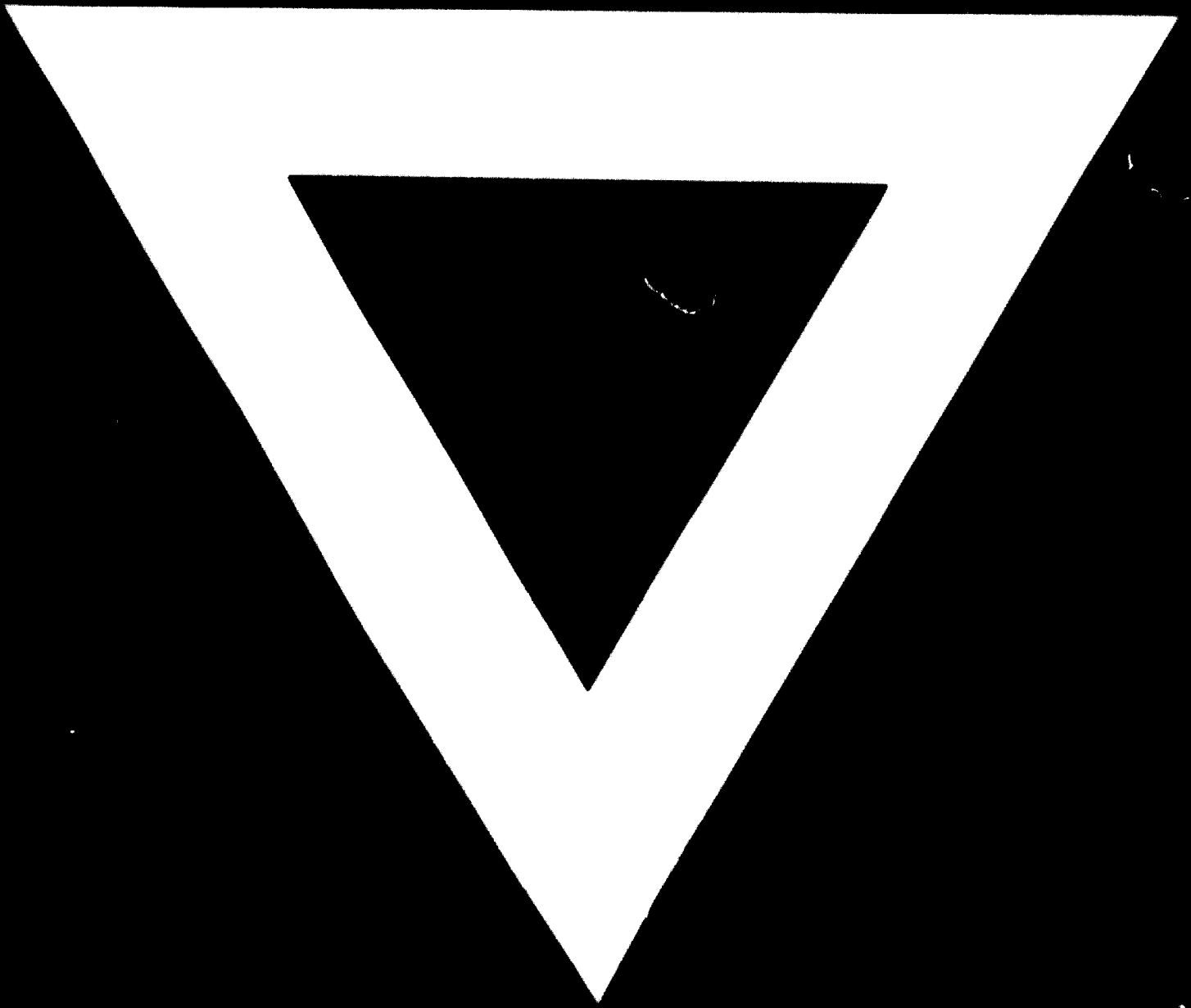
55. Many of the developing countries are endowed with abundant raw materials for steelmaking. Besides, the developing countries have also the advantage of cheap labour required for construction, operation, and maintenance. On the basis of these advantages, it may be reasonably concluded that, in many of these developing countries, steel production can be installed in the classical sense of comparative cost advantage and not on the basis of 'comparative religion' as some economists state.

56. In addition, the iron and steel industry makes valuable contribution to regional development. The establishment of an iron and steel plant in an economically undeveloped region attracts a number of industries large and small to the region, and the steel plant becomes the nucleus of a new industrial belt. As a result, the natural resources of the region are developed and better utilized.

57. The contribution of the steel industry to the process of economic growth through rapid expansion of the forward and backward linked industries, capital formation, rapid technological progress, external economies etc. is likely to vary from country to country. Where the forward and backward linkages are the highest, the iron and steel industry will contribute the maximum to the overall growth of the economy.

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