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THE CAPITAL GOODS INDUSTRY AND THE DYNAMICS OF ECONOMIC DEVELOPMENT IN LDCs - THE CASE OF BRAZIL

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The capital goods industry and the dynamics of economic development in LDCs - The case of Brazil.

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1 - Introduction

This paper is addressed to the discussion of the role of the capital goods industry in the development of a LDC (less-developed country), analysing in some detail the case of Brazil.

The second section reviews the role of the capital goods industry in the processes of capital accumulations and technical progress in an economy whose "stylized carachteristics" are drawn from the example of the advanced capitalist economies. It concludes with the question whether such conditions are found in LDCs. The rest of the paper tries to answer this querry.

The third section recalls the intellectual background of the "battle for the industrialization" of the LDCs and the different roles the capital goods industry was ascribed in the development of such countries.

The three following sections analyse the development of the Brazilian capital goods industry during its phases of import substitution growth and decline (section 4), the boom of the "Brazilian miracle" (section 5) and the following crisis (section 6). Their focus is on the development of local production of capital goods and the role played in such development by the factors suggested by the literature reviewed in Section 3 as warranting the capital goods production in a LDC.

Section 7 takes up the issue of technological development in the Brazilian capital goods industry and its relationship to exports and, to a much lesser extent, employment.

Finally, Section 8 sums up the answers provided in the preceding parts, relating the development of the Brazilian

capital goods industry to the more general aspects of its pattern of capitalist development.

Since Brazil is the largest producer of capital goods in the Third World (China excluded)[1], with a domestic content of supply comparable to that of the advanced countries[2] and is also one of the main exporters of capital goods among LDCs[3], part of which are attributed to local technological development, its case is relevant not only on its own but for other LDCs as well.

(1) UNCTAD (1982) estimates show that Brazil accounted for 13% of capital goods production in the Third World (China included). Those figures probably underestimate the Brazilian share by including in other countries' figures some consumer goods production.

(2) See Section 5.

(3) See Section 6.

2 - The capital goods industry and the development of advanced capitalist economies

The capital goods industry (CGI), i.e. the industry which produces equipment and machinery, holds a distinguished place in the history of development theory. Analysts of the Industrial Revolution, the classical economists gave it a place of honour in their explanations of both the specificity of capitalist development, of what distinguished it from earlier modes of production, and of the strenght of such development.

Among them, Marx is probably the author which carried the analysis of the role played by the machinery industry in the development of capitalism further. He argued that only when the production of machines was made by machines, when the capital goods industry was mechanized, the capitalist mode of production reached its full form as "modern industry". Only then, he argued, capitalists were able to subordinate workers to machinery. The social labour process then became "objectively" run by the logic of capital accumulation without the constraints posed by the "subjectivity" of labour. Throughout the whole industrial process, from the production of machines to the "machinofacture" of wage goods, everywhere, workers became "appendages to machines" and capital imposed its rationale (Marx, 1968a). The latter led to an increase in the use of machinery, raising the productivity of labour but at the same time, tended to decrease the rate of profit by reducing the share of the capital capable of generating a surplus (variable capital) in total capital, a contradictory process which, according to Marx, was typical of capitalism. Moreover, the relationship between the capital goods industry (together with other industries manufacturing producers goods) and the industries producing consumer goods (respectively, Departments I and II of the economy) played a crucial role in the dynamics of the capitalist system, as can be seem in Marx's analysis of expanded reproduction (Marx 1968b).

Kalecki (1977) would later argue that "several of the modern theories of growth", including the Harrod-Domar well-known

model, could be interpreted as "variations over the theme of the marxist scheme of expanded reproduction" (p.6), which can be summarized by an inter-departamental relationship between profits in the sector producing wage-goods and wages in the other(s) sector(s) and by a relationship between the rate of investment and the stock of capital. This type of relationships have in fact been widely used to explain the unstable and cyclical pattern of development of capitalism (see Matthews (1959) for a review).

Economic development results from the combination of capital accumulation and technical progress. The two processes, capital accumulation and technical progress, are in fact inter-twinned and the industry producing machinery plays a role as important in the latter as in the former. Innovations in the capital goods industry normally lead to an increase in productivity of industries using its products and innovations in such industries (either in their products or their processes) normally require embodiment in capital goods (which are often modified for such new purposes). Since the machinery produced for one user can be often utilized by others (eventually with adaptations) the capital goods industry acts as the main locus for the diffusion of innovations throughout the economic system.[1] The same role is played in terms of training manpower. Moreover, if we assume that there is technical progress in the capital goods industry and therefore new vintages of machinery are more productive than older ones, new investments benefit from such increased productivity, expanding effective demand and further investment, building up a "virtuous circle" of capital accumulation and technical progress (Salter, 1960), a hypothesis often put forward to explain the recent development of advanced countries. (Dosi, 1982).

Technical progress in the capital goods industry in its turn, is based on a "collective process" in which take part the purchasers of machinery, engineering firms, suppliers of parts and components of the machines, and universities and research

(1) See Rosenberg (1963) for an extended discussion of the role of capital goods industry in the diffusion of innovations.

institutes, besides the actual producers of capital goods. When carried out in a context where there is considerable division of labour this process is carachterized by sinergy - i.e. the result is greater than the sum of the parts. Since innovation in this industry is based mainly on design and manufacturing technology improvements, which develop through time, experience, at the level of the firm and of the industry, is a prime determinant of innovation capability, raising barriers to entry of new-comers. Although computer-aided-design and computer-aided-manufacturing have recently expanded, some of the skills necessary to innovate in the industry (notedly in basic design) are person-embodied, learned by experience — and transferred from one enterprise to another by changes in employment. For such reasons important differences may be found between the private and social calculus of costs and benefits of innovating in the capital goods industry, warranting State intervention to foster it (Erber, 1977).

The post-war literature on the relationship between innovation and international competition strenghtens further the dynamic importance of the capital goods industry. The studies of innovations and of their diffusion suggest that they require a proximity of capital goods suppliers, especially in early stages of introduction of innovations. Producers of capital goods play an important (albeit often poorly documented) role in suggesting improvements in processes and products which play an important role in their customers' competitive position. Moreover, when the innovation is a capital goods itself, the proximity to a supplier is necessary to ensure proper technical assistance and maintenance. Thus, the development of technical capability in the capital goods industry is an important asset in international competitiveness.

Furthermore, exports of capital goods themselves, have become one of the main items of international trade. For the main developed economies (U.S., Germany, Japan, U.K.) they represented more than 40% of their total exports in 1975, a share which had increased over the decade (Fajnzylber, 1983). Developing countries account for almost all of the export surplus of capital

goods from developed economies, and for more than a fourth of total world imports. Nonetheless, trade between LDCs in machinery and transport equipment is increasing: in 1979 about 8% of the LDCs' total imports of such commodities was originated by other developing countries, from about 6% in 1975 (UNCTAD, 1982). Exports of capital goods from LDCs to developed economies are still quite limited although they represent an important share for the leading producers[1]. It should be noticed that only a limited number of LDCs are exporters of capital goods (Brazil, Korea, Singapore, Yugoslavia and, to a lesser extent, India and Argentina). (UNCTAD, 1982).

However in order to fulfill the dynamic roles above discussed the development of capital goods technology and production must be accompanied by a parallel development of the financial system, which is able to respond to the investment decisions of entrepreneurs which underlie the purchase of new capital goods (cf. Kalecki, 1968). This is a crucial point to understand the problems of LDCs in this industry, as will be seen in more detail later.

Although he argued that the development of the machinery industry was a necessary condition for the development of capitalism, Marx did not hold that the inverse relationship was true.In fact he seems to have shared the faith of this predecessors that the development of machinery held the promise of alleviating the drudgery and hardship of work, provided the right social relations of production were present. His followers, such as Luxemburg (1961), argued that indeed, socialism would increase the use of machinery relative to capitalism. Thus, the trend toward an increasing use of machinery in developed economies became so established that some authors interpret it as one of the "natural trajectories" followed by technical progress in our civilization (Nelson and Winter, 1977). Only more recently, in the wake or the counter-culture movement, has this trend been

(1) Especially Korea and Brazil which exported to advanced countries, respectively two thirds and one-third of total capital goods exports in 1980 (UNCTAD 1982).

contested, but with litle practical consequence, as far as one can judge.

3 - The CGI and LDCs - The background

But, what about the economies which in the early stages of development of capitalism had became part of the system in the role of suppliers of raw materials and primary products? Ricardo's repply was that the law of value and comparative advantages operated in such a way that "old countries are constantly impelled to employ machinery and new countries to employ labour" (Ricardo 1973 p.26). This view of relative comparative advantages was preserved when the neo-classical paradigm became dominant in the present century, in the Heckscher-Ohlin-Samuelson version, and it implied different rates of diffusion of the use of machinery and different rates of development of local production of capital goods[(1)].

As regards the marxist paradigm, Marx himself, did not spend much time on the as subject. Nonetheless, he seems to have believed that sooner or later capitalism would spread to the former colonies and other less developed countries and, as part of this process, one can presume, a local capital goods industry would develop[(2)]. For a while marxist writers followed his lead and held that imperialism would industrialize the less developed countries[(3)].

Nonetheless, from the twenties onwards, an other strand in marxist thought prevailed — that capitalism is a fetter on the development of the LDCs. Thus, marxist orthodoxy, became

(1) The assumptions of continuity and substitutability of the neo-classical paradigm led to an emphasis on projects and not on sectors (cf.Stewart, 1976).

(2) This is an interpretation based on his articles on India, published in the New York Herald Tribune and on his letters to Vera Zazulich (Marx, 1968).

(3) See Santi (1973) for a review of the ideas of the "classics" of imperialism (Bukharin, Hilferding, Luxemburg, Lenin) onthe subject. In the twenties Lenin changed the views he puts forward in "Imperialism" and supported the idea that imperialism would not lead to the industrialization of the LDCs.

that imperialism, allied to the pre-capitalists landlords and the "comprador" bourgeoisie of the LDCs, were against the industrialization of such economies and, therefore, inimical to the development of a local capital goods industry. Against such "unholy alliance" the "progressive" sectors of society (peasants, workers and part of the enlightened urban middle class) should unite to a national industrial bourgeoisie to industrialize and modernize the economy and society[1].

This was the intellectual background against which the "battle for industrialization of the LDC's" was fought in the Second post-war period. Keynes'dictum that behind every politician there is a long-dead economist would prove true once again, with the difference that, in this case, economists, were often alive and at the front line too.

Proponents of industrialization of the Third World took as their prime enemy the neo-classical paradigm arguments that LDC's specialization in primary products was conducive to their development. Thus, they attacked at the same time both the prevailing international division of labour and the LDC's internal productive structure. Most of them believed that foreign investment would not be interested in the industrialization of the Third World, which would be the "historic task" of a national bourgeoisie aided by a clairvoyant state and by a "modern" middle classe with the support of workers and peasants. The majority also shared an optimistic view of the results of industrialization in terms of increasing the rate of growth of output, income and employment and reducing the political and economic inequalities. Nonetheless, they disagreed upon which industries should take precedence in re-structuring the economic structure of such countries.

In early proposals of industrialization of the LDC's, such as those put forward by Nurkse (1953) and Rosenstein Rodan (1961), the international supply of capital goods played a secondary role,

(1) See Varga (1963) for a modern restatement of this view.

since they emphasized the interdependence of consumer's demand and investment in consumer goods industries as the way out of the "vicious circle of misery" in which LDC's were entrapped. Machinery for the consumer goods industry was to be mainly imported.

Other proposals, such as those of the writers belonging to ECLA (e.g. Tavares 1964)[1] and Hirschman's (1958) brought the capital goods industry to the forefront. This reversal rested upon two pillars: a foreign exchange constraint and the dynamic effects of the "vertical interdependence" between industries producing consumer and intermediary goods and their suppliers of machinery.

4 - The CGI and import substitution

The foreign exchange constraint was seen as inherent to the specialization of the LDC's in primary goods; as a structural datum, resulting from several causes which the LDC's had not the power to alter[2].

The foreign exchange constraint played a double role in the dynamics of import substituting industrialization, the pattern wich prevailed in Latin America. On the one hand, it spurred industrial growth by limiting the amount of goods which could be imported, on the other it placed a limit on such growth by constraining the imports of capital goods and other inputs which were necessary to produce locally the goods previously imported:

(1) See Rodríguez (1982) for a detailed and critical review of ECLA's theories.

(2) Such as the smaller demand - and price - elasticity of primary goods in DCs as compared to the growth of demand for manufactured goods in LDCs, the structure of markets in which primary and manufactured goods were produced and sold, the pattern of technical progress, which tended to economize raw materials, and the different conditions faced by the two types of countries to appropriate the results of increased labour productivity due to technical progress.

For a full account of such arguments see Rodriguez (1982). See also Ellis and Wallich (eds.) (1961) for flair of the discussion at its height, at the Rio de Janeiro meeting of the International Economic Association, in 1957.

Therefore, in order to keep its momentum, the import-substituting model required a local production of capital goods[1].

Brazil is one of the countries which carried this process further,during second half of the fifties.According to Lessa (1964), in the period 1955/1960 the production of machinery and equipment in general increased over 100% and that of heavy electrical machinery over 200%. Investment in the sector increased even further: between 1955 and 1959 (the last year of the period for which there is data available) gross capital formation in the mechanical and electrical products industries increased at a yearly rate of, respectively, 43 and 38% in real terms. At the same time, the imported component in total supply of capital goods declined from 46% in the period 1950/55 to an average of 31% in the period 1956/62 (Erber et al, 1974).

Nonehtheless, in Brazil, in 1960, the capital goods industry accounted for less than ten per cent of the value added in manufacturing industry; about a fourth of the share it held in the U.S., Germany, Japan, France and the United Kingdom and less than a third than the share of the Italian capital goods sector (see Table 1). Indeed, a cross-country comparision taking into account their (GNPs, (Bergsman and Candal (1960)) suggested that until the early sixties the output of the Brazilian capital goods sector was below the international "norm". Although fourteen years later the share of the Brazilian capital goods industry in total manufacturing had increased faster than that of the more advanced countries, it was still between a half and a third of the share of the capital goods sector inthose countries[2].

(1) ECLA's argument is well summed by Tavares (1964, p.6) - "it can be asserted that given the conditions of the import substitution model, it is practically impossible for the industrialization process to proceed from the base to the apex of the production pyramid, that is to start with the more simply processed consumer goods and progress gradualy until it includes capital goods. The substitution process might be regarded as a building of which every storey must be erected simultaneously, although the degree of concentration on each varies from one period to another".

(2) Our estimates of the share of the capital goods industry in total Brazilian industrial output (12% at the peak in 1977) suggest that the figures in the Table I-1 (which are for value-added) may be overestimated, even bearing in mind that the OGI may have a higher than average value - added.

TABLE 1 - Share of the capital goods industry in total manufacturing industry's value added for Brazil and selected developed countries - 1960 and 1974 - in percentage

Country	1960	1974
United States	38.1	42.7
Japan	31.7	48.5
Germany	38.2	39.0
France	37.3	39.2
United Kingdom	41.1	40.5
Italy	29.9	36.5
Brazil	9.2	14.5

Source: Fajnzylber (1983).

The model of import substitution has been often chasticized precisely for its assumption of a rigid foreign exchange constraint and the policies which implemented such model for their neglead of export possibilities (e.g. Bergsman 1970). Moreover, as ECLA's studies warned, the dynamic possibilities of this type of industrialization were limited even in Brazil, since import substitution could be only partially extended to capital goods and intermediaty products, where it would sooner or later face up to either foreign exchange restrictions,natural resources scarcities, and/or problems of minimum scale of investments related to the size of the market. In the Brazilian case the same process which had produced the great economic expansion of the fifties had also led to increased political, social and economic imbalances, expressed by highly concentrated personal and income distribution, severing inflation rates and increased political strife.

As it is well known the political impasse was solved by a military coup in early 1964. After a recession during the period 1964/67, the economy was launched back on an expansion cycle, led by industrial growth, which reached its peak in the mid-seventies

and lasted until 1980 (see Tables 2 to 4). In the recent years, a recession to which no end is on sight has, for the first time since the War, reduced the Gross Internal Product (ibid).

5 - The CGI and the "miracle"

Two elements carachterize the boom period of 1968/74 (the "Brazilian miracle"): internally, the role played by the durable consumer industries, which grew at an yearly rate of 22.5% (see Table 3) and, externally, the favourable balance of payment conditions, based upon improved terms of trade and the availability of credit[1]. Thus, for the first time in her history of industrialization Brazil was not facing a foreign exchange constraint at a time of expansion. Imports of capital goods were especially stimulated by local fiscal incentives tariff exemptions[2], tied-in foreign credit, scarcity of local finance and over valued exchange rates[3] (Suzigan et al. 1974, Erber 1977, 1982).

As one would expect under such conditions, imports of capital goods soared — during the 1967/74 period they increased 367% in real terms, an yearly rate of 24,6%, their share in total Brazilian imports (oil included) reaching a peak of 41% in 1971 and 1972 (from a fourth in 1965) (Malan and Bonelli 1983) (see Tables 4 and 5).

(1) Brazilian foreign debt grew from US$ 3.8 billions in 1968 to US$ 17.2 billions in 1974.

(2) It is estimated that 80 per cent of capital goods in Brazil benefited from incentives or concessional treatment (Castelo Branco 1976, Tyler 1980).

(3) The share of private finance in total finance of capital goods imports rose from 36% in 1970 to 49% in 1978. Local credit conditions for the purchase of capital goods were less favourable than those granted by foreign sources and local funds were available only for a fraction of total local production of capital goods (probably less than ten percent) (ibid.).

TABLE 2 - AVERAGE YEARLY GROWTH RATES OF THE BRAZILIAN ECONOMY GROSS INTERNAL PRODUCT AND ITS MAIN SECTORS - 1968/82 IN PERCENTAGE

PERIOD	GIP	GIP PER CAPITA	AGRI CULTURE	INDUSTRY	COMMERCE	TRANSPORTS & COMMUNICATIONS
1968/74	10,93	8,05	5,13	12,20	11,42	12,69
1975/ 78	6,36	3,79	4,25	7,29	4,85	8,68
1979/80	7,28	4,66	5,65	7,28	7,31	10,71
1981/82	-1,30	-3,64	2,03	-4,10	-3,04	-2,40
1928/82	7,83	4,83	4,55	7,93	7,08	9,93

Source: Malan and Bonelli (1983).

TABLE 3 - BRAZILIAN INDUSTRIAL PRODUCTION AVERAGE YEARLY REAL GROWTH RATES ACCORDING TO USE OF PRODUCTS - 1968/82 IN PERCENTAGE

	1968/74	1975/78	1979/80	1981/82	TOTAL 1968/82
Intermediary Products	12,9	6,7	7,0	-5,0	7,9
Capital Goods	13,3	8,3	8,3	-5,2	8,6
Durable Consumer Products	18,3	6,0	5,8	-14,9	8,3
Non-Durable Consumer Products	22,5	6,0	9,2	-11,3	11,2
TOTAL	8,8	5,1	4,8	-0,2	6,0

Source: Malan and Bonelli (1983).

TABLE 4 - BRAZIL: PRODUCTION, IMPORTS AND EXPORTS OF CAPITAL GOODS - 1970-1982
(Millions of US$)

Year	Production (1)	Exports (2)	Production for Home Market (3)=(1)-(2)	Imports (4)	Consumption (5)=(3)+(4)	Percent $(\frac{2}{1})$	Percent $(\frac{2}{4})$	Percent $(\frac{3}{5})$
1970	2,499	125	2,374	945	3,319	5.0	13.23	71.5
1974	8,468	646	7,822	3,135	10,957	7.6	20.6	71.4
1975	9,423	893	8,550	3,944	12,494	9.5	22.6	68.4
1979	16,933	2,420	14,997	3,779	18,776	14.3	64.0	79.9
1980	18,047	3,360	14,687	4,384	19,071	18.6	76.6	77.0
1982	13,081	3,323	9,758	3,278	13,036	25.4	101.4	74.8

Sources:

Production - Erber (1982) and FIBGE.

Exports - Araujo Jr., and Reis (1981) and CACEX Reports.

Imports - Malan and Bonelli (1983).

TABLE 5 - BRAZIL - SHARE OF CAPITAL GOODS IMPORTS AND EXPORTS IN TOTAL IMPORTS AND IMPORTS - 1970-1982 - IN PERCENTAGE FOR SELECTED YEARS

YEAR	IMPORTS	EXPORTS
1970	37.7	4.5
1971	41.3	n.a.
1975	32.3	10.3
1979	20.9	15.9
1980	19.1	16.7
1981	18.2	18.0
1982	16.9	16.5

Sources:

Imports - Malan and Bonelli (1983)

Exports - Araujo Jr. and Reis (1981) and CACEX Reports.

The bias against local production of capital goods imparted by the economic policy of the period via prices and credit is coherent with the other main traits of the strategy for economic and political development of the regime — to maximize short term growth (inclusive as a legitimizing factor) based on the durable consumer goods industry and on foreign credit. In this sense, the surge in imports reflects the economic and political conditions of the period.

However the increase of imports of capital goods cannot be attributed only to the policies above mentioned. Part of the imports were for parts and components to be used by local production — reflecting one of the weaknesses of the Brazilian industrial structure, the undevelopment of the network of suppliers, which leads,on the one hand,to a high degree of vertical integration of the larger firms (see below) and,on the other,to imports.(1)

Another part of imports can be attributed to gaps between the local design and production capability and demand requirements. The latter are, in turn, deeply influenced by the use of imported specifications of equipment by the main purchasers of capital goods — foreign subsidiaries acting in the durable consumer goods and intermediary industry and State enterprises providing infra-structure services and intermediary products. As shown by Mazzuchielli (1977) the former were responsible for the majority of imports of series-produced machinery and the latter for the imports of custom-built capital goods. Part of the imports of subsidiaries can be attributed to their strategy of standardizing their technology world-wide and possibly also to intra-group trade. The specifications of equipments used by State agencies reflect also the relative undevelopment of engineering firms in Brazil, which usually performed only the detail engineering actitivities of the projects, leaving the basic design and

(1) According to data from FIPE (1978), imports of components and parts for eletrical and non-eletrical machinery increased their share in total imports of such products from 16 to 28 percent between 1971 and 1975.

equipment specifications to foreign contractors (Ford et al.1977). This division of labour has been shown (Erber 1974, Alves and Ford 1975) to be highly influenced by the financing structure of the projects, with foreign funding (inclusive by international agencies) biasing choices in favour of imported plant design and specifications (besides imported capital goods). Therefore, although "pure" gap-imports certainly existed, as in every economy, a part of them are a result of entrepreneurial strategies and economic policies which strenghten the undevelopment of local production and design capabilities in the capital goods industry and related engineering services in what amounts to be a vicious circle, since the above-mentioned capabilities are developed through experience, which imports prevent.

Nonetheless, and this is important to stress, the expansion of imports did not prevent the internal production of capital goods from growing. In fact, during the period 1968/74, the local output of capital goods increased at a spetacular yearly rate of 18.3%, well-above the average of industry. Thus the domestic content supply of capital goods at its lowest point (1975) was 68.4% of total consumption, increasing in later years to about 80% (see Table 4).

Such domestic supply ratios are comparable to those of much larger economies such as the Federal Republic of Germany (84% in the same year) and Italy (77% in 1978). Sweden which has a similar apparent consumption (US$17.6 billions in 1978, compared to US$15.9 billions for Brazil) had a much smaller domestic supply ratio: 65 per cent.(1)

Thus, the Brazilian case suggests that although a foreign exchange constraint may be a strong incentive to set up a capital goods industry in a LDC, as shown by the period of import substitution of the fifties, it is not a necessary condition for the further development of the industry, as shown by period we have just discussed. In the latter the main factor leading to

(1) In the United States the domestic supply ratio was 92 per cent in 1977. Data from UNCTAD (1982).

the development of the capital goods industry were the inter-industrial relationships in a process similar to that prevailing in advanced capitalist countries. Nonetheless, as we have seen, the capital goods industry in Brazil is responsible for a much smaller share of industrial output than in those economies (see Table 1), in spite of its growth. This differentia specifica has received considerable attention in the explanation of the downswing of the cycle in the aftermath of the "miracle" and we discuss it in more detail in the next section.

6 - The crisis: inter-industrial relations and the new foreign exchange constraint

One of the first "development economists" to focus primarily upon the role played by interindustrial relationships in the dynamics of industrialization was Hirschman (1958). Building upon the concept of "backward" and "forward" inter-industrial linkages and their dynamic effects in terms of inducing investment, he strongly argued in favour of investing in industries which produce intermediary and capital goods rather than consumer goods, since the former presented higher combined linkages and, therefore, had a greater impact upon investments in other industries.

While Hirschman's argument was essentially of a prescriptive nature, the theme of the interindustrial investment relationship was revived in the early seventies,when the pattern of development which had emerged in Latin America after the period of import substitution was critically assessed by the "dependence" analysts.

Although the battle for industrialization had been won, for many of its combatents it was a Pyrrhic victory. Contraty to the optmistic hopes of fifties, the pattern of development was by and large "perverse": even where capital accumulation had been resumed, as in Brazil (after the recession of 1963/67), it was

based upon the production of durable consumer goods and upon as increasingly unequal income distribution, often enforced by authoritarian political regimes. Moreover, it was led by foreign enterprises, backed up by heavy state investments with the national bourgeoisie playing a secondary (albeit profitable) role. This new pattern of development led to a change in the links between hegemonic and dependent economies and, according to the "dependence" authors, technology, capital goods and finance were now the main links in the new "web of dependence".

In an early formulation (Cardoso 1973), the underdevelopment of the local capital goods industry and the reliance on imported technology were seen as limiting the process of capitalist development of the periphery, since the Department I of such economies (the sector producing means of production), was said to be virtually non-existent there, preventing a productive complementarity required by capital accumulation and draining the dynamic stimula to the central economies. The Brazilian case showed this to be an over-simplification: an internal technical capability[1] and the production or capital goods developed with the process of industrialization.

Although they are critical of the "dependency theory" general frame of analysis, some recent studies of the dynamics of capital accumulation in the context of an LDC "late" capitalist development have emphasized precisely the role played by the relationship between the capital goods industry and other sectors, using a Kaleckian scheme to explain the cyclical nature of such development. (e.g. Tavares (1978), Tavares and Belluzzo (1979).

Such studies argue that the relative small size of the capital goods sector in such an economy prevents the CGI of playing the dynamic role it fulfills in the developed capitalist economies via the multiplier and accelerator effects and via increased productivity. Thus, the effects of an autonomous investment (either by enterprises producing consumer goods or by State enterprises producing intermediary goods) which are

(1) See below, Section 7.

transmitted to the capital goods industry and fed back by this industry into the rest of the economy via its own investment, which increases employment[1] (and thus the demand for other goods and services), productivity (by offering new vintages of more efficient capital goods) and purchases of other goods and services (enlarging, among others, the capital goods itself), are, according to such authors, much smaller in a LDC than in a developed economy.

Therefore, in a LDC there is a propensity for the dynamic effects of an autonomous investment to be dissipated much earlier on than in an advanced economy and, since both in intermediary and consumer goods (mainly durable consumer) there is a trend to invest in capacities which are ahead of demand (because of indivisibilities and/or oligopolistic competition) such economies have a deep-seated proponsity for sharp cycles. When autonomous investments are being made in consumer and intermediary goods, economic activity increases sharply because of the size of such investments relative to the already installed capacity, only to contract sharply too when their first-order effects are over.

In an economy, such as Brazil, where the leading sector is producing durable consumer goods using capital-intensive techniques and, at the same time, the average income is low, policies of income concentration[2] and of financing the purchases of such goods may be instrumental to foster capital accumulation during the upswing, albeit at a very high social cost, but cannot prevent a sharp downswing. Under such conditions the phase of expansion takes up on especially "perverse" form in terms of income distribution and social equity which is aggravated in the recession by unmitigated unemployment [3].

(1) The capital goods industry is relatively labour-intensive and uses higly skilled and highly paid manpower.

(2) As it is well known Brazilian income distribution is especially skewed and Government policies rendered it worse, especially during the boom period.

(3) There are no unemployment benefits in Brazil.

Although imports of capital goods can be interpreted as a further "drain" from the dynamic point of view, they are not a necessary condition for this argument — even with autarky in capital goods supply, the dynamics of capital accumulation would be stunted if the relative size of the industry were small.

The argument can be further extended if me look at the carachteristics of the network of activities for designing and producing capital goods discussed above. The relative undevelopment in Brazil (and in other LDCs, as shown by UNCTAD (1982)) of the network of suppliers and engineering services on the one hand reduce the inter-industrial linkages and, on the other, reduce the productivity on the system, by leading the capital goods enterprises to a much higher vertical integration than their counterparts in advanced countries, losing the "economies of specialization" which are a proeminent feature of the industry (Rosemberg 1963).

Finally, this argument draws the attention to the problems of the financial system of the country to finance the production and purchase of locally-produced capital goods. If such system is not able to provide for such financing, investment may be postponed or not made at all or purchases of capital goods may diverted abroad. This may happen withouth a savings constraint, since savings may exist but be oriented to other uses (e.g. the purchase of durable consumer goods).

Such analysis, which shift the focus from the foreign exchange constraint to the inter-industrial relationships and to the role played by internal financing conditions was developed for the Brazilian case, but it may be relevant to other LDCs as well.

In fact, Fajnzylber (1983) has suggested that the relative undevelopment of the capital goods industry is one of the main distinguishing traits of the industrialization of LDCs.

Thus, from the prospective of the authors mentioned above, a slow-down in economic growth was to be expected after the leading

durable consumer goods industries had completed their expansion by the mid-seventies and, in fact,the growth rates of the two groups of industries show a considerable reduction in the period 1975/78 (see Table 3).

The Government which took over in 1974 seemed intent precisely to change this structure,since its Development Plan (II PND) gave top priority to the complex of industries producing intermediary products and capital goods. According to the Plan this would, at the same time, reduce the foreign exchange constraint[1] by increasing the domestic content of the supply of intermediary products and capital goods and increase the national control of the economy, since State enterprises would supply the intermediary products, directly or in joint ventures,and Brazilian private enterprises are important suppliers of capital goods, public works and engineering services.

The story of the period cannot be dealt in detail here but its main traits illustrate the problems of trying to change the productive structure of the economy without changing its financial structure as well.

The capital goods industry, especially the Brazilian enterprises[2] responded to the prospects of the Plan by increasing their productive capacity sharply - the average fixed investment of projects presented to the Industrial Development Council by enterprises producing capital goods during the period 1974/76 was 2.6 times greater than the average for the period 1971/73. Over the same period the National Development Bank (BNDE) increased its loans to the capital goods industry in the same proportion[3] (Erber, 1982).

However, apart from increasing the funds of BNDE and its subsidiaries, which is the main source of long-term finance to

(1) The trade balance which was in equilibrium in 1973, showed a deficit of US$4.7 billions in 1974, caused by a jump in imports from US$6.2 billions in 1973 to US$12.6 billions next year, a fourth of which were of capital goods and 45% of intermediary products (oil-another 22%- excluded).

(2) Data on direct foreign investment show that the main expansion of foreign enterprises (especially in mechanical machinery and shipbuilding) ocurred earlier in the cycle - during the 1971/74 period (See Erber, 1982).

(3) Only Brazilian firms have access to the Banks' funds.

industry in Brazil, no major changes were made in the internal finance system to support the larges investments foreseen by the Plan, especially by the State. The financial policy, of the period rested upon a mounting public debt, based on open market operations and on a swelling external debt, which increased over five times between 1973 and 1978, most of which was pegged to floating interest rates[1]. As a consequence,internal interest rates tended to increase in real terms over the period, stifling private investment further.

Under the double pressure of rising inflation and foreign exchange constraints (fuelled by increased oil prices and mounting international interest rates) the ambitions of the Plan were abandonned in favour of a stop-and-go policy, which lasted from 1977 to 1980, strongly influenced by political events[2]. Although the State curtailed its investments to control inflation and instructed its enterprises to fund as much as possible the remaining projects from external sources, while internal interest rates were increased to stimulate private enterprises to do the same, the State projects which did take off (especially those in the energy sector - hydropower and oil) were instrumental in sustaining the demand for capital goods until the end of the decade. Nonetheless, the Plan left the capital goods industry saddled with a capacity which has been widely underutilized and which holds no prospect of being fully used in the near future.

In the more recent past the foreign exchange constraint has been a prime determinant of the recessionary policy followed by the Brazilian Government since 1980 (Malan and Bonelli, 1983). The reduction in industrial activity and public and private investment has been felt especially in the local output of capital goods which declined at average yearly rate of 15% in the period 1981/82 (see Tables 2 and 3). Estimates for 1983 show that the reduction in capital goods production has deepened — in August of that year the level of output was estimated to be 18% lower than a year before

(1) In 1978 (when the net external debt was US$ 32 billion) an increase in one percentage point of the LIBOR led to an increase of US$300 millions in interest payments by Brazil.

(2) E.g. the campaign in the press against the "excessive" role of the State in the economy.

and no evidence was available of a recovery (ibid.)[1]. Taking into account only the production for the Brazilian market, by excluding exports, the fall is even more severe (see Table 4) - the 1982 level is less than two-thirds of the 1979 output. Imports of capital goods also fall, but less sharply (the 1982 imports are 87% of the 1979, after an increase in 1981)[2]. This relative inelasticity of imports is probably due to same causes previously discussed, since the latter have remained largely inaltered.

This implies that even if there is scope for same import-substitution in the Brazilian capital goods industry, to implement such policy would require acting upon such factors, making deep changes in economic and political conditions.

However, there are three important differences between the present Brazilian situation and the foreign exchange constraint normally treated in the literature of "development economics".

First there is the role played by the capital goods industry in the foreign exchange constraint (FEC). Contrary to other situations of FEC, which appear at times of expansion, the present recession has reduced the share of capital goods imports in total imports, from the peak of 41% in 1971/72 to 17% in 1982. Moreover, and most important, the trade balance of the capital goods industry has steadily improved - while in 1970 Brazilian exports of capital goods represented 13% of imports, in 1982 they were greater than imports (see Table 4). A recent study (Araujo Jr. and Reis, 1981) show that about a third of such exports were purchased by OECD countries, the rest, being sold to other LDCs. The world recession seems to have affected such exports causing a reduction of more than 20% in their value from 1982 to 1981, more than proportional the drop in total Brazilian exports (see Tables 4 and 5).

(1) In comparison, during the recession of 1964/67 the internal capital goods production continued to grow at a 6% yearly rate. (Erber, 1977).

(2) Nonetheless the domestic component in 1982 was still high - three-fourths of total supply (see Table 4).

Secondly, there is the nature of the Brazilian present FEC, which has financial rather than trade roots. Differently from the traditional FEC of the development literature, the present Brazilian FEC is not to be found at balance of trade level, caused by an excess of imports over exports, but rather at the level of the balance of services and the capital account, caused by the service of debt and by the reduced inflow of capital (see Table 6). The nature and magnitude of the Brazilian FEC are such that no improvements in the balance of trade[1] can overcome it, if it is not accompanied by a drastic change in the conditions which link the Brazilian economy to the international financial system.

Finally, as a consequence, the main influence of the FEC upon the capital goods industry is not exerted via restriction on imports, as it is during an import-substituting model, when it stimulates the local production of goods, but rather through the recessionary effects it has upon the general level of economic activity which, then, reduce the demand for both imported and locally produced capital goods.

7 - Exports and Technical Progress

In the course of the recent decade capital goods exports have increased considerably - their value in 1982 was over 26 times greater than in 1970 (see Table 4). Their importance for the industry increase with the internal recession (ibid), so that in 1982 they accounted for a fourth of total production, and they also play a significant role in alleviating the foreign exchange constraint of the economy, accounting in 1982 for 17% of total Brazilian exports (see Table 5). In international terms, Brazil has become of the main exporters among LDCs[2], although its share in total world trade is still marginal.

(1) Capital goods exports accounted for 17% of total Brazilian exports in the period 1980/82.

(2) In 1979 Brazilian exports represented 15% of total capital goods exports by LDCs, roughly the same share of capital goods production in the Third World (Araujo Jr. and Reis 1981 and UNCTAD 1982).

TABLE 6 - BRAZIL: BALANCE OF PAYMENTS - 1973/82
(In US$ millions)

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
I. Trade	+7	-4,690	-3,540	-2.255	+97	-1,024	-2,840	-2,829	+1,202	+778
Exports (FOB)	6,199	7,951	8,670	10,128	12,120	12,659	15,244	20,132	23,293	20,175
Imports (FOB)	-6,192	-12,641	-12,210	-12,383	-12,023	-13,683	-18,084	-22,962	-22,091	-19,397
II. Services	-1,722	-2,433	-3,162	-3,763	-4,134	-5,062	-7,920	-10,212	-13,135	-17,050
Non factors & others	-965	-1,533	-1,429	-1,574	-1,576	-1,805	-3,098	-3,591	-3,604	-5,128
Interests	-514	-652	-1,498	-1,810	-2,104	-2,696	-4,186	-6,311	-9,161	-11,357
Profits & dividends	-243	-248	-235	-380	-455	-561	-636	-310	-370	-565
III. Transfers	...	1	2	4	...	71	18	155	199	-7
IV. Current Account	-1,715	-7,122	-6,700	-6,013	-4,037	-6,015	-10,742	-12,886	-11,734	-16,279
V. Capitals	+3,512	6,254	6,189	6,651	5,269	10,916	7,657	9,804	12,773	7,867
Direct Investment	+940	887	892	962	810	1,071	1,491	1,146	1,584	986
Loans (*)	+4,495	6,961	5,933	7,761	8,424	13,811	11,228	11,070	15,554	12,517
Repayments (*)	-1,672	-1,920	-2,172	-2,992	-4,060	-5,324	-6,385	-5,020	-6,242	-6,916
Others (**)	-251	326	1,536	920	96	1,358	1,323	2,608	1,877	1,280
VI. Errors & Omissions	+382	-68	-439	554	-602	-639	130	-408	-414	-544
VII. Superavit/Deficit	+2,179	-936	-950	1,192	630	4,262	-3,215	-3,490	625	-8,956
Reserves	6,416	5,269	4,040	6,544	7,256	11,895	9,689	6,913	7,507	3,994
Gross Debt	12,572	17,166	21,171	25,985	32,037	43,511	49,904	53,848	61,411	69,654

(*) Average and long term
(**) Short term included

Source: Malan and Bonelli (1983)

Part of this growth may be due to price factors, since Brazilian export prices rose less than the average (see Table 7), reflecting both the competitiveness of Brazilian firms and the Government fiscal and credit incentives to exports. However, several studies of Brazilian export performance have attributed this success to technological factors (Araujo Jr. and Reis 1981, Araujo Jr. et al. 1983; Guimarães et al. 1983).

Other authors (e.g. Lall 1982), building upon the experience of Brazil and other NICs (especially Korea and India) argue that the technological development achieved by such LDCs through "minor innovations" in the capital goods industry and engineering services is an indicator of their dynamic comparative advantages and that a new international division of labour is emerging, in which "the comparative advantage of developed versus developing countries will be determined not so much by skill requirements in general, but by skill inputs based on specific learning processes which cannot be replicated in developing countries" (Lall 1982, p.174, original emphasis).

The technological development of the Brazilian capital goods industry has been studied by many authors (e.g. Cruz 1983 , Erber 1982, among the most recent ones(1)). Such studies show that the Brazilian capital goods industry has acquired considerable mastery over the full set of design and manufacturing technological activities for a range of products, based on the tradition of metalworking in Brazil(2) and on processes of copying-and-adapting. Nonetheless, the evidence available suggests that such trajectory of technological development is limited and that the Brazilian industry tends to rely on imported technology for new and more complex products.

Part of the shift to the imported technology can be attributed

(1) See Erber (1977 and 1981) for a full set of references.

(2) The Brazilian industrial metalworking tradition goes back to the early decades of this century. Comparing the achievements of Brazilian firms to those of other Latin American countries, Cruz (1983) emphasizes the role played by such experience. See also Section (1) above.

TABLE 7 - PRICE INDEXES OF CAPITAL GOODS EXPORTS FROM BRAZIL, JAPAN, FEDERAL REPUBLIC OF GERMANY AND THE U.S. - 1970/79

Year	All, except Brazil (1)	Japan (2)	FRG (3)	U.S. (4)	Brazil (5)	(5/1)
1970	63	68	49	76	68	1.08 (100)
1971	67	71	55	77	67	1.06 (93)
1972	71	77	62	78	69	0.97 (90)
1973	81	87	79	80	76	0.94 (87)
1974	91	97	87	91	90	0.99 (92)
1975	100	100	100	100	100	1.00 (93)
1976	103	98	103	107	105	1.02 (94)
1977	112	104	116	114	110	0.98 (91)
1978	129	126	137	123	116	0.90 (83)
1979	139	124	155	134	121	0.87 (81)

Source - Araujo Jr. and Reis (1981).

to technical factors, since "reverse engineering" is difficult to apply when the gap between the previous experience of the firm and current requirements of design and manufacturing are large and time for learning is short. In this sense, the steep upswing of demand in the Brazilian two cycles of the post-war period and the shift of demand from the non-durable consumer goods industry to the durable consumer and intermediary sectors probably created a gap of time-and-requirements which induced the use of imported technology. Moreover the main purchasers of capital goods in the period used mainly continuous flow processes, where "reverse engineering" of machinery is more difficult to perform, especially in the absence of engineering services (plant design and specification) capabilities.

The literature on the industry (especially Erber 1977, 1982) has shown that the import of technology does entail the development of a local technological capability - in fact it argues that such capability is inherent to the licensing relationship. On the other hand it also shows that such learning is limited, so as to preserve the relationship. This should be no cause of surprise if one considers the rationale of the exporter of technology.

Exporters of technology have a deep-seated interest in ensuring that their customers possess some technological capabilities, since their earnings are usually pegged to the latters sales and because the responsibilities of licensor and licensee are very difficult to apportion in cases of failure, breakages, etc. which may jeopardize the licensor's international reputation. Thus, the importer of technology must be at least able to manufacture the goods and/or operate the processes according to the specifications, failing which the licensor must teach the licensee how to do it.

Moreover, in order that a product can be manufactured, all its parts and components must be specified to minute detail, and such specification must conform to the available supply of materials, parts and components, as well as to the specific production conditions of the local manufacturer. Therefore, the

stage of detailed design[1] is better performed locally where the product is to be manufactured, than abroad, where the licensor is located. For all parties, then, it is desirable that the licensee should know how to produce detailed designs.

Although manufacturing know-how and detailed design skills are a necessary condition for introducing innovations (as well as for production), they are not sufficient for purposes of innovation: basic design skills are necessary for innovation. Moreover, the mastery of the first two skills does not lead necessarily to a basic design capability: although in some products, especially mechanical products, it is often possible to progress from one to the other; in others, notedly in products which perform atomic or molecular transformation, there is a

(1) The design of a machine goes through three main stages (Asimow, 1962):

(i) Feasibility - The design process starts from a need recognition. Such are then converted into the essential functions the equipment must perform and the latter expressed by specific performance requirements (e.g. capacity of containment and support). If, by confronting the resources available to the firm with such requirements and other constraints (e.g. delivery time), the enterprise decides that the equipment is feasible, it may end up with a set of feasible design concepts from which one will be chosen in the next stage.

(ii) Basic design - Sometimes called "preliminary design", this is,technically, the most important stage in the design process since it involves not only the choice of the design concept to be implemented but also the specification of the structure of the equipment (the arrangement of its parts) and the definition of the materials, sub-assemblies and components to be used in its manufacture. The main elements which determine the competitive possibilities of a machine (technical performance, cost and delivery time) are defined at this stage.

(iii) Detailed design - here the main consideration is to provide information for production as each part is drawn in detail to be manufactured,with emphasis being placed upon dimensions and tolerances.

The relative importance of the three stages of design will depend on largely the novelty of the product for the enterprise. When the product is well known to the enterprise, the emphasis is on optimization of the characteristics of the product at the preliminary design stage, the importance of feasibility increasing with the novelty of the product.

In terms of the categories of R&D, more often used in the literature on innovation, according to international definitions (e.g. the Frascatti Manual of the OECD) the feasibility and basic design stages should be included in "development", as long as the design is for a new product, but detailed design should be excluded. For a fuller analysis of the design stages and technical references, see Ember (1977).

discontinuity of knowledge between basic design on the one hand and detailed and manufacturing technology on the other.

Since, basic design skills are not necessary for producing the goods, the exporter of technology has no interest in closing such gap; quite the contrary, the teaching of such skills could foreclose a future source of revenues and even nurture a future competitor, especially where technical progress is incremental and engineering-based as in the capital goods sector. The same applies to the skills for the feasibily stage of design. For branches where innovation is not only design - intensive but also science-based, such as eletronics, the transfer of technology is much more limited.

Thus, licensing does provide for learning but it is partial learning - a type of learning which, at the same time, ensures the licensor's revenues and the continuation of the relationship over time. Such technical control is strenghtened by legal provisions: as it is well known, technology is not sold, but leased - the owner of the technology does not forsake the property of the technology, only allows the licensee to use it for a limited duration of time, under certain conditions, some of which may by quite restrictive (export prohibitions, tied-in imports, etc). Such legal control applies even in the absence of patents, although the latter strenghtens it.

The same pattern of limited learning was observed in the case of foreign subsidiaries, where the parent company had to transfer a manufacturing and detailed design capability but not the others. The Latin American literature on MNCs suggests that this strategy was not only due to scale-economies in the production of technology but also to the extraordinary profits they reaped through "technology-related" intra-firm transactions (Vaitsos 1974, Fajnzylber and Tarragó 1976).

Thus, the evidence of the literature argues that the transfer of technology is structurally limited on the side of the supplier of technology. Moreover, it is structurally limited on the side of the importer too.

In fact, one of the main questions posed by this literature was: since the local entrepreneurs were aware of such limitations (as shown by the research) and of the costs they entailed (tied-in imports, export prohibitions, threats of being ousted from the market by a subsidiary after the licensee had tested the market, or having to pay for the technology in equity; at least relinquishing the control of some important decisions), why did they not invest more in their own technology, walking, so to speak "on two legs"?

The answer showed that many factors were at work, among which six ranked especially high:

- The competition of foreign technology, which, being easily imported, put a high risk on attempting to develop local technology, especially where lead times were longer and costs higher. Government policies related to foreign investment, imports of capital goods (where project financing played a crucial role) and import of disembodied technology were important determinants of such competition.

- The pressure of clients. which often made the use of imported technology a conditio sine qua non, barring thus the possibility of developing local technology. This was especially observed in Brazil for capital goods and engineering services, inclusive for State enterprises purchases.

- The structures of the markets where such enterprises operated, which placed a premium on the monopoly they were granted by the licensor, and also allowed them to pass on to the customers the cost of the technology imported.

- The size of the local market, relative to the expenditures necessary to develop local technology and the lack of protection of such technology.

- The short term horizon with which local enterprises operated, in many cases due to the lack of planning by the State.

- The political outlook of local enterpreneurs, who were more afraid of being controlled by the State than by foreign firms.

Thus, at one level of analysis, the answer was that the dynamics of economic and political forces was such that there was no incentive to the local entrepreneurs (and even less to subsidiaries of foreigh firms) to develop a technological capability beyond that provided by technological transfer. This conclusion could be used to justify State intervention to foster such further development - and it often was.

The preceding analysis has, however, further implications to carachterize the specificity of the development of LDCs. First it argues that the import of technology (similarly to the import of capital goods) is a necessary conditions in phases of fast capital accumulation and structural change. But, second, it points out that such technology imports prevent the local capital goods industry from playing the same role in the "virtuous circle" of growth of the developed economies, since the CGI is unable to generate or fully absorb the whole range of technological capabilities, and the links between the industry, engineering services and other activities are only partially established, creating a "vicious circle" of undevelopment.

The same limitations impinge upon the thesis that the NICs could rely upon their technological capability in capital goods and engineering services to break the foreign exchange constraint, fashioning a "new international order". Such capability is, as use have seen, structurally limited and its relevance for the insertion of such countries in the international division of labour is likely to be further reduced in the future.

Although the way out of the present cycle is not in sight, it is clear that it will be associated with a deep change in the technical basis of the world economy, of which some aspects are already visible in the development of eletronics and biotechnology of which the former is especially important for the capital goods industry and related services.

Electronics is well know, based upon large-scale scientific activity on the frontiers of technology and its activities are to a considerable extent aimed at meeting changing needs of high-income, brand-conscious consumers, activities in which the LDCs have no comparative advantagens. The resources used for innovation in those industries are highly concentrated in the advanced countries and the theory and experience of diffusion of innovations strongly suggest that the rate of diffusion of such innovations will be much faster in the centre than in the LDCs, widening their gap; not only in research and development but also in manufacturing technology.

Moreover the diffusion of eletronics will affect many of the activities in which the NICs could have comparative advantages as regards both more and less-developed countries than them. This applies, for instance for the simpler (non-eletronic) machine-tools and the labour-intensive detailed design services they would sell to the advanced countries (Lall 1982), which are likely to be replaced by numerically-controlled machine tools and computer-aided design[1], produced more efficiently in the central countries. The latter may also prove to be strong competitors in the markets of the least developed countries (markets not to be overlooked in the present crisis), since eletronics will reduce the costs of adaptation of designs and of scaling-down of process and equipment to suit the specific needs of such countries[2].

Another cycle-related factor which may reduce the technology exports of LDCs is their capacity to finance them. The present balance of payments problems faced by countries such as Brazil, Mexico, Argentina, Korea, will probably undermine further their technology export capability by reducing their capacity to finance such exports in conditions similar to those provided by the more advanced countries.

(1) For evidence on the gap of diffusion of eletronic-based capital goods between central and peripheral economies see, among others, UNCTAD (1982), Taulie (1983). For computer-aided design see Kaplinsky (1982).

(2) As it is well known, one of the main features of the eletronic innovations is that they break the link between automationand large-scale production, allowing for the automation of batch production.

Finally, the present phase of the cycle may lead to a reduction of the technological capability of the LDCs, not only in relative terms (the widening gap argument outlined above) but also in absolute terms, by two mechanisms. The first is the closure of local firms, unable to resist the international crisis and the restrictive policies local Governments have put in practice to control inflation and balance the external account (at least in Latin America). The sectors producing the goods and services composing the technology exports are likely to be specially affected, given the role played by their local public enterprises demand for their survival. The drastic cut-down in public investment in such countries finds no compensation from increased exports, since protectionist and/or contractionist policies are spreading, with feed-back effects[1]. The closure of such enterprises means the liquidation of a technical capability which will take long to reconstruct, even when the new upswing comes. (Cruz, 1983).

The second mechanism is the shift of manufacturing from LDCs to the central countries by multinational companies. Stimulated by the new possibilities of automation opened up by electronics and by an increased weight attached to product-quality in competition, this seems to be already hapening in eletronic semiconductor production (Rada 1982). It is still unclear how extensive this phenomenon will be but it clearly abodes bad for the capital goods and related services technology and production capabilities of the LDCs.

The conclusion that technological dependence is just part of a specific pattern of development is also important to avoid some pitfalls of technological determinism - it is not simply by changing the degree of technological self-reliance that this pattern of development will be radically transformed - a "naive optmism" often found, in the literature. The determinants of technological dependence have to be sought not only at the level of the lack

(1) For instance, one of the leading manufacturers of machine tools in Brazil recently went into receivership when their Mexican market closed. The reduction of investment of OPEC countries will also reduce the markets for the LDCs technology exports.

of technical and scientific skills in LDC's (although they may be a powerful constraint in some cases) but especially at the level of the economic and political considerations which guide the action of the enterprises and of the State as regards the development of local technical capabilities.This view also leads to a reassessment of the role explicit science and technology policies may have in changing the technological dependence. When such policies do not converge with the other policies (e.g. policies related to foreign investment) their efficacy is severely limited, since they alone, cannot change the pressures and inducements (some of which were mentioned above) which lead the enterprises to rely mainly on imported technology.

This argument seems to be applicable to another major strand in the literature - that the development of a capital goods industry in the LDCs is justifiable if such development would lead to the use of more labour-intensive technologies and to the production of goods and services more appropriate to the level of income of the bulk of the population in such countries. Although such use of the technological and manufacturing capabilities of the capital goods industry is highly desirable from the point of view of equity and social welfare, it faces as a necessary condition a drastic change in the political and economic conditions which rule the present pattern of development of Brazil and other LDCs.

8 - The CGI and the pattern of development of LDCs - some conclusions

The issue of the specificity of the patternal development of LDCs is one of the most important dividing lines between authors which deal the problems of development. Some authors have argued that, if unimpeded, capitalism tends to reproduce itself on a world-wide scale, generating similar productive and distribution structures (e.g. Rostow, 1960) while others have stressed the specificity of the insertion of LDCs in the international division of labour in terms of commercial, investment and financial

relationships which, coupled to their internal productive and distribution structures (strongly influenced by their colonial heritage), fashion a pattern of development which is not only specific but more limited than that of the "central" economies.

The analysis of the Brazilian capital goods industry[1] lends weight to the second group of authors. Although Brazil is the largest producer of capital goods in the Third World, its capital goods industry does not seem able to play the same role in the dunamics of capital accumulation and technical progress it does in the advanced countries, nor to break the foreign exchange constraint of the economy.

The limited development of the local capital goods production and technology is the result of many, inter-related, factors among which are worth stressing the financial structure of the economy and the interindustrial relationships. The former has given a new character and strenght to the foreign exchange constraint and, thus, to the relationships between Brazil, the advanced countries and the international financial system, which now play a decisive role in the internal development of the capital goods industry. The latter are based upon highly skewed income and wealth distributions. To change both, so that the capital goods industry fulfills the same role it does in advanced countries would require very deep changes in the economic social and political structures of the Brazilian society and in the way the Brazilian economy is articulated to the international system. Such changes would indeed require a great change in the Brazilian pattern of development and, last but not least, in the way the international economic and political systems are structured and operate.

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(1) The same applies to the related engineering services.

REFERENCES

Alves, S. and Ford, E. (1975) - O comportamento tecnológico das empresas estatais: a escolha de firmas de engenharia, a escolha de processos industriais e a compra de bens de capital, FINEP, mimeo, Rio de Janeiro.

Araujo Jr., J. T. and Reis, E. (1981) - "Exportações de bens de capital: desempenho recente e perspectivas". IPEA/INPES, mimeo, Rio de Janeiro.

Araujo Jr., J. T. et al. (1983). "Exportação de Manufaturados, Concorrência e Mudança Tecnológica: um estudo da experiência brasileira dos anos 70". IEI/UFRJ, Relatório de Pesquisa, Rio de Janeiro.

Asimow, M. (1962) - An Introduction to Design, Prentice Hall, USA.

Bergsman, J. (1970) - Brazil - Industrialization and Trade Policies. Oxford University Press, London.

Castelo Branco, F. (1976) - "Importações de Bens de Capital e Substituição de Importações: algumas considerações sobre o problema recente no Brasil." Universidade de Brasília, M.A. Thesis, Brasília.

Cardoso, F.H. (1973) - Autoritarismo e Democratização, Paz e Terra Terra, Rio de Janeiro.

Cruz, H. (1983) - Mudança tecnológica no setor metal-mecânico do Brasil - Resultados de estudos de casos, Tese de Livre-Docência, Universidade de São Paulo, São Paulo.

Dosi, G. (L982) - "La circolaritã tra progresso tecnico e crescita: alcune osservazioni sulla "legge Verdoorn-Kaldor"."L'Industria, vol. III, n.2.

Ellis, H. and Wallich, H. (1961) - Economic Development for Latin America, Macmillan & Co., London.

Erber, F. (1974) - "A Empresa Estatal e a Escolha de Tecnologia", Ciência e Cultura, vol. 26, n.12.

_____ (1977) - Technological Development and State Invertention: a study of the Brazilian Capital Goods Industry, D. Phil Thesis, University óf Sussex.

_____ (1981) "Science and Technology Policy in Brazil: a Survey of the Literature", Latin America Research Review, vol. SV, n.1.

_____ (1982) - Technology issues in the capital goods sector - a case study of leading industrial machinery producers in Brazil. UNCTAD, Geneva.

Erber, F. et al. (1974) - Absorção e criação de tecnologia na indústria de bens de capital. FINEP, Série de Pesquisas n. 2, Rio de Janeiro, Brazil.

Fajnzylber, F. (1983)- La Industrializacion Trunca de America Latina, Editorial Nueva Imagen, Mexico.

Fajnzylber, F. and Tarragõ, T. (1976) - Las Empresas Transnacionales - expansión a nivel mundial y proyección en la industria mexicana, Fondo de Cultura, Mexico.

FIPE, Fundação Instituto de Pesquisas Econômicas (1978 - Pesquisa complementar sobre substituição de importações. FIPE, mimeo, São Paulo, Brazil.

Ford, E. et al. (1977) - A oferta de serviços de consultoria de engenharia no Brasil. FINEP, mimeo, Rio de Janeiro.

Guimarães, E. et al. (1983) - "O Progresso Técnico e o Desempenho das Exportações Brasileiras de Manufaturados", mimeo, FUNCEX, Rio de Janeiro.

Hirschman, A. (1958) - The Strategy of Economic Development, Yale University Press. New Haven.

Kalecki, M. (1977) - As Equações Marxistas de Reprodução e a Economia Moderna in M.Kalecki - Crescimento e Ciclo das Economias Capitalistas, Ed. Hucitec, São Paulo.

Kaplinsky, R. (1982) - "Trade intechnology: who, what, where and when?" International Workshop on Facilitating Indigenous Technological Capability, Edinburgh.

Lall, S. (1982) - Developing Countries as Exporters of Technology, Macmillan, London.

Lessa, C. (1964) - "Quinze Anos de Política Econômica", Centro CEPAL/BNDE, mimeo, Rio de Janeiro.

Luxemburg, R. (1961) - The Accumulation of Capital, Routledge and Kegan Paul Ltd., London.

Malan, P. and Bonelli, R. (1983) - "Crescimento Econômico, Industrialização e Balanço de Pagamentos - O Brasil dos Anos 70 aos Anos 80". IPEA/INPES, Textos para Discussão Interna n.60, Rio de Janeiro .

Marx, K. (1968a) - "Matériaux pour l'"Economie"" - in K. Marx, Oeuvres, Vol. II, Bibliothèque de la Pleiade, NRF, Paris.

_____ (1968b) - "Materiaux pour le Deuxiéme Volume du Capital", ibid.

Matthews, R. (1959) - The Trade Cycle, James Nisbet & Co. Ltd., Cambridge.

Mazzuchielli, F. (1977) - "A expansão inconclusa: considerações sobre o setor de bens de capital no Brasil. Universidade de Campinas, M.A. thesis, Campinas.

Nelson, R. and Winter, S. (1977) "In search of a useful theory of innovation", Research Policy.

Nurkse, R. (1953) - Problems of Capital Formation in Underdeveloped Countries, Oxford University Press.

Rada, J. (1982) - Structure and Behaviour of the Semiconductor Industry, IMI, mimeo, Geneva.

Ricardo, D. (1973) - The Principles of Political Economy and Taxation, J.M. Dent & Sons Ltd., London.

Rodriguez,O. (1981) - A Teoria do Desenvolvimento da CEPAL. Forense Universitária, Rio de Janeiro.

Rosenberg, N. (1963) - "Capital goods, technology and economic growth". Oxford Economic Papers, vol. 15.

Rosenstein-Rodan, P. (1961) - "Notes on the Theory of the Big Push" in Ellis, H. and Wallich, H. (eds.O, op.cit.

Rostow, W. (1960) - The Stages of Economic Growth, Cambridge University Press.

Salter, W. (1960) - Productivity and Technical Change, Cambridge University Press, Cambridge.

Santi, P. (1973). "El debate sobre el imperialismo en los classicos del marxismo", Cuadernos de Pasado y Presente n. 10, Cordoba.

Stewart, F. (1966) - "Capital Goods in Developing Countries in Cairncross and Puri (eds.), Employment, Income Distribution and Development Strategy, MacMillan, London.

Suzigan, W. et al. (1974) - Crescimento Industrial no Brasil: incentivos e desempenho recente. IPEA/INPES, Relatório de Pesquisa n. 29, Rio de Janeiro, Brazil.

Tauile, J.R. (1983) - "A difusão de máquinas-ferramenta com controle numérico (MFCN) no Brasil e algumas implicações para o desenvolvimento econômico", in Ciência, Tecnologia e Desenvolvimento, no. 2, CNPq/UNESCO.

Tavares, M.C. (1964) - "The growth and decline of import substitution in Brazil", Economic Bulletin for Latin America vol. IX, no. 1.

_____ (1978) - Ciclo e crise - o movimento recente da industrialização brasileira. Tese para Professor Titular, Universidade Federal do Rio de Janeiro, Rio de Janeiro.

Tavares, M.C. and Belluzzo, L. (1979) - "Notas sobre o Processo de Industrialização Recente no Brasil", Revista de Administração de Empresas, vol. 19, n.1.

Tyler, W. &1980) - "Restrições à importação e incentivos fiscais para o setor de bens de capital no Brasil, 1975/79". Pesquisa e Planejamento Econômico, vol. 10, n.2.

UNCTAD (1982) - The impact of eletronics technology on the capital goods and industrial machinery sector: implications for the developing countries, UNCTAD Secretariat, Geneva.

Vaitsos, C. (1974) - Intercountry Income Distribution and Transnational Enterprises, Oxford University Press.

Varga, E. (1963) - O Capitalismo do Século XX, Biblioteca Universal Popular, Rio de Janeiro.

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