

Brazilian Industry in the 1990s: What Can Already Be Said?*

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Abstract

The objective of this paper is to revisit the issue of the impact of trade liberalization on Brazilian industry, extending to the period 1989-98 a series of indicators relating to structural changes and both technical and allocative gains in efficiency, that were originally calculated by Moreira and Corrêa (1996) for the period 1989-95. The results obtained confirm the conclusions of the previous study, corroborating their opinion that the impact of opening was generally in the desired and expected direction, despite the unfavorable macroeconomic environment that prevailed for most of the period in question. The updating of this study reveals that during the second half of the decade a movement towards the greater specialization of industry advanced, albeit at a slower pace, in line with the availability of domestic resources. As in the preceding period, this trend showed all the signs of intra-industry specialization.

1. Introduction

The 1990s marked the transition by Brazilian industry to a new trade regime, whereby it left behind at least four decades of heavy protectionism against imports. The inheritance of the old regime is still the subject of heated discussions, but certain facts are undeniable. During this period, a wide and diversified industrial structure was established, with manufacturing industries expanding their share of GDP from 19% in 1955 to 30% in 1990. This increase reflected accelerated rates of growth that finally spread to the whole of the economy, and permitted average GDP growth for the period of 6.3%. The expansion of industry also made possible a diversification of Brazilian exports. Manufactured goods that represented around 1% of total exports in 1955 had come to represent some 50% of exports by the end of the 1980s. This legacy should by no means be underestimated, but at the same time, recognition of the achievements of the old regime should not be used as an excuse to overlook its shortcomings. This is particularly the case, since a clear vision of its negative aspects is a necessary condition for drawing up policies that allow the country and its industrial base to continue to evolve.

The distortions created by the import substitution regimes have already been discussed at length and documented in the literature on trade and development [Krueger (1984)], while analyses of the Brazilian case [Moreira (1995) and Franco (1998)] suggest that country has been no exception to the rule. The problems are concentrated around five principal points:

- a) protection particularly favored sectors demanding resources that were scarce within the country, such as capital and technology, leading to the inadequate use of abundant resources, such as labor and natural resources;
- b) high protection barriers provided an incentive for the entry of a large number of producers to capital- and technology-intensive sectors, most of which were multinational corporations, hindering the achievement of economies of scale;
- c) frequent recourse to high levels of nationalization that was incompatible with the level of technological development and the size of the Brazilian market led to inefficiencies and the wasting of resources at all points of the production chain;
- d) the high protection barriers around the domestic market created a strong bias against exports, blocking the achievement of economies of scale and the associated efficiency gains, since domestic prices were permitted to remain well above those of the international market;
- e) as a consequence of points (b) and (d), Brazilian companies that were restricted to a fragmented domestic market did not succeed in achieving a size that allowed them to reduce their disadvantages of scale by comparison with their international competitors; and
- f) protection barriers against imports and disincentives against exports isolated local producers from international competition, undermining incentives for reducing costs and introducing new products.

At the end of the 1980s, the significance and seriousness of these distortions manifested themselves through signals such as outdated products [Fonseca (1996)], low productivity and low growth in productivity [McKinsey (1997) and Bonelli and Fonseca (1998)], uncompetitive scales of operation [Tadini (1993) and Lago et al. (1979)], and a fall in export sales of manufactured goods, particularly for labor-intensive industries [Lucke (1990)]. The change in regime made these deficiencies even more apparent, and set in motion a series of pressures for their correction. Moreira and Corrêa (1996) made a first attempt to evaluate these changes, presenting evidence that until 1995 pointed in two directions: significant structural adjustments, largely led by a greater penetration of imports, that affected capital-intensive sectors more profoundly, particularly capital goods; and gains in technical and allocative efficiency, as demonstrated by faster growth in productivity and by sharp reductions in sector margins.

The objective of this article is to revisit these changes that have occurred during the course of the 1990s, taking advantage of the fact that data is now available for a longer period of the new regime (1989-98). It is also possible to draw on a more extensive literature on the subject. This study is organized into three sections, in addition to this introduction. In the following section, an attempt is made to analyze the changes from the point of view of the sectorial allocation of resources, and the role of trade liberalization in these changes. The third section discusses these impacts in terms of technical and allocative efficiency, while the final section presents the main conclusions.

2. Structural Changes

Trade and Industry Coefficients

Moreira and Corrêa (1996) worked with a series for gross production in current dollars (1989-95) for 45 sectors of the manufacturing industry, defined according to the input-output matrix for 1980 (=100). For the years 1989, 1990 and 1992, they used original information from the Annual Industry Survey (PIA) of the Brazilian Statistics Institute (IBGE), converting this to dollars at the average exchange rate for the year in question. On the basis of this information, they estimated the value of production for other years using the nominal production index, which they derived by multiplying the PIM-PF physical production index by a sectorial price index based on the 1980 matrix. This latter index was in turn constructed on the basis of the Getúlio Vargas Foundation's Wholesale Price Index (IPA-OG). The authors then harmonized trade data (Secex and Internal Revenue) with production data using a NBM/1980 sector matrix translator¹.

Three years later, a longer and revised series of PIAs (1989 and 1995) is now available, as is another source of data: the National Accounts (1990-97)². Other estimates were also made of the value of industrial production, on the basis of the censuses of 1985 and 1996 cited in Hagenauer et al. (1998). The PIAs nevertheless remained the most up-to-date primary source for data on industrial production volumes, and thus appear to us to be the most reliable source³. In order, therefore, to extend the analysis of the impact of opening to the remainder of the decade, we decided to maintain these as our principal source of data. As in the previous study, the PIM-PF and IPA-OG were used to update the current dollar industrial production series from 1995 to 1998. We also decided to widen the scope of the study, increasing the number of sectors covered from 45 to 49, corresponding to a sample that in 1995 accounted for 89% of the gross value of production, compared to 75.5% in Moreira and Corrêa (1996).

Graph 1 shows the first results relating to the trade coefficients for the manufacturing industry. The new series confirms the penetration behavior of imports, measured both in terms of production and of apparent consumption. This may be divided into three distinct periods: a gradual increase during 1989-94, explosive growth in 1995 and a return to more gradual growth from 1996 onwards. These differences in growth rate appear to have been influenced not only by the timetable of tariff reductions, but also by the behavior of the exchange rate and by GDP growth over the period. A simple econometric exercise suggests that import penetration is positively correlated with GDP, possibly in association with greater income elasticity of imports that in turn results from a greater import component for investment (see below). This is normally linked to higher rates of GDP growth, as well as to the more sophisticated nature of imported consumer goods. There are also signs of a positive correlation with the real exchange rate, which is contrary to expectations. We must nevertheless take into consideration the fact that this result was not statistically significant,

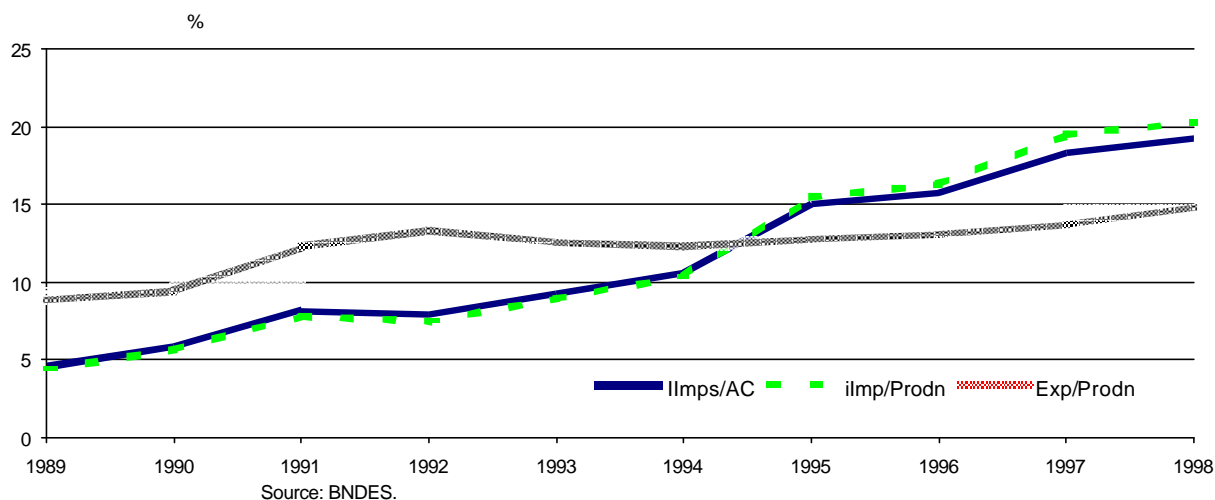
¹ For further details of methodology, see Moreira and Corrêa (1996).

² The 1996 PIA, was also available at the time of writing of this article. At the same time, given changes in classification and the unit of statistical registration used by the IBGE, it was not possible to harmonize these results with those of previous years.

³ National Accounts estimate data on the basis of the PIM and the IPA.

and that the devaluation of the exchange rate initially leads to a reduction in the dollar value of domestic production, thus increasing the coefficient of penetration.

Graph 1- Trade Coefficients of Manufacturing Industry: 1989-98



Whatever the factors that may have influenced the rate of growth of import coefficients, it is important to reaffirm that this increase was not only expected, but also desired in the light of the Soviet-style levels of openness of Brazilian industry at the end of the 1980s. The path to a more efficient allocation of resources and economies of scale passes inexorably via growth in imports. It may nevertheless be argued that the same path leads to deindustrialization. At the same time, when compared with international experience, these levels of import coefficients reached at the end of the period (19.3% in terms of apparent consumption and 20.3% in terms of production) do not support the hypothesis that this has actually happened.

Table 1 presents the evolution of the import penetration coefficients for the principal OECD countries between 1970-90. As may be seen, all countries experienced a significant increase in imports during the period, reflecting the multilateral reduction in trade barriers to manufactured goods. The new advances achieved with the Uruguay Round of the General Agreement on Trade and Tariffs (GATT) that was concluded in 1993, suggests that these coefficients probably continued to rise after 1990. In any case the levels at the start of the decade are already sufficient to place the Brazilian experience in perspective. The only countries with a coefficient below that achieved by Brazil in 1998 were the United States and Japan. Adam Smith had already said that the division of labor was limited by the size of the market. That is, it can hardly be expected that the Brazilian economy, equivalent to 10% of the U.S. and 13% of the Japanese economy, will work efficiently with a degree of industrial diversification approaching these countries, particularly if we take into consideration the differences in terms of human capital and technological development. A comparison with Mexico (in terms of the import/production ratio), a country that like Brazil is normally classified as “recently industrialized” or “developing”, also shows that the Brazilian import coefficient (20.3% in terms of imports/production) is closer to its lower limit.

TABLE 1
Import Penetration Coefficients* for Manufacturing: Selected Countries – 1970-90

Country	1970	1980	1989/1990
Australia	15.6	19.2	24.8
Canada	24.6	30.7	35.1
Denmark	41.1	43.7	50.2
Finland	27.9	27.8	31.4
France	14.5	21.3	29.9
Germany	13.4	19.8	26.8
Italy	15.7	20.0	21.3
Japan	4.0	5.5	6.3
Holland	42.0	53.0	70.2
Norway	39.8	38.7	42.9
Sweden	29.5	35.9	41.3
United Kingdom	14.6	22.9	30.0
United States	4.4	8.7	13.9
Mexico**	-	40.5	88.1***

Sources: OECD (1994) and Dussel Peters (1997).

*Imports divided by apparent consumption.

** Imports divided by production.

*** 1995.

It is true that geographical variables also have a decisive influence on the degree of openness of an economy [Frankel and Romer (1996)]. In the case of Brazil, the size of the country and its population, as well as its distance from its principal markets conspire to reduce this degree. At the same time, these variables taken in isolation are hardly sufficient in themselves to justify a degree of import penetration much lower than that obtained in 1998. This point is illustrated by a comparison with countries whose markets are closer in size to that of Brazil, and that have certain geographical characteristics in common, such as Canada (with regard to land area) and Australia (with regard to land area and distance from its principal markets), whose penetration coefficients are respectively 80% and 28% higher than that of Brazil.

The new series also confirms that the share of export production grew during the period, albeit at a slower and more uniform pace than the growth of import coefficients (Graph 1). In other words, the data corroborates the expectation that the change of regime, by reducing the anti-export bias and promoting gains in productivity (see next section), would increase the importance of the external market for producers of manufactured goods. It is important to note that this expectation was confirmed despite an unfavorable macroeconomic environment, particularly with regard to the real exchange rate. This same environment, together with the specific difficulties of expanding foreign sales [Roberts and Tybout (1996)] appears to underlie the growing differential in the growth of export and import coefficients observed during the period. With the consolidation of the new regime and the improvement in macroeconomic conditions, in particular, with the real devaluation of the currency, this differential is expected to diminish, principally as a result of export growth. As has already been noted, it seems unlikely that Brazilian industry will come to operate in an efficient manner with levels of import penetration below those registered in 1998.

Trade Coefficients and Sectors

Tables 2, 3, 5, 6 and 7 present the results of trade coefficients for the 49 sectors, which are grouped by the level of the factor and by six categories of product. Starting with import coefficients (Tables 2 and 3) and restricting our comments to the relationship between imports and apparent consumption (the rankings on the basis of the two import coefficients are very similar⁴), the new series confirms the differentiated impact of imports on various sectors, reflecting the comparative and competitive advantages of the country and the need for economies of scale and specialization (Table 2). As expected, the most affected sectors continue to be technology-intensive ones, most notably the manufacture of other vehicles, electronic and communications material and equipment, as well as machines, equipment and instruments, for which imports exceeded 50% of apparent consumption. The newcomer to this group is other vehicles, with a surge in imports in the last two years, led by imports of airplanes.

The high coefficients reported for the technology-intensive group should not, however, be hastily interpreted as evidence that the same group is doomed. Substantial economies of scale and specialization within such sectors may imply higher penetration coefficients, even in developed countries, albeit with these largely compensated by equally high export coefficients. That is, specialization occurs within industries, rather than necessarily between them. Table 4 illustrates this point. As may be verified, the principal OECD countries, with the exception of Japan, presented higher penetration coefficients in more technology-intensive sectors. The levels of these coefficients (our classification of technology-intensive sectors corresponds approximately to the medium and high technological intensity categories of the OECD) are close to or even higher than those achieved by Brazil in 1998. In addition, as will be seen below, technology intensive sectors also achieved the highest export penetration coefficients in Brazil in the same year, pointing to a pattern of intra-industry specialization.

⁴ The Spearman correlation coefficient is 0.97 (significant at the 1% level).

TABLE 2
Coefficient of Imports/Apparent Consumption – 1989-98 (%)

Sector by Factor Intensity	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Capital-intensive										
Chemicals excluding petrochemicals and carbochemicals	41.4	43.2	48.9	34.1	33.0	39.5	47.2	51.2	53.8	57.9
Resins, fibers, elastomers	6.3	9.9	12.1	10.9	14.7	16.1	28.2	31.9	31.3	33.0
Fertilizers and soil supplements	9.8	13.2	17.8	18.7	21.6	19.4	21.2	23.7	26.1	27.2
Miscellaneous chemicals	5.7	5.0	4.8	6.8	8.0	9.9	11.7	11.6	13.3	15.0
Oil refining	3.1	2.9	5.9	8.3	14.3	11.2	13.6	15.4	15.7	12.1
Other metal products	1.5	2.3	3.8	2.7	3.3	4.4	7.0	8.7	11.8	11.5
Basic and intermediate petrochemicals	4.0	4.6	8.4	5.1	5.8	8.8	12.0	12.5	12.0	9.9
Steel	1.9	1.9	2.8	4.5	3.3	3.8	5.9	5.5	6.7	8.8
Cast and wrought steel products	0.5	1.1	1.4	1.0	0.8	1.0	1.5	2.3	3.7	6.2
Plastic sheeting	0.2	0.7	0.9	0.7	0.7	2.4	8.0	5.2	3.6	5.0
Average*	7.4	8.5	10.7	9.3	10.6	11.6	15.6	16.8	17.8	18.7
Labor-intensive										
Treatment, spinning and weaving of natural fibers	3.5	3.9	6.6	5.5	14.1	13.1	16.9	22.1	23.4	18.1
Spinning and weaving of artificial and synthetic fibers	0.8	1.6	3.1	2.5	4.3	10.5	21.6	13.8	16.5	17.7
Glass and glass articles	4.0	5.9	7.6	6.2	6.8	9.0	13.1	16.0	16.2	15.2
Other textile industries	1.0	1.3	2.7	2.8	1.9	2.8	7.2	8.7	12.3	13.1
Footwear	0.4	0.7	2.3	0.7	1.2	3.2	8.1	9.2	11.8	9.6
Apparel and accessories	0.3	0.5	0.7	0.7	0.6	1.0	5.1	6.1	7.9	7.7
Plastic articles	0.5	1.2	1.8	1.4	2.2	2.7	5.1	5.9	6.4	6.1
Perfumes, soaps and candles	1.6	1.6	2.1	1.4	1.7	2.6	4.4	4.5	5.2	5.7
Average*	1.5	2.1	3.4	2.6	4.1	5.6	10.2	10.8	12.5	11.6
Technology-intensive										
Manufacture of other vehicles	18.8	23.1	27.6	32.8	29.0	23.6	29.7	37.5	57.5	70.8
Electronic and communications materials and equipment	11.6	17.6	27.3	26.4	25.8	33.5	41.6	47.3	62.0	66.6
Machinery, equipment and instruments, including components and accessories	13.3	20.6	31.2	25.5	26.3	30.0	41.1	50.4	55.7	56.9
Equipment for the production and distribution of electricity	8.2	9.2	15.6	11.6	13.8	15.0	24.1	29.8	34.5	42.2
Motors and vehicle components	6.0	8.9	17.1	13.9	14.6	18.0	22.3	25.4	28.0	34.7
Conductors and other electric materials, excluding vehicles	8.8	11.1	12.3	11.7	12.1	17.7	18.7	21.7	25.5	26.5
Tractors and transport machinery, including components and accessories	1.7	3.5	13.3	9.3	7.2	5.5	13.0	17.6	23.3	24.4
Rubber industry	4.8	5.2	6.5	6.9	8.2	11.4	16.2	16.2	19.6	22.3
Automobiles, trucks and buses	0.0	0.2	1.9	2.8	5.8	8.7	12.5	7.8	11.9	17.7
Electrical appliances and equipment, including household and office appliances	3.8	4.0	5.6	4.7	7.2	8.1	11.4	13.3	14.9	15.6
Pharmaceuticals industry	6.9	9.0	11.5	8.9	9.9	11.4	12.1	15.0	14.1	14.4
TV, radio and hi-fi equipment	4.9	6.5	10.0	7.6	7.7	11.4	16.1	15.5	15.3	14.0
Paper, board and paper products	1.4	3.2	4.5	3.6	4.2	5.1	9.4	9.3	10.4	11.1
Average*	6.9	9.4	14.2	12.8	13.2	15.3	20.6	23.6	28.7	32.1

Natural Resources										
Wheat milling	12.5	17.8	26.0	26.0	32.0	37.2	35.4	17.2	32.5	34.5
Non-ferrous metals	8.0	9.0	11.4	14.1	14.5	16.1	26.2	23.6	27.7	27.0
Pulp and mechanical pastes	10.3	10.5	11.9	7.0	12.5	9.6	20.8	14.2	21.5	24.7
Lumber industry	1.2	2.9	3.4	3.0	2.5	3.9	6.3	9.8	14.1	15.4
Fruit and vegetable products, including juices and condiments	2.3	3.9	3.7	4.8	5.1	7.2	13.2	9.2	8.2	9.9
Other food industries	3.0	4.0	4.1	2.7	3.5	4.0	7.6	8.3	8.0	7.6
Refining of vegetable oils and production of fats for the food sector	1.3	1.6	2.6	1.9	3.1	3.7	4.3	6.7	6.9	6.6
Cooling and preparation of milk and dairy products	4.3	2.8	4.0	1.4	2.4	3.8	6.8	5.5	5.2	6.3
Other non-metallic mineral products	1.8	2.3	3.0	2.9	2.5	2.8	4.4	5.7	6.5	5.8
Slaughtering and meat processing	8.4	6.9	4.4	3.9	2.2	3.3	5.1	4.8	5.7	5.5
Beverage industry	3.5	4.4	5.1	4.2	3.4	3.9	6.7	6.7	6.3	4.9
Tobacco industry	0.1	0.1	0.8	1.1	1.0	1.1	1.5	1.7	2.4	2.7
Cement, concrete and fiber cement components and structures	0.1	0.1	0.3	0.5	0.4	0.6	1.0	1.2	1.6	1.6
Manufacture of animal feed	0.3	0.6	0.7	0.9	1.2	0.7	1.1	1.0	1.8	1.5
Cement and clinker	0.3	0.2	0.2	0.3	0.3	0.6	1.0	0.9	0.9	0.9
Slaughtering and processing of poultry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Coffee industry	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.3	0.1
Sugar industry	0.0	0.0	0.0	0.6	0.4	0.4	0.4	0.3	0.1	0.0
Average*	3.2	3.7	4.5	4.2	4.8	5.5	7.9	6.5	8.3	8.6
Total Industry	4.5	5.9	8.1	7.9	9.2	10.6	15.1	15.8	18.4	19.3

Source: BNDES

*Simple average.

TABLE 3
Imports/Production – 1989-98 (%)

Sector by Factor Intensity	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Capital-intensive										
Chemicals, excluding petrochemicals and carbochemicals	53.3	56.6	68.2	42.0	41.3	53.0	69.5	75.3	82.5	93.9
Resins, fibers and elastomers	6.2	9.8	12.1	10.8	15.1	16.6	32.9	38.9	37.8	41.5
Fertilizers and soil supplements	10.8	14.9	21.1	22.6	26.9	23.7	26.3	30.3	34.5	36.6
Miscellaneous chemicals	5.8	5.1	4.8	6.9	8.2	10.2	12.1	12.1	14.0	16.2
Oil refining	3.0	2.8	6.1	8.7	15.9	11.9	15.4	17.7	18.3	13.4
Other metal products	1.5	2.3	3.6	2.6	3.2	4.2	6.9	8.8	12.2	11.9
Basic and intermediate petrochemicals	3.8	4.5	8.3	5.0	5.7	8.8	12.3	12.9	12.2	9.9
Steel	1.6	1.6	2.2	3.1	2.4	2.8	4.3	4.0	5.2	6.8
Cast and wrought steel products	0.5	1.1	1.4	1.0	0.8	0.9	1.5	2.3	3.7	6.2
Plastic sheeting	0.2	0.7	0.9	0.7	0.7	2.4	8.6	5.5	3.7	5.2
Average*	8.7	9.9	12.9	10.3	12.0	13.5	19.0	20.8	22.4	24.2
Labor-intensive										
Spinning and weaving of artificial and synthetic fibers	0.8	1.6	3.1	2.4	4.3	11.2	26.4	15.2	18.6	20.2

Sugar industry	0.0	0.0	0.0	0.5	0.3	0.3	0.2	0.2	0.1	0.0
Average*	2.9	3.4	4.4	4.1	4.9	6.0	7.5	5.6	7.8	8.1
Total Industry	4.3	5.7	7.8	7.4	8.9	10.4	15.5	16.3	19.4	20.3

Source: BNDES.
*Simple average.

TABLE 4
Import Penetration Coefficients* by Degree of Technology Intensity:
Selected Countries – 1988-90 (%)

	High	Medium	Low
United States	18.4	18.5	8.8
Canada	63.4	53.3	16.8
Japan	5.4	5.9	6.6
France	31.6	34.1	21.4
Germany	37	29.5	20.9
Italy	22.8	28.9	15.7
United Kingdom	42.4	39.4	19.8
Mexico**	351.4	207.8	53.18

Sources: OECD (1994) and Dussel Peters (1997).

* Imports divided by apparent consumption within the manufacturing industry.

** Imports divided by production – data for 1995.

Far removed from technology-intensive sectors and almost level with each other are sectors that are intensive in capital and natural resources, with coefficients of 19.3% and 18.7% respectively. Of note in the first group are wheat milling, non-ferrous metals, and pulp and mechanical pastes, reflecting the shortage within Brazil at competitive prices of raw materials such as wheat, copper and certain kinds of pulp. The remaining sectors within this category represent, as expected, coefficients well below the industry average. Among capital-intensive sectors, chemicals excluding petrochemicals or carbochemicals, resins, fibers and elastomers, fertilizers and soil supplements are of particular note, with coefficients well above the average for the industry. It may again be argued that these are cases of sectors in which economies of scale and specialization are important, thus causing them to have high penetration coefficients. Finally, there are the labor-intensive sectors with coefficients well below the industry average, as might be expected, reflecting the low cost of domestic labor.

Table 5 presents results on export coefficients. As previously mentioned, the ranking is led by the technology-intensive category, with 13 component sectors, of which only 4: television, radio and hi-fi equipment; paper, board and paper products; conductors and other electrical materials; and the pharmaceutical industry have coefficients below the industry average. It is worth stating that the sector with the highest coefficient both within the category and for industry as a whole – manufacture of other vehicles – achieved this position in the last two years, as a result of the success of the new generation of Embraer airplanes. Close behind the technology-intensive sector is, as expected, the natural resource-intensive category, which is composed of some of the main Brazilian export sectors, such as pulp and mechanical pastes; lumber; fruit and vegetables, including juices; and non-ferrous metals. Capital- and labor-intensive sectors in turn present the lowest export coefficients, below the industry average. Among these results, it is the performance of labor-intensive sectors that continues to surprise, remaining, with the exception of footwear, far from reflecting their full export potential.

Tables 6, 7 and 9 present the same trade coefficients for manufacturing industries, grouped by category of good. The new series confirms the trend identified by Moreira and Corrêa (1996)⁵ towards greater import penetration in the capital goods sector, exceeding a 50% share of the domestic market in 1997 (Table 6). The imports/production coefficients in turn show that in 1998, capital goods imports exceeded local production (Table 7). The other categories show much lower coefficients, with durable consumer goods (excluding automobiles) and transport goods (basically automobiles, buses and trucks) of particular significance due to rapid growth in import coefficients over the last two years (import/apparent consumption ratios of 63% and 75% respectively, compared to an average of 22% for other categories).

TABLE 5
Exports/Production Coefficient – 1989-98 (%)

Sector by Factor Intensity	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Capital-intensive										
Chemicals excluding petrochemicals and carbochemicals	24.6	25.5	28.6	18.9	16.4	18.6	22.3	28.3	29.1	31.7
Steel	16.4	17.7	24.8	34.8	31.0	29.7	31.0	30.7	27.1	29.0
Resins, fibers and elastomers	8.7	11.0	12.2	12.1	12.6	13.6	16.4	16.8	17.1	15.8
Basic and intermediate petrochemicals	8.1	8.2	10.3	7.5	7.2	7.9	10.4	9.9	10.6	9.9
Other metal products	4.1	5.3	8.5	7.4	7.2	8.4	8.1	8.1	9.1	8.9
Miscellaneous chemicals	4.1	3.5	3.9	5.7	6.5	7.5	8.1	7.9	8.5	8.7
Cast and wrought steel products	0.9	1.5	2.7	1.7	1.7	1.9	2.6	3.0	2.9	5.2
Fertilizers and soil supplements	1.3	1.8	2.8	2.0	2.5	1.4	2.5	2.2	2.1	2.0
Oil refining	6.3	4.3	3.4	4.2	4.5	5.3	2.5	2.7	1.9	2.0
Plastic sheeting	0.1	0.2	0.4	1.8	2.3	2.1	1.6	1.1	1.0	1.0
Average*	7.5	7.9	9.8	9.6	9.2	9.6	10.5	11.1	11.0	11.4
Labor-intensive										
Footwear	26.1	24.7	42.3	37.2	37.3	37.6	38.8	44.7	51.1	56.3
Other textile industries	7.2	7.1	13.6	18.3	13.4	11.4	11.4	11.7	12.5	13.8
Treatment, spinning and weaving of natural fibers	8.3	9.1	13.8	10.5	8.3	9.4	12.8	11.4	12.4	12.2
Glass and glass articles	5.2	4.7	7.6	8.4	8.9	7.5	7.3	7.5	8.2	9.2
Spinning and weaving of artificial and synthetic fibers	2.2	1.9	3.9	6.4	4.0	4.9	3.9	5.2	6.4	6.0
Apparel and accessories	1.6	1.4	1.8	3.0	2.5	2.2	3.1	3.4	3.5	3.2
Perfumes, soaps and candles	1.4	1.1	1.8	1.9	2.5	2.6	2.8	2.9	2.4	2.9
Plastic articles	0.7	0.9	1.3	1.7	2.3	2.1	1.8	1.9	2.4	2.6
Average*	6.6	6.4	10.8	10.9	9.9	9.7	10.2	11.1	12.4	13.3
Technology-intensive										
Manufacture of other vehicles	24.0	24.7	23.9	34.2	23.6	21.7	19.9	30.7	47.7	71.5
Tractors and transport machinery, including components and accessories	19.2	18.1	36.4	31.7	21.5	20.6	28.6	42.2	42.0	38.1
Motors and vehicle components	14.9	18.7	32.1	25.1	22.3	22.9	24.2	25.2	26.5	34.7
Machinery, equipment and instruments, including components and accessories	7.8	8.4	14.9	13.8	16.2	17.0	17.4	21.8	22.6	23.6

⁵ See Moreira and Corrêa (1996), for each category of use, drawn up on the basis of the Deind/IBGE classifications. The capital goods and transport equipment category is composed of automobiles, trucks and buses. This procedure was adopted as it was not possible to derive separate physical production indices for these 3 products.

Electrical appliances and equipment, including household and office appliances	9.0	9.2	15.6	14.9	17.3	14.6	14.9	15.7	18.1	23.0
Equipment for the production and distribution of electricity	6.4	6.5	14.7	12.8	14.7	19.3	23.1	25.3	20.2	20.8
Rubber industry	6.6	7.4	10.6	14.2	14.9	14.9	14.4	15.6	17.1	19.7
Electronic and communications materials and equipment	4.2	4.9	9.8	8.6	5.6	5.7	5.9	8.3	14.8	19.3
Automobiles, trucks and buses	8.0	6.3	8.3	12.7	9.7	7.4	4.2	5.3	9.4	14.3
TV, radio and hi-fi equipment	9.1	9.3	12.7	13.1	8.9	8.5	7.6	7.6	9.0	13.0
Paper, board and paper products	3.2	8.4	10.1	12.5	12.7	13.3	13.1	11.1	12.0	12.2
Conductors and other electric materials, excluding vehicles	6.4	6.5	8.5	10.2	10.4	9.3	10.3	10.2	10.2	8.9
Pharmaceuticals Industry	1.7	1.8	2.5	2.4	2.2	2.0	2.0	2.3	2.2	2.3
Average*	9.3	10.0	15.4	15.9	13.8	13.6	14.3	17.0	19.4	23.2
Natural Resource-intensive										
Pulp and mechanical pastes	54.5	55.1	60.1	54.2	62.2	55.2	70.2	53.5	64.0	66.5
Lumber industry	14.8	23.9	35.4	35.2	35.3	50.6	52.1	55.4	59.4	61.9
Sugar industry	11.0	17.4	15.4	16.8	20.3	21.6	44.3	36.0	38.6	43.7
Fruit and vegetable products, including juices and condiments	33.3	43.8	35.8	43.2	33.8	36.1	42.3	40.1	27.3	35.2
Non-ferrous metals	20.6	24.2	30.4	37.5	34.7	34.9	41.4	40.8	39.6	34.6
Slaughtering and processing of poultry	14.8	14.3	22.1	17.9	23.6	20.4	19.6	25.3	25.7	21.1
Tobacco industry	1.8	2.2	5.1	6.9	7.7	12.3	13.6	14.7	14.9	20.8
Coffee industry	17.7	13.0	14.0	14.9	23.7	21.7	28.7	22.6	20.9	16.7
Slaughtering and meat processing	8.8	6.3	12.4	17.2	16.0	11.9	12.1	12.1	11.6	14.5
Other non-metallic mineral products	4.3	5.0	6.7	7.4	7.9	8.0	8.7	8.7	8.6	8.4
Refining of vegetable oils and production of fats for the food sector	9.3	7.8	5.3	5.0	2.2	2.7	3.3	3.2	4.4	5.3
Other food industries	3.7	4.4	5.1	5.6	5.5	4.1	3.7	3.2	4.3	4.4
Manufacture of animal feed	7.0	8.3	7.3	7.8	7.8	4.8	5.5	5.4	4.9	1.6
Beverage industry	0.8	1.4	1.9	1.9	2.1	2.7	2.1	2.0	1.5	1.4
Cement, concrete and fiber cement components and structures	0.6	0.7	0.7	0.8	1.0	0.8	1.2	1.2	1.4	1.2
Wheat milling	0.1	0.1	0.2	0.5	0.4	0.5	0.7	0.6	1.6	0.6
Cement and clinker	0.3	0.4	0.3	0.3	0.4	0.2	0.3	0.3	0.4	0.4
Cooling and preparation of milk and dairy products	0.0	0.0	0.0	0.2	0.4	0.0	0.1	0.2	0.1	0.1
Average*	11.3	12.7	14.3	15.2	15.8	16.0	19.4	18.1	18.3	18.8
Total Industry	8.8	9.4	12.3	13.3	12.5	12.2	12.7	13.0	13.7	14.8

Source: BNDES

*Simple average.

TABLE 6

Penetration Coefficient: Imports/Apparent Consumption (%)

Category of Good*	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Non-Durable Consumer Goods	2.6	3.0	4.0	3.4	3.7	4.4	7.2	7.0	7.9	8.1
Durable Consumer Goods	7.8	9.2	12.9	10.9	11.6	12.3	16.7	18.5	24.9	30.3
Processed Intermediate Goods	5.2	6.4	8.6	8.8	10.1	12.2	16.9	17.8	19.7	20.8
Intermediate Goods	2.2	2.9	4.8	5.5	8.8	7.5	10.3	11.4	12.2	10.4
Capital Goods	11.4	17.7	28.1	23.7	23.8	28.0	39.0	46.9	54.8	57.0
Capital Goods, Transport Equipment	2.1	3.2	6.3	6.7	9.0	11.6	14.9	12.9	16.5	22.6
Industry Total	4.5	5.9	8.1	7.9	9.2	10.6	15.1	15.8	18.4	19.3

Source: BNDES.

TABLE 7

Penetration Coefficient: Imports/Production (%)

Category of Good*	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Non-Durable Consumer Goods	2.5	2.8	3.8	3.1	3.4	4.2	7.0	6.7	7.7	7.9
Durable Consumer Goods	7.4	8.9	12.3	10.1	11.2	12.2	17.5	19.5	26.6	29.3
Processed Intermediate Goods	4.9	6.1	8.0	8.1	9.6	11.8	16.9	18.0	20.4	21.9
Intermediate Goods	2.1	2.7	4.6	5.3	8.6	7.1	10.0	11.5	12.5	10.5
Capital Goods	11.9	19.8	33.3	26.8	27.2	33.2	54.0	71.5	94.0	100.3
Capital Goods, Transport Equipment	1.9	3.0	5.6	5.9	8.4	11.4	15.8	13.2	17.0	23.2
Industry Total	4.3	5.7	7.8	7.4	8.9	10.4	15.5	16.3	19.4	20.3

Source: BNDES.

The arguments used to qualify the high penetration indices attained by technology-intensive goods also apply to capital goods for the simple reason that most such goods can be classified in either category. That is to say, economies of scale and specialization normally generate high penetration coefficients, even in countries that are more efficient in producing such goods. Table 8 illustrates this point. As may be observed, capital goods in the principal OECD countries, with the usual exception of Japan, have penetration coefficients well above the industry average. In addition, the coefficients for countries such as Germany, the United Kingdom and Canada at the start of the decade were not far from those achieved by Brazil in 1998, while Mexico, a country that is normally cited as having a poorly developed capital goods industry, had penetration coefficients that in 1995 were 40% above those of Brazil (Table 7).

TABLE 8
Import Penetration Coefficients:*
Selected Capital Goods and Countries – 1988-90 (%)

	Non-electrical machinery	Computers	Electrical machinery	Communications Equipment	Capital Goods Average	Industry Average
United States	15.4	34.9	19.1	30.7	25.0	13.9
Canada	66.7	86.2	51.2	60.5	45.6	35.1
Japan	3.6	7.1	2.8	4.0	35.3	6.3
Germany	27.2	97.7	18.8	29.7	23.9	26.8
United Kingdom	34.9	77.1	30.9	39.7	44.5	30.0
Mexico**	464.0	242.5	90.8	-	140.0	88.0

Source: OECD (1994).

*Imports divided by apparent consumption in the manufacturing industry.

** Imports divided by production – 1995 data.

The increase in the capital goods export coefficient during the period to its second-highest level in 1998 also militates against a view that the sector is likely to disappear. At the same time, the difference between the import and export coefficients shows that there are still economies of scale and efficiency gains to be made, particularly through an intensification of an export drive. Resende and Anderson (1999) call attention to the fact that specialization occurred between 1990-97 in lower technology content capital goods, showing concern regarding the negative impact of technical progress. While such concerns may be legitimate, we should not lose sight of the situation that prevailed prior to the opening. So-called high technology content goods were produced, in most cases, by large multinationals, with prices far above those of the international market, albeit for products that were far from the technological frontier. While there may have been gains in terms of learning, these can hardly have offset the losses arising from raised investment costs and barriers to innovation imposed by other sectors of the economy. In any case, the devaluation of January 1999 and the efforts on the part of the government to rectify market failures in the funding of exports and local production [see Mendonça de Barros and Goldstein (1998)] have created more favorable conditions for a redirection of the category towards more sophisticated goods, albeit this time without imposing a prohibitive cost to society in terms of lower investment and slower diffusion of technological progress.

TABLE 9
Trade Openness Coefficient: Exports/Production (%)

Category of Good*	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Non-Durable Consumer Goods	6.9	7.9	9.1	10.4	10.2	9.2	10.3	10.4	10.2	10.7
Durable Consumer Goods	12.6	12.7	16.6	17.7	14.8	13.2	12.4	14.3	19.8	32.7
Processed Intermediate Goods	10.1	10.9	14.9	15.9	14.7	15.1	16.8	16.9	16.6	16.5
Intermediate Goods	7.0	7.6	8.5	10.0	10.6	11.8	12.5	10.6	10.4	10.1
Capital Goods	7.7	7.9	14.7	13.6	13.1	14.5	15.3	18.9	22.6	24.2
Capital Goods, Transport Equipment	10.5	10.8	15.7	17.1	14.4	12.5	9.6	11.1	14.3	20.4
Industry Total	8.8	9.4	12.3	13.3	12.5	12.2	12.7	13.0	13.7	14.8

Source: BNDES.

As with capital goods, all other categories of good experienced increases in export coefficients (Table 9). The levels reached nevertheless remain modest, particularly for non-durable consumer and intermediate goods. The former relate to labor-intensive sectors, on which we have

already commented, as well as to non-traded goods such as beverages (especially beer and soft drinks), which despite being tradable in theory are non-tradables in practice, on account of the difficulties of transport and distribution. The explanation on the basis of non-tradables also holds for intermediate goods such as cement and glass.

Composition of Product

Another way of evaluating the impact of the change in regime on the allocation of resources within industry is through the analysis of changes in the composition of industrial production and the principal causes of these changes. In similar fashion to Moreira and Corrêa (1996), an attempt was made to identify the origin of gains or losses in the shares of various sectors, whether due to changes in consumer preferences, in the composition of spending (investment and consumption) or in relative prices, represented by the variable of domestic demand; whether due to changes in the sector in question's share of total exports, deriving from alterations in export coefficients, or to changes in the relevant sector's share of total imports, deriving from variations in import coefficients.

To this end, we repeated Chenery's growth accounting exercise [Chenery et al. (1986)] for the period 1989-98, isolating the principal sources of growth of the sector product. In order to reduce the volatility that normally characterizes these results, we used an average of the values for 1989 and 1990 as a base year, and an average of the values for 1997 and 1998 as a final year. In algebraic terms we have:

$$\Delta q_i = \left(\frac{\Delta CA_i}{q_i^0} - \frac{\Delta CA}{q^0} \right) + \left(\frac{\Delta X_i}{q_i^0} - \frac{\Delta X}{q^0} \right) - \left(\frac{\Delta M_i}{q_i^0} - \frac{\Delta M}{q^0} \right) \quad (1)$$

where Δq_i is the change in the relative share of sector i between 1989-90 and 1997-98, q_i^0 is the gross average value of production in sector i in 1989-90, q^0 is the gross average value of industrial production in 1989-90, and ΔCA_i , ΔX_i and ΔM , the respective changes in apparent consumption, exports and imports of sector i for the period 1989-90 to 1997-98.

Δq_i would thus be explained by components that incorporate the changes in domestic demand (the first term of the equation), in the export coefficients (second term), and in import coefficients (third term). A positive second term, for example, could be interpreted as a positive contribution to the relative share of the sector, due to an increase in the export coefficients superior to those of industry as a whole.

Table 10 presents the results for the 49 sectors, grouped by factor intensity. As may be verified, sectors that make intensive use of natural resources show the greatest gains (32.8%). On the one hand, these gains were driven by growth in domestic demand above the industry average, and are probably associated with changes in the level of consumption, with the spread of new products and with increases in real income due to stabilization [Bonelli and Gonçalves (1998)]⁶; on the other, as might be expected, they were due to growth in export coefficients above the industry average, as well as by a growth in import coefficients below it.

The other category to show gains in share was that of technology-intensive sectors, although in this case, the gain was far more modest (3.7%), and was concentrated in the pharmaceutical; automobile, vans, buses and trucks; conductors and other electrical materials; motors; and

⁶ Bonelli and Gonçalves also analyze changes in industrial structure, but do so for classes of industry for the period 1985-96 at constant prices, on the basis of the census and PIM-PF data. The results nevertheless point to gains by these natural resource-intensive sectors.

autocomponent sectors. In these four cases, by contrast with what occurred in the other sectors within this category, the negative impact of foreign trade was more than offset by domestic demand. The negative contribution of external trade to this category had already been expected (with import coefficients growing above the industry average without being compensated by growth in export coefficients), in so far as the sectors in question were among the main beneficiaries of protection, and were characterized by overdiversified small-scale firms. At the same time, the causes of the negative contribution of domestic demand are less obvious. There is no doubt, however, that the relative prices of these sectors fell sharply in the period after opening (see next section), undoubtedly contributing to this performance (an indirect effect of foreign trade).

Among the categories that experienced losses, these were led by labor-intensive sectors, the relative shares of which fell substantially (-31.7%). It is important to emphasize that the contribution of external trade was positive as expected (-8.9% for imports against -4.1% for exports), with only the poor performance of exports preventing a higher figure. The losses recorded nevertheless reflect domestic demand, which, with the exception of perfumes, soaps and candles, was well below the industry average. The low-income elasticity that these sectors normally present may be one of the factors that explain this result.

Capital-intensive sectors also sustained substantial losses (11.3%), due, in the same way, to domestic demand. As with technology-intensive sectors, changes in relative prices appear to have had a significant effect on these results (see next section). The contribution of foreign trade was not only small but also negative, solely as a result of export performances. The import coefficient increased by less than the industry average, reflecting the comparative advantages acquired in the steel and basic metallurgy sectors. The only sectors where imports made a significant negative contribution were: chemicals excluding petrochemicals; fertilizers; and resins, fibers and elastomers, for which cases import substitution seems to have gone beyond what would be recommended for the size of market in question, as well as the level of available resources within the country.

An important question that arises from an analysis of the changes in the composition of industrial output regards the behavior of the value of production (VP) and of value added (VA)⁷. Given the characteristics of the import substitution regimes examined above, we might expect that the change in regime would result in a fall in the ratio VA/VP. That is, the search for economies of scale and specialization would eventually reduce the degree of integration of firms and of the industrial structure as a whole. In addition to the change in regime, another force acting in this direction has been the recent trend among management towards outsourcing.

An analysis of the behavior of added value nevertheless faces an important obstacle in the availability of data. The available primary series (PIAs) only extends until 1995, and unlike the case of VP, there is no reliable proxy that we may use to update this⁸. Despite this problem, an analysis of the period 1989-85 allows us to shed some light on the trends that prevailed in this area.

⁷ It would also be possible to add current values *versus* constant values to the question. In this study, we have chosen, as Moreira and Corrêa did, to restrict our analysis to current values, since changes in relative prices are understood as an integral part of the impact caused by the change in regime.

⁸ It should be remembered that the available series is the value of industrial transformation (VIT), a concept that is close to but different from VA, in so far as various associated expenses such as freight, advertising, maintenance, transport and communications are not deducted. As observed above, data from the 1996 PIA is already available, but entails a serious problem of compatibility with previous years.

TABLE 10
Variations in the Composition of Industrial Production – Average for 1989-90/Average for 1997-98
 (%)

<i>Sector-Matrix*</i>	<i>Relative Share</i>	<i>Sources of Changes in the Relative Shares of Sectors^b</i>		
		<i>Domestic Demand</i> (a)	<i>Exports</i> (b)	<i>Imports</i> (c)
Activities				
Capital-intensive sectors				
Chemicals excluding petrochemicals and carbochemicals	46.6	91.5	14.3	59.2
Oil refining	17.4	26.2	-8.1	0.7
Fertilizers and soil supplements	17.0	35.4	-4.3	14.1
Miscellaneous chemicals	11.4	7.3	0.6	-3.5
Basic and intermediate petrochemicals	-2.8	-7.7	-3.4	-8.3
Other metal products	-8.7	-12.8	-1.7	-5.8
Resins, fibers and elastomers	-20.1	-9.3	-1.6	9.1
Plastic sheeting	-33.6	-41.3	-4.7	-12.4
Cast and wrought steel products	-35.5	-44.2	-3.8	-12.6
Steel	-43.8	-50.6	-6.4	-13.2
Total	-11.3	-10.6	-3.9	-3.2
Technology-intensive sectors				
Pharmaceuticals Industry	157.9	177.6	-1.1	18.6
Automobiles, vans, trucks and buses	42.9	45.2	4.0	6.2
Conductors and other electric materials, excluding vehicles	8.0	18.5	-1.3	9.2
Motors and vehicle components	6.1	7.8	10.1	11.8
Paper, board and paper products	-6.2	-13.9	0.6	-7.1
Rubber industry	-9.5	-14.1	4.4	-0.3
Tractors and transport machinery, including components and accessories	-10.7	-22.6	11.8	-0.1
TV, radio and hi-fi equipment	-14.7	-16.4	-5.4	-7.1
Equipment for the production and distribution of electricity	-24.7	-14.9	3.8	13.7
Manufacture of other vehicles	-26.8	-24.7	14.5	16.6
Machinery, equipment and instruments, including components and accessories	-26.9	8.7	3.7	39.2
Electrical appliances and equipment, including household and office appliances	-38.8	-46.7	-1.9	-9.9
Electronic and communications materials and equipment	-46.9	2.4	-0.7	48.6
Total	3.7	13.8	3.1	13.2
Labor-intensive sectors				
Perfumes, soaps and candles	61.3	56.0	-2.2	-7.5
Glass and glass articles	48.0	50.7	2.7	5.4
Plastic articles	10.1	4.9	-3.3	-8.5
Other textile industries	-24.7	-28.7	-2.5	-6.5

Footwear	-41.6	-54.4	0.8	-12.0
Treatment, spinning and weaving of natural fibers	-53.3	-52.6	-8.1	-7.5
Spinning and weaving of artificial and synthetic fibers	-55.6	-58.6	-4.5	-7.5
Apparel and accessories	-65.1	-72.1	-5.5	-12.5
Total	-31.7	-36.6	-4.1	-8.9
Natural resource-intensive sectors				
Beverage industry	99.8	96.1	-3.5	-7.2
Other food industries	86.9	84.8	-1.1	-3.3
Manufacture of animal feed	86.9	81.3	-6.8	-12.3
Slaughtering and processing of poultry	67.4	33.0	19.5	-14.8
Cement and clinker	65.3	56.5	-4.9	-13.7
Refining of vegetable oils and production of fats for the food sector	55.5	56.1	-6.2	-5.6
Sugar industry	46.7	-9.3	41.1	-14.9
Pulp and mechanical pastes	34.9	0.6	28.2	-6.1
Cooling and preparation of milk and dairy products	34.6	29.3	-5.1	-10.5
Wheat milling	33.7	71.6	-3.8	34.1
Tobacco industry	33.4	5.1	16.1	-12.2
Coffee industry	31.1	12.1	4.2	-14.7
Fruit and vegetable products, including juices and condiments	17.0	15.5	-7.4	-8.9
Slaughtering (excl. poultry) and meat processing	11.2	-7.4	1.7	-16.8
Other non-metallic mineral products	-0.4	-10.0	-1.4	-10.9
Cement, concrete and fiber cement components and structures	-13.2	-22.1	-4.8	-13.7
Lumber industry	-18.2	-55.2	26.2	-10.9
Non-ferrous metals	-22.1	-27.4	1.6	-3.6
Total	32.8	20.5	3.7	-8.6

Source: BNDES

^(a) Listed in decreasing order of gains.

^(b) Change in relative share is equal to the sum of the columns (a) + (b) - (c). See text and equation (1).

Table 11 presents the relationship between VA and VP for the 49 sectors, which are again grouped by factor intensity. Beginning with the results for industry as a whole, a real fall in the VA/VP ratio may be observed, albeit only from 1994 onwards, with an acceleration in the penetration of imports, and even then only in a timid manner.

This result nevertheless hides more pronounced reductions, particularly in technology-intensive sectors in which restrictions of scale and technology on the vertical integration of industrial structures are more significant. The only sectors in the category to escape this trend were paper, board and paper products, the pharmaceutical sector, and automobiles, trucks and buses. The result for the last of these sectors (34%) raises suspicions with regard to problems of measurement, in so far as it goes against the trend among automobile manufacturers towards the transfer to third parties of the largest possible number of stages in the production process. Another possibility is that this process only took root after 1995. The other category that showed a reduction in the VA/VP ratio was that of labor-intensive industries, principally in apparel and accessories, spinning and weaving of artificial fibers, and footwear, with these registering reductions of over 10%.

These reductions in technology- and labor-intensive sectors were largely compensated by increases in capital- and natural resource-intensive sectors. In the case of the latter sectors, this result is not surprising, since the scope for division of labor in these is reduced, economies of scale are less significant, and Brazil enjoys important competitive advantages on account of its endowment of resources. In the case of the former sectors for which a fall in this ratio is to be expected, the aggregate result can basically be explained by the performance of the oil refining and steel sectors, which are in turn due to institutional factors (the abolition of Petrobrás' monopoly in 1997), as well as to competitive advantages all along the production chain. For the great majority of the other sectors within the category, the trend, as expected, was towards deverticalization. By confirming these trends present in the PIA data, it may be said that the change in regime did not produce, at least in its first six years of transition, the feared "hollowing out" or "Mexicanization" of Brazil's industrial structure – that is, the reduction of industrial activities to mere assembly of finished goods. The numbers thus point to an expected and desirable trend towards deverticalization that generally occurred in an extremely gradual way and that has been correcting the excesses produced by years of import substitution. Thus, in so far as the macroeconomic environment has become more favorable, with interest and exchange rates that promote investment and economic growth, and in so far as the government is attempting to remedy the imperfections in funding, there is no reason to reject a further deepening of the division of labor in Brazilian industry, albeit this time on a more rational and sustainable basis.

TABLE 11
Relationship between Value Added* and the Value of Production in Manufacturing Industries – 1989-95

Description of Sectors	Value Added (VA)/Value of Production (VP)						
							Change (%)
	1989	1990	1992	1993	1994	1995	Average 1994-95/Average 1989-90
Capital-intensive							
Plastic sheeting	0.60	0.55	0.51	0.52	0.51	0.43	-18.01
Miscellaneous chemicals	0.65	0.71	0.65	0.69	0.63	0.56	-12.58
Other metal products	0.64	0.63	0.62	0.66	0.59	0.53	-11.36
Chemicals excluding petrochemicals and carbochemicals	0.69	0.64	0.63	0.71	0.60	0.59	-9.78
Cast and wrought steel products	0.60	0.60	0.68	0.61	0.56	0.54	-8.81
Fertilizers and soil supplements	0.33	0.36	0.37	0.43	0.42	0.27	-0.66
Resins, fibers and elastomers	0.54	0.46	0.54	0.57	0.55	0.49	3.95
Basic and intermediate petrochemicals	0.45	0.39	0.44	0.47	0.48	0.42	5.74
Oil refining	0.47	0.44	0.61	0.63	0.61	0.63	36.18
Steel	0.39	0.32	0.52	0.55	0.55	0.50	45.98
Average	0.53	0.51	0.56	0.58	0.55	0.50	3.06
Technology-intensive							
Equipment for the production and distribution of electricity	0.75	0.76	0.76	0.77	0.68	0.50	-22.04
Electrical appliances and equipment, including household and office appliances	0.61	0.61	0.59	0.60	0.53	0.49	-16.13
Electronic and communications materials and equipment	0.75	0.71	0.79	0.73	0.66	0.58	-15.58
Motors and vehicle components	0.68	0.65	0.67	0.66	0.59	0.53	-15.49
Manufacture of other vehicles	0.73	0.63	0.76	0.74	0.65	0.50	-15.45

Tractors and transport machinery, including components and accessories	0.56	0.45	0.61	0.59	0.47	0.40	-14.52
TV, radio and hi-fi equipment	0.60	0.52	0.60	0.67	0.53	0.44	-12.68
Machinery, equipment and instruments, including components and accessories	0.70	0.69	0.73	0.71	0.66	0.61	-8.43
Conductors and other electric materials, excluding vehicles	0.54	0.63	0.65	0.64	0.58	0.51	-7.09
Rubber industry	0.56	0.52	0.64	0.66	0.59	0.51	1.34
Paper, board and paper products	0.52	0.51	0.57	0.59	0.56	0.50	2.00
Pharmaceuticals Industry	0.66	0.69	0.74	0.80	0.76	0.70	8.70
Automobiles, vans, trucks and buses	0.41	0.43	0.59	0.52	0.55	0.58	34.77
Average	0.62	0.60	0.67	0.67	0.60	0.53	-6.20
Labor-intensive							
Apparel and accessories	0.62	0.62	0.60	0.59	0.44	0.57	-18.73
Spinning and weaving of artificial and synthetic fibers	0.65	0.63	0.67	0.62	0.59	0.49	-15.79
Footwear	0.66	0.63	0.57	0.61	0.60	0.53	-12.51
Glass and glass articles	0.71	0.71	0.71	0.71	0.68	0.61	-8.62
Plastic articles	0.64	0.62	0.72	0.66	0.61	0.57	-6.53
Treatment, spinning and weaving of natural fibers	0.50	0.51	0.59	0.64	0.56	0.46	0.78
Other textile industries	0.52	0.57	0.58	0.69	0.58	0.53	2.49
Perfumes, soaps and candles	0.54	0.63	0.62	0.66	0.70	0.57	9.45
Average	0.60	0.61	0.63	0.65	0.60	0.54	-6.18
Natural resource-intensive							
Tobacco industry	0.77	0.74	0.69	0.72	0.57	0.42	-34.87
Coffee industry	0.44	0.33	0.48	0.48	0.36	0.31	-13.34
Fruit and vegetable products, including juices and condiments	0.55	0.59	0.46	0.46	0.46	0.54	-12.59
Lumber industry	0.68	0.65	0.66	0.70	0.63	0.54	-12.27
Cement, concrete and fiber cement components and structures	0.58	0.57	0.54	0.57	0.54	0.51	-8.54
Pulp and mechanical pastes	0.72	0.58	0.62	0.54	0.58	0.62	-8.26
Non-ferrous metals	0.53	0.52	0.53	0.55	0.54	0.44	-7.30
Slaughtering (excl. poultry) and meat processing	0.36	0.30	0.34	0.36	0.33	0.30	-3.59
Other non-metallic mineral products	0.69	0.66	0.67	0.71	0.68	0.64	-2.08
Refining of vegetable oils and production of fats for the food sector	0.37	0.31	0.43	0.40	0.43	0.28	3.84
Wheat milling	0.27	0.37	0.45	0.46	0.34	0.33	4.38
Beverage industry	0.59	0.62	0.65	0.68	0.68	0.64	9.14
Sugar industry	0.43	0.42	0.50	0.57	0.49	0.45	9.79
Other food industries	0.55	0.48	0.61	0.64	0.61	0.55	11.78
Manufacture of animal feed	0.32	0.30	0.32	0.29	0.38	0.33	14.71
Slaughtering and processing of poultry	0.47	0.39	0.47	0.45	0.50	0.49	14.85
Cooling and preparation of milk and dairy products	0.34	0.35	0.44	0.44	0.42	0.42	21.16
Cement and clinker	0.59	0.51	0.76	0.74	0.74	0.62	22.87
Average	0.52	0.48	0.54	0.54	0.52	0.47	0.54
Industry Total	0.56	0.55	0.60	0.61	0.57	0.53	-0.60

Source: IBGE Annual Industry Survey.

* Industrial Manufacturing Value used as *proxy*. See footnote 10.

TABLE 12
Structural Changes in Industry according to Value of Production and Value Added at Current Prices– 1988-95

Description of Sectors	Share of VA*	Share of VP
	Change (%)	Change (%)
	Average 1994-95/Average 1989-90	Average 1994-95/Average 1989-90
Capital-intensive		
Plastic sheeting	-39.77	-25.67
Cast and wrought steel products	-32.18	-25.19
Miscellaneous chemicals	-25.89	-13.56
Other metal products	-25.07	-14.76
Steel	-11.16	-38.33
Fertilizers and soil supplements	-7.35	-6.73
Resins, fibers and elastomers	-4.75	-7.21
Basic and intermediate petrochemicals	9.32	3.94
Oil refining	34.80	-0.38
Chemicals excluding petrochemicals and carbochemicals	41.32	57.57
Total	-5.31	-14.85
Technology-intensive		
Manufacture of other vehicles	-46.70	-36.34
Equipment for the production and distribution of electricity	-41.86	-24.95
Electronic and communications materials and equipment	-34.93	-22.08
Electrical appliances and equipment, including household and office appliances	-28.71	-14.16
Machinery, equipment and instruments, including components and accessories	-16.17	-7.70
Tractors and transport machinery, including components and accessories	-11.17	5.66
Motors and vehicle components	-10.40	6.96
Conductors and other electric materials, excluding vehicles	-7.15	1.37
TV, radio and hi-fi equipment	-6.01	9.05
Rubber industry	-5.85	-6.25
Paper, board and paper products	1.40	0.55
Pharmaceuticals Industry	90.74	78.02
Automobiles, vans, trucks and buses	99.84	48.02
Total	5.45	8.98
Labor-intensive		
Spinning and weaving of artificial and synthetic fibers	-46.82	-36.44
Apparel and accessories	-42.39	-24.88
Treatment, spinning and weaving of natural fibers	-31.21	-31.41
Footwear	-28.91	-18.18

Other textile industries	-11.42	-12.36
Plastic articles	-9.42	-2.31
Glass and glass articles	12.48	24.35
Perfumes, soaps and candles	53.39	43.14
Total	-21.33	-14.62
Natural resource-intensive		
Cement, concrete and fiber cement components and structures	-40.76	-34.76
Lumber industry	-38.13	-28.80
Non-ferrous metals	-28.20	-21.75
Fruit and vegetable products, including juices and condiments	-26.45	-14.43
Tobacco industry	-25.68	15.86
Other non-metallic mineral products	-11.58	-8.96
Coffee industry	9.01	25.99
Wheat milling	11.81	8.67
Slaughtering (excl. poultry) and meat processing	15.24	19.44
Other food industries	43.45	30.05
Pulp and mechanical pastes	46.18	58.43
Cooling and preparation of milk and dairy products	53.40	27.29
Refining of vegetable oils and production of fats for the food sector.	54.13	51.84
Sugar industry	58.13	45.23
Cement and clinker	67.14	36.53
Beverage industry	69.81	57.30
Slaughtering and processing of poultry	79.45	54.90
Manufacture of animal feed	96.55	72.48
Total	15.28	16.95

Source: IBGE Annual Industry Survey.

* Industrial Manufacturing Value used as *proxy*. See footnote 10.

These changes observed in the VA/VP ratio raise a further question with regard to the divergences in the results of structural changes in industry according to whether the variable used is VA or VP. In order to measure this effect, an attempt was made in Table 12 to compare the results based on the two variables for the period during which both were available. As may be observed, while there are divergences in the magnitude of movements, they have exactly the same sign in all categories, as well as for the vast majority of sectors. This coincidence of results arises from the high degree of correlation between the two variables (0.93). It is also important to point out that the direction of the indicated changes coincides with those of the period 1989-98, that are presented in Table 10.

3. Efficiency Gains

The transition to an open economy is generally associated in the literature with gains in technical and allocative efficiency. The first of these generate productivity gains and arise from three kinds of effect [Tybout and Westbrook (1995)]:

- *economies of scale* – the opening of the economy exposes local firms to competition from imports, increasing the scale of production and reducing the average cost;

- *the market share effect* – greater competitive pressure causes the more efficient firms to increase their market share, eventually resulting in an increase in the average productivity of industry; and
- *the “residual” effect* - productivity gains from other sources than those mentioned in items (a) and (b), such as product and process innovations, management innovations, learning, externalities, etc.

Gains in allocative efficiency in turn result from an allocation of resources that is compatible with the comparative advantages of the country (thus leading to gains in well-being) as well as with the reduction of the market power of firms, caused by the dismantling of trade barriers (that move market structures towards perfect competition).

Technical Efficiency

In the case of Brazil, the analysis of such gains is far from complete, although a number of important advances have been made since the publication of Moreira and Corrêa (1996). Bonelli and Fonseca (1998), Rossi Junior and Cavalcanti (1999) and Hay (1997) succeeded in deriving estimates of the behavior of total factor productivity (TFP), despite the enormous empirical difficulties involved. The first two of these articles, that worked with PIM-PF and PIM-DG data, and that used similar methods, derived results that point to accelerated growth of TFP after 1990. Bonelli and Fonseca estimated average annual growth of 3.35% between 1991-97, above the estimates of Rossi Junior and Cavalcanti for the same period (2.15%). Hay, who used large company data from the PIA, estimated average growth in TFP of around 9.2% during the period 1990-94.

In the field of partial productivity, specifically of labor productivity, a number of advances were made in terms of overcoming the difficulties associated with estimates based on physical production (PIM-PF), which were until recently the only data available. As had already been observed in Moreira and Corrêa (1996), and in articles by other authors [Salm, Saboia and Carvalho (1997) and Bonelli (1996)], these estimates may contain an upward bias, due to the fall in the VA/VP ratio described in the previous section that resulted from the greater penetration of imports and the movement towards outsourcing. This problem gives particular cause for concern in sector estimates, since for industry as a whole, the impact of imports and outsourcing (when this occurs within an industrial sector) would be captured in the physical production indices of intermediate sectors.

Two estimates of added value in industry were recently published that could, in principle, resolve this problem: the series of National Accounts for 1990-97, and the PIA series mentioned above. Table 13 presents the results. The period 1990-95 is the only one for which it is possible to compare results from the three sources, and as may be observed, all estimates point towards growth in productivity during the period. This, however, is the only consensus conclusion that can be extracted from the results. The disparities between the growth rates are large, even when the methodological differences between the research approaches are taken into consideration. A priori, we might expect firstly, that the results based on PIA and National Accounts data would be close to each other, since both work with the concept of value added, and secondly, that both would produce growth rates below that of the approach based on PIM, due to the changes in the VA/VP ratio. We nevertheless observe that the PIA numbers are closer to, and even greater than the PIM-PF numbers. In addition, this proximity hides important differences in terms of component variables. The divergences between the growth of physical production – PIM (12.9%) and value added - PIA (0.7%) may be attributed to the trend towards deverticalization mentioned above, although the differences in terms of levels of occupation seem to have a methodological basis. There are also divergences with regard to the distribution of gains over the period. In the case of the PIA series, these are concentrated during the period 1990-93, while in the PIM-PF series they are distributed more homogeneously throughout the period.

TABLE 13
Change in Levels of Occupation, Value Added and Labor Productivity in Manufacturing Industries (%)

	PIA ¹			National Accounts ²			PIM ³		
	Occ'n	VA	Productivity	Occ'n	VA	Productivity	Occ'n	PF	Productivity
1992/90	-22.3	9.1	32.7	-11.1	-4.0	8.0	-16.9	-4.8	14.7
1993	-1.9	9.3	11.2	0.0	8.3	8.3	-1.7	8.1	9.9
1994	-0.6	-7.1	-6.0	0.5	6.9	6.5	-2.2	7.8	10.2
1995	-9.9	-9.1	0.9	-1.3	2.0	3.3	-1.8	1.7	3.6
1996	-	-	-	-4.2	2.8	7.3	-11.2	1.1	13.8
1997	-	-	-	-3.9	4.2	8.4	-5.8	3.6	9.9
1998	-	-	-	-	-	-	-9.2	-3.4	6.4
1990-95	-31.7	0.7	47.5	-11.8	13.4	28.7	-21.6	12.9	43.9
1990-97	-	-	-	-18.8	21.5	49.7	-34.3	18.3	80.1
1990-98	-	-	-	-	-	-	-40.4	14.3	91.6

Source: IBGE.

(1) Annual Industry Survey (PIA). Ratio between added value (VTI – see footnote 10), deflated by the industrial IPA (1990=100), and employees linked directly to production.

(2) National Accounts. Ratio between value added (previous year's prices) and employment levels.

(3) Monthly Industrial Survey. Ratio between physical production and employment levels within production.

Table 14 extends this comparison to sectors of the manufacturing industry, albeit only to those for which the classification allows a more direct comparison. What is evident is that at this level, these disparities are even more apparent, but that the pattern of greater proximity between the respective results of PIA and PIM-PF is maintained.

Finally, what this series of results confirms is that the only certainty with regard to the behavior of labor productivity in the post-liberalization period is with regard to growth. The gains, even according to the most modest estimates (National Accounts) may be classified as substantial. At the same time, the evaluation of their exact magnitude, their distribution by sector and time period, and the impact of the trend towards specialization, still depend on a further research effort. In addition, progress is also required in terms of isolating the contribution of liberalization, and in splitting this contribution into the different effects mentioned: scale, share and residual. A number of contributions on this subject already exist. Rossi Junior and Cavalcanti (1999) have run a regression based on PIM-PF and PIM-DG category data for the period 1985-97, and have detected signs of a positive correlation between productivity (labor and TFP) and imports, as well as a negative correlation between productivity and protection (nominal and effective). Hay's results suggest that there were "large effects" both during opening and the recession at the start of the 1990s, but do not allow these to be quantified [Hay (1997, p. 22)]. In similar fashion, and on the basis of estimates of the degree of concentration after opening, Moreira (1999) found evidence that the effects of scale and share were relevant, particularly in the sectors dominated by foreign companies. At the same time, no effort was made to quantify these.

TABLE 14
Changes in Labor Productivity by Sector of the Manufacturing Industry (%)

	1995-97			1995-97	
	PIA	National Accounts	PIM	National Accounts	PIM
Steel	43.2	63.2	-	30.4	-
Rubber	9.4	35.1	25.4	33.6	45.9
Pharmaceuticals	25.8	-	18.3	-	10.8
Perfumes	56.3	-	20.7	-	7.9
Plastics	49.9	21.7	46.4	26.5	25.0
Footwear	20.8	12.4	-	10.5	-
Coffee	89.5	0.3	-	-3.9	-
Tobacco	-54.9	-	66.1	-	-12.0
Slaughtering	33.0	8.2	-	9.5	-
Milk	87.7	-4.1	-	19.4	-
Sugar	23.9	-9.1	-	22.7	-
Beverages	44.2	-	32.9	-	20.4
Automobiles	350.2	97.8	-	35.3	-

Source: IBGE.

(1) Annual Industry Survey (PIA). Ratio between value added (VTI – see footnote 10), deflated by the industrial IPA (1990=100), and employees linked directly to production.

(2) National Accounts. Ratio between added value (previous year's prices) and employment levels.

(3) Monthly Industrial Survey. Ratio between physical production and employment levels within production.

Allocative Efficiency

In the case of allocative efficiency, in addition to the structural movements observed in the preceding section, the principal evidence for gains derives from the behavior of mark-ups. In Moreira and Corrêa, measurements of the behavior of sector mark-ups during the period 1990-95 pointed to a substantial and largely generalized fall (averaging 22.4%) in this indicator for the various sectors of the manufacturing industry. Corrêa (1997), using a more extensive and up-to-date series for the same indicators (1989-96), found a negative correlation between sector mark-ups and import penetration. Hay (1997) in turn identified substantial reductions in the profits of large companies during the period between 1986-88 and 1993-94 (35%), and found a positive correlation between profits and the level of protection of the domestic market (import tariffs). This kind of evidence points not only towards gains in allocative efficiency, but also to gains in technical efficiency deriving from scale effects. This is because lower mark-ups are usually associated with more elastic demand curves and a greater scale of production.⁹

With the aim of verifying the most recent trends in sector mark-ups and the permanence of efficiency gains over time, we repeated the exercise carried out by Moreira and Corrêa (1996) for a

⁹ According to Cournot's classic result.

$$\frac{P - cmg}{p} = \frac{H}{e}$$

in which p is the price, cmg is the marginal cost, H is the Herfindal-Hirschman index of concentration and e the price elasticity of demand. [Scherer and Ross (1990)].

longer time period: 1990-98¹⁰. On this occasion, we were also able to draw on a longer series of technical coefficients from the IBGE's input-output matrix for 1990-95, allowing us to restrict the theoretical hypothesis of fixed technical coefficients to 1996-98. For this period, the major increases in productivity and imports had already occurred.

Table 15 presents the results from the 38 sectors for which the necessary information could be found. As may be observed, the new series confirms the substantial reductions in mark-ups for all categories during the period 1990-95 (an industry average of -21.1%) and a deepening of this trend during the following period of 1995-98, albeit at a slower pace (-5.3%)¹¹. For the cumulative period 1990-98, the fall was led by the labor-intensive category (-33.6%), calling attention to the accumulated inefficiencies of these sectors, despite the advantages derived from the relative abundance of labor. This group is followed by capital- (-28.8%) and technology-intensive (-26.3%) categories, both of which show substantial reductions, according to an expected trend, given the degree of protection previously enjoyed by these sectors. Natural resource-intensive sectors show the smallest reductions (-11.6%), in line with Brazil's competitive advantages in this area.

Observing these sectors on a case-by-case basis, it is significant that only 6 of the 38 show increase in mark-ups during the period 1990-98: the steel, pharmaceuticals, beverages, cement components and structures, equipment for the production and distribution of electricity, and rubber sectors. Of these, only 2 achieved increases in relative prices (the change in sector prices adjusted for IGP inflation), namely pharmaceuticals and beverages, both of which are sectors with strong *non-traded* characteristics: That is to say, sectors whose transportation and distribution (beverages) difficulties, or the existence of internationally concentrated production (pharmaceuticals) prevent more effective competition by imports. In the other sectors, the increase in margins was achieved by a reduction in costs in excess of the reduction in prices. That is, the efficiency gains were not passed through to consumers for reasons possibly linked to a local market structure that was still concentrated (steel, equipment for the production and distribution of electricity, and rubber) or to the non-traded characteristics of the products in question (cement components and structures).

TABLE 15
Changes in Mark-up, Price and Real Costs by Factor Intensity - 1990-98

Factor	D Mark-up			D (Price/IGP)			D (Cost/IGP)		
	1990-95	1995-98	1990-98	1990-95	1995-98	1990-98	1990-95	1995-98	1990-98
Capital									
Steel	6.7	-6.1	0.2	-17.1	-10.0	-25.4	-22.1	-4.1	-25.3
Miscellaneous chemicals	-13.7	1.7	-12.2	-34.5	-5.4	-38.0	-24.0	-7.0	-29.3
Resins, fibers and elastomers	-5.1	-13.6	-18.1	-28.3	-15.4	-39.4	-24.3	-2.1	-25.9
Basic and intermediate petrochemicals	-21.9	-8.4	-28.4	-40.9	-10.3	-47.0	-24.4	-2.1	-26.0
Other metal products	-33.0	-3.6	-35.5	-39.3	-7.8	-44.0	-9.0	-4.3	-13.0

¹⁰ As in Moreira and Corrêa *op. cit.*, we attempted to estimate the behavior of gross mark-up, defined according to the following price equation:

$$p_j = (1 + \mathbf{a}_j) \sum_i^n a_{ij} p_i$$

where p_j is the final product price (sector matrix) j ; \mathbf{a}_j is the *mark-up* represented by the percentage applied to average direct costs (labor and raw materials) to cover the remuneration of capital and indirect costs; a_{ij} is the quantity of raw material i required to manufacture a unit of product j (technical coefficients) and p_i is the price of raw material i . Both p_i and p_j were constructed on the basis of the IPA-OG in product terms, using the index weight of these as a weighting factor.

¹¹ During the period 1990-95, margins fell at an average of 4.6% per year. In the following period, the rate of this reduction slowed to 1.3% per year.

Chemicals excluding petrochemicals and carbochemicals	-23.1	-19.4	-38.1	-31.1	-14.2	-40.8	-10.4	6.4	-4.6
Fertilizers and soil supplements	-40.4	3.5	-38.3	-53.4	-3.4	-55.0	-21.9	-6.6	-27.0
Plastic sheeting	-54.9	-11.2	-60.0	-62.7	-18.5	-69.6	-16.5	-8.2	-23.3
Average	-23.2	-7.1	-28.8	-38.4	-10.6	-44.9	-19.1	-3.5	-21.8
Labor-intensive									
Perfumes, soaps and candles	-15.9	-1.1	-16.8	-20.5	-5.8	-25.1	-4.8	-4.8	-9.4
Treatment, spinning and weaving of natural fibers	-9.7	-8.3	-17.1	-32.2	-14.8	-42.2	-24.9	-7.1	-30.2
Spinning and weaving of artificial and synthetic fibers	-12.2	-12.2	-22.9	-35.1	-18.9	-47.4	-25.9	-7.6	-31.5
Plastic articles	-28.4	-10.6	-36.0	-40.3	-18.0	-51.0	-16.5	-8.2	-23.3
Other textile industries	-42.1	-1.6	-43.0	-56.5	-8.6	-60.3	-24.3	-7.2	-29.7
Footwear	-27.2	-22.8	-43.8	-32.3	-21.7	-47.0	-7.2	1.4	-5.9
Glass and glass articles	-57.1	3.8	-55.5	-67.1	2.2	-66.4	-23.1	-1.6	-24.4
Average	-27.5	-7.5	-33.6	-42.7	-10.9	-49.2	-18.1	-5.0	-22.1
Technology-intensive									
Pharmaceuticals Industry	26.4	30.6	65.1	19.8	24.2	48.8	-4.8	-4.8	-9.4
Equipment for the production and distribution of electricity	0.7	4.3	5.0	-23.8	-5.5	-28.0	-24.5	-9.4	-31.6
Rubber industry	7.8	-3.7	3.7	-9.0	-9.1	-17.2	-15.2	-5.6	-19.9
Paper, board and paper products	3.6	-24.5	-21.7	0.0	-31.1	-31.1	-3.4	-8.7	-11.8
Conductors and other electric materials, excluding vehicles	-20.0	-10.0	-28.0	-39.6	-18.4	-50.7	-24.5	-9.4	-31.6
Manufacture of other vehicles	-19.4	-10.9	-28.3	-38.3	-16.6	-48.5	-23.2	-6.4	-28.1
Motors and vehicle components	-33.0	-4.9	-36.3	-48.8	-11.0	-54.4	-23.2	-6.4	-28.1
Electrical appliances and equipment, including household and office appliances	-26.3	-15.3	-37.6	-46.6	-24.8	-59.9	-27.2	-11.3	-35.4
Tractors and transport machinery, including components and accessories	-33.9	-11.9	-41.8	-40.9	-14.7	-49.6	-10.6	-3.2	-13.4
Machinery, equipment and instruments, including components and accessories	-40.0	-10.5	-46.4	-46.1	-13.4	-53.3	-10.2	-3.1	-13.0
Automobiles, vans, trucks and buses	-41.6	-8.9	-46.8	-61.0	-17.7	-67.9	-33.1	-9.7	-39.6
TV, radio and hi-fi equipment	-52.8	-14.8	-59.8	-65.7	-24.4	-74.1	-27.2	-11.3	-35.4
Electronic and communications materials and equipment	-66.8	-7.8	-69.4	-75.7	-18.2	-80.2	-27.2	-11.3	-35.4
Average	-22.7	-6.8	-26.3	-36.6	-13.9	-43.5	-19.6	-7.7	-25.6
Natural resource-intensive									
Beverage industry	33.9	10.9	48.5	19.6	11.5	33.3	-10.7	0.6	-10.2
Cement, concrete and fiber cement components and structures	20.4	7.5	29.3	-7.4	5.7	-2.2	-23.1	-1.6	-24.4
Other food industries	-11.0	9.6	-2.5	-25.7	21.2	-9.9	-16.4	10.5	-7.6
Cement and clinker	-6.7	-4.3	-10.7	-28.6	-5.8	-32.7	-23.1	-1.6	-24.4
Other non-metallic mineral products	-17.9	-0.2	-18.0	-36.9	-1.7	-38.0	-23.1	-1.6	-24.4
Cooling and preparation of milk and dairy products	-21.0	1.0	-20.2	-14.9	1.0	-14.0	7.6	-0.1	7.6
Fruit and vegetable products, including juices and condiments	-30.1	9.1	-23.8	-37.9	9.7	-31.9	-10.7	0.6	-10.2
Non-ferrous metals	-20.0	-5.0	-24.0	-45.7	-18.4	-55.7	-32.0	-14.0	-41.6
Lumber industry	-27.4	-13.3	-37.0	-36.5	-11.7	-43.9	-11.8	1.9	-10.2
Pulp and mechanical pastes	-47.0	-17.7	-56.4	-48.8	-24.9	-61.6	-3.4	-8.7	-11.8
Average	-12.7	-0.2	-11.5	-26.3	-1.4	-25.7	-14.7	-1.4	-15.7
Industry Total	-21.1	-5.3	-24.3	-35.0	-9.6	-40.0	-17.9	-4.7	-21.5

Source: BNDES, based on IBGE input-output matrix and IPA-FGV data.

In Table 16, sectors were aggregated by category of good, again confirming the falls in margin for all the categories during the period 1990-95, as well as the deepening of this trend in the subsequent period, with the exception of non-durable consumer goods. The behavior of this last sector is largely explained by the importance and performance of non-traded sectors such as pharmaceuticals and beverages. The capital goods sector in turn led the reduction in mark-ups with an impressive reduction of 47%. With numbers like these, it can be said with a reasonable degree of confidence that the gains, in terms of reduction of the cost of domestic investment, were substantial. Finally, the performance of intermediate sectors shows that the efficiency gains spread to the whole of the production chain, which together with gains in productivity, aids in explaining why most of the sectors analyzed also achieved important reductions in their costs.

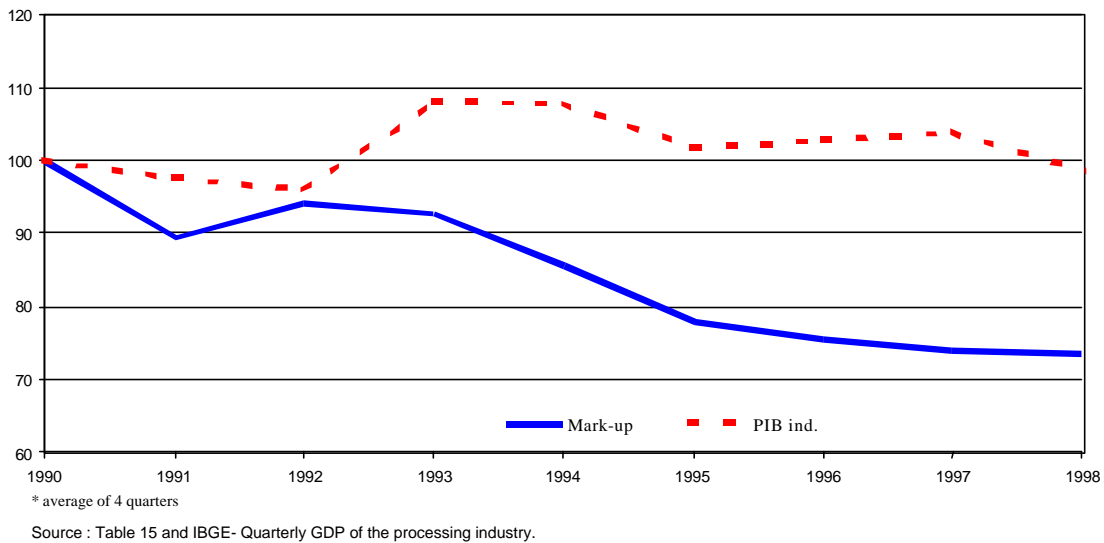
TABLE 16
Change in Mark-up, Price and Real Costs by Category of Use – 1990-98

Category of Use	D Mark-up			D (Price/IGP)			D (Cost/IGP)		
	1990-95	1995-98	1990-98	1990-95	1995-98	1990-98	1990-95	1995-98	1990-98
Non-Durable Consumer Goods	-3.5	13.2	9.2	-21.0	1.5	-17.5	-9.8	-1.3	-10.9
Durable Consumer Goods	-36.8	-12.1	-44.4	-50.2	-21.9	-60.8	-25.9	-9.6	-33.0
Intermediate Goods	-13.4	-6.6	-19.2	-36.1	-12.7	-44.0	-21.1	-5.5	-25.3
Unprocessed Intermediate Goods	-12.8	-12.7	-23.9	-32.2	-9.6	-39.4	-15.9	-3.2	-18.8
Capital Goods	-45.7	-2.5	-47.0	-46.7	-12.9	-52.8	-18.1	-6.7	-23.3
Capital Goods, Transport Equipment	-39.2	-7.3	-43.6	-54.9	-14.3	-61.1	-28.1	-8.0	-33.8

Source: BNDES, on the basis of the IBGE input-output matrix, as well as the IPA-FGV.

While this set of results suggests a strong correlation between liberalization and the behavior of sector *mark-ups*, any categorical statement would require a more detailed econometric study capable of isolating the impact of the change in regime from the other variables that normally affect the profit margins of firms, particularly the level of activity [see Roberts and Tybout (1996)]. To judge by the data in Graph 2, this variable, at least for the industry average, seems to have had little influence on the behavior of the *mark-up* during the period.

Graph 2 – Performance of Mark-up and of GDP* for Processing Industry. 1990=100



Another point that we should avoid losing sight of is that opening to trade causes a reduction in margins not only because it makes markets more competitive, but also because it causes a shift in relative prices against sectors that were previously more protected, as was the case with the manufacturing industry. Within Brazil, this movement was reinforced by the appreciation of the real exchange rate from 1992 onwards, which may have caused a reallocation of resources over and above what was justified by the country’s comparative advantages. The extent of this overshooting will nevertheless only become clear in the medium to long term, as and when the market adjusts to the new level of the exchange rate that became effective from January 1999 onwards.

4. Conclusions

The recent performance of Brazilian industry largely confirms the conclusions of Moreira and Corrêa (1996) with regard to the impact of trade liberalization in the first half of the decade. That is, it corroborates the evaluation that this impact was generally in the expected and desired direction, despite the unfavorable macroeconomic environment that prevailed for most of the period in question. In the second half of the decade, the trend towards greater specialization of production consolidated itself, albeit at a slower pace, in line with the availability of domestic resources. As in the previous period, this movement had all the nuances of intra-industry specialization.

In the vast majority of the sectors, an increase in the share of exports continued to accompany a greater penetration of imports, maintaining the expectations of intra-industry specialization. It is also true that the difference in the pace of these trends remained, albeit to a lesser degree. At the same time, in the face of the difficulties created by the macroeconomic environment, and the specific obstacles to expansion of external sales for a country that spent such a long time “looking inwards”, it can hardly be claimed that such behavior was unexpected. With the consolidation of the new regime and the improvement in the macroeconomic environment, particularly with the devaluation of the exchange rate, this differential should be reduced, principally by growth in exports. The level of penetration achieved by imports, which can hardly be considered excessive by international standards, does not justify expectations that these will be the main basis for the adjustment.

The structural changes caused by the trend towards specialization have also failed to indicate a significant harmful impact on Brazil’s growth prospects, given the eventuality of a shift in

technology-intensive sectors, which actually showed an increase in share, both in terms of value added, and in terms of value of production. It is true that the capital goods segment, which is considered a key category in the generation and spread of technological progress, continued to lose ground to imports. Here too, however, international comparisons do not permit us to conclude that a shift has taken place, but that there has been a process of specialization that was necessary in the light of the economies of scale involved. The same is suggested by the growing share of exports in the production of capital goods. In this case, we should not yet lose sight of the situation that prevailed before the opening. So called “high technology-content” goods were produced, for the most part, by large multinationals at prices well above those of the world market, even though these were nowhere near the technological frontier. While there may have been gains in terms of learning, these hardly compensated the losses due to the increased costs of investment and the barriers to the spread of such innovations to the other sectors of the economy.

It is also true that, as a consequence of the specialization process, there was a fall in the ratio of value added and value of industrial production, particularly in technology-intensive sectors. The magnitude of the fall does not suggest that a Mexican-style “hollowing out” process took place, so much as a necessary adjustment to the excesses committed by the previous regime.

Here too, we should not lose sight of the fact that in several sectors, particularly technology-intensive ones, value added, when measured at international prices, was very small or even negative.

The most recent evidence also reinforces the conclusion that there were substantial gains in terms of technical and allocative efficiency, even if much research remains to be done in this field. With regard to the first aspect, estimates of both total factor productivity and labor productivity continue to point to significant gains over the course of the decade, strengthening the argument that at the end of the 1980s, industry was far from the international frontier. With regard to allocative efficiency, advances in natural resource-intensive sectors and the confirmation of sharp reductions in profit margin in the vast majority of sectors also suggest that important gains have been achieved.

Finally, it is also worth highlighting that a positive evaluation of the impact of opening over the course of the decade should not be confused with a conclusion that Brazilian industry has already completed its process of adjustment to the new regime. While there is no remaining doubt that various stages of this process have already been completed, others lie ahead. A recent study by McKinsey (1997), for example, suggests international best practice is still a long way away, or in other words, important gains in productivity have yet to be achieved. We may conjecture that, in addition to the question of management, a substantial portion of these gains may be extracted through economies of scale, that is, the formation of companies that are sufficiently large to compete on an equal footing with its rivals in the developed, as well as the developing world. Facing this issue is becoming an ever more urgent priority, since the disadvantages of size are being magnified by the advance of globalization and the recent wave of mergers and acquisitions that have characterized industries throughout the world.

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