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Structural changes and external vulnerabilities in the Brazilian economy: 1995-2009[1]

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Abstract: From the 1990s, the reorientation of the development model, which switched from protective of industrial sector to intensifier of the trade liberalization process, brought the need for reorganization of large productive sectors of the Brazilian economy, were openly forced to face global competitors, within the established international conditions. Thus, during the 1990s, the Brazilian economy experienced a period of fast and deep changes, combining the process of intensification of trade liberalization with a view of industrial and technological policy which combines sectoral and systemic dimension, with privatization of important sectors of the economy (such as electricity and telecommunications sectors), and a stabilization program (Real Plan), based on a fixed exchange rate, with important effects on the whole economy. This article aims to assess the evolution of external vulnerability and structural changes in terms of generating value added in the Brazilian economy in the period 1995-2009, subdivided into three sub-periods, namely 1995-2000, 2000-2005 and 2005 -2009, by means of a novel treatment of the inter-sectoral output multipliers. The data base was the annual input-output matrices from Brazil for 1995, 2000, 2005 and 2009, structured into 42 sectors.
The main results indicated a very satisfactory behavior of the national economy over time, with a predominance of positive gains in the ability to generate value added and lower imports of intermediate inputs by the most technologically advanced industries and by services, and fewer losses and greater external dependence for the minority of sectors, particularly in recent years.

Key words: Structural changes, external vulnerabilities, regional economy.

1. INTRODUCTION

From the 1990s, the reorientation of the development model, which switched from protective of industrial sector to intensifier of the trade liberalization process, brought the need for reorganization of large productive sectors of the Brazilian economy, were openly forced to face global competitors, within the established international conditions.

Thus, during the 1990s, the Brazilian economy experienced a period of fast and deep structural changes, combining the process of intensification of trade liberalization with a

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view of industrial and technological policy which combines sectoral and systemic dimension, with privatization of important sectors of the economy (such as electricity and telecommunications sectors), and a stabilization program (Real Plan), based on a fixed exchange rate, with important effects on the whole economy.

The substantial adjustments promoted by the Brazilian industry in the 1990s were more than production and employment. The qualification, productivity, and wages, also adjusted in response to the intensification of trade liberalization in progress from the beginning of the decade. There is every indication that these events result from the effects of the restructuring production process of the domestic industry, based primarily on the implementation of modern management techniques and quality control and on adoption of technology towards skilled labor.

Another issue that emerges from this process and worries researchers is the concentration movement, both in the productive and in assets fields (mergers, acquisitions, entry of large oligopolistic firms in the market, expanding production scales, etc.), involving even a regional dimension, with sub-national government (state) adopting industrial policies embodied in aggressive strategies to attract investments and increasing its already significant share in the national and/or state GDP [VASCOCELOS; CASTRO (1999) and BONELLI; VEIGA (2003)]. Accordingly, at the regional level, the responses to changes in the 1990s, although moving in the same direction, present particular aspects due to its own characteristics.

According to Giambiagi et al. (2005), from 1999 the country began a short process of growth interrupted by the Brazilian energy crisis, by the contagion of the Argentine crisis and by the terrorist attacks of September 11, 2001 in the United States. With cuts of 20% in energy demand in 2001 compared to the previous year, the national energy crisis resulted in three consecutive quarters of GDP decline in 2001. The contagion of the Argentine crisis reduced capital inflows in Brazil, while the terrorist attacks shook the international markets.

In the period between 2003 and 2008, according to the Dating Committee of Economic Cycles (CODACE, 2009), the Brazilian economy experienced continued expansion of GDP, with cumulative growth of 30%. In the labor market was observed considerable raise in the formalization of labor relations and clear downward trend in unemployment rate (CORSEUIL; FOGUEL, 2011).

Nevertheless, the international financial crisis of 2008 shook, temporarily, the trajectory of national economic growth. The impacts were particularly hard during the last quarter of 2008 and first quarter of 2009. The international credit lines were drawn back, there was

a sharp drop in commodity prices, which resulted in the devaluation of the Real against the U.S. dollar and the deterioration of the indicators of economic activity and employment (MINISTÉRIO DA FAZENDA, 2010).

However, the continued growth was guaranteed by the soundness of fiscal and monetary fundamentals which were pursued over the period. The economy began to grow, generating significant primary surpluses of public accounts and inflation controlled by the target system. Instead of getting into debt in order to grow, Brazil began to expand with debt reduction (MINISTÉRIO DA FAZENDA, 2010).

Given this path of 14 years of the national economy and despite the existence of a vast literature devoted to its evaluation in several aspects, makes it interesting to study, at sectoral level, external vulnerability and ability to generate value added of national economy in the period from 1995-2009 by means of a new treatment of the inter-sector production multipliers.

Therefore, the objective of this research is to evaluate the evolution of external dependence and changes in terms of generating value added of sectors of the Brazilian economy in the period from 1995-2009, subdivided in to three sub-periods, namely 1995-2000 and 2000-2005 and 2005-2009. Specifically aiming at:

- quantifying then net growth effect resulting from the variation of the value added generated in the sectors during the period;
- quantifying the external dependence effect resulting from the import of inputs by the sectors in the period;
- classifying the sectors according to these effects;
- providing a set of indicators to support the planning of both national public policies and private actions.

Besides this introduction, the article is divided in to four parts. The second describes the methods and data, while the third discusses the results. The fourth and last part presents the concluding remarks and suggestions for future researches.

2. METHODS AND DATA

2.1. Source of data

For this study were used the annual input-output matrices from Brazil for 1995, 2000, 2005 and 2009, structured into 42 sectors, and estimated by Guilhoto and Sesso Filho (2005), available at http://www.usp.br/nereus.

2.2. Theoretical Foundation

2.2.1. Sectoral linkages indices

The analysis of intersectoral relations of a given economy is based on the fact that the products can be used by both industries, as intermediate inputs, as well as consumers, to attend the needs of final demand. Whereas in the input-output model, final demand is autonomous, it becomes possible to determine the amount to be produced in each sector and the relative intensity of transactions in different industries, in other words, intersectoral links.

In the literature, several methods are reported that aim to measure the intersectoral links in order to identify key sectors, in the definition of Rasmussen (1956) and Hirschman (1958), or growth poles according to Perroux (1977) and Myrdal (1957).

From the spatial or regional point of view, the search for development, since 1950, has attracted considerable interest in the concept of 'links' as a means to identify key sectors for the promotion of industrial development strategies. It is believed that the concentration of resources, especially capital and entrepreneurial ability in key sectors would enable faster growth of output and employment than if they were allocated in other sectors (McGilvray, 1977).

Although there is consensus regarding the importance of intersectoral linkages in determining stimulus to economic growth and regarding the fact that the process of economic transformation is often stimulated by the relatively small number of sectors, seems to be little agreement regarding identification of key sectors. For McGilvray (1977), factors that play a dominant role in the development process of the countries, as trade patterns and international competitiveness, availability of natural resources, skill/talent business and technology, are not explicitly recognized when seeking to determine sectors key. According to Guilhoto et al. (1994), part of the confusion is due to the difficulty in identifying what are the sectors that contribute above average for the economy, in an ex-post and ex-ante view.

Based on Guilhoto et al. (1994) proposal to consider the various available methods for measuring linkages index as complementary in the analysis of a particular economy, which would determine key sectors in a more balanced and broad, and considering the linkages index that can be derived from input-output tables as a first step in identifying potential areas of development projects (McGilvray, 1977), are exposed, in this section, the methods used to identify sectors that more become dynamic an economy[6].

[6] Other indices used to measure intersectoral linkages can be seen in Clements-(Cella (1984) Clements (1990) Guilhoto et al. (1994) and Guilhoto et al. (1996).

2.2.1.1 The Rasmussen-Hirschman index

The Rasmussen-Hirschman indices linkages have been very applied and discussed in the literature by McGilvray (1977), Hewings (1982), Guilhoto et al. (1994), among others. These measures, originally devised by Rasmussen (1956), were used as a means of identifying key sections by Hirschman (1958).

Considering the internal structure of the economy based on input-output model and following the last two authors, one may determine the sectors that have greater power chaining within the economy. In other words, one can calculate the backward linkages index, which estimate how much an industry demand from the other sectors, and the forward linkages index, which tell how much an industry is demanded by others.

Thus, based on the Leontief inverse matrix (Leontief, 1986) given by the equation $B = (I - A)^{-1}$, with b_{ij} defined as an element of this matrix B, B* as the average of all elements of L e $L_{\bullet j}$ e $L_{i\bullet}$ as the sum of a column and a typical line B, given respectively as:

$$L_{\bullet j} = \sum_{i=1}^{n} l_{ij} \qquad \text{e} \qquad L_{i\bullet} = \sum_{j=1}^{n} l_{ij} \qquad \text{i, j=1,2,...n} \tag{2.1}$$

So:

Backward linkage index (power of dispersion):

$$U_j = \left[L_{\bullet j} / n\right] / L^* \tag{2.2}$$

Forward linkage index (sensitivity of dispersion):

$$U_i = \left[L_{i\bullet} / n\right] / L^* \tag{2.3}$$

For Rasmussen and Hirschman, values greater than 1, both backward and forward linkages index, indicate above average sectors and, therefore, key sectors for economic growth.

Particularly considering the backward linkage index, these indicators show the effect of a unit change in final demand of sector j on the production of all sectors. The higher the value of these coefficients, the greater the impact of the change in final demand sector j and over all others.

2.2.1.2. Net growth (or efficiency) and external dependency effects

The Rasmussen-Hirschman backward linkage indicators can be used to evaluate both the gains in the capacity of an economy to generate value added as well as the changes in external dependency of an economy from one year to another, according to Lopes et al

(2011).

In this context, and following the methodology showed by this authors, the column sums of the Leontief inverse matrix (backward linkage indices) allows to evaluate the effect on the total product resulting from the increases by one unity in final demand of each sector, which can be divided in three terms: interindustry flows, value-added and imported inputs[7]. Furthermore, an important property applies, that is the sum of the last two terms is equal to unity, exactly the value of the initial stimulus (exogenous). This is why, in equilibrium, the total value of final demand sector is equal to the gross value added plus imported inputs from all sectors.

From this property, and after a convenient arrangement of these terms, the evolution of backward linkage indices, value added and imported input coefficients over time can be used to detect structural changes in the economy.

In other words, one can quantify the capacity to generate more or less value added by unit of final demand, call for Amaral, Lopes e Dias (2010) as an 'efficiency effect' or 'net growth effect', and the necessity to import more or less intermediate inputs, for the authors certain kind of 'external dependency effect'. Besides, one can classify the productive sectors according to a particular combination of both effects, finding a new kind of 'key sectors', those presenting a positive 'efficiency' change and negative 'dependency change.

Thus, considering a unitary increase in j sector's final demand, $\Delta y_j = 1$, its effects on total production are:

$$\sum_i \Delta X_i = \sum_i b_{ij} = b_{0j} \qquad (2.4)$$

By the equilibrium condition between total sectoral final demand and total primary inputs, we have:

$$\Delta y_j = 1 \Rightarrow \Delta(\Sigma_i v_i + \Sigma_i m_i) = 1 \qquad (2.5)$$

where v_i and m_i are the value added and the value of imported inputs used by sector I, respectively.

Defining and assuming as constants the value-added coefficients ($a_i^v = v_i/x_i$) as well as the imported inputs coefficients ($a_i^m = m_i/x_i$), we have:

$$1 = \Sigma_i b_{ij} a_i^v + \Sigma_i b_{ij} a_i^m \qquad (2.6)$$

Dividing both sides of (2.6) by b_{0j}:

$$1/b_{0j} = \Sigma_i (b_{ij}\, a_i^v) / \Sigma_i b_{ij} + \Sigma_i (b_{ij}\, a_i^m) / \Sigma_i b_{ij}, \qquad (2.7)$$

and, representing by v^*_j and m^*_j the terms in the right hand side of (2.7) (the weighted aver-

[7] For a good exposition of the basic structure and results of the Leontief model see Miller and Blair (2009).

age of value-added and imported inputs coefficients, respectively), we arrive finally at:

$$1 = b_{0j} (v^*_j + m^*_j) \quad (2.8)$$

The expression (2.8) can be used as in a dynamic or as in a comparative static to detect and quantify the changes in the productive structure of an economy. In the present paper, (2.8) will be used in a comparative static.

Suppose that, for each sector j, we have, between two given years, a decrease in b_{0j}. This means that, in order to satisfy a unitary increase in sector j final demand it is necessary a smaller increase in the global production of the economy. In this case, we must have $\Delta m^*_j+\Delta v^*_j > 0$, and so four situations are possible in a two dimensional space with axes Δv^*_j and Δm^*_j:

-when $\Delta v^*_j > 0$ and $\Delta m^*_j < 0$, the decrease in b_{0j} goes with a larger capacity to generate value added (a beneficial 'net' growth effect) and a lower necessity of imported inputs (a reduced external dependency effect) – let's call this area A, the most virtuous one;

-if $\Delta v^*_j > 0$, $\Delta m^*_j > 0$ and $\Delta v^*_j/\Delta m^*_j > 1$, there is a simultaneous increase in 'net growth effect' and 'external dependency', with the first dominating the second (area B);

-with $\Delta m^*_j > 0$, $\Delta v^*_j > 0$, but $\Delta m^*_j/\Delta v^*_j > 1$, the increase in 'external dependency' is relatively more significant than the increase in 'net growth effect' (area C);

-finally, with $\Delta m^*_j > 0$ and $\Delta v^*_j < 0$, the decrease in b_{0j} is totally due to an increase in 'external dependency', with a simultaneous decrease in the capacity to generate value added (area D, the most disadvantageous situation).

For the case of a b_{0j} increase we must have $\Delta m^*_j+\Delta v^*_j < 0$, a worse situation for the economy, at least from the 'capacity to generate more value added' point of view. The four possible areas now are (in a descending order):

-Area A': $\Delta v^*_j > 0$ and $\Delta m^*_j < 0$, with $\Delta v^*_j < |\Delta m^*_j|$

-Area B': $\Delta v^*_j < 0$ and $\Delta m^*_j < 0$, with $|\Delta v^*_j| < |\Delta m^*_j|$

-Area C': $\Delta v^*_j < 0$ and $\Delta m^*_j < 0$, with $|\Delta v^*_j| > |\Delta m^*_j|$

-Area D': $\Delta v^*_j < 0$ and $\Delta m^*_j > 0$, with $|\Delta v^*_j| > \Delta m^*_j$

3. RESULTS AND DISCUSSION

With the application of the method described above for the Brazilian economy in the period from 1995-2009, divided into three periods, namely, 1995-2000, 2000-2005 and 2005-2009, and using the input-output matrices for1995, 2000, 2005 and 2009 with 42 sectors estimated by Guilhoto and Sesso Filho (2005), the general conclusion that can be drawn from

the results presented in Tables 1-6 is a significant improvement and maturation of the Brazilian productive system between 1995 and 2009 considering the analyzed aspects. In other words, a smaller number of sectors started to require large increase in the overall production of the economy to raise their final demands in one unit at the same time that most sectors reduced their external dependence for imported inputs.

The increase in the number of sectors that could increase their final demands in a unit with a small increase in global production and that reduced the need for imported inputs for the production process reflects the improvement in the production pattern of the national economy as well as its diversification and capacity to compete with foreign economy within the trade liberalization process underway in the country. Thus, from 1995 to 2009, the number of sectors with these characteristics increased from 13 to 32, as shown in following Tables.

The observation of the results separately by sub-period may reveal a reality that, at first sight, seems less positive. However, the evaluation of the results in this way makes it possible to check in detail the evolution of the national productive structure, of the generated value added and of the external dependence confronted with the policies adopted over the period and observe their virtuous path in response to the changes that occurred not only in Brazil, but that is common to several countries.

The scenario that precedes the period from 1995-2000 comes from the post-implantation of the Real Plan in 1994, when the country stabilized the price level growth, started to adopt fixed and valued exchange rate regime and initiated a period of deep structural reforms, with the economy showing moderate rates of growth. According to Camargo (2006), from then on, the pattern of structural functioning of the national economic system was changed, extending the range of planning of private decisions and making the potential consumer repressed by recessions and high inflation from previous periods rise again.

In the short term, the change of exchange rate regime worsened the unemployment situation in the country, mainly because of the low growth of the period, given the deep structural reforms which the country experienced with the implementation of the Real Plan and the intensification process of commercial opening in course. The reduction of tariffs and the exchange rate overvaluation changed relative prices in favor of imported goods, leading to industry reorganization, changes in technology, organization of work and unemployment (CACCIAMALI, 2000). Added to this scenario is the Mexican crisis of the late 1994 which strongly affected the emerging markets in the first half of 1995.

The period from 1995/98 maintained the fixed exchange rate regime and the appreciation of the national currency, with deficits in the trade balance and high interest rates, which prevented the achievement of macroeconomic stability and return to growth.

During this period, the international financial market was the scene of two other important crises, which harmed Brazil due to the reduced flow of foreign loans. The first crisis in 1997, in Asian countries, initially originated in Thailand, spread to South Korea, Indonesia and Malaysia, and the second in Russia in 1998 (GIAMBIAGI et al., 2005).

In January 1999 floating exchange rate with a temporary rise in interest rates began to be adopted, which came to be gradually reduced (BRESSER-PEREIRA, 2005), and there was an improvement in the trade balance (BAER, 1996 and GREMAUD et al.2005).

In this context, the results showed, for the first sub-period, 1995-2000, that there were fewer sectors with negative variation of b_{0j}, 13, than with positive variation of b_{0j}, 29 (Tables 1 and 2). The behavior of this coefficient reveals the biggest or smallest capacity to generate sectoral value added, respectively. For sectors with negative variation of b_{0j} only Oil and Gas (3) is located on Area A, the most beneficial to the economy as it has, in addition to greater net growth effect, less external dependence. However, this sector wasn't important in terms of share of total production, accounting for only 0.4% of the gross value of production in the period from 1995-2000.

Between the period from 1995-2000, the largest number of sectors with negative variation of b_{0j}, 8, was located on area D, which shows increased external dependence and simultaneous decrease in the ability to generate value added (Table 1 and Figure 1). It is worth emphasizing that in this area are located many important sectors for economic growth, as Parts and other Vehicles (12), Non-ferrous Metallurgy (6), Siderurgy (5) Cars, trucks and buses (11), Machinery and Equipment (8) Footwear (23), among others, sectors strongly affected by trade liberalization and the appreciation of the exchange rate after the Real Plan.

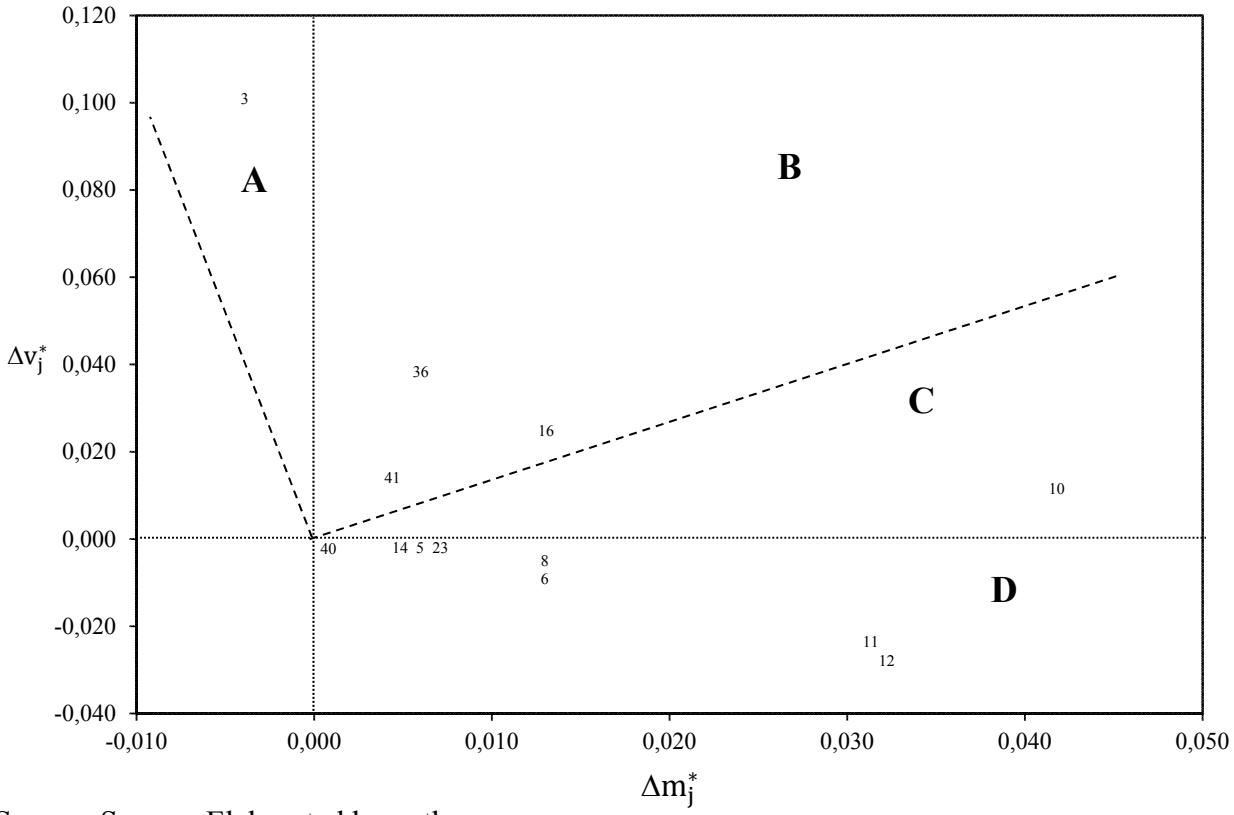
Areas B and C of Table 1 are intermediate. On area B are located 3 sectors, Public Administration (41) Communications (36) and Chemical Elements (16), which showed between 1995 and 2000, both increase inability to generate value added and rise in external dependence, predominantly the first one. Area C was represented only by Electrical Equipment (10), sector with positive net growth but with increasing dominance of imported inputs.

Table 1. Distribution of sectors in areas with Δb0j < 0, and sectoral share in gross value of production (GVP), imports (M) and the value added (VA), Brazil, 1995-2000.

Area		Sectors	Δb_{0j}	Δm_j^*	Δv_j^*	GVP (%)	M (%)	VA (%)
A	3	Oil and Gas	-0,351	-0,004	0,101	0,4	0,2	0,9
						0,4	**0,2**	**0,9**
	41	Public Administration	-0,038	0,004	0,013	13,0	15,3	5,6
B	36	Communication	-0,136	0,006	0,038	0,9	0,7	0,7
	16	Chemicals Elements	-0,186	0,013	0,025	1,0	0,3	1,8
						14,9	**16,3**	**8,0**
C	10	Electronic Equipment	-0,219	0,042	0,009	2,6	1,3	6,8
						2,6	**1,3**	**6,8**
	12	Parts and other Vehicles	0,000	0,032	-0,032	1,4	1,0	3,1
	40	Realty Services	-0,001	0,001	-0,001	5,0	8,4	0,2
	6	Non-Ferrous Metallurgy	-0,009	0,013	-0,011	0,5	0,3	0,9
	14	Pulp, Paper and Printing	-0,010	0,005	-0,002	1,8	1,4	2,4
D	5	Siderurgy	-0,017	0,006	-0,002	1,1	0,7	3,3
	11	Cars, Trucks and Buses	-0,022	0,031	-0,026	1,8	0,8	4,0
	8	Machinery and Equipment	-0,026	0,013	-0,007	1,2	0,8	2,4
	23	Footwear	-0,028	0,007	-0,002	0,8	0,4	1,0
						13,7	**13,7**	**17,3**

Source: Elaborated by authors.

Figure 1. Sectoral distribution with negative variation of b_{0j}, Brasil, 1995-2000.



Source: Source: Elaborated by authors.

Among the sectors with positive variation of b_{0j} none was found in the area with positive variation of the capacity to generate more value added and less need for imported inputs (A') and 28 were on area D', the least beneficial to the economy since the sectors there classified showed, besides greater external dependence, dominance of lower net growth effect (Table 2 and Figure 2).

Table 2. Distribution of sectors in areas with Δb0j> 0, and sectoral share in gross value of production (GVP), imports (M) and value added (VA), Brazil, 1995-2000.

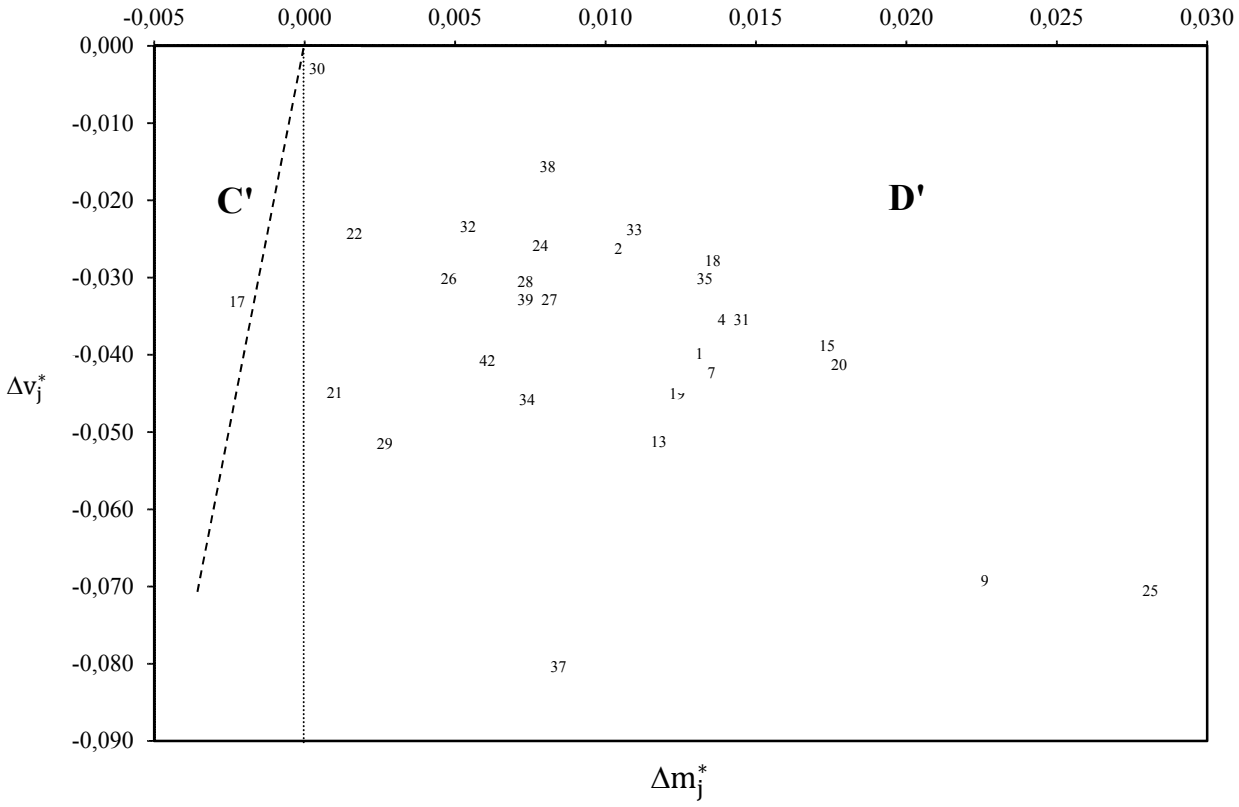
Area		Sectors	Δb_{0j}	Δm_j^*	Δv_j^*	GVP (%)	M (%)	VA (%)
C'	17	Oil Refining	0,168	-0,002	-0,033	2,6	1,2	13,0
						2,6	**1,2**	**13,0**
	29	Vegetal Oil	0,276	0,003	-0,051	0,8	0,3	1,0
	25	Vegetal Products	0,191	0,028	-0,070	0,5	0,3	0,5
	9	Electrical Equipment	0,183	0,023	-0,069	1,1	0,9	2,1
	37	Financial Institution	0,182	0,008	-0,080	7,4	8,7	2,3
	21	Textile Industry	0,160	0,001	-0,045	1,3	1,1	2,9
	28	Sugar Products	0,135	0,007	-0,029	0,6	0,2	0,3
	13	Wood and Wood Products	0,131	0,012	-0,051	1,3	1,2	1,0
	27	Dairy Products	0,128	0,008	-0,033	0,8	0,4	0,4
	26	Meat Products	0,128	0,005	-0,030	1,3	0,6	0,7
	20	Plastics	0,108	0,018	-0,042	0,9	0,6	2,7
	19	Pharmaceutical and Veterinary	0,105	0,012	-0,044	1,3	1,2	1,9
	7	Other Metal Products	0,101	0,013	-0,040	1,2	1,1	1,9
	24	Coffee Products	0,095	0,008	-0,026	0,2	0,1	0,0
D'	15	Rubber	0,094	0,017	-0,039	0,3	0,2	0,9
	42	Private Nonmarket Services	0,089	0,006	-0,041	2,1	2,4	1,0
	4	Non-Metallic Minerals	0,080	0,014	-0,036	1,0	0,8	1,4
	22	Clothing	0,080	0,002	-0,025	1,3	1,2	1,4
	31	Other Industrial Products	0,078	0,014	-0,036	0,3	0,3	0,5
	34	Trade	0,073	0,007	-0,045	8,4	11,2	3,4
	1	Agriculture	0,066	0,013	-0,039	4,7	5,6	3,2
	18	Other Chemicals	0,064	0,014	-0,027	0,7	0,4	2,2
	39	Business Services	0,064	0,007	-0,033	4,8	5,5	2,7
	2	Mining	0,053	0,011	-0,026	0,8	0,6	1,1
	35	Transport	0,051	0,013	-0,031	4,2	4,4	3,3
	32	Public Utilities	0,049	0,006	-0,024	2,5	2,7	1,7
	33	Construction	0,043	0,011	-0,024	5,7	5,5	4,1
	38	Families Services	0,021	0,008	-0,016	7,6	8,3	4,4
	30	Other Food Products	0,011	0,000	-0,002	2,5	1,3	5,0
						65,9	**67,2**	**54,1**

Source: Elaborated by authors.

Among these sectors are Textiles (21) and Clothing (22) which had revealed and exacerbated its lack of competitiveness, with the trade opening and with the exchange rate

appreciation, besides various sectors of services branch related to infrastructure, which had, until the mid-1990s, competitive disadvantages and additional costs relating to foreign competitors.

Figure 2. Sectoral distribution with positive variation of b_{0j}, Brasil, 1995-2000.



Source: Source: Elaborated by authors.

Particular attention should be paid to the fact that the sectors on area D' were responsible together for, approximately, 66% of production, 67% of imports and 54% of domestic value added in 1995. On area C' Oil Refining (17) showed simultaneous decrease in both effects, predominantly the reduction of external dependence.

The need for imported inputs to the production process was, in general, great for most sectors and industries were starting productive restructuring and modernization. Thus, between 1995 and 2000 a few sectors, such as Oil and Gas (3) and Oil Refining (17), which had already been benefited indirectly by the positive results from the National Alcohol Program (PROALCOOL), had lower external dependence and, in the first case, greater ability to generate value added. The Oil Refining sector (17) showed decrease in net growth effect, which may be attributed to the substitution of gasoline by ethanol in the national car fleet.

The sub-period from 2000-2005 revealed reduction in the number of sectors with negative variation of b_{j0} from 13 to 10. However, the number of sectors located on area A increased from 1 to 8 and there was no occurrence of sectors on areas C and D. Taking into account areas A and B, 50% of the sectors were service sectors. In other words, from the10 classified in these two areas, 5 were dedicated to some sort of service in the period, namely Private Nonmarket Services (42), Business Services (39), Financial Institutions (37), Communications (36) and Public Utilities (32) (Table 3 and Figure 3).

Table 3. Distribution of sectors in areas with $\Delta b0j < 0$, and sectoral share in gross value of production (GVP), imports (M) and the value added (VA), Brazil, 2000-2005.

Area		Sectors	Δb_{0j}	Δm_j^*	Δv_j^*	GVP P (%)	M (%)	VA (%)
A	21	Textile Industry	-0,011	-0,013	0,016	1,1	0,8	1,8
	42	Private Nonmarket Services	-0,017	-0,002	0,008	2,0	2,2	0,9
	7	Other Metal Products	-0,027	-0,006	0,013	1,2	0,9	1,8
	23	Footwear	-0,027	-0,006	0,011	0,7	0,4	0,8
	39	Business Services	-0,039	-0,002	0,017	4,2	4,8	2,4
	33	Construction	-0,044	-0,003	0,017	5,6	5,5	4,3
	37	Financial Institution	-0,191	-0,003	0,079	5,6	5,9	2,1
	28	Sugar Products	-0,316	-0,004	0,061	0,5	0,2	0,2
						20,9	**20,7**	**14,4**
B	36	Communication	-0,018	0,001	0,006	3,5	3,6	2,4
	32	Public Utilities	-0,019	0,001	0,006	3,3	3,5	2,1
						6,8	**7,1**	**4,5**

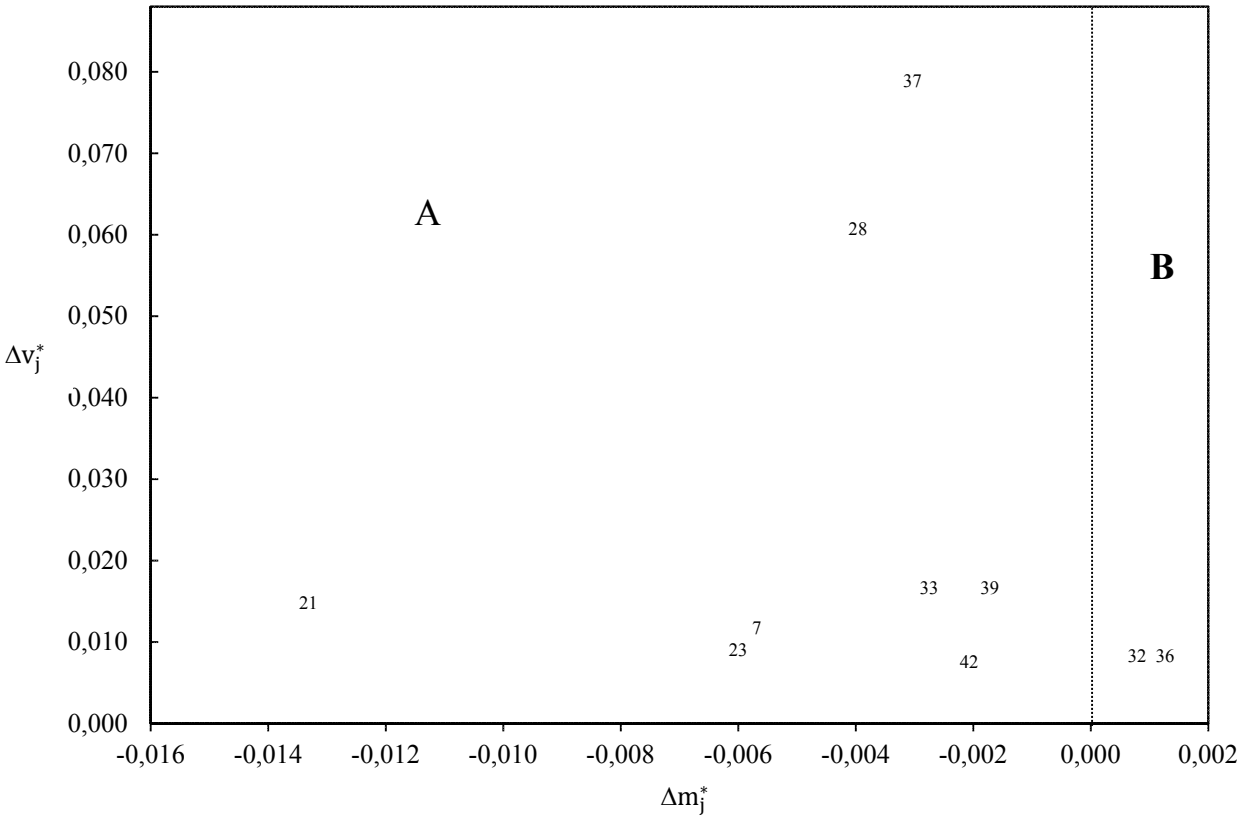
Source: Elaborated by authors.

With regard specifically to the sectors of infrastructure, which until the mid-1990s were almost exclusively under the responsibility of the public sector, characterized by reduced fixed investments, technological, management and services operation gaps, the period from 2000 -2005 shows the result of the redefining regulatory model occurred from the second half of the 1990s, in order to attract private investment, both to complete projects initiated and discontinued due to lack of resources, and to reduce the costs of implementation of the new infrastructure projects.

Starting from 1995 the Federal Government extended the privatization program to infrastructure services, edited the Concessions Law and the constitutional amendments of suppression of several state monopolies (oil industry, telecommunications, distribution of piped gas and reinsurance) and eliminated constitutional discrimination against foreign companies operating in Brazil. Moreover, established the sectoral regulatory agencies, endowed

with financial and operational autonomy, and edited the specific legislation for each sector included in the reforms (BONELLI, VEIGA, 2003).

Figure 3. Sectoral distribution with negative variation of b_{0j}, Brasil, 2000-2005.



Source: Source: Elaborated by authors.

Despite the fact that the results of these initiatives are heterogeneous, varying greatly between service providers sectors, they can be considered, in general, positive in terms of attracting investment, expansion of domestic supply and increased competition.

Among the sectors with positive variation of b_{0j} in the period from 2000-2005, 6 were located on the area with positive variation of the capacity to generate more value added and less need for imported inputs (A'), and 11 were found on area D'. On C' area 13 sectors were detected and on B' 2 (Table 4 and Figure 4). Compared with the period from 1995-2000, the period from 2000-2005 showed a small increase in the number of sectors with b0j > 0, from 29 to 32, but even so, many sectors improved their position in terms of external dependence, being located on areas A', B' and C', a total of 21 sectors, compared to only 1 in the initial period. Considering only areas D and D', the number of sectors decreased from 37 to11,

showing a reduction in the number of sectors with higher external dependence and dominance of lower net growth effect between 1995-2000 and 2000-2005.

Table 4. Distribution of sectors in areas with Δb0j > 0, and sectoral share in gross value of production (GVP), imports (M) and the value added (VA), Brazil,2000-2005.

Area		Sectors	Δb_{0j}	Δm_j^*	Δv_j^*	GVP (%)	M (%)	VA (%)
	17	Oil Refining	0,026	-0,008	0,003	3,8	1,3	14,6
	18	Other Chemicals	0,020	-0,006	0,002	0,9	0,4	2,3
	15	Rubber	0,019	-0,011	0,006	0,3	0,2	0,9
A'	2	Mining	0,011	-0,004	0,001	0,7	0,6	0,9
	9	Electrical Equipment	0,003	-0,009	0,008	1,0	0,6	2,2
	20	Plastics	0,001	-0,008	0,007	0,9	0,5	2,7
						7,6	**3,6**	**23,6**
	31	Other Industrial Products	0,021	-0,005	-0,001	0,3	0,3	0,5
B'	4	Non-Metallic Minerals	0,008	-0,002	0,000	0,9	0,7	1,4
						1,3	**1,0**	**1,9**
	29	Vegetal Oil	0,165	-0,004	-0,020	0,7	0,2	0,5
	11	Cars, Trucks and Bus	0,289	-0,009	-0,042	1,6	0,7	4,5
	8	Machinery and Equipment	0,137	-0,004	-0,028	1,3	0,9	2,4
	10	Eletronic Equipment	0,107	-0,006	-0,020	1,8	1,1	6,1
	13	Wood and Wood Products	0,097	-0,002	-0,023	1,1	1,0	1,0
	30	Other Food Products	0,072	-0,005	-0,009	1,6	1,0	1,8
C'	22	Clothing	0,068	-0,002	-0,016	1,0	0,9	0,8
	19	Pharmaceutical and Veterinary	0,064	-0,001	-0,017	1,4	1,2	2,0
	5	Siderurgy	0,054	-0,001	-0,012	1,2	0,7	2,6
	38	Families Services	0,051	0,000	-0,018	7,6	8,5	4,9
	26	Meat Products	0,033	0,000	-0,006	1,4	0,6	0,4
	25	Vegetal Products	0,209	-0,015	-0,024	1,3	0,5	2,5
	12	Parts and other Vehicles	0,207	-0,015	-0,030	1,4	0,8	3,7
						23,3	**18,1**	**33,2**
	27	Dairy Products	0,209	0,002	-0,037	0,7	0,3	0,3
	1	Agriculture	0,139	0,004	-0,052	4,8	5,5	3,9
	24	Coffee Products	0,138	0,004	-0,027	0,2	0,1	0,0
	3	Oil and Gas	0,105	0,002	-0,035	1,1	1,0	1,1
	35	Transport	0,080	0,000	-0,026	4,6	4,8	4,2
D'	14	Pulp, Paper and Printing	0,073	0,001	-0,019	2,1	1,7	2,1
	41	Public Administration	0,026	0,001	-0,012	11,3	14,5	4,3
	40	Realty Services	0,013	0,001	-0,012	6,1	10,6	0,3
	34	Trade	0,009	0,003	-0,008	7,7	10,1	3,4
	6	Non-Ferrous Metallurgy	0,006	0,007	-0,008	0,5	0,4	1,0
	16	Chemicals Elements	0,000	0,010	-0,011	1,0	0,6	1,8
						40,1	**49,5**	**22,5**

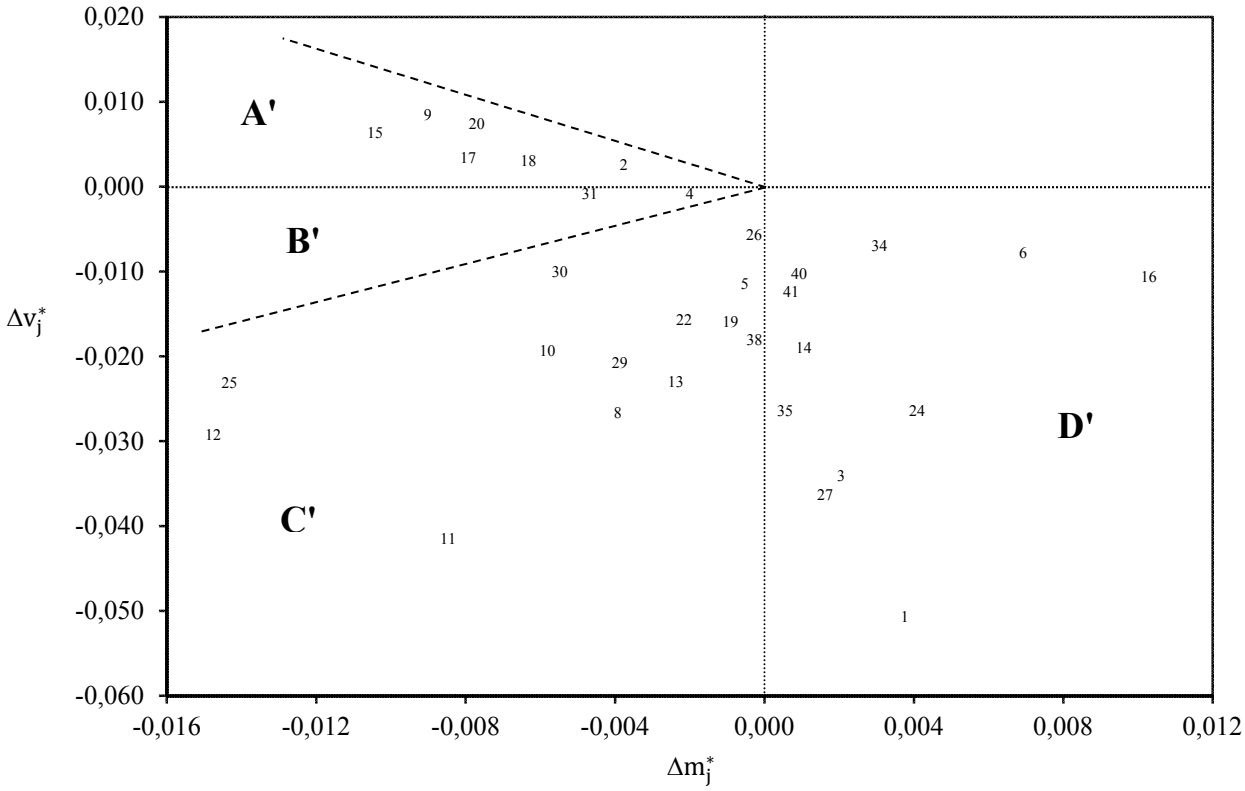
Source: Elaborated by authors.

We could say that these findings were the result of the changes implemented in the national economy over the period, making it more robustly structured and able to produce domestically many of the inputs required for its production process.

Between 1995-2000 and 2000-2005, two findings are important for what they mean in terms of changes in the sectoral pattern of behavior in Brazil. The first is the improvement in the ability to generate sectoral value added and reduce external dependence in some sectors, especially the Textile Industry (21), Other Metal Products (7), Footwear (23) and Construction (33), sectors with more technology. The second is the absolute and relative gain of importance of the activities traditionally associated with the service sector, with greater involvement in the production in the period from 2000-2005.

Thus, on areas A and B are the Private Nonmarket Services sectors (42) Business Services (39), Financial Institutions (37), Communications (36) and Public Utilities (32), in which modern technologies began to promote an important productive revolution in the industrial apparatus, since, according to Bonelli and Veiga (2003), it is estimated that a large share of employment in the industrial sector started to be devoted to service production from the 1990s.

Figure 4. Sectoral distribution with positive variation of b_{0j}, Brasil, 2000-2005.



Source: Source: Elaborated by authors.

The sub-period from 2005-2009 reserved for the national economy a very positive scenario in sectoral terms, with 21 of them being located on area A, 10 on B and 1 on C, a total of 32 (Table 5 and Figure 5).

Table 5. Distribution of sectors in areas with $\Delta b0j < 0$, and sectoral share in gross value of production (GVP), imports (M) and the value added (VA), Brazil, 2005-2009.

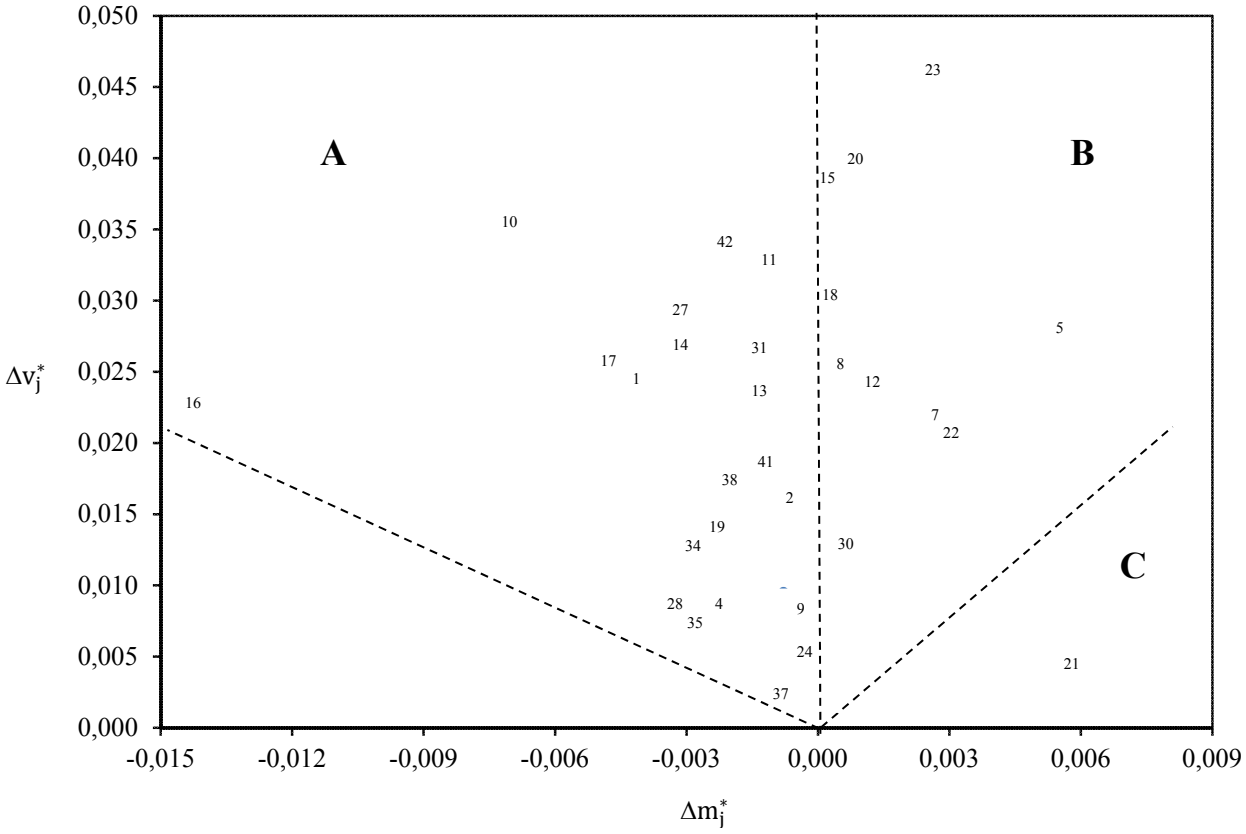
Area		Sectors	Δb_{0j}	Δm_j^*	Δv_j^*	GVP (%)	M (%)	VA (%)
	37	Financial Institution	-0,004	-0,001	0,003	5,3	6,8	1,7
	35	Transport	-0,016	-0,003	0,008	4,8	5,0	3,9
	34	Trade	-0,021	-0,003	0,013	7,8	10,6	3,9
	28	Sugar Products	-0,026	-0,004	0,009	0,7	0,5	0,2
	4	Non-Metallic Minerals	-0,027	-0,002	0,010	0,9	0,7	1,2
	24	Coffe Products	-0,034	-0,001	0,006	0,2	0,1	0,0
	41	Public Administration	-0,037	-0,002	0,018	11,4	14,6	4,7
	9	Electrical Equipment	-0,037	-0,001	0,010	1,1	0,7	1,9
	16	Chemicals Elements	-0,038	-0,014	0,023	1,1	0,7	2,4
	38	Families Services	-0,043	-0,002	0,017	6,2	7,0	3,9
A	19	Pharmaceutical and Veterinary	-0,045	-0,002	0,015	1,2	1,0	1,7
	2	Mining	-0,054	-0,001	0,016	0,9	0,8	1,1
	1	Agriculture	-0,064	-0,004	0,025	5,1	5,6	4,6
	42	Privati nonmarket Services	-0,084	-0,002	0,035	1,8	2,2	0,7
	13	Wood and Wood products	-0,085	-0,001	0,024	1,1	0,9	0,8
	14	Pulp, Paper and Printing	-0,088	-0,003	0,026	1,8	1,4	1,8
	31	Other Industrial Products	-0,093	-0,001	0,027	0,3	0,3	0,4
	17	Oil Refining	-0,107	-0,005	0,026	4,7	1,7	16,5
	10	Eletronic Equipments	-0,116	-0,007	0,036	1,6	0,8	5,2
	27	Dairy Products	-0,154	-0,003	0,029	0,6	0,2	0,3
	11	Cars, Trucks and Bus	-0,186	-0,001	0,033	1,9	0,5	4,8
						60,4	**62,0**	**61,6**
	30	Other Food Products	-0,066	0,001	0,013	1,6	1,0	1,5
	7	Other Metal Products	-0,091	0,003	0,022	1,5	1,3	1,9
	22	Clothing	-0,091	0,003	0,022	0,7	0,6	0,7
	8	Machinery and Equipment	-0,115	0,000	0,026	1,6	1,0	2,7
	12	Parts and other vehicles	-0,122	0,001	0,024	2,1	1,2	4,5
B	5	Siderurgy	-0,139	0,005	0,028	1,9	1,2	4,3
	18	Other Chemicals	-0,143	0,000	0,031	0,9	0,5	2,1
	20	Plastic	-0,171	0,000	0,039	0,9	0,5	2,4
	15	Rubber	-0,171	0,001	0,040	0,4	0,2	0,9
	23	Footwear	-0,227	0,003	0,047	0,6	0,4	0,6
						12,2	**7,9**	**21,5**
C	21	Textile Industry	-0,040	0,006	0,005	0,9	0,7	1,1
						0,9	**0,7**	**1,1**

Source: Elaborated by authors.

Only on area A, is concentrated half of the industries in which the Brazilian economy was structured in this study, which showed greater ability to generate value added and

less need to import inputs for the production process. These sectors together accounted for about 60% of production, 62% of imports and value added in the period of 2005-2009.

Figure 5. Sectoral distribution with negative variation of b_{0j}, Brasil, 2005-2009.



Source: Source: Elaborated by authors.

Between 2005-2009, no sector is positioned on area D while the number of sectors with positive variation of b_{0j} fell from 32, from 2000-2005, to 10, from 2005-2009 (Table 6 and Figure 6).

In the case of the Brazilian economy it is not difficult to explain the positive evolution of productive structure in terms of reduction of external dependence and increase in the ability to generate value added between 1995 and 2009. This was a period of normalization of political conditions, economic stabilization, inclusive social policies, not negligible changes in industrial policy and foreign trade, breaking monopoly, privatization, international economic integration and relatively strong and convergent growth at macroeconomic level.

Nevertheless, considering the sectoral focus of this study, it is important to review, even rapidly, the dynamics of sectoral policies in Brazil in the focused period so that the results mentioned above make more sense.

An important fact in Brazil in the early years of the 1990s was the inflection in the design of industrial policy and foreign trade. According to Bonelli e Veiga (2003, p. 3) "'horizontal policies ' aimed at increasing competitiveness and exports, gain relevance *vis-a-vis* sectoral policies and measures, which had virtually monopolized government efforts in these public policy areas until the 80s".

Table 6. Distribution of sectors in areas with Δb0j > 0, and sectoral share in gross value of production (GVP), imports (M) and the value added (VA), Brazil, 2005-2009.

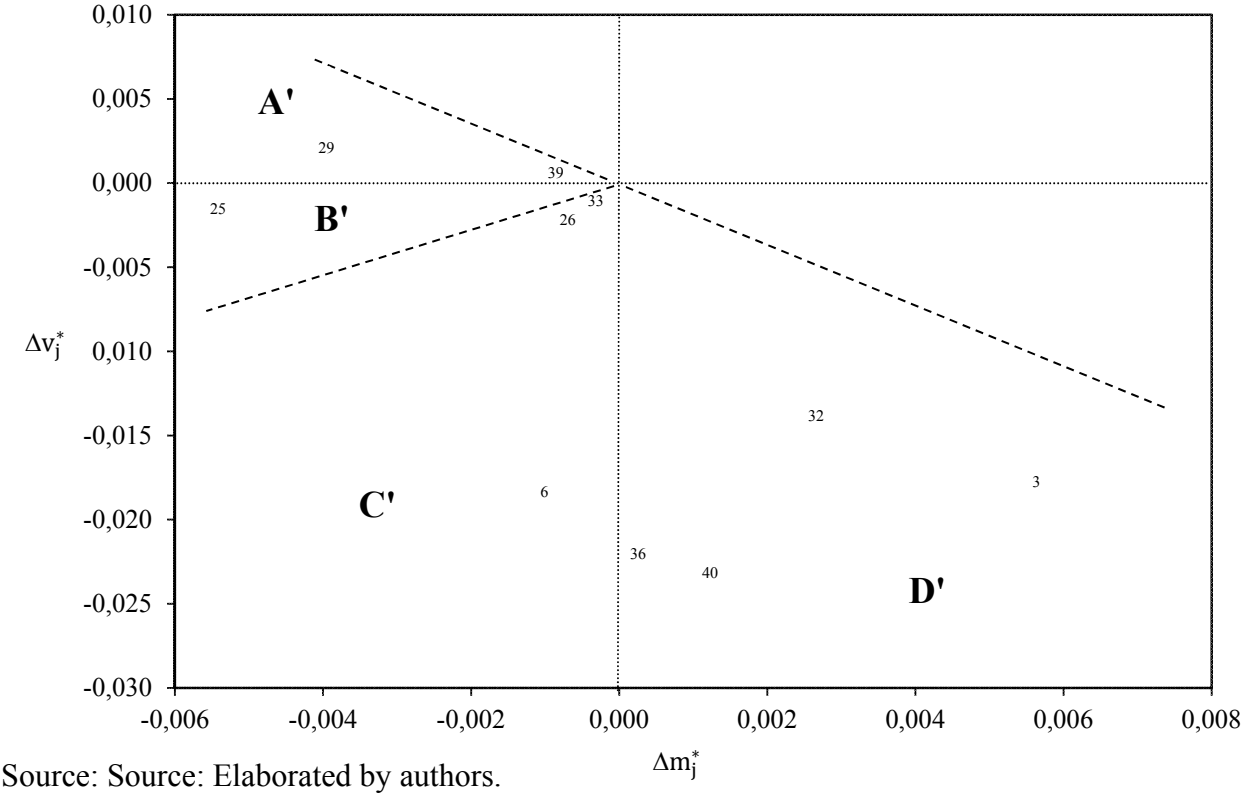
Area		Sectors	Δb_{0j}	Δm_j^*	Δv_j^*	GVP (%)	M (%)	VA (%)
A'	29	Vegetal Oil	0,015	-0,004	0,002	0,9	0,2	0,4
	39	Business Services	0,000	-0,001	0,001	3,8	4,6	1,8
						4,7	**4,8**	**2,2**
B'	25	Vegetal Products	0,044	-0,005	-0,002	1,4	0,6	1,7
						1,4	**0,6**	**1,7**
C'	6	Non-Ferrous Metallurgy	0,087	-0,001	-0,019	0,6	0,4	1,3
	26	Meat Products	0,013	-0,001	-0,002	1,7	0,8	0,3
	33	Construction	0,005	0,000	-0,001	4,4	4,8	2,9
						6,7	**6,0**	**4,5**
D'	36	Communication	0,065	0,000	-0,023	3,7	4,0	2,6
	3	Oil and Gas	0,045	0,006	-0,019	1,9	1,7	2,2
	32	Public Utilities	0,033	0,003	-0,015	3,5	3,9	2,2
	40	Realty Services	0,028	0,001	-0,024	4,7	8,3	0,3
						13,8	**18,0**	**7,3**

Source: Elaborated by authors.

However, the increasing attention directed to horizontal policies did not generate, at any time, the abandonment of 'sectoral axis' policies, which returned in 1995, giving priority treatment to investments in sectors such as automobiles, textiles, footwear, clothing, aerospace, electronics, information and automation. Allied to incentive programs at federal level, these sectors were also target of state industrial policies.

Thus, what is important to note in this context is the change of vision that permeates the new policy: this changed from a vision that emphasizes the priority sectoral dimension domestic supply growth to a vision of industrial and technology policy in which the combination of sectoral focus with a systemic view must prevail (BONELLI; VEIGA, 2003).

Figure 6. Sectoral distribution with positive variation of b_{0j}, Brasil, 2005-2009.



Source: Source: Elaborated by authors.

4. CONCLUDING REMARKS

In this article we propose a method to study the structural changes in the Brazilian economy in the period from 1995-2009, using traditional indicators of Hirschman-Rasmussen from the production multipliers of the Leontief inverse matrix. This method is suitable for assessing the sectoral external dependence (heavy reliance on imported inputs) and the low value added generated in domestic production, important vulnerabilities in several open economies, such as the Brazilian one from the 1990s.

The analysis of the Brazilian productive structure between the period of 1995 and 2009, divided into three sub-periods, namely, 1995-2000, 2000-1005 and 2005-2009, showed a very satisfactory performance of the national economy over the time, with predominance of positive gains in the ability to generate value added and reduce intermediate input imports by most technologically advanced sectors and by services sectors, and fewer losses in the ability to generate value added and greater external dependence for the minority of the sectors, particularly in more recent years.

The growth of external dependence is not necessarily bad. It can be the result of the greatest benefits of international division of labor and specialization of production. What

is not desirable, initially, is that the decrease in national production needed to satisfy the increasing domestic demand is just a consequence of the replacement of domestic production by imports.

So, what was observed was a visible modernization of the production system in Brazil, with more sectors of medium and high technology and sectors associated with the production of service positioning themselves on virtuous areas of greatest generation of value added and less external dependency. This development of the national economy over the studied period reflects, undoubtedly, the effort for modernization imposed by the intensification of trade liberalization process that, by joining private agents and public sector, implemented necessary changes so that Brazil could participate more actively in the global liberalization movement and deeper integration with the international economy.

It is important to note that, although limitations in traditional gross multipliers used in this study (Oosterhaven and Stelder, 2002), the proposed method can be used as a simple device but visually evocative to quantify the structural changes of a given economy. Moreover, with some refinements, the method can also be useful to compare the evolution of two or more economies over their development paths.

For future studies, it is recommended to analyze the evolution of the Brazilian economy from 1980 to the most recent year (for which there is input-output matrix) with the objective of verifying the sectoral structure before and after the intensification of trade liberalization occurred in the 1990s. Another proposal would be to compare two economies along their development paths, for example, Brazil and some other economy with which Brazil has closer trade relations. Finally, studies that are dedicated to evaluate specific sectors would be welcome and would allow greater detail of public and private actions directly applied to them.

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