LINKAGES OF THE PROCESSING SECTORS IN THE BRAZILIAN ECONOMY THROUGH THE INTERNALIZATION OF THE INTERMEDIATE INPUTS IMPORTED, 2000, 2004 and 2009.

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Abstract

The study investigates the importance of imported intermediate inputs by technological intensity, in the Brazilian processing industry for the years 2000, 2004 and 2009. It is used as database, the input-output matrices available in NEREUS (Regional and Urban Economics Laboratory, University of São Paulo). The sectors were aggregated and classified according to the methodology OECD for the technological intensity. The linkage indices of Rasmussen-Hirschman and the sectors of influence field showed that when the imported intermediate inputs are inserted in the production, there are significant improvements in the areas of high and medium-high technology, making clear that ceasing to import intermediate inputs in some sectors and starting to produce them internally could result in advantages for the country, in the internationally competitive sectors, for instance, the sectors 3 – Equipment for radio, TV and communication; 4 - Office and computer material; 5 – Machines and electrical devices; 6 - Vehicles, trailers and semitrailers; 7 – Chemical products, exclusive pharmaceutical; 11 - Metal Products; 12 - Coal, refined oil products and nuclear fuel.

Keywords: Imported Intermediate Inputs, Technological Intensity, Processing Industry, Input-Output Matrix.

Resumo

O trabalho busca analisar a importância e consequências dos insumos intermediários importados por intensidade tecnológica, na indústria de transformação brasileira, para os anos de 2000, 2004 e 2009. Utiliza-se, como base de dados, as Matrizes de Insumo-Produto disponíveis em NEREUS (Núcleo de Economia Regional e Urbana da Universidade de São Paulo). Os setores foram agregados e classificados de acordo com a metodologia da OCDE para intensidade tecnológica. Os índices de ligações de Rasmussem-Hirschman e o campo de influência dos setores evidenciaram que insumos intermediários importados inseridos na produção, provocam melhorias significativas nos setores de alta e média alta tecnologia. Fica claro que deixar de importar insumos intermediários em alguns setores e passar a produzi-los internamente poderia resultar em vantagens, para o país, em setores competitivos internacionalmente, como são o caso dos setores: Equipamentos de rádio, TV e comunicações; Material de escritório e informática; Máquinas e equipamentos elétricos; Veículos automotores, reboques e semirreboques; Produtos químicos, exclusive farmacêuticos; Produtos metálicos; Carvão, produtos do petróleo refinado e combustível nuclear.

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Palavras Chaves: Insumos Intermediários Importados, Intensidade Tecnológica, Indústria de Transformação, Matriz Insumo-Produto.
Área 9 - Economia Industrial e da Teconologia
Classification JEL: L - Industrial Organization; L6 - Industry Studies: Manufacturing

INTRODUCTION

In the long term, the process of exchange appreciation generates change in the exporting agenda of a country in order to increase the export of primary goods and imports of manufactured goods, which causes a reduction in the participation of the manufacturing in the added value according to Marconi and Rocha (2012). The reasons that explain the increase in consumption by the families in Brazil also justify, directly or indirectly, the strong increase in imports, mainly when associated with other factors such as under-funding for expanding the industrial production capacity. This situation is similar to that observed by Britto (2003) for Brazil regarding the industrial production in the 1990s, which also depended on certain proportion of imported inputs. In your model, the industrial production increased, but with increases in imported components.

According to the authors, the real exchange rate appreciated in emerging countries, when not inactivated by the managers of the economic policies, ends up discouraging exports of manufactured goods and encouraging the participation of the imports of these products in the overall supply of the economy, both in the form of final and intermediate goods. One motivation to increase the imports, in this scenario of exchange appreciation, is the compensation of the reduction in the revenues, in Brazilian Reais, with exports, through the reduction of costs in Reais of the inputs imported in cheapest form. This process can reduce the participation of the processing industry in the added value, discouraging the exports of manufactured goods.

In addition, it is considered that the increased use of imported products in the production process would result in gains for the Brazilian manufacturing production, given the embedded technology. The reduction in domestic production of intermediate goods used as inputs in the processing industry, resulting from the largest imports of this input, is largely offset by the gains in production of final goods. Considering that the intermediate input presents increasing returns to scale, which cheapens the final good production (since the imported input purchase is more advantageous than the domestic, given a cost reduction of this input through the rise in the exchange rate, for instance), it is expected an increase in the external demand for intermediate inputs imported.

It is recognized that after the intensification of the free-market policies in the 1990s, all developing countries started associating growth and development to their capacity to attract productive investments in knowledge- and technology-intensive sectors, in order to produce goods and services in increasing scale, with higher added value, variety, diversification and technological sophistication. Thus, it is questioned: Were there production losses or gains with the use of imported intermediate inputs in the national processing industry during the periods of 2000, 2004 and 2009? In case of losses, what has been happening to the production structure of the Brazilian processing industry?

The replacement of the use of manufactured intermediate inputs produced, domestically, by imported intermediate inputs promotes the discussion on the transfer of technology from advanced to developing countries. Thus, this study analyzes through the Rasmussem-Hirschman and the influence field indices, the importance and consequences of the imported intermediate inputs by technological intensity. It is also showed in which sectors occur improvements in the amount of linkages of the productive chain with the insertion of intermediate inputs in the production. To achieve this objective, sectors were classified

according to the technological intensity defined by the OCDE and it was used the Input-Output Matrix (IOM) available in NEREUS (2013) – (Nucleus for Regional and Urban Economy of the University of São Paulo), being classified under a viewpoint of technological intensity. It is also worth highlighting that the assumption of economic isolation, with the prohibition to import intermediate inputs, serves only as an exercise of analysis regarding the impact of the imported intermediate inputs on the sectors under research in the present study, within the Brazilian economy.

In addition to this introduction, the study presents a review of the literature on innovation and sectorial linkages, empirical studies on the use of imported intermediate inputs inserted in the discussion, and the results of the interaction between imported intermediate inputs and the processing industry using the Rasmussem-Hirschman and influence field indices. Finally, it will be made the concluding considerations.

RELATIONSHIP BETWEEN INNOVATION, SECTORIAL LINKAGES AND ECONOMIC DEVELOPMENT

For Schumpeter (1982), the economic development depends on the factor technology, in which the technological innovation is responsible for the rupture and/or improvement of new techniques and production processes. The models developed by the neo-Schumpeterian authors are based on the temporal interaction between the business strategies, in which are involved in a same market, added to the search process for innovations, and the selection process of these these innovations.

Freemam (1981) incorporated the technical progress as important variable, not only for the company growth, but also for the market as a whole. The author brought up basic characteristics of the strategies. The ideas of this author are interpreted within the theoretical structure of Schumpeter (1982), as being necessary mechanisms for a change contained in the concept of creative destruction. Nelson and Winter (1982) agree with Schumpeter (1982) in which only the strongest companies will survive from their competitive advantages, and the weakest will tend to disappear from the market. In order to continue growing, the companies must continue to search for innovations.

Along the same line of analysis, it is added that the products and processes are developed in each company in different technological form, innovating whenever necessary. The search for technological improvements in the companies does not occur through the already existing knowledge, but from it, the companies in the search for new technologies make the most appropriate choices. The companies search to improve, diversify and innovate their technologies only in the areas that they have conditions to use and construct a technological basis; to this end, they analyze the existing markets, their structures and forms of distribution, for instance. What the company can do, in the future, is closely conditioned by what the company was able to do in the past. This approach of company of Dosi (1984) resembles the approach of Schumpeter, according to which the knowledge and innovation constitute one important variable to the acquisition of competitive advantages for the companies.

In Penrose (1995), innovations are also what generate competitive advantages for the company. They are fundamental for the acquisition of new knowledge or for introducing new processes and services in the company. These ideas resemble the idea of Schumpeter, once for this author, the innovations are responsible for the creations of new products or production processes. The research of both authors on the companies relate to the exploration of the relationships between resources and profitability, that is, the corporate profit. For Penrose (1995) and Schumpeter (1982), the competition based on the imitation, and the

appropriation of the innovation returns, enable differences of profitability among companies and means for accumulating resources.

From the pioneer studies of Schumpter on the role of the innovation in the economic development, until the unfolding of these studies with the neo-Schumpeterian authors relating the importance of innovation to the company and to the economic development, it becomes clear that, sectors technologically denser have better conditions of technological overflows, which in turn will depend on the sectorial relationships among their productive chains. In this respect, Hirschman (1958) was one of the pioneers who dealt with the economic development and the sectorial in backward and forward linkage direction.

For Hirschman (1961), the development depends less on finding optimal combinations for the existing resources and production factors, and more on invoking and enumerating the resources and abilities that lead to the development and that are hidden, dispersed or misused. For the author, there would be resources whose availability would increase directly by their own use, thus highlighting the importance of learning as a form of magnifying the effects of feedback and chain among sectors. For the author, the economic delay is due to the insufficient amount of decisions related to the development, and this would be associated with the generation and appropriate direction of human action. In the case of developing countries, the difficulties would be found exactly in the lack of coordination between savings and investment, that is, a relationship of casualty of the investment on savings. The development is limited by the difficulties in channeling the existing savings to the existing opportunities for productive investments and by the scarcity of abilities to make and implement development decisions.

The development would be related to transformations or radical changes, in terms of "creative destruction" of Schumpeter (1982). According to the author, the mechanisms that lead to the distancing from the balance are exactly those that would form an appropriate standard for the development process. In other words, imbalances are what trigger changes, which in turn would result in new imbalances. In the case of underdeveloped countries, balance would mean to remain in underdevelopment. At each new boost, a certain sector would take the advantages of the foreign economy generated by a previous expansion, at the same time in which new foreign economies would be created by this sector in order to be explored by other sectors.

In line with the effect complementarity of the investment, Hirschman (1958) defines the concepts of backward and forward linkages[6]. For the author, the backward linkages refer to any non-primary economic activity that will induce efforts to supply, through domestic production, the necessary inputs to that activity. On the other hand, the forward linkages are any activities that, by their very nature, do not meet exclusively the final demands, and will induce efforts so that their products can be used as inputs in some other activities.

Another important point is that the cumulative character of the development would be more related to the observation of the linkage effects of two or more companies seen together than the effect of these companies in separate. For Hirschman (1961), given the potentiality of the transforming effects, the effects of backward linkages would be more important than the forward linkages. The forward linkage does not occur alone, the backward linkage, which would result in demand pressures, must always follow it.

Thus, according to Hirschman (1961), it would be exactly the lack of interdependence and linkages among the sectors that form the economic system one characteristic of the underdeveloped countries. For the author, these countries would remain based on segments characterized by rare or weak effects of linkages among sectors. For the

[6] The issue of Hirschman's work (1961) is to emphasize sectoral linkages, causing needs of their positive dynamics versus, imports of inputs (embedded technologies) used in various sectors of the economy.

author, the imbalances, if well understood and faced, could magnify the development for causing dynamic effects and, regarding the overcoming of the underdevelopment, this must come from the own unbalanced character of the development process.

ESTIMATION METHODOLOGY AND DATA SOURCE

For the input-output system, it can be observed as presented in Leontief (1988, p. 10) that, the simplest form to describe the input-output matrix is to say that it shows the flows of goods and services among the several economic sectors during a particular period of time, in monetary terms. In other words, the matrix presents all buying and selling interrelationships (intermediate goods, final goods, added value, etc.) of a given economy. The basic relationship can be seen in the Box 1.1 and in a more complete form in the Box 1.2, but if only three sectors (agricultural, industrial and service) are considered. More specifically, it should be remembered that "the input-output method is an adaptation of the neoclassical theory of general balance for the empirical study of the quantitative interdependence among the interrelated economic activities" (LEONTIEF, 1988, p. 73).

From the illustrations of the Boxes 1.1 and 1.2, it is possible to observe three fundamental factors of the input-output analysis of Leontief (1988, p. 75-80): a) the technical or of input coefficients a_{ij} (1); b) the matrix of technical coefficients $A = \lfloor a_{ij} \rfloor$ (2) and c) the inverse matrix (6) that bears its name, $L = (I - A)^{-1}$.

Box 1.1 Relationships among intermediate demands, final demands and gross value of production

Demandas Intermediárias (Intersetoriais)				Demanda Final (Consumo + Investimento + Gasto do Governo + Exportações)	Valor Bruto de Produção
z_{11}	z_{12}	…	z_{1n}	y_1	x_1
z_{21}	z_{22}	…	z_{2n}	y_2	x_2
…	…	…	…	…	…
z_{n1}	z_{n2}	…	z_{nn}	y_n	x_n

Source: Adapted from Lopes and Vasconcellos (2008, p. 54).

Box 1.2 Input-output relationships in a national system (economy with three sectors)

Destination of Production (Purchase) / Origin of Production (Sale)	Intermediate Demands (or Intersectorial)			Final Demand (C + I + G + X)	Gross Value of Production
	Agriculture (Sector 1)	**Industry** (Sector 2)	**Services** (Sector 3)		
Agriculture (Sector 1) **Industry** (Sector 2) **Services** (Sector 3)	z_{11} z_{21} z_{31}	z_{12} z_{22} z_{32}	z_{13} z_{23} z_{33}	y_1 y_2 y_3	x_1 x_2 x_3
Imports (M)	m_1	m_2	m_3		
Indirect Net Tax (IIL)	iil_1	iil_2	iil_3		
Added Value	va_1	va_2	va_3		
Gross Value of Production	x_1	x_2	x_3		

Source: Adapted from Lopes and Vasconcellos (2008, p. 54).

As presented by Chiang and Wainwright (2006, p. 110), the static version of the Leontief model, under which this study is guided, has the following research problem: "Which product level each of the *n* industries of an economy should produce in order to be

exactly sufficient for satisfying the total demand of that product?" In this regard, still according to the authors, given some assumptions (presented subsequently), in order to produce each unit of the jth goods, the amount of input for the ith goods has to be fixed, according to the coefficient presented by the Equation (1).

$$a_{ij} = \frac{z_{ij}}{x_j} \Rightarrow z_{ij} = a_{ij} . x_j \qquad \text{(j = 1, 2, 3, ..., } n \text{ ; i = 1, 2, 3, ..., } n\text{)} \tag{1}$$

Thus, for the *n* industries meeting sufficiently the demands for inputs generated by themselves and by others, as well as the final demand of an open economy, their product level x_j must satisfy the following equations (Chiang and Wainwright, 2006, p. 111-114):

$$\begin{aligned} x_1 &= a_{11}x_1 + a_{12}x_2 + ... + a_{1n}x_n + y_1 \\ x_2 &= a_{21}x_1 + a_{22}x_2 + ... + a_{2n}x_n + y_2 \\ &..... \\ x_n &= a_{n1}x_1 + a_{n2}x_2 + ... + a_{nn}x_n + y_n \end{aligned} \tag{2}$$

in which, as presented in the Box 1.1., y_i represents the final demand of the sector i, x_i the gross value of production of the same sector and $a_{ij}x_j$ the demand for input of the sector *i* by the sector *j*.

By rearranging equations, putting y_i in evidence, it is observed the following system of *n* linear equations:

$$\begin{aligned} (1-a_{11})x_1 - a_{12}x_2 - ... - a_{1n}x_n &= y_1 \\ -a_{21}x_1 + (1-a_{22})x_2 - ... - a_{2n}x_n &= y_2 \\ &..... \\ -a_{n1}x_1 - a_{n2}x_2 - ... + (1-a_{nn})x_n &= y_n \end{aligned} \tag{3}$$

Written in matrix form:

$$\begin{bmatrix} (1-a_{11}) & -a_{12} & ... & -a_{1n} \\ -a_{21} & (1-a_{22}) & ... & -a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ -a_{n1} & -a_{n2} & ... & (1-a_{nn}) \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix} \tag{4}$$

in which it can be rewritten as follows:

$$\left\{ \begin{bmatrix} 1 & 0 & ... & 0 \\ 0 & 1 & ... & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & ... & 1 \end{bmatrix} - \begin{bmatrix} -a_{11} & -a_{12} & ... & -a_{1n} \\ -a_{21} & -a_{22} & ... & -a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ -a_{n1} & -a_{n2} & ... & -a_{nn} \end{bmatrix} \right\} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix} \tag{5}$$

From the relationship (5) it can be deduced:

$$(I - A)X = Y \tag{6}$$

and thus it can be "(...) obtained the only system solution from the equation (...)" (Chiang and Wainwright, 2006, p. 112):

$$X = (I - A)^{-1}Y \tag{7}$$

The relationship presented in (7) summarizes the explanatory power of the input-output analysis regarding the behavior of the economies. In other words, it is observed how an impact in the final demand (Y) affects the value of the production (X) and this, in turn, affects

other variables such as employment, wage, imports, taxation and etc. Thus, it is possible to observe the importance of this method to the countries.

However, currently, the world wide calculated by Marcel P. Timmer (2012), presents a discrepancy in time of approximately 7 years (being the last occurring in 2011)

In order to estimate the input-output system originally defined by Leontief, it was used the approach to the technology based on the industry, which assumes that the composition of the production of a given sector may change, however, this sector has to maintain its constant participation in the market of goods that this sector produces (Miller e Blair, 2009). For the matrix estimation with technology based on the industry, it is defined initially the matrices:

$$B = U(\hat{X})^{-1} \quad (8)$$

$$D = V(\hat{Q})^{-1} \quad (9)$$

in which B represents the matrix of technical coefficients o each sector in relation to each product used as input, D determines the fixed proportion, for each product, of the sectors that produce them and B and D are composed, respectively, of the coefficients $b_{ij} = \frac{u_{ij}}{x_j}$ e $d_{ij} = \frac{v_{ij}}{q_j}$.

The manipulation between these two matrices generates, as presented in Guilhoto and Sesso Filho (2010), the following relationship:

$$X = (I - DB)^{-1}Y \quad (10)$$

Thus, the equation (10) refers to the sector-by-sector approach with the technology based on the industry. This approach, with this technology, is what most closely approximates to the original model of Leontief and, therefore, is the standard in which is generally used to transform the matrices of production and of uses and resources in the model of Leontief. Note that, in this case, the matrix DB would be equivalent to the matrix A of technical coefficients of Leontief, thus $L = (I - DB)^{-1}$ would be equivalent to $L = (I - A)^{-1}$, which is the inverse matrix of Leontief, being l_{ij} its elements.

In the case of the original matrix, U is uses and resources, Q is production and M is imports. Considering that, the matrix of imports available in NEREUS does not include the imports of final goods (vector), it can be assumed that the matrix of imports is composed of intermediate imported inputs.

U $_{110 \times 56}$, in which U is the matrix of uses and resources.
Q $_{56 \times 110}$, in which Q is the matrix of production.
M $_{110 \times 56}$, in which M is the matrix of intermediate imported inputs, where:
M $_{110 \times 56}$ = B $_{110 \times 56}$ x (diag m $_{1 \times 56}$) $_{56 \times 56}$
X $_{1x56}$, in which X is a vector line $_{1x56}$, line 111 of the matrix U.

After aggregation of the sectors:
$Ua_{110 \times 24}$
$Qa_{24 \times 110}$
$Ma_{110 \times 24}$
Xa_{1x24}
Mp = multiplier of production without imports
$Mp_{24 \times 24} = Qa_{24 \times 110} \text{ X } Ua_{110 \times 24}$
$Da_{24 \times 110} = (\text{diag Xa})^{-1}_{24 \times 24} \text{ X } Qa_{24 \times 110}$
$Ba_{110 \times 24} = Ua_{110 \times 24} \text{ X } (\text{diag Xa1})^{-1}_{24 \times 24}$
$A_{24 \times 24} = Da_{24 \times 110} \text{ X } Ba_{110 \times 24}$
in which A is the matrix of technical coefficients
$IMPO_{24 \times 24} = Da_{24 \times 110} \text{ X } Ma_{110 \times 24}$
in which IMPO is the matrix of intermediate imported inputs
$MIP_{24 \times 24} = Da_{24 \times 110} \text{ X } Ua_{110 \times 24}$
in which MIP is the sector x sector input-output matrix
IMPORT is a vector line $_{1 \times 24}$, line 112 of the matrix U
Inverse of Leontief = $B1 = (I - A)^{-1}$
$B1 = {}_{24x24}$

From the basic model of Leontief (Miller and Blair, 2009), defined previously, and following Rasmussen (1957) and Hirschman (1958), the sectors with the highest linkage degree within the economy can be determined, that is, it can be calculated both the backward linkage indices, which would provide how much such sector would demand from others, and the forward linkage indices, which would provide the amount of products required of other economic sectors by the sector in question.

Thus, from the equation (10) it is defined b_{ij} as an element of the inverse matrix of Leontief *B*, *B** as the average of all elements of *B* and B^*_j, and B^*_i as the sum of a typical column and row of *B*, then the indices will be:

Backward linkage indices, $U_j = [B^*_j / n] / B^*$

Forward linkage indices, $U_j = [B^*_i / n] / B^*$

in which, values higher than 1 of the indices will indicate sectors above average and, therefore, key-sectors for the economic growth.

The influence field approach, developed by Sonis and Hewings (1989) and Sonis and Hewings (1994), aims at solving or minimizing problems presented by the linkage indices of Rasmussen-Hirschman, which allow evaluating the importance of the impacts of each sector/product/input on the economy. However, they do not allow determining the main connecting links, i.e., the relationships among the most important sectors within the economy and, whose variations of the coefficients would have greater impacts on the system. Therefore, the influence field approach complements the analysis of the backward and forward linkage indices.

The matrix of technical coefficients of production $A = |a_{ij}|$ and the matrix of incremental variations for the direct coefficients of input, $E = |\varepsilon_{ij}|$ are used for the calculation of the influence field. The inverse matrices of Leontief are $L = (I - A)^{-1}$ and $L(\varepsilon) = [I - A + \varepsilon)]^{-1} = |l_{ij}(\varepsilon)|$. According to Sonis and Hewings (1989 and 1994), if the variation is low and occurs only in a direct coefficient, then:

$$\varepsilon_{ij} = \begin{cases} \varepsilon & i = i_1, j = j_1 \\ 0 & i \neq i_1 \; ou \; j \neq j_1 \end{cases}$$

The influence field of this variation can be approximated by the expression:

$$F(\varepsilon_{ij}) = \frac{\left\lfloor L(\varepsilon_{ij}) - L \right\rfloor}{\varepsilon_{ij}} \qquad (11)$$

in which $F(\varepsilon_{ij})$ is the matrix (n x n) of the influence field for the coefficient a_{ij}.

In order to determine which coefficients have the greatest influence field, it is associated with each matrix $F(\varepsilon_{ij})$, a value that is given by:

$$S_{ij} = \sum_{k=1}^{n}\sum_{l=1}^{n}\left[f_{kl}(\varepsilon_{ij})\right]^2 \qquad (12)$$

Thus, the key sectors of economy are those that have the highest coefficients S_{ij}, that is, the greatest influence fields.

RESULTS AND DISCUSSION

This section of the study presents the linkages of the sectors and their importance within the Brazilian processing industry, with highlights to which sectors are considered key[7] sectors and which sectors would be positively and/or negatively affected if intermediate inputs would cease to be imported. The objective was to show which sectors would be benefited when inputs are not imported, and which classification of technological intensity would be these sectors. In order to initiate this analysis, it has also to be considered the value of production for a more careful verification, because there may be sectors that are not considered keys, but they have high volume of production, generating employments and attracting investors, for instance. Therefore, certain volumes of production justify the special attention to this sector, whether forward or backward.

The Table 1 shows the value of the production in the Brazilian processing industry by groups of technological intensity, 2000, 2004 and 2009 and for instance, the sector 23 – Services has strong forward linkage index and has the highest volume of production among the sectors analyzed. Other sectors such as: 15 - Textile, leather and footwear; 21 – Construction; and 22 – Commerce; are sectors that are not considered key sectors, for not possessing forward and backward indices (higher than 1), but, they have high volume of production and, probably, generate a considerable volume of employment.

The backward and forward linkage indices, and the total production in each sector for the year 2000, are presented in the Table 2, considering and not considering the intermediate imported inputs. In the Table 2, it is observed that the sectors that can be considered key sectors were: 7 - Chemical products, exclusive pharmacists (medium-high tech), 11 – Metallic products and 12 – Coal, products of refined oil and nuclear fuel (medium-low tech), 17 – Wood and its products, paper and cellulose (low tech). These sectors possess forward and backward linkage indices (higher than 1), and therefore are considered key sectors.

[7] The contents of back links determine how much an industry demand of others, and indexes facing connections determine how much an industry is demanded by others. Values greater than 1, will indicate above average sectors, and therefore key sectors for economic growth.

Table 1 – Value of the production in the Brazilian processing industry by groups of technological intensity, 2000, 2004 and 2009. In millions of Brazilian Reais.

Setores	2000	2004	2009
High Technology			
1 – Pharmaceutical	16,529	23,041	39,496
2 – Medical devices for optics and of precision	5,821	9,550	15,268
3 – Equipment for radio, TV and communication	22,712	34,231	28,788
4 – Office and computer material	7,296	9,069	20,756
Medium-High Technology			
5 – Machines and electrical devices	20,100	34,775	59,498
6 – Motor vehicles, trailers and semitrailers	58,724	136,058	210,008
7 – Chemical products, exclusive pharmaceutical	75,350	153,447	179,297
8 – Machines and mechanical equipment	25,933		60,196
Medium-Low Technology		44,388	
9 – Rubber and plastic products	24,302	31,555	52,257
10 – Non-metallic mineral products	18,858	131,437	169,590
11 - Metallic products	57,195	101,411	150,105
12 – Coal, refined oil products and nuclear fuel	51,716	57,477	84,648
Low Technology			
13 – Unspecified manufactured products and recycled goods	20,619	28,020	38,675
14 - Food, beverages and tobacco	55,891	83,080	106,152
15 - Textiles, leather and footwear	127,976	251,897	370,327
16 – Furniture and products of the various industries	19,861	31,486	44,393
17 – Wood and its products, paper and cellulose	31,125	58,100	64,334
Other Sectors			
18 – Agriculture	95,761	203,132	276,447
19 – Extractive Industry	35,111	81,639	130,624
20 - S.I.U.P	66,749	121,900	170,669
21 – Construction	112,683	157,372	285,293
22 – Commerce	154,460	260,583	493,217
23 - Services	671,638	1,012,315	1,744,893
24 – Public Services (Educ. Health. Adm. and Social Sec.)	227,161	376,772	685,810
Total	2,003,571	3,432,735	5,480,741

Source: Elaborated by the author.

In the column 2 of the Table 2, when the imports of intermediate inputs is replaced by the domestic production, an expressive change in the linkage indices mainly the backward indices occurs. Sectors previously considered keys start to present higher backward and forward indices, with the exception of the sector 17 – Wood and its products, paper and cellulose, which is no longer a key sector. Sectors that were regarded as backward key sectors only, remained backward key sectors, that is, they became stronger (with higher linkage indices), when they ceased to import intermediate inputs. Such sectors are: 3 – Equipment for radio, TV and communication; 4 – Office and computer material; 5 – Machines and electrical devices; 6 – Motor vehicles, trailers and semitrailers; 7 - Chemical products, exclusive pharmaceutical; 8 – Machines and mechanical equipment; 11 - Metallic products; and 12 – Coal, refined oil products and nuclear fuel. It can be noticed that there was increase in the value of the linkage indices of the key sectors, for both forward and backward, especially in the sectors of high and medium-high technology. These sectors started to produce more and to sell to other sectors and, thus, they reduced the foreign dependence of imported intermediate inputs.

In the Table 2 such sectors are: 3 - Equipment for radio, TV and communication; 4 – Office and computer material; 5 – Machines and electrical devise; 6 – Motor vehicles, trailers and semitrailers; 7 – Chemical products, exclusive pharmaceutical; 8 – Machines and mechanical equipment; 11 – Metallic products; and 12 - Coal, refined oil products and nuclear fuel. It can be noticed that there was increase in the value of the linkage indices of the key sectors, for both forward and backward, especially in the sectors of high and medium-high technology. These sectors started to produce more and to sell to other sectors and, thus, they reduced the foreign dependence of imported intermediate inputs.

Table 2 – Linkage indices of the sectors importers of intermediate inputs in the Brazilian processing industry 2000.

Sectors	Importing Intermediate Inputs		Not Importing Intermediate Inputs	
High Technology	Backward	Forward	Backward	Forward
1 – Pharmaceutical	0,93	0,60	0,90	0,54
2 - Medical devices for optics and of precision	0,84	0,57	0,84	0,53
3 - Equipment for radio, TV and communication	1,10	0,83	1,23	0,98
4 - Office and computer material	1,03	0,57	1,24	0,52
Medium-High Technology				
5 - Machines and electrical devices	1,09	0,76	1,12	0,79
6 - Motor vehicles, trailers and semitrailers	1,13	0,73	1,20	0,73
7 - Chemical products, exclusive pharmaceutical	1,13	1,71	1,19	2,04
8 - Machines and mechanical equipment	1,05	0,70	1,06	0,71
Medium-Low Technology				
9 - Rubber and plastic products	1,12	0,86	1,20	0,83
10 - Non-metallic mineral products	1,03	0,72	1,00	0,65
11 - Metallic products	1,05	1,39	1,06	1,46
12 - Coal, refined oil products and nuclear fuel	1,20	1,09	1,27	1,12
Low Technology				
13 - Unspecified manufactured products and recycled goods	0,97	0,67	0,93	0,60
14 - Food, beverages and tobacco	1,19	0,83	1,13	0,76
15 - Textiles, leather and footwear	1,09	0,86	1,06	0,79
16 - Furniture and products of the various industries	1,02	0,58	1,00	0,51
17 - Wood and its products, paper and cellulose	1,02	1,01	0,99	0,95
Other Sectors				
18 – Agriculture	0,87	1,10	0,83	1,04
19 - Extractive Industry	0,94	1,14	0,90	1,34
20 - S.I.U.P	0,88	1,23	0,82	1,17
21 – Construction	0,95	0,63	0,90	0,56
22 – Commerce	0,75	1,43	0,69	1,37
23 - Services	0,82	3,41	0,75	3,49
24 - Public Services (Educ. Health. Adm. and Social Sec.)	0,78	0,60	0,70	0,53

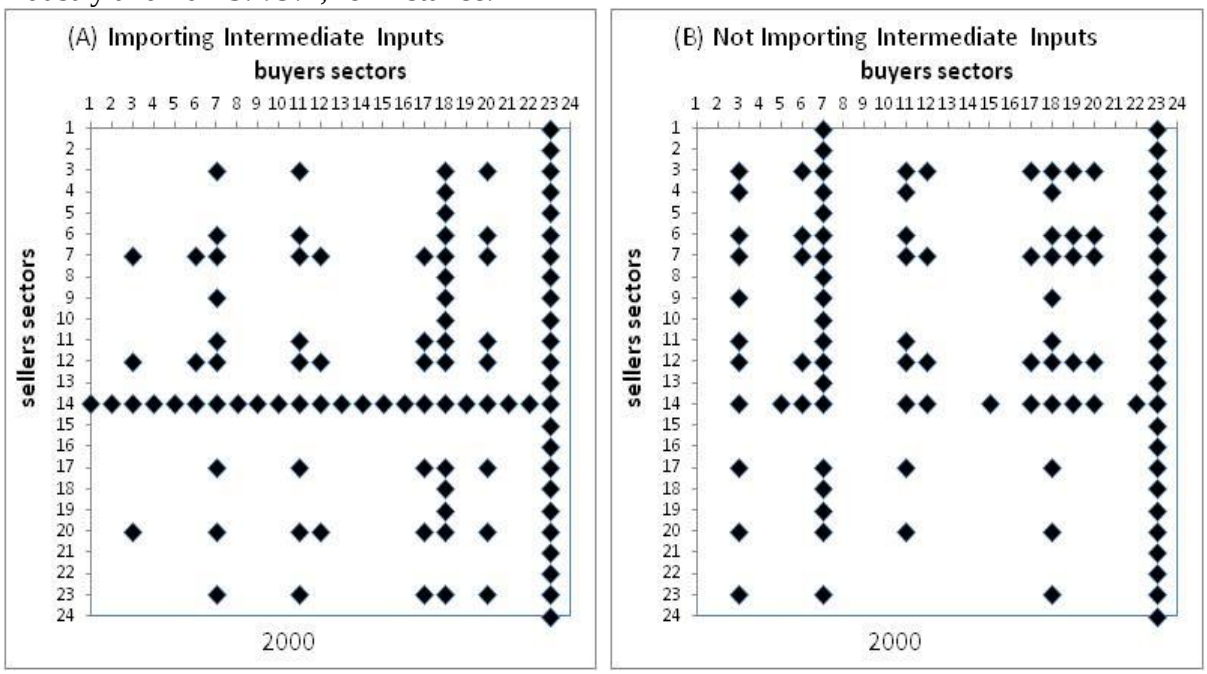
Source: Elaborated by the author.

There are some points that must be considered for a more careful verification of these results. First, the results confirm that the processing industry sectors could be better articulated if there was no need to import intermediate inputs, that is, importing intermediate inputs cause a derangement among sectors. This lack of articulation was verified in the studies of Chesnais (1996); Pacheco (1996a and 1996b); Schor (2004) and Breitbach et al (2007). Second, it can be observed that the sectors considered of high, medium-high and medium-low technology presented better linkage among sectors when the intermediate inputs are not imported. This can be verified observing the forward and backward linkage indices, when the values of the indices increase, in the column 2 of the Table 2, for the year 2000. On the other hand, in the sectors considered as being of low technology and in other non-industrial sectors, the values of the linkage indices decrease in all sectors, for both backward and forward, that is, if there was greater incentive in the production of intermediate inputs destined for the processing industry, internally, the sectors that would improve their articulations with other economic sectors would be those classified as being of high, medium-high and medium-low technology.

The values of the linkage indices of the Table 2 can be confirmed by Sant”anna (2013), who found a linkage index of 1.31 for the sector 11 – Metallic products and 1.09 for the sector 17 – Wood and its products, paper and cellulose; and Bastos and Costa (2013), who also found linkage indices of 0.87 to backward and 0.61 to forward in the sector 1 – Pharmaceutical, and 1.08 to backward and 2.08 to forward for the sector 7 – Chemical products, exclusive Pharmaceutical.

The influence field for the year 2000 is presented in Graph 1, with the purchasing and selling sectors for the 24 aggregated sectors and classified by technological intensity, considering (Graph 1-A) and not considering (Graph 1-B) the imports of intermediate inputs.

In the general, looking at the Graph 1, when it is not considered the imports of intermediate inputs in the production, the connecting links that mostly stand out are in the sectors of high and medium-high technology, that is, there is an improvement in the linkages of the sectors mainly in the sectors of high and medium-high technology. This result can be viewed on both sides, of the selling and purchasing sectors. It is noticed that there is also a change in the other sectors not classified by technological intensity, but with great importance within the economy, such as is the case of the sectors 18 – Agriculture; 19 – Extractive Industry and 20 - S.I.U.P, for instance.



Graph 1 – Influence field for the sectors importers of intermediate inputs in the Brazilian processing industry, 2000.
Source: Elaborated by the author.

In the Part A of the Graph 1, the sector 14 – Food, beverage and tobacco stood out as strong seller, that is, this sector has an intense relationship with the economic sectors in the forward direction. This sector sells to all other sectors. As to the sector 23 – Services, they stood out as purchasing sector. It purchases from all other economic sectors, presenting thus strong backward linkage. By considering the Part B of the Graph 1, it can be noticed a loss of linkage of the sector 14 – Food, beverage and tobacco. In other words, when the intermediate inputs are no longer imported, it was shown an improvement in other sectors of the industry, and the economy started to be less dependent on the sector 14 – Food, beverage and tobacco. As to the sector 7 – Chemical products, exclusive pharmaceutical, an increase in the linkages of the sectors from the purchaser side occurred: this sector started to have a better connection with the other economic sectors, when the imports of intermediate inputs were inserted in the production.

This improvement, mainly in the sectors classified by technological intensity as being of high and medium-high technology, can be verified by the amount of connecting links between sectors and their linkages in the year 2000. It can be verified that when the intermediate inputs were no longer imported, the connecting links were increased. This showed that a reduction in the imports of intermediate inputs strengthens internally the sectors

of high and medium-high technology. As to the sector 3 - Equipment for radio, TV and communication, the fact of not importing intermediate inputs increased the links, from 5 to 10 on the seller side, and from 4 to 11 links on the purchaser side. The links of the sector 7 – Chemical products, exclusive pharmaceutical, increased from 10 to 19 on the purchaser side. The sum of the connecting links is always higher in the sectors classified as being of high, medium-high and medium-low technology, and lower in the sectors of low technology and other non-industrial sectors, when the intermediate inputs are imported, than when they are not imported. In other words, there is an improvement in the industrial sectors technologically better classified, showing a potential gain of production with the internalization and incentive to the creation and development of technologies related to intermediate inputs.

The forward and backward linkage indices for the year 2004 are presented in the Table 3. According to the presented methodology, those sectors that present indices above 1 are considered key sectors.

The forward and backward key sectors, in the year 2004, were: 7 – Chemical products, exclusive pharmaceutical; 11 – Metallic products and 12 – Coal, refined oil products and nuclear fuel. These sectors are strengthened in the forward and backward direction, when the imports of intermediate inputs are no longer considered. The sector 17 – Wood and its products, paper and cellulose, considered as being a forward and backward key sector, ceases to be a sector key when the intermediate inputs are no longer imported.

Table 3 – Linkage indices of the sectors importers of intermediate inputs in the Brazilian processing industry 2004.

Sectors	Importing Intermediate Inputs		Not Importing Intermediate Inputs	
High Technology	Backward	Forward	Backward	Forward
1 – Pharmaceutical	0,94	0,56	0,92	0,50
2 - Medical devices for optics and of precision	0,88	0,55	0,90	0,51
3 - Equipment for radio, TV and communication	1,13	0,84	1,27	0,97
4 – Office and computer material	1,07	0,54	1,28	0,47
Medium-High Technology				
5 - Machines and electrical devices	1,06	0,78	1,10	0,81
6 - Motor vehicles, trailers and semitrailers	1,22	0,79	1,28	0,78
7 - Chemical products, exclusive pharmaceutical	1,11	1,85	1,16	2,22
8 - Machines and mechanical equipment	1,11	0,70	1,16	0,71
Medium-Low Technology				
9 - Rubber and plastic products	0,99	0,85	0,97	0,80
10 - Non-metallic mineral products	1,03	0,73	1,05	0,65
11 - Metallic products	1,13	1,48	1,23	1,53
12 - Coal, refined oil products and nuclear fuel	1,11	1,17	1,15	1,21
Low Technology				
13 - Unspecified manufactured products and recycled goods	0,94	0,61	0,88	0,53
14 - Food, beverages and tobacco	1,19	0,82	1,10	0,74
15 - Textiles, leather and footwear	1,11	0,85	1,05	0,76
16 - Furniture and products of the various industries	1,03	0,56	1,00	0,48
17 - Wood and its products, paper and cellulose	1,03	1,02	0,99	0,93
Other Sectors				
18 – Agriculture	0,88	1,11	0,84	1,02
19 - Extractive Industry	0,97	1,29	0,94	1,67
20 - S.I.U.P	0,85	1,28	0,79	1,22
21 – Construction	0,91	0,61	0,86	0,53
22 – Commerce	0,74	1,41	0,66	1,34
23 - Services	0,81	3,04	0,73	3,12
24 - Public Services (Educ. Health. Adm. and Social Sec.)	0,77	0,57	0,69	0,49

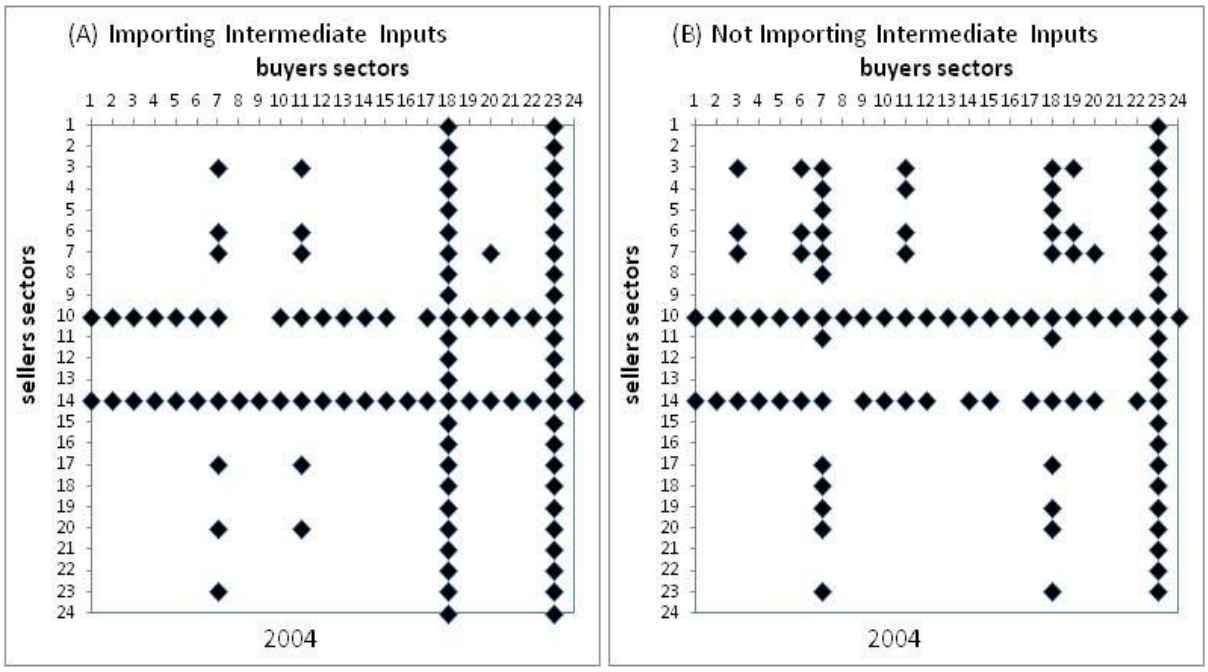
Source: Elaborated by the author.

Other sectors that have indices higher than 1, forward or backward, that is, strong on the seller side or on the purchaser side, improve their participation in the production when the imports of intermediate inputs are not considered. (sector 3 – Equipment for radio, TV and

communication, which for instance, is increased from 1.13 to 1.27, without the imports of intermediate inputs). Again, it is worth highlighting that the sectors: 15 - Textiles, leather and footwear; 22 – Commerce; and 23 – Services, are not considered key sectors, but they possess large volume of production.

In 2004, in comparison with 2000, it was verified an increase in the entry of imported intermediate inputs. First due to the low GDP growth, in 2003, when compared to 2004 and, second, due to an exchange rate more favorable to the imports in general, from 2004, as highlights Lacerda and Nogueira (2010), with a overvaluation of the exchange rate of 37% from 2004 to 2007. The Table 3 shows that the sectors that suffered most from this increase in the imports of intermediate inputs were the sectors of high technology, mainly the sectors 1 – Pharmaceutical and 2 – Medical devices for optics and of precision, in which it can be observed a reduction in the value of the backward and forward linkage indices, showing difficulty to better articulate with the other economic sectors.

The influence field for 2004 is presented in Graph 2, in which illustrates that, the tendency of when intermediate inputs are no longer imported, follows the same trajectory of 2000, that is, when the imports of intermediate inputs is internalized, an improvement in the connecting links, for both forward and backward, occurs in the sectors classified as being of high and medium-high technology.



Graph 2 – Influence field for the sectors importers of intermediate inputs in the Brazilian processing industry, 2004.

Source: Elaborated by the author.

In the Part A of the Graph 2, it was verified that the sectors with more linkages were concentrated in the sectors of medium-low and low technology. As to the Part B, the linkages were concentrated in sectors of high and medium-high technology, indicating that the imports of intermediate inputs has hampered sectors of high and medium-high technology, internally.

Again, the sector 14 – Food, beverage and tobacco stood out as strong seller, that is, this sector has a strong relationship with all economic sectors in the forward direction. This sector sells to all other sectors, as can be seen in the Part A of the Graph 2. The sector 23 – Services stood out as purchaser sector, in which purchases from all other economic sectors, thus presenting strong backward linkage. Other two highlights, which did not appear in 2000

and started to stand out in 2004, were the sectors: 10 – Non-metallic mineral products as great seller and 18 – Agriculture as great purchaser.

By looking at the Part B of the Graph 2, it can be noticed a loss of linkages of the sector 14 – Food, beverage and tobacco, that is, when intermediate inputs are no longer imported, it shows an improvement in other sectors of the industry, and the economy starts to be less dependent on this sector. Also for the sector 7 – Chemical product, exclusive pharmaceutical, an increase occurred in the linkages of the sectors on the purchaser side. Hence, this sector starts to connect better with the other economic sectors, when the imports of intermediate inputs is internalized. The sector 7 – Chemical products, exclusive pharmaceutical was consolidated even more as seller sector, starting to connect with all economic sectors. As to the sector 18 – Agriculture, it ceased to be purchaser of all the other economic sectors, that is, when intermediate inputs are no longer imported it can be observed an improvement in the sector 18 – Agriculture, because this is no longer dependent on all the other economic sectors, as shows the Part A of the Graph 2.

It can be verified the same tendency of 2000, that is, when the intermediate inputs are no longer imported, the connecting links are increased, mainly in the sectors classified by technological intensity such as those of high and medium-high technologies. The decrease in the imports of intermediate inputs strengthened, internally, the sectors of high and medium-high technology. As to the sector 3 – Equipment for radio, TV and communication, for instance, the fact of not importing intermediate inputs increased the links from 4 to 7, on the seller side and from 2 to 5 link for the purchaser sectors. For the sector 7 – Chemical products, exclusive pharmaceutical, the links increased from 8 to 14, in the purchaser sectors.

Table 4 – Linkage indices of the sectors importers of intermediate inputs in the Brazilian processing industry 2009.

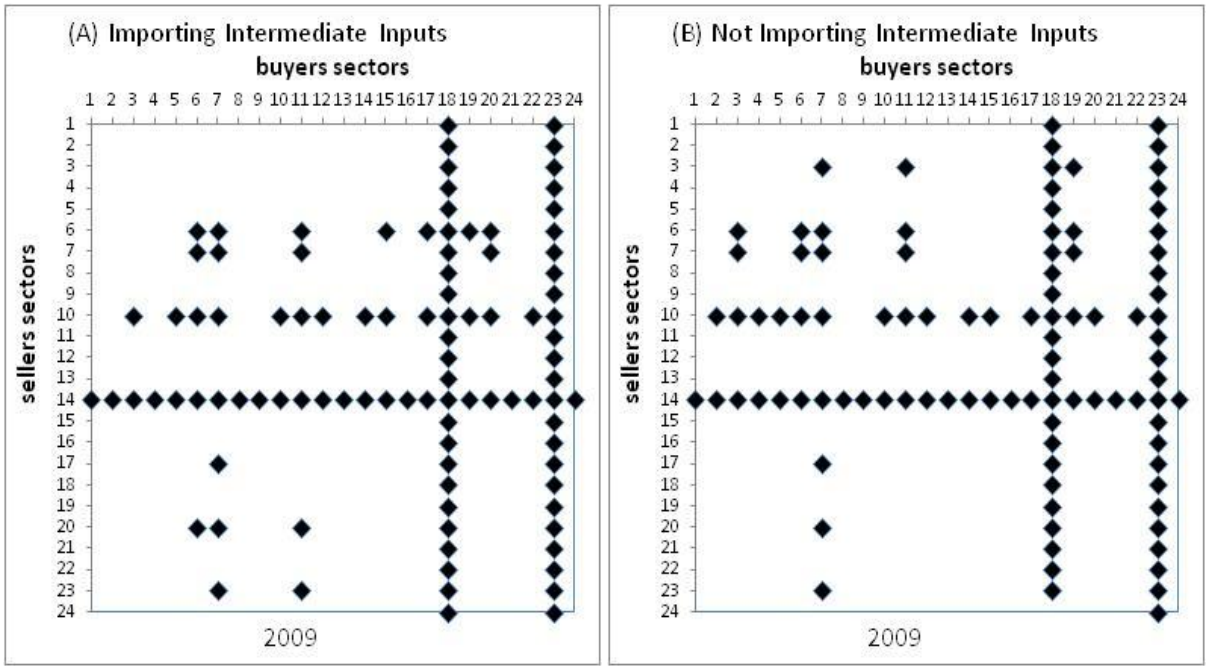
Sectors	Importing Intermediate Inputs		Not Importing Intermediate Inputs	
High Technology	Backward	Forward	Backward	Forward
1 – Pharmaceutical	0,92	0,56	0,89	0,50
2 - Medical devices for optics and of precision	0,85	0,56	0,86	0,52
3 - Equipment for radio, TV and communication	1,11	0,73	1,22	0,86
4 – Office and computer material	1,05	0,55	1,26	0,49
Medium-High Technology				
5 - Machines and electrical devices	1,09	0,81	1,12	0,83
6 - Motor vehicles, trailers and semitrailers	1,21	0,81	1,26	0,81
7 - Chemical products, exclusive pharmaceutical	1,11	1,47	1,15	1,75
8 - Machines and mechanical equipment	1,05	0,69	1,11	0,69
Medium-Low Technology				
9 - Rubber and plastic products	1,03	0,82	1,01	0,79
10 - Non-metallic mineral products	1,05	0,74	1,07	0,68
11 - Metallic products	1,14	1,45	1,19	1,51
12 - Coal, refined oil products and nuclear fuel	1,09	1,13	1,12	1,17
Low Technology				
13 - Unspecified manufactured products and recycled goods	0,91	0,61	0,87	0,55
14 - Food, beverages and tobacco	1,21	0,78	1,14	0,73
15 - Textiles, leather and footwear	1,05	0,87	1,02	0,81
16 - Furniture and products of the various industries	1,01	0,56	0,99	0,49
17 - Wood and its products, paper and cellulose	1,08	0,95	1,05	0,89
Other Sectors				
18 – Agriculture	0,89	1,13	0,85	1,08
19 - Extractive Industry	0,99	1,27	0,96	1,51
20 - S.I.U.P	0,89	1,15	0,84	1,08
21 – Construction	0,94	0,62	0,91	0,56
22 – Commerce	0,75	1,56	0,68	1,50
23 - Services	0,81	3,58	0,75	3,71
24 - Public Services (Educ. Health. Adm. and Social Sec.)	0,77	0,58	0,71	0,51

Source: Elaborated by the author.

The forward and backward linkage indices, for the year 2009, can be seen in Table 4, and show that, in general, they contain few alterations in relation to the analyzed in 2000 and 2004. The forward and backward key sectors were: 7 - Chemical products, exclusive pharmaceutical; 11 - Metallic products and 12 – Coal, refined oil products and nuclear fuel. For these sectors, when the imports of intermediate inputs are no longer considered, they are strengthened in the forward and backward direction.

The sector 17 – Wood and its products, paper and cellulose, considered a forward and backward key sector in 2000 and 2004, ceases to be key sector in 2009. Other sectors that have forward or backward indices higher than 1, that is, strong on the seller or on the purchaser side, improved their participation in the production when the imports of intermediate inputs were no longer considered: the sector 3 – Equipment for radio, TV and communication, for instance, was increased from 1.11 to 1.22, without the imports of intermediate inputs. The sector 23 – Services possesses strong forward linkage (index above 3), in the three years of analysis.

The influence field, in 2009, can be seen in Graph 3, where it is observed the same tendency in relation to the found in 2000 and 2004, when the intermediate inputs were no longer imported.



Graph 3 – Influence field for the sectors importers of intermediate inputs in the Brazilian processing industry, 2009.
Source: Elaborated by the author.

By internalizing the imports of intermediate inputs, it occurs an improvement in the linkages of the sectors, for both forward and backward linkages, mainly in the sectors classified as being of high and medium-high technology. By looking at the Part A of the Graph 3, the sectors with higher linkages are concentrated in the sectors of medium-low and low technology. As to the Part B of the Graph 3, the linkages are concentrated in sectors of high and medium-high technology.

As seen in 2000 and 2004, also in 2009, the sector 14 - Food, beverage and tobacco, was associated with all the economic sectors in the forward direction. This sector sells to all the other sectors; ass can be seen in the Part A of the Graph 3. In addition, the sector 23 – Services maintained its prominence as sector purchaser from all the other

economic sectors, thus presenting strong backward linkage. The sector 18 – Agriculture showed to be a great purchaser.

By looking at the Part B of the Graph 3, it can be noticed an improvement in the linkages of the sector 7 – Chemical products, exclusive pharmaceutical, on the purchaser side: this sector started to connect better with the other economic sectors, when the imports of intermediate inputs were internalized in the production. As to the sector 18 – Agriculture, it maintained the linkage as purchaser from all the other economic sectors. The sector 23 – Services acted as purchaser from all the other economic sectors, both in the Par A and B of the Graph 3, in 2009.

It can be verified that it follows the same tendency of 2000 and 2004, that is, when intermediate inputs were no longer imported, the connecting links were increased, mainly in the sectors classified by technological intensity as being of high and medium-high technology. The reduction in the imports of intermediate inputs strengthens, internally, sectors of high and medium-high technology. As to the sector 3 – Equipment for radio, TV and communication, for instance, the fact of not importing intermediate inputs increases the links from 2 to 5 on the seller side, and from 2 to 4 links, for the purchaser sectors. The sector 7 - Chemical product, exclusive pharmaceutical, maintained in 7 the links in the purchaser sectors.

Thus, the values found in this study help to better understand the ideas of Cano and Silva (2010), where the authors stress the need for a government policy built from a view of the complexity of the productive structure of the country and supported by the perception that the several sectors and productive chains play differentiated roles in the dynamics of the development, in terms of generation and dissemination of innovations, competitiveness and international dynamism and fulfillment of the basic needs of the population. Still according to the authors, there is a clear need to design a contemporary industrial and technological policy, in a long-term perspective, emphasizing the dimension of innovation and the aggregation of technology to the Brazilian products.

It is necessary to consider the positive effect in relation to the transfer of technology, when the intermediate inputs are commercialized with the advanced economies, for instance. However, according to Pacheco (1996), it is important to pay attention to the effects of the trade opening of the country, from the new international competitive environment, they tend to be very negative for the Brazilian regions that are not integrated to the international market. For the author, the highest competitiveness of the industry is reached through the weight increase in the imported component, weakening the internal inter-industry nexus of the country, and reducing the linkage effects. The result is lower aggregation of added value and discouragement of the growth of the national economy.

It is also consensus that the transfer of technology through the imports of intermediate inputs and the international trade with P&D-intensive countries (technological leaders) brings benefits to any country that connects with the advanced economies. However, for Brazil, it can also be verified an imbalance among the sectors, through the reduction of linkages when the imports of intermediate inputs are considered. However, it is important to emphasize that Lööf and Andersson (2008) stress that the imported inputs can be better than the national inputs and that the international trade can benefit the importer countries with access to new products or new varieties of existing products. For the authors, greater access to new imported inputs and equipment can increase the productivity, and the best technology incorporated to the imported inputs can allow the companies to improve the methods of production. Kasahara and Rodrigues (2007) showed a positive impact from the use of foreign intermediate inputs for the company productivity in the case of Chile. Zaclicever and Pellandra (2012) found evidence of a positive effect between the increase of foreign inputs in

the Uruguayan industrial enterprises and the productivity during 1997-2008, which is positively related to the technology incorporated in the imported inputs.

In line with the ideas of Chesnais (1996), the results of this paper for Brazil show that, when the intermediate inputs of high and medium-high technology are no longer imported, these sectors become better articulated among them, show an improvement in the indicators of Rasmussem-Hirschman and a lower dependence of the country in relation to the intermediate inputs imported. According to Pacheco (1996a and 1996b), the higher competitiveness of the industry is achieved through the increase of the weight of the imported component, weakening the internal inter-industry links of the country and reducing the linkage effects. The result is a lower aggregation of value and discouragement of the growth of the national economy.

The results of Rodrigues et al (2013) show tendency of positive gains in the capacity of the Brazilian economy to generate added value and a lower dependence on the imports of intermediate inputs, mainly by the sectors technologically advanced, when they studied the foreign dependence, generation of added value and structural change in Brazil, using data of MIP structured in 42 sectors subdivided into three sub-periods: 1995 a 2000; 2001 a 2005; and 2006 a 2009. According to the authors, a lower number of sectors began to require large increase in the global production to raise, in one unit, their final demands at the same time in which more sectors reduced their external dependence relatively to imported inputs. These results, found by the authors, are convergent with the results found in this study, in the sense that a reduction of intermediate inputs imported has positive impacts on the production of the Brazilian economy, mainly for the sectors of high and medium-high technology.

FINAL CONSIDERATIONS

The results found in this study show that all sectors cease to gain in production by importing intermediate inputs, and begin to encourage the production of these inputs internally. Thus, there is a production improvement, mainly in the sectors of high and medium-high technology, and this becomes clear graphically in the results, showing that there were gains in linkages among sectors and in all sectors, mainly of high and medium-technology. These linkage gains can also be observed through the increase in the linkage indices of Rasmussem-Hirschman, when the imports of intermediate inputs are no longer considered.

Thus, it can be noticed that, for the Brazilian processing industry, the initial hypothesis is confirmed, that is, the hypothesis that the intensification of the free-market policies, occurred as from 1990, by contributing to an increased international competition, increased the access of the Brazilian industries to import intermediate inputs mainly of high and medium-high technology. The results showed that, these imported intermediate inputs inserted in the production, cause significant improvements in the sector of high and medium-high technology. It becomes clear that ceasing to import intermediate inputs in some sectors and to begin producing them internally could result in advantages for the country in sectors internationally competitive, such as the case of the sectors: 3 – Equipment for radio, TV and communication; 4 – Office and computer material; 5 – Machines and electrical devices; 6 – Motor vehicles, trailers and semitrailers; 7 – Chemical products, exclusive pharmaceutical; 11 – Metallic products; 12 – Coal, refined oil products and nuclear fuel.

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