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INTERDEPENDENCE AMONG THE BRAZILIAN STATES: AN INPUT-OUTPUT APPROACH

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Interdependence among the Brazilian States: an Input-Output approach[1]

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ABSTRACT

The principal aim of this paper is to evaluate the inter-regional linkages based on the many-region input-output table for Brazilian regions, for the year 1996, elaborated by FIPE. This work utilizes the extraction method by Strassert, 1968 and Schultz, 1977 and modified by Dietzenbacher *et al* (1993). Instead of extracting one sector from a sector-based model, we will examine the effects of hypothetically extract a region from a many-region model. The method calculates the "backward linkages"; the "forward linkages" are obtained analogously from the matrix of allocation coefficients.

Key-words: inter-regional input-output, linkages, regional economics.

JEL classification: R15, R58

1. Introduction

The recent period of transformation in the world trade can be summarized by the increase in the world trade, mainly in manufacture goods, a tendency of reduction of tariffs and other trade barriers (based on the General Agreement on Tariffs and Trade – GATT) and the creation of free trade areas or economic agreements among the countries in a specific area.

These transformations have been creating a direct impact in the Brazilian economy. In the period of 1990-2000, the Brazilian exports increased, from US$ 31.4 billions to US$55.1 billions. The share of exports in the Brazilian GDP also increased: it was 6.4% in 1990

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and reached 9.1% in 2000. Despite the increase of Brazilian exports, the share of Brazilian exports in the total world trade had a small decrease from 0.93% to 0.88% between 1990 and 2000.

In the Brazilian literature there are several works that discuss the impact of these trends upon the Brazilian economy as a whole. Among them Carvalho and Parente (1999) used the partial equilibrium approach in order to evaluate the potential total commercial and sector impacts that an implementation of NAFTA agreement caused in Brazilian economy; Fundação Getúlio Vargas - FGV (1999) investigate, via GTAP (Global Trade Analysis Project), the process of tariffs liberalization with Mercosur and European Union considering two alternative scenarios (total and partial tariffs liberalization). The literature also presents a small amount of works that measures the impact upon the specific regions in Brazil. Included in this category, Haddad *et al* (2002) measured the trade gains from regional trade agreements via EFES-IT model; Domingues (2002) developed a CGE model to verify the impact of different trade agreements upon São Paulo state economy.

Given the regional economic disparities in Brazil (that can be measured by the regional difference in the accumulation of physical and human capital, transport costs, technology, production structure, diversification of tradable goods, regional share in Brazilian GDP-presented at Table 1 -, etc) we can assume that an increase in the international trade could lead to more concentration in the Brazilian regional development. Based on the models of economic geography we can affirm that the growth of international trade with a specific country could lead to a process of geographic polarization and to the growth of intra-regional and interregional income disparities. As observed by Krugman (1991) and Venables (1996) with the process of trade liberalization the importance of the factors that determine the economies of agglomeration (scale economies, market size and transport costs) became less important. On the other hand, the distribution among the regions of factors as natural resources, infrastructure and human capital became more important in the production process and in the definition of the level of income.

In a recent work, Haddad and Perobelli (2002) found a high degree of concentration in the international trade among the states of South and Southeast of Brazil (Table 2). In this work, the authors also calculated the Revealed Comparative Advantage (RCA) in the trade between the Brazilian states and specific regions in the world. They showed that the majority of the states located in the North, Northeast and Center-West of Brazil have RCA in a small number of products and mainly in primary products (with a low degree of incorporated technology). Hence, *ceteris paribus*, the less developed region will be put aside of that process.

Table 1. States and Regions Shares in GDP (1985-1999)

Regions	*Years*			
	1985	*1990*	*1995*	*1999*
North	3,84	4,94	4,64	4,45
Northeast	14,10	12,86	12,78	13,11
Southeast	60,15	58,83	58,72	58,25
South	17,10	18,21	17,89	17,75
Center-West	4,81	5,16	5,98	6,44
Brazil	100,00	100,00	100,00	100,00

Source: IBGE (1999) - Contas Regionais

Table 2. Brazil: Share of States Exports and Imports by destination and origin (1997/1999)

(%)

	Mercosur		***Nafta***		***Rest of Ftaa***		***E.U.***		***ROW***		***Total***	
	Exp	***Imp***	***Exp***	***Imp***	***Exp***	***Imp***	***Exp***	***Imp***	***Exp***	***Imp***	***Exp***	***Imp***
North	**2**	**1**	**4**	**6**	**3**	**7**	**7**	**3**	**8**	**15**	**5**	**7**
Northeast	**6**	**8**	**10**	**6**	**4**	**23**	**7**	**4**	**9**	**8**	**8**	**7**
Southeast	**67**	**57**	**62**	**76**	**71**	**57**	**51**	**76**	**50**	**63**	**58**	**69**
South	**24**	**33**	**23**	**10**	**20**	**12**	**29**	**15**	**30**	**12**	**26**	**16**
Center-West	**1**	**2**	**1**	**2**	**1**	**1**	**6**	**1**	**3**	**2**	**3**	**2**
Brazil	100	100	100	100	100	100	100	100	100	100	100	100

Source: Haddad and Perobelli (2002)

Some policy intervention should be made in order to integrate the less developed regions in the process of international trade and, as a consequence, to improve the development of those regions. In order to address these policies and deal with the problem of differences in regional development, it is important to have the complete picture of the problem. To implement a policy in efficient terms, it is crucial that policymakers know as much as they can about the region. So, we can highlight some points that can help them to deal with this problem.

Firstly, it is important to understand the relationships among the Brazilian states; in other words, how the states interact and how strong are the linkages among the states. We can use Input-output framework to analyze these issues[4]. We can also use a CGE approach in order to capture other features, such as labor market, costs and consumption behavior, product differentiation, etc, in the region. These frameworks are complementary and work in the sense of better explain the region.

As pointed before, there is in the Brazilian literature a great number of works that measure the impact of the transformations in the world trade upon the Brazilian economy as a whole. On the other hand, there is a small number of works concerned about the impacts in a more disaggregate level (*e.g* Brazilian states). Based on this gap in the Brazilian literature and with the aim of better understanding of the Brazilian regions, the authors are also developing, as a further step, a computable general equilibrium model (CGE) that seeks verifying how the transformations in the international trade will affect the 27 Brazilian states[5]. However, in order to implement this analysis, it is necessary to carry out a few steps prior to it. For instance, it is important to specify in a correct way the consumption functions, production functions, cost functions, estimate trade elasticity and to understand the interactions among the states. Hence, the present paper will work as a first step to the CGE approach. This paper is organized as follows: in the second section, we firstly present a brief review of the debate on how to measure the linkages among sectors and regions. Secondly, the regional extraction method is presented. The third section presents the empirical results for the Brazilian economy and, in the fourth part some conclusions are made.

[4] In this paper we will apply the extraction method in the interregional input-output framework.

[5] This model will try to measure the impacts of shocks on tariffs, incentives for specific sectors, trade agreements and others upon the labor market and the different productive sectors in each state, for example. However, the CGE approach won't be developed in the context of the present paper.

2. Theoretical Framework

Input-output models are useful for analyzing the effects of changes in one sector upon the others. Hence, this framework seems to be very suitable to understand how important is a sector (or region) in a multi-regional context or which is the impact of a slow down in the production of a specific sector (or region) upon the rest of the economy.

Moreover, input-output analysis can be useful in order to detect or describe sectoral dependences (or linkages) and in order to analyze the production structure of the economies. In these respects, the literature presents a great number of papers in this field. First of all we will make a brief review the analysis on the interdependencies of the production sectors.

Hirschman presented the concept that "because of interdependencies, any non primary activity which does not only produce for final demand exerts two distinct effects by means of its demand for and supply of inputs respectively" (Hirschman, 1958 – p. 100). It is possible to analyze the effects on the demand and on the supply side: the idea of backward linkage can be illustrated as a stimulus from the demand on the other domestic sector in order to satisfy its intermediate requirements. In Cella's (1984 p-74) words "on the supply side we can affirm that the supply also stimulates domestic production because it may induce use of its output as an input in new activities (forward linkages)".

One of the most well know work in this field is Chenery and Watanabe (1958) who took the column sum of the input matrix A as a measure of the direct backward linkages. With the aim of capturing the indirect effects, Rasmussen (1956) suggests to use the Leontief inverse $(I - A)^{-1}$ instead of input matrix.

Based on the Leontief inverse matrix and on the concept of backward and forward linkages, Rasmusssen (1958) and Hirschman (1958) came up with the idea of Key sector analysis[6]. They proposed a method to verify which are the sectors that present the greater

[6] The presentation of this methodology is based on Haddad (1999) and Sonis *et al* (1995).

impact upon the economic system. They took b_{ij} as a typical element in the Leontief inverse, B. They define $b_{.j}$, $b_{i.}$, and $b_{..}$ as the column, row and total sums of B, respectively. They also define $B^* = b_{..} / n^2$ as the average value of all elements of B. Based on the definitions above they calculate the backward linkage index U_j (power of dispersion) and the forward index U_i (sensitive of dispersion) in this way:

$U_j = \frac{\left(b_{.j} / n \right)}{B^*}$ and $U_j = \frac{\left(b_{i.} / n \right)}{B^*}$, where n is the number of sectors.

The indices can be interpreted as follows: If $U_j>1$ – a unit change in final demand of sector j creates an above average increase in the economy; *i.e*; sector j generates above average response in other sectors; If $U_i>1$ – a unit change in all sector's final demand creates an above average increase in sector i; *i.e:* sector i displays above average dependence on the output of other sectors.

Hence, sectors that presents both $U_j>1$ and $U_i>1$ can be classified as key sectors in the economy.

In order to verify how these impacts spread through the economy, Sonis and Hewings (1994) developed the concept of Fields of Influence[7]. It was developed to verify if the impact of a coefficient change (technology change) was concentrated on one or two other sectors or more broadly diffused throughout the economy[8]. This framework can be exemplified based on the idea of a small change (ε) in only one input parameter, a_{ij}. The basic solution of the coefficient change problem may be presented as follows:

$A = \|a_{ij}\|$ is the matrix of direct input coefficients;

$E = \|\varepsilon_{ij}\|$ is the matrix of incremental changes in the direct input coefficients;

$B = (I - A)^{-1} = \|b_{ij}\|$ is the Leontief inverse before changes;

$B(\varepsilon) = (I - A - E)^{-1} = \|b_{ij}(\varepsilon)\|$ is the Leontief inverse after changes;

[7] The presentation of that methodology draws on Haddad (1999), Sonis, Hewings and Lee (1994) and Sonis *et al* (1995).
[8] For further example of the application of the methodology of linkages, Key sector and Fields of Influence for the Brazilian economy, see Sonis, *et al* (1995) and Haddad (1999).

Assuming that the change occurs in location (i_1, j_1), we have:

$$\varepsilon_{ij} = \varepsilon \quad i = i_1, \; j = j_1$$
$$\quad 0 \quad i \neq i_1, \; j \neq j_1$$

The field of influence can be derived from the approximate relation:

$$F(\varepsilon_{ij}) \cong \frac{\lfloor B(\varepsilon_{ij}) - B \rfloor}{\varepsilon_{ij}}$$

where $F(\varepsilon_{ij})$ represents the matrix of the field of influence of the change on the input coefficient, a_{ij}. The rank-size ordering of the elements, S_{ij}, is implemented with the aim of determine which is the coefficient that have the greatest field of influence. So, the value of S_{ij} associated with the matrix $F(\varepsilon_{ij})$ will be:

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

Another interesting way to compute linkages is by means of the method of hypothetical extraction. The original method of hypothetical extraction (Strassert, 1968) can be explained as follows: given the vector of final demand, the product is calculated for each one of *n* sectors. The next step is to isolate one of the *n* sectors. To proceeds this isolation in a hypothetical manner, the rows and columns related to the extracted sector in the input coefficients matrix (matrix *A*) will assume the value zero. The hypothetical product for each one of the *n-1* sectors will be calculated based on the reduced vector of final demand. The effect of the extraction of a specific sector will be measured by the difference between the two types of products (with restriction and without restriction). The size of the difference will indicate the importance of the sector that was hypothetically isolated in the economy context (Dietzenbacher *et al*, 1993). Based on the original method of extraction, it is impossible to discriminate backward and forward linkages.

The literature also presents different approaches for the extraction method. Cella (1984) proposed an improvement on the original method. Instead of starting with the two types of linkages (backward and forward) the author defined first the total linkages effect of a specific industry and then sought to identify the other two components. The measure of total linkages proposed by Cella (1984) has the following characteristics: a) it was constructed based on a consistent input-output model of the economy with a fixed set of technical coefficients, b) it is possible to split the result into two components (backward and forward linkage) and c) it does not include the feedback process that are intrinsic to the selected industry[9].

However Clements (1990) argumented that the decomposition of linkages proposed by Cella (1984) overestimated the forward linkages. According to Clements (1990) the second part of Cella's forward linkages measure is really a part of backward linkages. In order to solve (or minimize) this problem, Clements (1990) proposed a new disaggregation of total linkages[10].

The regional extraction method, which will be presented in more detail in the next section[11], makes some adaptations in the Strassert's original method. Instead of extracting a sector we will implement a regional extraction (one at a time) in the inter-regional input-output model. Hence, we can examine how the isolation of one region will affect the product of the rest of the economy. It also allows the differentiation between backward[12] and forward[13] linkages. With the purpose of reaching this aim, the extraction will occur precisely in these linkages. In order to calculate the backward linkages of a sector (or region), all intermediate deliveries that this sector (or region) buys are hypothetically extracted. For the forward linkages, all the intermediate deliveries that a sector (or region) sells are extracted. Based on these steps, it is possible to calculate the backward linkages of the isolated region, and also indicate the dependence of this region upon the inputs from the rest of the economy. The forward linkages are derived in a dual

[9] For more details see Cella (1984).
[10] For more details see Clements (1990).
[11] The method is based on Dietzenbacher *et al* (1993).
[12] The backward dependence of a buying region (or sector) with respect to a selling region (sector).
[13] The forward dependence of a selling region (or sector) with respect to a buying region (sector).

manner. Instead of using the input coefficients matrix (matrix A) we will use the output coefficients (allocation matrix)[14].

2.1 Regional Extraction Method[15]

Consider the general case of an inter-regional input-output model with N regions and n productive sectors in each region[16]. The model is given by:

$$x = Ax + f \tag{1}$$

where: x – the nN-element column output vector.

A – the nN x nN matrix of input coefficients.

f – the nN-element column vector of final demand.

The solution of equation (1) will be:

$$x = (I - A)^{-1} f \quad or \quad Lf$$
$$where \;\; L = (I - A)^{-1} \;\; is\ the\ Leontief\ Inverse$$

The output vector is partitioned as follows[17].

$$x = (x^{1'}, \ldots, x^{I'}, \ldots, x^{N'})$$
$$where \;\; x^I = (x_1^I, \ldots x_i^I, \ldots x_n^I)'$$

The coefficient matrix is constructed as follows:

$$A = \begin{bmatrix} A^{11} & \cdots & A^{1N} \\ \vdots & \ddots & \vdots \\ A^{N1} & \cdots & A^{NN} \end{bmatrix} \tag{2}$$

The extraction method considers the effect of hypothetically isolate one region upon the output of the rest of the economy. Without loss of generality, let's suppose that the first region was extracted. Thus, the remaining N-1 regions will represent the rest of the

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14 For further applications of this method see Van Der Linden (1998) and Dietzenbacher and Van Der Linden (1997).

15 This section is based on Dietzenbacher, *et al* (1993).

16 The regions will be represented by superscripts $I,J= 1,\ldots,N$ and the products by subscripts $i, j= 1,\ldots, n$.

17 The vector f can be partitioned in the same way.

economy[18]. Hence, we can write $x = (x^{1'}, x^{R'})'$ *with* $x^R = (x^{2'},\ldots,x^{I'},\ldots,x^{N'})'$ a *n(N-1)* element column vector.

In a similar way, we have:

$$A = \begin{bmatrix} A^{11} & A^{1R} \\ A^{R1} & A^{RR} \end{bmatrix} \tag{3}$$

Analogous to the equation (3), the Leontief inverse in its partitioned form is given by

$$L = (I - A)^{-1} = \begin{bmatrix} L^{11} & L^{1R} \\ L^{R1} & L^{RR} \end{bmatrix} \tag{4}$$

Based on the equation (4) we have:

$$x^1 = L^{11} f^1 + L^{1R} f^R \tag{5a}$$

$$x^R = L^{R1} f^1 + L^{RR} f^R \tag{5b}$$

With the hypothetical extraction of region 1, the model in equation (1) will be reduced and will assume the form:

$$\bar{x}^R = A^{RR} \bar{x}^R + f^R$$

The vector $\bar{x}^R$ represents the product of the rest of the economy for the reduced model. The solution of the reduced equation is:

$$\bar{x}^R = (I - A^{RR})^{-1} f^R \tag{6}$$

The difference between x^R (equation 5b) and $\bar{x}^R$ (equation 6) will give the extraction effect of region 1 upon the product of the rest of the economy. In order to interpret the

[18] In order to represent these regions we will use the superscript *R*.

elements of vector $x^R - \overline{x}^R$, we have to calculate the matrix L as the inverse of partitioned matrix as follows:

$$L^{1R} = L^{11} A^{1R} (I - A^{RR})^{-1} \tag{7a}$$

$$L^{R1} = (I - A^{RR})^{-1} A^{R1} L^{11} \tag{7b}$$

$$L^{RR} = (I - A^{RR})^{-1} + (I - A^{RR})^{-1} A^{R1} L^{11} A^{1R} (I - A^{RR})^{-1} \tag{7c}$$

Hence we have:

$$x^R - \overline{x}^R = L^{R1} f^1 + \left[L^{RR} - (I - A^{RR})^{-1} \right] f^R \tag{8a}$$

$$= (I - A^{RR})^{-1} A^{R1} L^{11} \left[f^1 + A^{1R} (I - A^{RR})^{-1} f^R \right] \tag{8b}$$

The interpretation of the expression $x^R - \overline{x}^R$ can be divided into two parts: a) the first one $\left(L^{R1} f^1\right)$ describes the production in the rest of the economy that is necessary to satisfy the final demand f^1 in region 1 and b) the second part, $\left[L^{RR} - (I - A^{RR})^{-1} \right] f^R$, describes the production in the rest of the economy $L^{RR} f^R$ that is necessary to satisfy the final demand in the rest of the economy f^R.

We can observe that the elements of vector $x^R - \overline{x}^R$ show the interdependence between the region 1 and the other regions. According to Dietzenbacher *et al* (1993), these interdependencies are fundamentally backward in their nature. These can be demonstrated using the matrix A^{R1} (whose elements indicate the backward dependence of *1* on *R*) and A^{1R} (whose elements indicate the backward dependence of *R* on *1*).

In order to better understand the expression $x^R - \overline{x}^R$, we will use the equation (8b) and examine this equation using the idea of interregional spillover effect and interregional feedback effects developed by Miller and Blair (1985).

In order to satisfy the final demand f^1 in region 1, this region must produce $L^{11}f^1$. Region 1 does not have all the inputs necessary to reach this level of production. So, with the aim of achieving this production, it is necessary that region 1 purchases inputs direct from the other regions. The amount of inputs purchased will be $A^{R1}L^{11}f^1$. To provide these inputs, the production in the rest of the economy is required to become $\left(I - A^{RR}\right)^{-1} A^{R1}L^{11}f^1$. The same analysis can be made for the demand in the rest of the economy f^R.

Applying the traditional idea of inter-regional feedbacks to region 1, it is possible to affirm that the feedbacks for this region will be obtained by comparing the outputs of region 1 within the inter-regional model to the outputs of region 1, within the single-region model. In a mathematical form we have:

$$x^1 - \overline{x}^1 = L^{11}f^1 + L^{1R}f^R - \left(I - A^{11}\right)^{-1} f^1 \tag{9}$$

Taking the equations (7) and (8) and interchanging the superscripts *1* and *R* we will have:

$$x^1 - \overline{x}^1 = \left(I - A^{11}\right)^{-1} A^{1R}L^{RR}\left[f^R + A^{R1}\left(I - A^{11}\right)^{-1} f^1\right] \tag{10}$$

Based on the regional extraction framework it is possible to affirm that the vector $x^1 - \overline{x}^1$ measures the backward dependence of the rest of the economy on the region 1. In other words, the vector enables us to measure the impact of extracting, from the economy, all the *N-1* regions in R upon the output of the remaining region 1.

2.2 Forward Linkages

We can affirm that there exists direct forward dependence of one sector (or region) when the other sectors (or regions) require much of its product as an input. From the accounting equation $x = Te + f$, where T – is the matrix of intermediate delivers, *e* is the summation column vector, $e = (1,1,...,1)'$, f – is the final demand vector and x – is the product vector it is possible to define $x = Ax + f$, where $A = T\hat{x}^{-1}$.

The matrix B (product matrix or allocation matrix) is taken in order to calculate the forward dependence. That matrix can be defined as follows:

$$B = \hat{x}^{-1} T \tag{11}$$

In similar way, the accounting equation $x' = e'T + v'$, where v' – is the row vector of primary inputs imply that:

$$x' = x'B + v' \tag{12}$$

Which can be rewritten as:

$$x' = v'(I - B)^{-1} = v'G \tag{13}$$

The equation (1) presents the demand driven input-output model and the equation (12) is the dual form of equation (1) and can be taken as supply driven input-output model.

The forward linkages can be obtained based on the vector $(x - \bar{x})'$. We can implement the extraction (or isolation) of one region. When the region 1 is extracted we will have:

$$\begin{aligned}(x - \bar{x})' &= \left[\left(x^1 - \bar{x}^1\right)', \left(x^R - \bar{x}^R\right)' \right] \\ &= \left(v^{1'}, v^{R'}\right) \left\{ \begin{bmatrix} G^{11} & G^{1R} \\ G^{R1} & G^{RR} \end{bmatrix} - \begin{bmatrix} \left(I - B^{11}\right)^{-1} & 0 \\ 0 & \left(I - B^{RR}\right)^{-1} \end{bmatrix} \right\}\end{aligned} \tag{14}$$

Hence, the vector $\left(x^{R} - \overline{x}^{R}\right)'$ will represent the forward linkages of region 1 upon the rest of the economy and the vector $\left(x^{1} - \overline{x}^{1}\right)'$ will represent the forward linkages of the rest of the economy upon region 1.

3. Empirical Results for the Brazilian economy

The empirical results of the extraction method for the Brazilian economy are based on the 1996 interregional input-output table for the 27 Brazilian states. For the present purpose, the Brazilian table was aggregated into 8 sectors. The sectoral classification is as follows: 1 – Agriculture, 2 – Industry, 3 – S.I.U.P, 4 – Construction, 5 – Trade, 6 – Financial services, 7 – Public sector and 8 – Other services[19].

3.1 Backward Effects

The results presented in this section are based on the equations 8 and 9. Tables A1.1 – A1.2 and A2.1 - A2.2 in the appendix indicate in each column the production effects after the extraction of the state in the analysis. These tables present the results in absolute values and as a percentage of the actual production.

North:

When one of the states of the North region is isolated, the analysis of Table A1.1 shows that there is a small effect on the product of the other states situated at North region. On the other hand, when the states located at North are isolated there is a big effect at Southeast region, mainly at São Paulo and Minas Gerais states. In the analysis of Table A1.1, we can also verify that the impacts of the isolation of the states of the North region upon the states of South region are considerable. Using the results for the Amazonas and Pará states it is possible to verify that when these states are isolated, the fall in the São Paulo output reaches R$ 3882507 and R$ 2190094 respectively. These results represent the dependence of Amazonas and Pará on inputs from São Paulo. Hence, these results

[19] For more details about the matrix see Haddad *et al* (2002).

enable us to affirm that the macro region North does not face a great interaction among the states. Based on the BL[20] and IF_b results, it is possible to conclude that the backward dependence of the isolated state upon the rest of the Brazilian economy is bigger than the backward dependence of the rest of the Brazilian economy upon the isolated state for every state situated in North region $(BL > IF_b)$.

The *BL* results presented in Table A2.1, in relative terms, show that, based on the size of the dependent economy, the states located at North present a certain degree of dependence upon the rest of the Brazilian economy and this dependence (or linkage) is stronger over the Southeast and South states. These results fit with the idea that the linkages among small economies and huge economies are stronger[21]. Another interesting feature presented in Table A2.1 is the size of inter-regional feedback (measuring the dependence of the rest of Brazil upon the isolated member). The result shows the reduced importance of the region in the Brazilian economy context. The best result is obtained to the Amazonas state (0,154).

The comparison among the absolute results of *BL* (Table A1.1) and the *BL*'s result relative to the size of the economy (Table A2.1) shows an interesting aspect. The examination of BL results at the lower part of Table A1.1 enables us to affirm that the largest states (e.g Amazonas and Pará) show the strongest results, followed by Rondônia, Tocantins, Acre, Amapá and Roraima. On the other hand, the lower part of Table A2.1 shows that the strongest linkages were obtained to Acre, followed by Roraima, Tocantins, Pará, Roraima, Amazonas and Amapá. Based on these results, it is possible to affirm that the backward linkages of the largest states at North are now very moderate.

Northeast

Based on the results for the Northeast presented on Table A1.1, we can affirm that: a) there is a reduction on the product of Pernambuco, Bahia and Ceará states when the other states of the region northeast are isolated, b) for all states $BL > IF_b$, meaning that the

[20] Is the column-wise summation of the off-diagonal elements in Table A1.1

[21] See the results in Table A2.1 for Acre, Amapá, Rondônia, Roraima and Tocantins states.

backward dependence of the isolated state upon the rest of the Brazilian economy is larger than the backward dependence of the rest of the Brazilian economy upon the isolated state and c) we can also verify that there is a huge impact upon the Minas Gerais and São Paulo economies when the states of Northeast are hypothetically isolated. For example, we find that the total output of Minas Gerais is decreased by R$ 1813559 if Bahia is isolated. When Ceará is isolated, the total output of Sao Paulo is decreased by R$ 2629924. These results represent the dependence of Bahia and Ceará on inputs from Minas Gerais and São Paulo respectively.

The importance of Pernambuco, Bahia and Ceará states in the context of Northeast is verified also in relative terms, which means based on the size of the economy of each state. These results are presented at Table A2.1. When Alagoas, Bahia, Ceará, Paraíba and Rio Grande do Norte are isolated, the output of Pernambuco decreases in a considerable amount. On the other hand, the output of Bahia decreases by a bigger amount when Pernambuco and Sergipe are isolated.

The examination of Table A2.1 also permits to verify the importance of São Paulo and Minas Gerais over all states at Northeast and also the importance of Rio de Janeiro, Paraná and Rio Grande do Sul over Bahia, Ceará and Pernambuco.

We can verify that the impact upon the product of Center-west and North states is small when the states located at Northeast are hypothetically isolated. Based on these results, we can conclude that the interaction between the Northeast and those regions is weak.

The result of IF_b (inter-regional feedback) for the region (Table A2.1) shows that, into the national context, the region presents a weak importance. It is important to highlight the results of Bahia (0.232), Pernambuco (0.223) and Ceará (0.130). The results for these states can be explained by historical perspective, by the share of these states on Brazilian GDP, etc.

Southeast:

This is the region that presents the strongest interaction within the macro region (see Table A1.2). We can observe that $BL<IF_b$, except for Espírito Santo state, which means that the backward dependence of the rest of the economy upon these states is bigger than the dependence of these regions (when hypothetically isolated) upon the rest of the Brazilian economy. The results for São Paulo, Minas Gerais and Rio de Janeiro can be explained by the industrial diversity, the size of the economy (share at GNP), etc. This result shows the importance of these states in the national context.

Based on Table A2.2, we can affirm that also in relative terms the states located in the southeast are more important. When we make a comparison among the relative result of *BL* for Minas Gerais (5.4), Rio de Janeiro (3.9) and São Paulo (2.1) and the results for the rest of the Brazilian economy, it is possible to corroborate the idea that, in terms of input supply, the smallest states depend more on the rest of the Brazilian economy than do the largest members. In other words, the inputs that are used in the southeast production process are found, in a considerable amount, in the Southeast itself or are imported from the rest of the world.

Another interesting characteristic of São Paulo, Minas Gerais and Rio de Janeiro can be demonstrated by the evaluation of the size of the inter-regional feedback (in relative terms). Table A2.2 enables us to affirm that these states have a great importance over the Brazilian economy.

South:

The South region also presents a strong macro regional interaction. We can verify that when one of its three states are isolated, not only the product of São Paulo is affected in a high degree but also are the products of Paraná, Santa Catarina and Rio Grande do Sul (see Table A1.2). In the lower part of Table A1.2 we can verify that for every state located at the South region $BL < IF_b$, which means that the backward dependence of the rest of the economy upon these states is bigger than the dependence of these regions (when hypothetically isolated) upon the rest of the Brazilian economy.

Center-west:

In absolute terms, we can affirm that the region presents a high degree of dependence with regard to the states located at South and Southeast of Brazil, mainly São Paulo and Minas Gerais. We can also see that Distrito Federal presents the biggest difference between *BL* and IF_b. This result corroborates the idea of dependence of Distrito Federal upon the rest of the Brazilian economy. The lack of productive diversity in Distrito Federal explains that result. In relative terms, Table A2.2 shows that there is a certain degree of interaction within the region and with São Paulo, Minas Gerais and Parana sates. It is important to emphasize the case of Paraná. As we can see on Table A2.2, the impact of the isolation of Mato Grosso and Mato Grosso do Sul results on an impact of 10.26 and 4.6 in relative terms over Paraná economy. Hence, we can conclude that, in bilateral terms, those states have a strong relationship[22].

Table 3 presents the differences between the bilateral linkages of two states. We can observe that each state shows a net backward dependence on Sao Paulo. Each state, except for Sao Paulo and Rio de Janeiro, also shows a net dependence on Santa Catarina state. In the other hand, we can find Distrito Federal at the other side and observe that it shows a net dependence on each other state.

The structure of linkages observed at Table 3 can be used as a proxy of hierarchical structure of net dependencies. It is possible to split the states into three groups. The first one is formed by the states of São Paulo, Santa Catarina, Rio Grande do Sul, Minas Gerais, Rio de Janeiro, Espírito Santo and Paraná. These states were responsible for more than 76% of Brazilian GDP in 1999. Amazonas, Goiás, Mato Grosso, Bahia, Sergipe, Pernambuco and Ceará would form the second group. This intermediate group has some special characteristics such as: the results for Goiás and Mato Grosso can be explained via the expansion of agriculture sector toward that region in the latest decade in Brazil, the "Zona Franca de Manaus" explains the position of Amazonas state and Bahia, Pernambuco and Ceará are the main economies at the Northeast of Brazil. The third group would be formed by 13 states that are responsible for less than 10% of the

[22] To better understand this relationship it is important to implement a sectoral analysis.

Brazilian GDP. So, they are states that present, of course, a high degree of dependence upon the others.

Table 4 shows the decomposition of the backward linkages into the first order effect and the induced effect (by means of equation (8a)). We can observe that the first order effect is much stronger than the induced effect. In the case of Distrito Federal it is almost 100%.

Table 3. Net Backward dependencies

	SP	SC	RS	MG	RJ	ES	PR	AM	GO	MT	BA	SE	PE	CE	PB	TO	MS	AC	RO	RN	PA	AL	RR	PI	MA	AP	DF
SP	0	570180	1378560	1483144	1600038	398056	3294247	2907279	1616830	2951071	5972426	475203	3306110	2538006	909476	215914	2710504	226576	519417	888243	2117969	1064208	141784	426857	1367427	175920	8755426
SC	0	0	87617	52150	0	36533	157747	162908	97918	309548	486946	49246	251289	208026	73169	20546	249821	18842	45566	76052	145461	62118	18162	41059	87361	25526	475149
RS	0	0	0	6883	4894	9433	182699	104134	114927	319998	645444	57150	285384	328073	101138	27566	415622	32836	54397	85528	203256	96250	22042	41143	142944	22454	550375
MG	0	0	0	0	53534	670776	146115	95969	533587	581730	1697025	103697	746330	477969	176267	141245	1323374	88946	81575	226025	554944	245912	34688	107747	395701	42488	2420218
RJ	0	34381	0	0	0	144291	19184	116734	118846	148710	1188645	53427	331044	258449	81892	15718	136898	12371	37518	109348	156104	112720	12243	40901	148476	14767	933857
ES	0	0	0	0	0	0	41428	21757	27121	54293	301231	25945	104506	96633	36102	4659	41478	3281	9033	44686	62782	160148	2305	15927	41388	6288	291245
PR	0	0	0	0	0	0	0	7903	210675	1448529	555491	93764	323882	211890	88945	26274	252664	34723	175118	165249	241313	99563	40681	40978	125353	15308	883648
AM	0	0	0	0	0	0	0	0	52	44933	158814	4783	51238	91287	16766	719	0	940	2525	5436	27978	3433	489	2717	5292	572	24226
GO	0	0	0	0	0	0	0	0	0	0	139555	10793	52082	43886	17212	132109	186095	15249	20709	25769	128427	13014	3683	13727	71685	9828	1023836
MT	0	0	0	0	0	0	0	0	10472	0	12591	0	9994	8692	4237	2948	126644	19460	48315	0	17104	1876	2912	1157	4080	1598	80661
BA	0	0	0	0	0	0	0	0	0	0	0	15799	192124	80493	44511	1821	19558	0	0	5335	27251	92065	5092	37082	21573	3962	54964
SE	0	0	0	0	0	0	0	0	0	1205	0	0	0	12359	0	550	1911	204	341	2526	7119	51145	172	5686	9987	1335	8357
PE	0	0	0	0	0	0	0	0	0	0	0	61659	0	138773	329877	0	65491	4723	3474	231794	60254	334034	0	37248	79438	5758	95208
CE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35181	0	21978	2182	3530	159090	43700	11646	1728	122501	99708	9704	36326
PB	0	0	0	0	0	0	0	0	0	0	0	3633	0	0	0	0	10888	890	744	36536	6737	64225	291	5970	8943	1161	12150
TO	0	0	0	0	0	0	0	0	0	0	0	0	9173	13443	2138	0	0	0	0	378	20420	416	5	246	344	18	140
MS	0	0	0	0	0	0	0	12224	0	0	0	0	0	0	0	703	0	0	15232	992	8056	0	1318	794	1978	1323	47793
AC	0	0	0	0	0	0	0	0	0	0	236	0	0	0	0	12	1752246	0	0	0	256	99	5	8	32	7	372
RO	0	0	0	0	0	0	0	0	0	0	2153	0	0	0	0	21	0	89	0	0	2577	15	38	35	95	25	1315
RN	0	0	0	0	0	0	0	0	0	4105	0	0	0	0	0	0	0	43	62	0	0	939	13	658	592	118	2029
PA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6958	0	520	7	0	15311	93	20078
AL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	835	0	0	0	0	0	4	4068	16125	876	1897
RR	0	0	0	0	0	0	0	0	0	0	0	0	1556	0	0	0	0	0	0	0	0	0	0	0	2	1	74
PI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6678	0	0	0	0	28	322
MA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	36	595
AP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
DF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Based on the regional extraction method

Table 4. Decomposition of Backward Linkages

	Backward Linkages	First Order Effect		Induced Effect	
		Abs	(%)	Abs	(%)
AC	512202	487715	95.22	24487	4.78
AP	354049	350173	98.91	3876	1.09
AM	5041823	4429792	87.86	612031	12.14
PA	4341512	4210693	96.99	130819	3.01
RO	1178178	1124064	95.41	54114	4.59
RR	301634	292047	96.82	9586	3.18
TO	638837	588601	92.14	50236	7.86
AL	3052553	2736335	89.64	316218	10.36
BA	13613343	12816613	94.15	796729	5.85
CE	5681642	5213647	91.76	467995	8.24
MA	2957946	2851545	96.40	106401	3.60
PB	2451166	2191900	89.42	259266	10.58
PE	7209378	6436461	89.28	772917	10.72
PI	1112252	1057147	95.05	55105	4.95
RN	2591889	2406320	92.84	185569	7.16
SE	1514499	1329735	87.80	184765	12.20
ES	2990489	2674050	89.42	316439	10.58
MG	7395871	6615023	89.44	780848	10.56
RJ	5127214	4799756	93.61	327458	6.39
SP	10983077	9675432	88.09	1307645	11.91
PR	8482032	7677766	90.52	804265	9.48
SC	3383868	2969018	87.74	414850	12.26
RS	4503133	4188071	93.00	315062	7.00
DF	15999921	15840880	99.01	159041	0.99
GO	3989145	3492180	87.54	496964	12.46
MT	7341953	6346149	86.44	995804	13.56
MS	8112892	7925438	97.69	187455	2.31

Source: Based on the regional extraction method

3.2 Forward Effects

Tables A3.1 – A3.2 and A4.1 – A4.2 in the appendix and Table 5 and 6 present the main results for the forward linkages. These results were calculated based on equation (14). The vector $x^R - \overline{x}^R$ measures the dependence of region 1 upon the regions in R (rest of Brazil) with regard to the sale of its output. On the other hand, vector $x^1 - \overline{x}^1$ represents the forward dependence of the regions in R upon region 1 (hypothetically isolated). The value of *FL* is obtained summing all off-diagonal elements in each column. IF_f represents the forward dependence of the rest of Brazil upon region 1, which means forward interstate feedbacks.

North:

The results presented at Table A3.1 show that there is a small impact within the region when one of the seven states (AC, AP, AM, PA, RO, RR and TO) is isolated. The results present some similarity with regard to the backward results. For every state situated at region North, we can see that the forward dependence of the isolated region upon the rest of the economy is bigger than the forward dependence of the rest upon the isolated region ($FL>IF_f$). In other words, the states at North face a high degree of dependence on the other states as markets for the sale of their products. That dependence can be better understood when we make the analysis taking into consideration the size of the economy. As we can see on the lower part of Table A4.1 AC, RO, RR and TO present the highest values.

Northeast:

It is better to divide the analysis of this region into two groups. First, we will examine the states of BA, CE and PE, which are the most important states within the region, and second we will examine the other states. Table A3.1 shows that when BA, CE and PE are isolated, the highest impact within the region occurs at BA, CE and PE. Despite the degree of this impact, we can also see that the impacts on Bahia, for instance, are smaller than the impacts on the states located at South and Southeast. For example, when Ceará is isolated the impact at São Paulo is R$ 1702855 and the impact at Bahia is R$ 210469.

For the other states, we can emphasize the importance of BA, CE and PE as a market for their products. But we can also highlight the importance of São Paulo and Minas Gerais as a market for the products from AL, MA, PB, PI, RN and SE.

For every state within the Northeast region $FL>IF_f$, which means that there is a high degree of dependence on the other states as a market for the sale of their products. In relative terms, we can observe in Table A4.1 that AL, RN, BA, MA and PB present the highest values.

Southeast:

The lower part of Table A3.2 shows that for every state, except São Paulo, $FL>IF_f$. The result for São Paulo shows that the rest of the economy has a high degree of forward dependence upon the São Paulo state, which means that the rest of the economy has a high degree of dependence on SP as a market for the sale of their products. But, when we implement the analysis in relative terms, we can verify that the "Mineira and Fluminense" dependence is really low (Table A4.2). Hence, we can also consider these economies as an important market for the sales of the other states.

South:

$FL>IF_f$ for every state located in the South region. We can also verify that, in relative terms, the region presents a low degree of dependence on the other states as a market for the sale of their products.

Center-west:

This region shows an interesting result for MT and DF. These states present the highest values of *FL* (in relative terms). They are 37,81 and 27,97 respectively, which means that both states have a high degree of dependence upon the other states as a market for the sale of their products.

Table 5 presents the results for net forward dependencies. We can observe that there are some small differences in the sequence of states. As we can observe for net forward dependence, every state, except Espirito Santo, depends on Sao Paulo. The most independent states are Rio de Janeiro, Santa Catarina and Minas Gerais.

Table 6 presents the decomposition of forward linkages. We can observe that the first order effect is more than 80% for every state.

Table 5. Net Forward Dependencies

	SP	RJ	SC	MG	ES	RS	AM	PR	GO	SE	MT	MS	BA	CE	PE	PB	TO	AC	RO	PI	RN	AL	PA	RR	MA	AP	DF
SP	0	287305	331090	167867	0	1136729	1103093	1814257	1196315	306390	2070349	1507784	3744560	1596612	1775315	536345	161968	162023	375187	256517	599773	624981	1400034	109185	815407	101310	6156435
RJ	0	0	58908	19375	42841	50078	72076	59392	117908	38545	129208	72192	924419	195760	213546	56038	14049	10537	33222	29340	89798	78428	119604	11477	104994	9926	779134
SC	0	0	0	609	6868	110849	103568	6444	77602	34593	222997	93344	342168	136179	146178	41907	16151	13480	34983	26098	54255	33009	101762	15065	53989	15531	348773
MG	0	0	0	0	267971	69149	32112	135197	418098	71842	413680	179198	1135672	307516	416416	101930	106993	61340	61498	66168	159485	149146	380993	26581	240130	24866	1711383
ES	183151	0	0	0	0	23460	15362	73064	34889	21269	52130	39619	273564	78198	72642	26280	4410	2990	9005	12170	39316	119764	51501	2302	31103	4485	252161
RS	0	0	0	0	0	0	41909	21152	96049	41251	248286	134116	474884	230583	174829	65605	22770	26070	44599	26848	65809	63519	150555	19263	91739	12672	432385
AM	0	0	0	0	0	0	0	41159	16584	6515	103050	23192	201985	99584	52685	15796	1075	1186	3618	2881	6822	8075	29639	757	5879	565	30097
PR	0	0	0	0	0	0	0	0	144121	44979	896665	309713	339126	121564	167429	47164	18834	23189	112999	22971	107341	54694	146048	29134	70758	8449	584591
GO	0	0	0	0	0	0	0	0	0	6352	0	21654	99403	25728	29023	9847	108309	11658	16554	9279	19168	7821	93206	3114	47716	6322	762640
SE	0	0	0	0	0	0	0	0	0	0	1349	298	3823	10332	0	0	564	199	391	4604	3002	34654	6101	187	7936	1017	8082
BA	0	0	0	0	0	0	0	0	0	0	0	0	0	40371	26185	4140	994	0	0	17571	6651	18056	9466	4453	7451	2606	45045
CE	0	0	0	0	0	0	0	0	0	0	0	760	0	0	0	9101	0	2213	3900	93079	176119	6347	35205	1930	82418	7885	35832
PE	0	0	0	0	0	0	0	0	0	60754	0	0	0	153508	0	250890	0	4917	3950	29502	246094	287772	56984	0	69301	4745	93689
MT	0	0	0	0	0	0	0	0	122508	0	0	0	13340	6565	6352	2620	3063	18962	55037	258	0	1142	15104	3051	1924	1299	74771
MS	0	0	0	0	0	0	0	0	0	0	32958	0	6491	0	4320	0	341	5445	9762	394	0	994	6336	811	1607	806	34992
PB	0	0	0	0	0	0	0	0	0	6949	0	948	0	0	0	0	0	1132	1078	6380	65444	72684	10265	433	11484	1167	13925
TO	0	0	0	0	0	0	0	0	0	0	0	0	0	13915	8099	1906	0	0	0	223	432	353	20485	5	321	15	41
AC	0	0	0	0	0	0	0	0	0	0	0	0	744	0	0	0	16	0	0	0	0	73	251	6	25	5	375
RO	0	0	0	0	0	0	0	0	0	0	0	0	2207	0	0	0	22	77	0	10	0	0	2325	43	63	19	1311
PI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	15430	6	178	31	408
RN	0	0	0	0	0	0	0	0	0	0	3509	2135	0	0	0	0	0	27	50	0	0	0	0	1	141	74	1646
AL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66	3352	1551	0	0	9	14583	746	1856
PA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9103	177	0	15	16222	75	21270
RR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1660	0	0	0	0	0	0	0	0	0	0	0	76
MA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	509
AP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41
DF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Based on the regional extraction method

Table 6. Decomposition of Forward Linkages

	Forward Linkages	*First Order Effect*		*Induced Effect*	
		Abs	*(%)*	*Abs*	*(%)*
AC	3491	3193	91.46	272	7.79
AP	1959	1819	92.86	169	8.61
AM	29870	28422	95.15	1437	4.81
PA	28118	26030	92.57	1939	6.89
RO	8381	7411	88.43	696	8.31
RR	2180	2019	92.61	136	6.25
TO	4572	4165	91.10	331	7.24
AL	19219	16637	86.57	2214	11.52
BA	88495	80568	91.04	5653	6.39
CE	36693	33061	90.10	2835	7.73
MA	17520	15942	90.99	1345	7.68
PB	15315	13447	87.80	1625	10.61
PE	39996	35601	89.01	3776	9.44
PI	7072	6227	88.04	644	9.11
RN	18648	16451	88.22	1856	9.95
SE	10223	9111	89.12	1229	12.02
ES	14496	13501	93.13	859	5.93
MG	43065	39838	92.51	2461	5.72
RJ	30459	28926	94.97	1072	3.52
SP	99649	92426	92.75	5057	5.07
PR	53946	49287	91.36	3354	6.22
SC	25464	23989	94.21	2063	8.10
RS	37596	35674	94.89	2827	7.52
DF	104367	98810	94.68	4764	4.56
GO	29141	25448	87.33	2188	7.51
MT	48750	44788	91.87	3268	6.70
MS	27333	25365	92.80	1419	5.19

Source: Based on the regional extraction method

4. Conclusions

The motivation of this paper was to explore the relationship among the Brazilian regions. As we saw, there are a great number of methodologies that can analyze the interdependencies between sectors and regions. In this paper, such analysis was carried out by means of the hypothetical extraction method. The results of the methodology applied for 1996 Brazilian interregional input-output table enables us to conclude that there is a huge concentration in the Brazilian regional development. Based on the analysis of the backward and forward effects we can point the importance of São Paulo state in the national context, in other words we can see that the majority of Brazilian states have a strong relationship with São Paulo state.

The methodology enables us to construct a hierarchy, in terms of backward and forward dependence, of the Brazilian states. As we can see the states with the higher degree of independence are located at the Southeast and South of Brazil.

The result enables us to compare the degree of dependence among the states within the macro region. In this respect, we can observe that both in terms of backward and in terms of forward linkages the South and Southeast presents a high degree of dependence within the region. On the other hand, the states located at North, Northeast and Center-west presents a low degree of dependence within the macro region. Based on these results we could affirm that an increase in final demand in the North and Northeast would induce effects in a higher degree at Southeast region than within the region. This kind of result is very important for the policymaker if they want to implement policies designed to reduce disparities across regions.

A further step in the study of interactions among the Brazilian states can be realized through the implementation of the methodology also in the sectoral level. Hence, we will measure the linkages among the states and sectors.

References

Carvalho, A and Parente, A (1999). Impactos comerciais da área de livre comércio das Américas. Texto para discussão, 653. Brasília, IPEA.

Cella, G (1984). The input-output measurement of interindustry linkages. *Oxford Bulletin of Economics and Statistics*, 46(1) 73-84.

Clements, B. J (1990). On the decomposition and normalization of interindustry linkages. *Economic Letters*, 33(4) 337-340.

Chenery, H. B and Watanabe, T (1958). International comparisons of the structure of production. *Econometrica,* (26), 487-521

Dietzenbacher, E, Van der Linden, J.A, Steenge, A. E (1993). The regional extraction method: EC Input-output comparisons. *Economic Systems Research*, 5(2) 185-207.

Dietzenbacher, E and Van der Linden, J. A (1997). Sectoral and spatial linkages in the EC production structure. *Journal of Regional Science*, 37(2) 235-247.

Domingues, E. P (2002).**Dimensão regional e setorial da integração brasileira na área de livre comércio das Américas.** Tese de Doutorado apresentada ao IPE/USP.

Fundação Getúlio Vargas (1999). Estudo sobre linhas estruturais da posição brasileira nos principais setores produtivos de interesse do Brasil, no âmbito das negociações do Mercosul com a União Européia (Estudo A). IBRE. Relatório de pesquisa para MDIC.

Haddad, E. A, Azzoni, C.R, Domingues, E.P and Perobelli, F. S (2002). Macroeconomia dos estados e matriz interestadual de insumo-produto. *Revista Economia Aplicada,* 6(4) out/dez.

Haddad, E.A and Perobelli, F.S (2002). Integração regional e padrão de comércio dos estados brasileiros. In: Anita Kon (org). **Unidade e Fragmentação: a questão regional no Brasil.** São Paulo. Ed Perspectiva. P 221-246.

Haddad, E. A, Domingues, E.P and Perobelli, F. S (2002). Regional effects of economic integration: the case of Brazil. *Journal of Policy Modeling* 24 p 453-482.

Haddad, E. A (1999). **Regional inequality and structural changes. Lessons from the Brazilian experience.** Ashgate.

Hirschman, A.O (1958). **The strategy of economic development.** New Haven, Conn: Yale University Press.

IBGE (1999). Contas regionais do Brasil. 1985-1997. Rio de Janeiro: Fundação IBGE.

Krugman, P and Elizondo, R.L (1996). Trade policy and the Third World metropolis. *Journal of Development Economics.* 49. 137-150.

Miller, R. E and Blair, P. D (1985). **Input-output analysis: Foundations and extensions.** Prentice Hall, Englewood Cliffs.

Rasmussen, P. N (1958). Studies in intersectoral relations. Amsterdan: North Holland.

Sonis, M, Guilhoto, J. J. M, Hewings, G.J.D and Martins, E. B (1995). Linkages, Key sectors, and structural change: some new perspectives. *The Developing Economics* 33(3) 233-270.

Sonis, M and Hewings, G. J.D (1994). Fields of influence in input-output systems. Discussion paper Regional Economics Applications Laboratory, University of Illinois.

Sonis, M, Hewings, G.J.D and Lee, J.K (1994). Interpreting spatial economic structure and spatial multipliers: three perspectives. *Geographical Analysis* 26(2). 124 – 151.

Van der Linden, J. A (1998). **Interdependence and specialization in the European Union: intercountry input-output analysis and economic integration.** PhD dissertation. University of Groningen. Netherlands.

Venables (1996). Equilibrium Locations of Vertically Linked Industries. *International Economic Review* 37(2). 341-359.

APPENDIX

Table A1.1 Backward Linkages - Absolute effect (in R$ 1.000.000)

State	*Isolated State*															
Affected	*AC*	*AP*	*AM*	*PA*	*RO*	*RR*	*TO*	*AL*	*BA*	*CE*	*MA*	*PB*	*PE*	*PI*	*RN*	*SE*
AC	40317	12	132	410	86	12	37	343	3309	259	106	165	1334	35	81	75
AP	5	13661	43	198	10	3	6	104	1294	946	40	125	1544	21	51	104
AM	1072	615	1877174	29672	3371	537	862	28092	218137	132220	5855	22557	116589	2966	6499	10651
PA	154	291	1694	507089	488	76	7512	17496	59405	55855	93642	14036	31667	39801	14966	5227
RO	174	36	846	3065	152253	55	76	413	4473	1104	296	270	1105	95	224	326
RR	7	4	48	69	17	14312	6	111	1565	212	41	114	3370	18	64	41
TO	25	25	143	27933	54	11	87690	764	6152	18494	462	2562	10705	303	524	363
AL	245	980	24659	16976	398	115	348	609821	225815	37033	24147	28227	147630	5769	9866	50517
BA	3073	5256	59323	86656	2320	6657	7973	317880	2786396	258534	69144	108980	644652	60303	110398	258485
CE	2441	10650	40933	99555	4634	1940	5051	48679	178041	1584635	157341	116204	222803	176934	298288	25261
MA	75	76	562	78331	201	39	118	8021	47570	57633	292004	11491	28265	955	1674	1665
PB	1055	1287	5791	20773	1014	404	423	92451	64469	81023	20435	621990	193695	7685	90234	12112
PE	6057	7302	65351	91921	4579	1814	1533	481664	452528	361576	107703	523572	2721154	55347	313044	104796
PI	27	49	248	46479	60	18	57	1701	23221	54433	930	1716	18100	161145	1211	340
RN	124	169	1063	8008	287	78	146	10805	105062	139198	2266	53698	81249	1868	489737	7847
SE	279	1439	5868	12346	667	213	913	101663	242686	37621	11653	8479	43137	6026	10373	611106
ES	3905	6338	34861	66794	11441	2387	4903	161806	407946	105762	43488	39347	116440	16285	48775	30066
MG	106417	43202	153647	573995	87341	36116	147273	250697	1813559	507451	407027	189609	773592	110679	236989	117509
RJ	12876	15729	181151	179510	41284	13887	16727	124620	1267257	282433	151969	87350	349871	42204	115469	59033
SP	230904	178805	3822507	2190094	543397	144670	222084	1097480	6416475	2629924	1392209	929678	3433036	437831	943198	507414
PR	36529	15804	103712	267554	214706	41788	26947	106665	623111	239433	129419	96098	338769	42705	177732	185118
SC	21776	25705	186654	151549	53040	18989	21000	77710	520940	231902	92399	80959	260732	42281	83535	53311
RS	34330	27068	164888	210575	60156	22995	28553	99546	681889	349621	153932	105391	296123	43425	89636	61457
DF	158	89	746	9227	276	65	578	1898	24180	5280	821	1184	5724	280	569	1020
GO	16830	10025	27343	138444	24347	3834	139249	15237	168040	61354	74361	20167	60488	14236	29986	17253
MT	25052	1705	134040	21361	106593	3534	5442	4432	36876	23502	15326	6800	17724	3062	5963	2889
MS	8611	1388	25570	10019	17410	1398	1022	2275	19342	8838	2937	2389	11034	1138	2539	1621
BL	512202	354049	5041823	4341512	1178178	301634	638837	3052553	13613343	5681642	2957946	2451166	7209378	1112252	2591889	1514499
Ifb	40317	13661	1877174	507089	152253	14312	87690	609821	2786396	1584635	292004	621990	2721154	161145	489737	611106
TO	552519	367711	6918997	4848601	1330431	315945	726527	3662373	16399739	7266277	3249950	3073156	9930532	1273397	3081626	2125605

Note: BL – Backward Linkages – Sum of the off-diagonal elements in each column

IFb – Backward Interstate feedbacks (the diagonal element in each column). Represents the backward dependence of the rest of Brazilian economy (a buying region) upon the isolated state (a selling region) TO – Total Effect – BL +IFb – only for the absolute figures)

Source: Based on the regional extraction method

Table A1.2 Backward Linkages, 1996 (Absolute Effects - R$1.000.000)

State	Isolated Sate										
Affected	ES	MG	RJ	SP	PR	SC	RS	DF	GO	MT	MS
AC	624	17471	505	4328	1805	2935	1495	529	1581	5591	1760857
AP	50	714	963	2885	496	179	4614	120	197	107	65
AM	13104	57678	64417	915227	95809	23746	60754	24972	27395	178972	13346
PA	4012	19051	23406	72124	26241	6088	7319	29305	10017	4257	1963
RO	2408	5766	3767	23980	39588	7475	5759	1591	3638	58278	2178
RR	82	1428	1644	2886	1107	827	954	138	151	622	81
TO	244	6028	1009	6169	672	454	987	718	7139	2494	319
AL	1657	4785	11900	33272	7102	15592	3296	3794	2223	2556	3110
BA	106715	116534	78612	444049	67619	33994	36445	79144	28485	24285	38901
CE	9129	29482	23983	91918	27543	23876	21548	41606	17468	14810	30816
MA	2100	11326	3493	24782	4065	5038	10988	1416	2676	11246	958
PB	3245	13342	5458	20202	7153	7791	4253	13334	2955	2563	13276
PE	11933	27263	18826	126926	14887	9444	10739	100932	8406	7730	76525
PI	358	2932	1303	10974	1727	1222	2282	601	509	1904	343
RN	4090	10964	6121	54955	12483	7482	4108	2598	4217	10068	1547
SE	4121	13812	5606	32211	91354	4065	4307	9976	6460	4094	3532
ES	2862620	374379	212199	703342	156918	36729	66258	295350	50910	77905	49105
MG	1045155	14553247	832433	3094694	567360	181059	288688	2490214	756801	638675	1349375
RJ	356490	778898	7017777	1390526	311161	239615	247169	942821	156275	168236	162712
SP	1101397	4577839	2990564	54419510	4705099	1306697	2479815	8811437	1864914	3126330	2910151
PR	115490	421245	291977	1410852	9097558	851092	556905	890555	307866	1733560	456932
SC	73263	233209	205234	736516	1008839	5419483	615060	477443	114634	357214	274170
RS	75691	295571	252063	1101255	739604	527443	6082887	553310	138694	344874	433433
DF	4105	69996	8964	56011	6907	2294	2935	258093	66945	6783	1996
GO	23789	223214	37429	248084	97191	16716	23767	1090781	2836752	371226	212985
MT	23612	56945	19526	175259	285031	47666	24876	87444	381698	1497527	314216
MS	7627	26000	25814	199648	204268	24349	17810	49789	26890	187573	1514368
BL	2990489	7395871	5127214	10983077	8482032	3383868	4503133	15999921	3989145	7341953	8112892
Ifb	2862620	14553247	7017777	54419510	9097558	5419483	6082887	258093	2836752	1497527	1514368
TO	5853109	21949118	12144991	65402588	17579589	8803352	10586020	16258013	6825897	8839481	9627261

Note: BL – Backward Linkages – Sum of the off-diagonal elements in each column
IFb – Backward Interstate feedbacks (the diagonal element in each column). Represents the backward dependence of the rest o (a buying region) upon the isolated state (a selling region) TO – Total Effect – BL +IFb – only for the absolute figures)
Source: Based on the regional extraction method

Table A 2.1 Backward Linkages - Relative effect (%)

State	Isolated State															
Affected	*AC*	*AP*	*AM*	*PA*	*RO*	*RR*	*TO*	*AL*	*BA*	*CE*	*MA*	*PB*	*PE*	*PI*	*RN*	*SE*
AC	0.003	0.001	0.001	0.002	0.002	0.001	0.002	0.004	0.006	0.001	0.001	0.002	0.004	0.001	0.001	0.001
AP	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.001	0.002	0.004	0.000	0.001	0.005	0.000	0.001	0.001
AM	0.063	0.034	0.154	0.002	0.060	0.052	0.037	0.320	0.395	0.529	0.054	0.215	0.362	0.055	0.068	0.149
PA	0.009	0.016	0.007	0.042	0.009	0.007	0.322	0.199	0.107	0.224	0.871	0.133	0.098	0.736	0.155	0.073
RO	0.010	0.002	0.003	0.015	0.012	0.005	0.003	0.005	0.008	0.004	0.003	0.003	0.003	0.002	0.002	0.005
RR	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.003	0.001	0.000	0.001	0.010	0.000	0.001	0.001
TO	0.001	0.001	0.001	0.137	0.001	0.001	0.007	0.009	0.011	0.074	0.004	0.024	0.033	0.006	0.005	0.005
AL	0.014	0.054	0.099	0.083	0.007	0.011	0.015	0.049	0.409	0.148	0.225	0.269	0.459	0.107	0.102	0.707
BA	0.182	0.291	0.239	0.424	0.041	0.650	0.341	3.614	0.232	1.035	0.643	1.037	2.003	1.115	1.147	3.617
CE	0.144	0.590	0.165	0.486	0.082	0.189	0.216	0.552	0.322	0.130	1.463	1.104	0.691	3.269	3.098	0.352
MA	0.004	0.004	0.002	0.383	0.004	0.004	0.005	0.091	0.086	0.231	0.024	0.109	0.088	0.018	0.017	0.023
PB	0.062	0.071	0.023	0.102	0.018	0.039	0.018	1.051	0.117	0.324	0.190	0.050	0.602	0.142	0.938	0.169
PE	0.358	0.405	0.263	0.449	0.081	0.177	0.066	5.470	0.818	1.447	1.001	4.981	0.223	1.023	3.252	1.463
PI	0.002	0.003	0.001	0.227	0.001	0.002	0.002	0.019	0.042	0.218	0.009	0.016	0.056	0.013	0.013	0.005
RN	0.007	0.009	0.004	0.039	0.005	0.008	0.006	0.123	0.190	0.557	0.021	0.511	0.252	0.034	0.040	0.110
SE	0.017	0.080	0.024	0.060	0.012	0.021	0.039	1.159	0.440	0.151	0.108	0.081	0.134	0.111	0.108	0.050
ES	0.231	0.351	0.140	0.327	0.203	0.233	0.210	1.840	0.738	0.423	0.404	0.374	0.362	0.301	0.507	0.420
MG	6.290	2.396	0.615	2.806	1.546	3.528	6.304	2.851	3.284	2.031	3.785	1.804	2.405	2.045	2.463	1.639
RJ	0.760	0.872	0.731	0.877	0.730	1.356	0.716	1.413	2.291	1.130	1.413	0.830	1.085	0.779	1.199	0.820
SP	13.639	9.913	15.417	10.704	9.616	14.134	9.502	12.461	11.607	10.522	12.943	8.839	10.660	8.088	9.799	7.061
PR	2.159	0.876	0.417	1.308	3.801	4.083	1.153	1.212	1.128	0.958	1.203	0.914	1.053	0.789	1.848	2.585
SC	1.288	1.425	0.751	0.741	0.939	1.855	0.899	0.884	0.943	0.928	0.859	0.771	0.811	0.782	0.868	0.745
RS	2.029	1.501	0.664	1.029	1.065	2.247	1.223	1.131	1.234	1.399	1.431	1.003	0.920	0.802	0.931	0.858
DF	0.009	0.005	0.003	0.045	0.005	0.006	0.025	0.021	0.044	0.021	0.008	0.011	0.018	0.005	0.006	0.014
GO	0.994	0.556	0.110	0.677	0.431	0.374	5.964	0.173	0.304	0.245	0.691	0.192	0.188	0.263	0.311	0.241
MT	1.481	0.095	0.538	0.104	1.887	0.345	0.233	0.050	0.067	0.094	0.143	0.065	0.055	0.057	0.062	0.040
MS	0.510	0.077	0.103	0.049	0.308	0.137	0.044	0.026	0.035	0.035	0.027	0.023	0.034	0.021	0.026	0.023
BL	30.265	19.629	20.321	21.077	20.853	29.468	27.343	34.680	24.632	22.735	27.502	23.312	22.392	20.550	26.930	21.126
Ifb	0.003	0.001	0.154	0.042	0.012	0.001	0.007	0.049	0.232	0.130	0.024	0.050	0.223	0.013	0.040	0.050

Note: BL – Backward Linkages – Sum of the off-diagonal elements in each column

IFb – Backward Interstate feedbacks (the diagonal element in each column. Represents the backward dependence of the rest of Brazilian economy upon the isolated s
upon the rest of Brazilian economy

Source: Based on the regional extraction method

Table A 2.2 Backward Linkages - Relative effect (%)

State	Isolated State										
Affected	ES	MG	RJ	SP	PR	SC	RS	DF	GO	MT	MS
AC	0.002	0.013	0.000	0.001	0.002	0.005	0.001	0.001	0.006	0.033	0.011
AP	0.000	0.001	0.001	0.001	0.001	0.000	0.005	0.000	0.001	0.001	0.001
AM	0.053	0.043	0.050	0.180	0.111	0.044	0.060	0.059	0.100	1.072	0.254
PA	0.016	0.014	0.018	0.014	0.030	0.011	0.007	0.069	0.036	0.025	0.010
RO	0.010	0.004	0.003	0.005	0.046	0.014	0.006	0.004	0.013	0.349	0.037
RR	0.000	0.001	0.001	0.001	0.001	0.002	0.001	0.000	0.001	0.004	0.002
TO	0.001	0.004	0.001	0.001	0.001	0.001	0.001	0.002	0.026	0.015	0.003
AL	0.007	0.004	0.009	0.007	0.008	0.029	0.003	0.009	0.008	0.015	0.005
BA	0.429	0.086	0.061	0.088	0.078	0.063	0.036	0.187	0.104	0.145	0.069
CE	0.037	0.022	0.019	0.018	0.032	0.044	0.021	0.098	0.063	0.089	0.048
MA	0.008	0.008	0.003	0.005	0.005	0.009	0.011	0.003	0.010	0.067	0.004
PB	0.013	0.010	0.004	0.004	0.008	0.014	0.004	0.032	0.011	0.015	0.015
PE	0.048	0.020	0.015	0.025	0.017	0.017	0.011	0.239	0.031	0.046	0.021
PI	0.001	0.002	0.001	0.002	0.002	0.002	0.002	0.001	0.002	0.011	0.003
RN	0.016	0.008	0.005	0.011	0.014	0.014	0.004	0.006	0.015	0.060	0.031
SE	0.017	0.010	0.004	0.006	0.106	0.008	0.004	0.024	0.024	0.024	0.011
ES	0.236	0.276	0.165	0.139	0.181	0.068	0.065	0.699	0.185	0.466	0.326
MG	4.208	1.305	0.645	0.610	0.655	0.334	0.285	5.893	2.753	3.820	1.798
RJ	1.430	0.573	0.630	0.274	0.358	0.442	0.243	2.232	0.568	1.006	0.683
SP	4.425	3.370	2.320	6.874	5.422	2.411	2.440	20.859	6.780	18.696	15.488
PR	0.465	0.310	0.227	0.278	0.780	1.573	0.548	2.108	1.120	10.368	4.622
SC	0.295	0.172	0.159	0.145	1.165	0.456	0.607	1.130	0.417	2.137	1.024
RS	0.304	0.218	0.195	0.217	0.853	0.975	0.533	1.310	0.504	2.063	1.249
DF	0.016	0.051	0.007	0.011	0.008	0.004	0.003	0.021	0.243	0.041	0.034
GO	0.096	0.164	0.029	0.049	0.112	0.031	0.023	2.582	0.233	2.221	0.368
MT	0.095	0.042	0.015	0.035	0.329	0.088	0.024	0.207	1.388	0.122	0.810
MS	0.031	0.019	0.020	0.039	0.236	0.045	0.018	0.118	0.098	1.123	0.065
BL	12.024	5.444	3.977	2.164	9.779	6.249	4.434	37.874	14.505	43.916	26.927
Ifb	0.236	1.305	0.630	6.874	0.780	0.456	0.533	0.021	0.233	0.122	0.065

Note: BL – Backward Linkages – Sum of the off-diagonal elements in each column

IFb – Backward Interstate feedbacks (the diagonal element in each column). Represents the backward dependence of the rest of Brazilian economy upon the isolated state

Source: Based on the regional extraction method

Table A 3.1 Forward Linkages, 1996 (Absollute Effects - R$1.000.000)

State	*Isolated State*															
Affected	*AC*	*AP*	*AM*	*PA*	*RO*	*RR*	*TO*	*AL*	*BA*	*CE*	*MA*	*PB*	*PE*	*PI*	*RN*	*SE*
AC	357916	11	112	414	101	14	43	326	3560	259	97	152	1184	33	85	68
AP	5	203879	35	183	11	4	6	87	1236	865	34	104	1209	18	49	91
AM	1298	600	3194592	31023	4336	799	1191	27494	250057	132710	6297	21472	105366	3119	7601	11459
PA	163	257	1384	2919739	564	91	8825	16585	63226	56745	88406	13036	27868	38579	15895	4956
RO	178	30	718	2889	831300	65	86	371	4511	1062	271	238	922	89	230	284
RR	8	4	43	75	23	226331	8	123	2209	264	43	122	3677	20	79	39
TO	27	22	116	29309	63	13	466950	736	6570	19279	445	2452	9726	300	575	358
AL	253	833	19419	16408	436	132	383	1868366	223953	35068	21366	24871	122087	5229	9885	48589
BA	2816	3842	48072	72692	2304	6663	7565	242009	9069306	210469	52650	82665	455639	47069	97125	218664
CE	2472	8750	33126	91950	4962	2194	5364	41415	170098	3718250	134784	98166	176300	155603	291188	21856
MA	72	60	417	72183	208	43	124	6784	45199	52366	1787705	9650	22260	828	1607	1461
PB	1284	1271	5675	23301	1316	556	546	97555	78525	89065	21134	1511725	191674	8206	106957	13851
PE	6102	5955	52681	84851	4873	2018	1627	409860	429454	329808	91561	442564	4020823	48267	304348	93669
PI	33	49	238	54009	79	26	77	1877	29499	62524	1006	1827	18765	698581	1499	394
RN	113	123	779	6793	280	81	143	8334	90474	115069	1747	41512	58254	1470	1846505	6707
SE	268	1108	4944	11057	675	227	922	83243	222487	32188	9397	6902	32916	4998	9709	1022473
ES	3468	4520	26797	54616	10737	2369	4597	120972	343076	84501	32583	29299	81046	12508	42009	24317
MG	78296	25482	98758	399109	66629	28259	112720	153494	1228543	332565	249935	117566	439959	69693	168314	84338
RJ	10996	10773	140024	139396	36798	13088	14885	87847	988680	216439	107680	61274	229297	30566	94500	43024
SP	167247	104683	2459351	1478395	407423	112455	168423	658500	4247505	1702855	839887	561183	1916458	269405	656664	340663
PR	25100	8920	66222	173355	151537	30634	19534	61655	397165	147564	74564	55641	181455	25075	118065	127712
SC	16645	15702	131977	108021	42085	15782	16653	49898	374731	158702	59029	51946	155376	27675	61670	39170
RS	27872	17564	118941	158933	50718	20156	24032	67435	513274	253233	103978	71606	186589	30149	70302	46501
DF	165	75	658	9313	324	79	691	1769	25525	5484	755	1082	4964	264	590	889
GO	13603	6538	17507	105416	20696	3356	117166	10303	127108	45017	50594	13743	38169	9975	23278	12856
MT	25364	1408	99859	19819	116460	3959	5925	3791	35872	21696	13270	5782	14167	2699	5756	2579
MS	7458	967	20143	8100	15737	1332	943	1731	16485	6944	2200	1778	7659	871	2172	1361
FL	391307	219547	3347994	3151612	939374	244394	512478	2154190	9919023	4112740	1963713	1716635	4482989	792709	2090151	1145858
IFf	357916	203879	3194592	2919739	831300	226331	466950	1868366	9069306	3718250	1787705	1511725	4020823	698581	1846505	1022473
TO	749223	423426	6542586	6071351	1770674	470725	979428	4022557	18988329	7830990	3751417	3228360	8503812	1491291	3936656	2168330

Note: FL – Forward Linkages – Sum of the off-diagonal elements in each column - IFf – Forward Interstate feedbacks (the diagonal element in each column)
TO – FL + IFf (only for the absolute values)
Source: Based on the regional extraction meth

Table A3.2 Forward Linkages, 1996 (Absolute Effects - R$1.000.000)

State	*Isolated Effect*										
Affected	*ES*	*MG*	*RJ*	*SP*	*PR*	*SC*	*RS*	*DF*	*GO*	*MT*	*MS*
AC	478	16956	459	5223	1911	3164	1802	540	1945	6402	2014
AP	35	616	847	3373	471	171	4892	116	216	109	161
AM	11435	66646	67948	1356257	107381	28409	77032	30754	34091	202909	43335
PA	3115	18116	19792	78361	27307	6259	8378	30583	12210	4715	1764
RO	1732	5131	3576	32236	38538	7102	6119	1635	4142	61423	5975
RR	67	1678	1611	3269	1500	717	894	156	242	908	520
TO	187	5727	837	6456	701	503	1262	731	8858	2862	602
AL	1208	4348	9418	33519	6961	16888	3916	3625	2482	2649	737
BA	69513	92871	64261	502945	58039	32563	38390	70570	27705	22532	9995
CE	6302	25049	20679	106243	26000	22523	22650	41315	19288	15131	7703
MA	1479	9804	2686	24481	3805	5040	12239	1264	2878	11346	593
PB	3019	15636	5237	24838	8478	10039	6001	15006	3896	3163	2726
PE	8404	23542	15751	141143	14027	9198	11761	98653	9146	7815	3339
PI	339	3525	1227	12887	2104	1577	3301	672	696	2441	477
RN	2692	8829	4702	56891	10724	7415	4493	2236	4111	9266	4307
SE	3048	12496	4480	34273	82733	4577	5250	8971	6504	3928	1659
ES	1517450	291851	164051	745983	131363	34037	67575	255071	48394	69582	44634
MG	559822	4520692	520788	2607835	387611	158707	276967	1773449	572661	464651	200296
RJ	206892	540162	3259024	1647265	243200	198269	231722	787429	141949	143809	91472
SP	562832	2775702	1934571	10818750	3106225	1035737	2237715	6225752	1403794	2237892	1711495
PR	58298	252414	183808	1291968	5594987	707340	532644	591723	217230	1169945	476060
SC	40906	159316	139361	704646	713783	2701706	585254	350854	91657	271419	118279
RS	44115	207819	181644	1100986	553796	474405	4018826	435481	117898	277080	154103
DF	2910	62066	8296	69317	7132	2081	3096	11078551	84957	7782	6277
GO	13505	154563	24041	207480	73108	14055	21850	847597	2868079	302451	46067
MT	17452	50971	14601	167543	273280	48422	28794	82553	424959	5030911	129022
MS	5016	21098	19279	203711	166347	24934	19986	41270	24413	161980	2846213
FL	1624801	4826933	3413948	11169129	6046525	2854133	4213984	11698007	3266322	5464191	3063612
IFf	1517450	4520692	3259024	10818750	5594987	2701706	4018826	11078551	2868079	5030911	2846213
TO	3142252	9347626	6672972	21987879	11641512	5555839	8232810	22776558	6134401	10495102	5909825

Note: FL – Forward Linkages – Sum of the off-diagonal elements in each column - IFf – Forward Interstate feedbacks (the diagonal element in each column). TO – FL + IFf (only for the absolute values)

Source: Based on the regional extraction meth

Table A4.1 Forward Linkages (Relative Effect - %)

State	Isolated State														
Affected	*AC*	*AP*	*AM*	*PA*	*RO*	*RR*	*TO*	*AL*	*BA*	*CE*	*MA*	*PB*	*PE*	*PI*	*RN*
AC	0.0291	0.0006	0.0005	0.0021	0.0019	0.0015	0.0020	0.0041	0.0068	0.0011	0.0009	0.0016	0.0041	0.0006	0.0010
AP	0.0003	0.017	0.0000	0.0009	0.0002	0.0004	0.0003	0.0011	0.0024	0.0038	0.0003	0.0011	0.0042	0.0004	0.0006
AM	0.0806	0.0337	0.264	0.0026	0.0804	0.0807	0.0553	0.3485	0.4806	0.5787	0.0607	0.2284	0.3666	0.0606	0.0851
PA	0.0101	0.0144	0.0063	0.241	0.0105	0.0092	0.4099	0.2102	0.1215	0.2474	0.8526	0.1386	0.0970	0.7499	0.1779
RO	0.0110	0.0017	0.0033	0.0146	0.068	0.0066	0.0040	0.0047	0.0087	0.0046	0.0026	0.0025	0.0032	0.0017	0.0026
RR	0.0005	0.0002	0.0002	0.0004	0.0004	0.018	0.0004	0.0016	0.0042	0.0011	0.0004	0.0013	0.0128	0.0004	0.0009
TO	0.0017	0.0012	0.0005	0.1477	0.0012	0.0013	0.038	0.0093	0.0126	0.0841	0.0043	0.0261	0.0338	0.0058	0.0064
AL	0.0157	0.0467	0.0891	0.0827	0.0081	0.0133	0.0178	0.153	0.4304	0.1529	0.2061	0.2645	0.4247	0.1016	0.1106
BA	0.1747	0.2154	0.2205	0.3663	0.0427	0.6723	0.3514	3.0671	0.769	0.9178	0.5078	0.8792	1.5851	0.9150	1.0870
CE	0.1534	0.4905	0.1520	0.4634	0.0920	0.2214	0.2492	0.5249	0.3269	0.308	1.2999	1.0440	0.6133	3.0248	3.2588
MA	0.0045	0.0034	0.0019	0.3638	0.0039	0.0043	0.0058	0.0860	0.0869	0.2284	0.146	0.1026	0.0774	0.0161	0.0180
PB	0.0797	0.0713	0.0260	0.1174	0.0244	0.0561	0.0254	1.2364	0.1509	0.3884	0.2038	0.124	0.6668	0.1595	1.1970
PE	0.3786	0.3338	0.2417	0.4276	0.0904	0.2036	0.0756	5.1944	0.8254	1.4382	0.8831	4.7068	0.334	0.9383	3.4061
PI	0.0021	0.0027	0.0011	0.2722	0.0015	0.0026	0.0036	0.0238	0.0567	0.2726	0.0097	0.0194	0.0653	0.057	0.0168
RN	0.0070	0.0069	0.0036	0.0342	0.0052	0.0081	0.0066	0.1056	0.1739	0.5018	0.0169	0.4415	0.2027	0.0286	0.151
SE	0.0166	0.0621	0.0227	0.0557	0.0125	0.0229	0.0428	1.0550	0.4276	0.1404	0.0906	0.0734	0.1145	0.0972	0.1087
ES	0.2152	0.2534	0.1229	0.2752	0.1992	0.2390	0.2136	1.5332	0.6594	0.3685	0.3142	0.3116	0.2820	0.2432	0.4701
MG	4.8586	1.4284	0.4530	2.0113	1.2360	2.8513	5.2364	1.9453	2.3611	1.4502	2.4105	1.2504	1.5306	1.3548	1.8837
RJ	0.6824	0.6039	0.6423	0.7025	0.6826	1.3206	0.6915	1.1133	1.9001	0.9438	1.0385	0.6517	0.7977	0.5942	1.0576
SP	10.3783	5.8681	11.2819	7.4504	7.5581	11.3468	7.8241	8.3456	8.1633	7.4256	8.1002	5.9684	6.6672	5.2370	7.3491
PR	1.5576	0.5000	0.3038	0.8736	2.8112	3.0910	0.9075	0.7814	0.7633	0.6435	0.7191	0.5918	0.6313	0.4874	1.3213
SC	1.0329	0.8802	0.6054	0.5444	0.7807	1.5924	0.7736	0.6324	0.7202	0.6920	0.5693	0.5525	0.5405	0.5380	0.6902
RS	1.7296	0.9845	0.5456	0.8009	0.9409	2.0338	1.1164	0.8547	0.9865	1.1043	1.0028	0.7616	0.6491	0.5861	0.7868
DF	0.0102	0.0042	0.0030	0.0469	0.0060	0.0080	0.0321	0.0224	0.0491	0.0239	0.0073	0.0115	0.0173	0.0051	0.0066
GO	0.8441	0.3665	0.0803	0.5312	0.3839	0.3387	5.4430	0.1306	0.2443	0.1963	0.4880	0.1462	0.1328	0.1939	0.2605
MT	1.5739	0.0789	0.4581	0.0999	2.1605	0.3995	0.2753	0.0480	0.0689	0.0946	0.1280	0.0615	0.0493	0.0525	0.0644
MS	0.4628	0.0542	0.0924	0.0408	0.2919	0.1344	0.0438	0.0219	0.0317	0.0303	0.0212	0.0189	0.0266	0.0169	0.0243
FL	24.282	12.307	15.358	15.729	17.426	24.660	23.807	27.302	19.063	17.934	18.939	18.257	15.596	15.410	23.392
IF	0.029	0.017	0.264	0.241	0.068	0.018	0.038	0.153	0.769	0.308	0.146	0.124	0.334	0.057	0.151

Source: Based on the regional extraction method

Table A4.2 Forward Linkages (Relative Effects - %)

State	Isolated State										
Affected	*ES*	*MG*	*RJ*	*SP*	*PR*	*SC*	*RS*	*DF*	*GO*	*MT*	*MS*
AC	0.0022	0.0140	0.0004	0.0012	0.0024	0.0067	0.0019	0.0013	0.0081	0.0443	0.0148
AP	0.0002	0.0005	0.0007	0.0008	0.0006	0.0004	0.0052	0.0003	0.0009	0.0008	0.0012
AM	0.0514	0.0549	0.0563	0.3034	0.1368	0.0598	0.0816	0.0735	0.1416	1.4041	0.3183
PA	0.0140	0.0149	0.0164	0.0175	0.0348	0.0132	0.0089	0.0731	0.0507	0.0326	0.0130
RO	0.0078	0.0042	0.0030	0.0072	0.0491	0.0149	0.0065	0.0039	0.0172	0.4250	0.0439
RR	0.0003	0.0014	0.0013	0.0007	0.0019	0.0015	0.0009	0.0004	0.0010	0.0063	0.0038
TO	0.0008	0.0047	0.0007	0.0014	0.0009	0.0011	0.0013	0.0017	0.0368	0.0198	0.0044
AL	0.0054	0.0036	0.0078	0.0075	0.0089	0.0355	0.0041	0.0087	0.0103	0.0183	0.0054
BA	0.3126	0.0764	0.0532	0.1125	0.0739	0.0685	0.0406	0.1687	0.1151	0.1559	0.0734
CE	0.0283	0.0206	0.0171	0.0238	0.0331	0.0474	0.0240	0.0988	0.0801	0.1047	0.0566
MA	0.0067	0.0081	0.0022	0.0055	0.0048	0.0106	0.0130	0.0030	0.0120	0.0785	0.0044
PB	0.0136	0.0129	0.0043	0.0056	0.0108	0.0211	0.0064	0.0359	0.0162	0.0219	0.0200
PE	0.0378	0.0194	0.0130	0.0316	0.0179	0.0194	0.0125	0.2359	0.0380	0.0541	0.0245
PI	0.0015	0.0029	0.0010	0.0029	0.0027	0.0033	0.0035	0.0016	0.0029	0.0169	0.0035
RN	0.0121	0.0073	0.0039	0.0127	0.0137	0.0156	0.0048	0.0053	0.0171	0.0641	0.0316
SE	0.0137	0.0103	0.0037	0.0077	0.1054	0.0096	0.0056	0.0214	0.0270	0.0272	0.0122
ES	0.126	0.2402	0.1359	0.1669	0.1673	0.0716	0.0715	0.6098	0.2010	0.4815	0.3278
MG	2.5173	0.407	0.4315	0.5834	0.4937	0.3340	0.2932	4.2401	2.3786	3.2154	1.4710
RJ	0.9303	0.4446	0.293	0.3685	0.3098	0.4173	0.2453	1.8827	0.5896	0.9952	0.6718
SP	2.5309	2.2844	1.6028	1.380	3.9564	2.1799	2.3692	14.8851	5.8307	15.4864	12.5698
PR	0.2621	0.2077	0.1523	0.2890	0.485	1.4888	0.5639	1.4148	0.9023	8.0961	3.4963
SC	0.1839	0.1311	0.1155	0.1576	0.9091	0.228	0.6196	0.8389	0.3807	1.8782	0.8687
RS	0.1984	0.1710	0.1505	0.2463	0.7054	0.9985	0.354	1.0412	0.4897	1.9174	1.1318
DF	0.0131	0.0511	0.0069	0.0155	0.0091	0.0044	0.0033	0.931	0.3529	0.0539	0.0461
GO	0.0607	0.1272	0.0199	0.0464	0.0931	0.0296	0.0231	2.0265	0.238	2.0930	0.3383
MT	0.0785	0.0419	0.0121	0.0375	0.3481	0.1019	0.0305	0.1974	1.7651	0.413	0.9476
MS	0.0226	0.0174	0.0160	0.0456	0.2119	0.0525	0.0212	0.0987	0.1014	1.1209	0.234
FL	7.306	3.973	2.828	2.499	7.701	6.007	4.462	27.969	13.567	37.813	22.500
IF	0.126	0.407	0.293	1.380	0.485	0.228	0.354	0.931	0.238	0.413	0.234

Source: Based on the regional extraction method