

IMPACTS OF CHANGES IN REGIONAL SUGAR AND ETHANOL EXPORTS UPON  
BRAZILIAN OVERALL ECONOMY<sup>1</sup>

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#### SUMMARY

This paper estimates the impact of an increase in Brazilian sugar and ethanol demand for exports upon the countries' overall production and employment. The impacts were simulated considering each of the major cane producing areas of the country (Center-South and North-Northeast). An inter-regional input-output matrix for the Brazilian economy was used for that purpose. It was observed that a demand shock, resulting from an expansion of sugar exports presented an impact of greater magnitude upon the countries' production and employment when compared to the impact from an increase in ethanol. In addition, the results indicated that when the impact is generated at the North-Northeastern Brazil, production and employment is more affected than when it begins at the Center-South region of the country. The result of how the economic benefits are disseminated in the economy is important to identify policies and establish targets for regional production.

Keywords: export, sugar, ethanol, Brazil, input output matrix.

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<sup>1</sup> This work is based on the thesis work of the following author: Cinthia Cabral da Costa.

## INTRODUCTION

In the second half of the 90s, Brazil became the world's largest producer and exporter of sugar, and also the major producer of fuel ethanol and cane, obtaining expressive volumes for each of these goods. In this context, the expansion of the international market for sugar, and the consolidation of an international market for ethanol became essential aspects for an balanced evolution of Brazilian cane, sugar and ethanol sector.

However, the international sugar market is subject to high protectionist measures that impose major obstacles for competitive countries that intend to increase its market share in this context.

The evolution of multilateral trade negotiations within the World Trade Organization (WTO) framework is expected to result in lower protectionist barriers imposed upon the sugar market by developed countries. In addition, the signature of the Kyoto Protocol by several countries has created expectations that an international market for ethanol may be consolidated in a near future. These facts represent important opportunities for Brazil since the hegemonic position assumed by the country in these markets is mostly due to the low production costs that have been reached by the cane industry. As countries gain comparative advantage, relative market share and profits tend to increase.

In this context, it has been considered important to evaluate the effects that an increase in external demand for these products may have upon the Brazilian economy, particularly with respect to overall production and employment.

Another aspect approached by this analysis is whether (and how) the shock derived from an increase in export demand for ethanol and/or sugar, is different when initiated at each of the two large cane producing areas of Brazil: the Center-South or the North-Northeast<sup>2</sup>. In principle, it is expected that these impacts will differ among these regions, particularly due to differences in their productive systems, technology, and economic conditions.

This analysis was conducted to obtain estimates of the impacts, upon employment and production, of the expected increases in export demand for sugar and ethanol, resulting from shocks in the international market.

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<sup>2</sup> The Center-South region is defined by aggregating the States of the Center-West, South, and Southeastern Brazil: Minas Gerais, São Paulo, Rio de Janeiro, Espírito Santo, Paraná, Santa Catarina, Rio Grande do Sul, Mato Grosso, Mato Grosso do Sul and Goiás. The North-Northeastern region includes the States of Alagoas, Pernambuco, Sergipe, Paraíba, Maranhão, Piauí, Bahia, Tocantins, Rio Grande do Norte, Pará, Amapá, Rondônia, Roraima and Amazonas.

## **2. METHODOLOGY**

The effects upon production and employment were simulated, considering first a demand shock of R\$1 million resulting from sugar and ethanol exports, respectively, at each of the main cane producing regions (Center-South and North-Northeast). These shocks are then evaluated in terms of the adjustments in aggregate production and employment levels, presenting effects that can be evaluated either at a regional or national level, as described in Miller & Blair (1985). The impact of a shock in regional demand was estimated using an inter-regional input-output matrix, constructed by Guilhoto<sup>3</sup> to express the relations for the Center-South and North-Northeast regional economies. The inter-regional input-output matrix was estimated for the year of 1999.

### **2.1 Simulation of the impact upon production**

The magnitude of an increase in the final demand for sugar and ethanol, respectively, upon the Brazilian production, was calculated through its direct, indirect and “income related” impacts.

The inter-regional analysis considered both the intra-regional (inside a specific region) and the inter-regional (between the two regions) input coefficients. The inter-regional trade flow, however, was considered only in the regional context in order to obtain a more precise analysis of the way changes are transferred within the Brazilian economy.

### **2.2 Employment**

The methodology used in this analysis to evaluate the factors that generate employment is similar to that employed by Najberg & Ikeda (1999). These authors considered that employment could be created in a given economy through three different ways: (i) directly (representing the increment in the number of employees in the sector primarily affected by the shock); (ii) indirectly (representing the employment generated in sectors related to the sugar and ethanol industry, such as the cane sector); and (iii) employment generated by “income effects” (assuming that an aggregate demand increase results in an income increase that allows production increase, particularly for high income elasticity goods, such as the case of some food groups, like yogurt in the Brazilian economy).

The adopted procedure implied in the association of the Leontief inverse matrix of input-output coefficients to the employment coefficients, such that the number of directly, indirectly and income-generated employments resulting from a change in final demand is obtained for each sector of the economy. Since inter-regional matrices were analyzed, the estimated employment and production multipliers captured not only the impact upon the region that was subject to the shock, but also the employment generated at all other related sectors within the regions considered for the analysis.

### **2.3 Input-output matrix**

Contrary to the input-output matrix published by the Instituto Brasileiro de Geografia e Estatística (IBGE), the matrix used in this analysis considers a less aggregated view of the sectors involved (Table 1 of Annex 1). The sectors that suffered the shocks from increased exports were sugar and ethanol production sectors (sectors 14 and 9 of the input-output matrix used).

The sensitivity of the export demand for sugar and ethanol in the Center-South and North-Northeast regions were identified, considering an inter-regional input-output matrix. To verify the effect on the Brazilian market, as a function of the simulated increase in the demand for sugar and ethanol export, direct and indirect impacts were estimated as well as those induced by an increase in family income on the production level and generation of direct, indirect and induced jobs in each of the two export regions (Center-South and North-Northeast).

The inter-regional input-output matrix was estimated for 1999. The inter-regional analysis was developed by means of input coefficients: intra-regional (within a specified region) and inter-regional (between one specified region and another). Thus, inter-regional commerce flow was incorporated in the analysis of each region obtaining a more realistic analysis of the commerce flux existing in the Brazilian economy.

The Leontief inter-regional matrix system, for the two regions,  $L$  and  $M$  can be described as:

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<sup>3</sup> GUILHOTO, J.J.M. (USP. FEA. Department of Economics, São Paulo). Personal communication, 2003.

$$\left\{ \begin{bmatrix} I & \vdots & 0 \\ \dots & \dots & \dots \\ 0 & \vdots & I \end{bmatrix} - \begin{bmatrix} A^{LL} & \vdots & A^{LM} \\ \dots & \dots & \dots \\ A^{ML} & \vdots & A^{MM} \end{bmatrix} \right\} \begin{bmatrix} x^L \\ \dots \\ x^M \end{bmatrix} = \begin{bmatrix} Y^L \\ \dots \\ Y^M \end{bmatrix} \quad (1)$$

where

$$Y^L = (I - A^{LL})x^L - A^{LM}x^M \quad \text{and} \quad Y^M = -A^{ML}x^L + (I - A^{MM})x^M,$$

and where:

$$A = \begin{bmatrix} A^{LL} & \vdots & A^{LM} \\ \dots & \dots & \dots \\ A^{ML} & \vdots & A^{MM} \end{bmatrix}, \quad X = \begin{bmatrix} x^L \\ \dots \\ x^M \end{bmatrix} \quad Y = \begin{bmatrix} Y^L \\ \dots \\ Y^M \end{bmatrix}.$$

Considering the  $n$  sectors of the Brazilian economy, the technical coefficient matrix  $A^{LL}$ , described in equation (1), can be constructed as follows:

$$A^{LL} = \begin{bmatrix} a_{11}^{LL} & a_{12}^{LL} & \cdot & \cdot & \cdot & a_{1n}^{LL} \\ a_{21}^{LL} & a_{22}^{LL} & \cdot & \cdot & \cdot & a_{2n}^{LL} \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ a_{n1}^{LL} & a_{n2}^{LL} & \cdot & \cdot & \cdot & a_{nn}^{LL} \end{bmatrix} \quad (2)$$

where the technical coefficients estimated for the inter-regional model are obtained as follows:

$$a_{ij}^{LL} = z_{ij}^{LL} / x_j^L \quad (3)$$

$$a_{ij}^{MM} = z_{ij}^{MM} / x_j^M \quad (4)$$

$$a_{ij}^{LM} = z_{ij}^{LM} / x_j^M \quad (5)$$

$$a_{ij}^{ML} = z_{ij}^{ML} / x_j^L \quad (6)$$

where  $a_{ij}^{LL}$  and  $a_{ij}^{MM}$  are the intra-regional coefficients;  $a_{ij}^{LM}$  and  $a_{ij}^{ML}$ , the inter-regional coefficients;  $z_{ij}^{LL}$  is the monetary flux of sector  $i$  to sector  $j$  within region  $L$ ;  $z_{ij}^{MM}$  is the monetary flux of sector  $i$  to sector  $j$  within region  $M$ ;  $z_{ij}^{LM}$  and  $z_{ij}^{ML}$  are the monetary fluxes from sector  $i$  to sector  $j$ , from region  $L$  to region  $M$  and from region  $M$  to region  $L$ ,

respectively;  $x_j^L$  and  $x_j^M$  are the total production levels of sector  $j$ , within regions  $L$  and  $M$ , respectively.

### 3. RESULTS AND DISCUSSION

The results presented in this analysis represent the impact of an increase by R\$1 million in sugar and ethanol exports, respectively, considering separate effects for each of the analyzed regions (Center-South and North-Northeast). The purpose of the simulations is to identify the sensitivity of regional responses to an export increase within the Brazilian economy. The shocks were simulated upon sector 14 (sugar production) and upon sector 9 (ethanol production), considering each of the regional matrices.

#### 3.1 Inter-regional and intra-regional production impacts of a shock upon sugar and ethanol demand

Initially, the impact of R\$1million increase in sugar exports upon the Brazilian economy was calculated. Next, the same value was applied to evaluate the impact of ethanol exports increase upon the Brazilian economy. Table 1 shows the production impact at each major cane production region: Center-South and North-Northeast.

The results presented in Table 1 indicate that an increase in the final demand for sugar will have a higher impact upon: Sector 14 – Sugar industry, where the sum of the direct, indirect and income effects summed to R\$1.186 million in the Center-South and to R\$ 1.173 million in the North Northeast; Sector 1 – Cane production, where the sum of the direct, indirect and income effects summed to R\$289 thousand in the Center-South and to R\$ 250 million in the North Northeast; and Sector 20 – Other services, where the sum of the direct, indirect and income effects summed to R\$511 thousand in the Center-South and to R\$ 611 thousand in the North Northeast. The higher impacts were identified in the sector directly subject to the shock, which was the Sugar industry, as expected, and also in the Cane production, since this is the major source of inputs and raw material for producing sugar. The Other services sector has aggregated several sectors that are usually treated in a more disaggregated form in the Brazilian official IBGE input-output matrix. This may explain the high impact observed for this sector, since it includes several sectors of the economy. It has

also been observed that an increase in the final demand for sugar in the Center-South increases production of the North-Northeast in a smaller proportion, when compared with the impact of

Table 1. Change in the production levels of North-Northeast (NNE) and Center South (CS) economic sectors, in R\$ thousand, as a result of an increase by R\$ 1 million in the final demand for sugar in each of these regions.

Sectors	Impact upon the NNE region		Impact upon the CS region	
	Increase in sugar demand for the NNE	Increase in sugar demand for the CS	Increase in sugar demand for the NNE	Increase in sugar demand for the CS
1 Sugarcane	249.64	19.16	55.24	288.81
2 Rest of agroindustry	109.50	18.29	72.41	80.86
3 Extractive	10.68	5.54	25.06	20.21
4 Metallurgy	25.46	8.80	51.01	49.46
5 Mechanics	15.98	3.05	50.62	58.46
6 Electric and electronic material	7.79	1.71	18.84	13.55
7 Transport material	3.43	0.90	38.67	21.52
8 Wood, furniture, cellulose, paper and graphic	19.40	4.44	50.25	45.93
9 Ethanol	4.75	0.52	9.61	8.60
10 Other chemical, non-petrochemical elements	7.07	2.30	14.76	15.20
11 Petroleum refining	52.66	15.69	105.07	96.38
12 Products of petroleum refining	46.29	13.29	68.15	57.94
13 Textile, clothes and footwear	50.48	10.00	58.91	73.26
14 Sugar industry	1172.63	1.47	14.65	1186.09
15 Other food products	116.40	13.41	72.02	77.21
16 Other industries	10.88	2.05	31.44	27.47
17 SIUP	99.33	8.26	39.47	89.74
18 Construction	13.12	1.00	4.74	13.70
19 Private services to families	127.47	11.91	32.58	67.57
20 Other Services	611.55	54.88	277.31	511.53

Source: research results.

an increase in the NNE final demand for sugar upon the CS sectors (this can be viewed comparing the forth and fifth columns of Table 1). To understand this point, one must observe that the sum of direct, indirect and income induced effect provoked by a R\$1 million increase

in sugar demand for the CS is above R\$50 thousand only for one NNE sector, which is Sector 20 – Other services. This same demand increase simulated for the NNE has resulted, however, in expansions above R\$50 thousand for several sectors of the Center-South region.

Table 2. Change in the production levels of North-Northeast (NNE) and Center South (CS) economic sectors, in R\$ thousand, as a result of an increase by R\$ 1 million in the final demand for ethanol in each of these regions.

Sectors	Impact upon the NNE region		Impact upon the CS region	
	Increase in ethanol demand for the NNE	Increase in ethanol demand for the CS	Increase in ethanol demand for the NNE	Increase in ethanol demand for the CS
1 Sugarcane	252.57	13.89	51.77	324.47
2 Rest of agroindustry	70.88	13.94	46.37	55.71
3 Extractive	7.87	4.74	18.01	16.47
4 Metallurgy	11.95	4.77	25.66	23.48
5 Mechanics	7.81	1.31	24.34	30.81
6 Electric and electronic material	4.89	1.06	11.68	9.20
7 Transport material	2.11	0.56	23.85	14.36
8 Wood, furniture, cellulose, paper and graphic	9.48	2.60	26.06	21.63
9 Ethanol	1007.53	0.45	6.34	1011.01
10 Other chemical, non-petrochemical elements	16.88	6.27	18.46	29.68
11 Petroleum refining	39.01	15.62	74.85	76.58
12 Products of petroleum refining	33.26	11.74	44.95	42.12
13 Textile, clothes and footwear	16.38	2.97	21.43	18.50
14 Sugar industry	52.08	8.91	14.50	62.18
15 Other food products	73.59	10.56	45.43	51.57
16 Other industries	5.32	1.42	17.44	14.36
17 SIUP	84.09	10.51	26.80	80.55
18 Construction	6.38	0.88	2.82	6.79
19 Private services to families	78.94	9.55	19.97	42.62
20 Other Services	373.92	46.36	174.16	322.23

The same impact was simulated considering a demand shock due to an increase in ethanol export demand. Table 2 shows the impact of the demand increase upon the NNE and CS regions. The impact of a shock on a given region upon production and employment in this

same region followed the same pattern observed for sugar. The direct impact of the shock is high for Sector 9 – Ethanol; Sector 1 – sugarcane; and Sector 20 – Other services.

Another important aspect is that the magnitude of these impacts is higher when compared to those generated by a demand increase in sugar, except for the cane sector. This may be explained by the fact that ethanol production is relatively more intensive in cane than sugar production.

It can also be observed that, similarly to what was verified with respect to an increase in sugar demand, the inter-regional impact of an increase in ethanol demand upon the Brazilian economy, was higher when the shock first impacted the North-Northeast region.

Figure 1 summarizes the results presented in Tables 1 and 2, and distinguishes the impacts as direct and indirect effects from total effects (sum of direct, indirect and income effects), upon the Brazilian economic production. The impact of a demand increase for sugar by R\$1million in the NNE was slightly multiplied, resulting in a relatively higher impact for the region's production, that presented an increase of R\$1.847 million. In the Center-South the reflection upon the region was even greater, amounting to R\$2.162 million. The intra-regional income induced impact of an R\$1million increase in sugar demand has been of similar magnitude, however, for both of the major Brazilian cane producing regions(R\$ 2.803 million of the CS and R\$ 2.754 million for the North-Northeast). The sugar demand increase presented inter-regional impacts relatively higher for the NNE upon the CS, by R\$1.09 million. Therefore, the total production impact for the Brazilian economy was higher when the NNE region had its final demand for sugar increased. The magnitude of this increase summed to an estimated value of R\$ 2.93 million.

The higher impact upon inter-regional relations to an increase in sugar demand from the North-Northeast upon the Center-South may be explained by the fact that the first region uses relatively more inputs produced in the second region in all economic activities affected by the simulated demand shock.

It has also been observed that the impact of the income effect, expressed by the difference between the value of total impacts (direct, indirect and induced) and the value of the sum of direct and indirect impacts is greater when the shock is simulated at the North-Northeast, compared to the value assumed when the shock is given upon the Center-South. It is assumed that a higher income effect from a shock in the North-Northeast upon the production in both regions is explained by the fact that the North-Northeast's aggregate

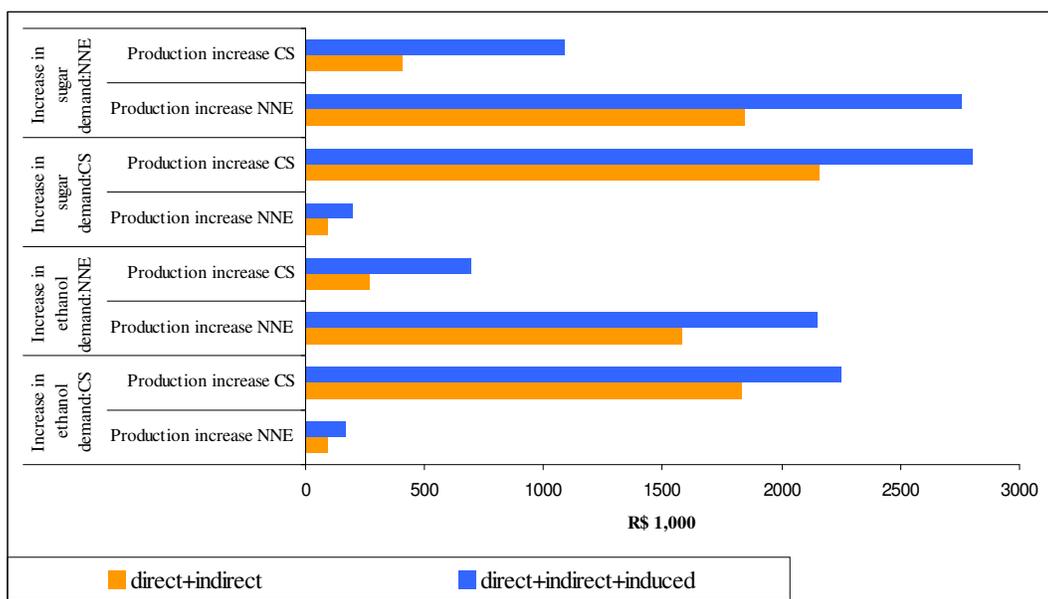


Figure 1 – Impacts in yearly economic production of Center-South and North-Northeastern Brazil, related to a R\$1 million increase in final demand for sugar and ethanol in these same regions; 1999. Note: the effect induced by income corresponds to the production increase due to the effect upon family income.

response to income is a much lower than for the Center-South. This induces a relatively higher response to an income increase.

The impacts of an increase in ethanol demand were very similar to the observed sugar demand. However, the effects upon the production level of the Brazilian economy due to an increase in ethanol demand were lower than those observed for sugar. Considering, for example, the total effect upon production (direct, indirect and induced effect from an income increase) of an ethanol demand increase by R\$ 1 million at the Center-South increased its own production by R\$2.254 million and the North-Northeastern income by R\$ 168 thousand. An impact of same magnitude upon the North-Northeast ethanol demand increased its own income by R\$ 2.155 million and the Center-South's production by R\$ 695 thousand.

### 3.2 Impact upon employment

Similar to what has been observed for production, the results of shocks provoked by ethanol and sugar export increases upon the employment level are, in general, more expressive when the impact is first upon the North-Northeast. Table 3 shows the results of the impact

when the increase in sugar demand occurs in the Center-South and in the North-Northeast upon employment.

The results presented in Table 3 also show that an impact upon the employment is much higher in the North-Northeast than in the Center-South when the impact is evaluated within the region.

Table 3. Change in the employment levels of North-Northeast (NNE) and Center South (CS) economic sectors (number of jobs created), as a result of an increase by R\$ 1 million in the final demand for sugar in each of these regions.

Setores	Impact upon the NNE region		Impact upon the CS region	
	Increase in sugar demand for the NNE	Increase in sugar demand for the CS	Increase in sugar demand for the NNE	Increase in sugar demand for the CS
1 Sugarcane	53.9	4.1	3.7	19.4
2 Rest of agroindustry	30.0	5.0	5.3	5.9
3 Extractive	0.2	0.1	0.2	0.2
4 Metallurgy	0.3	0.1	0.5	0.5
5 Mechanics	0.4	0.1	0.6	0.7
6 Electric and electronic material	0.1	0.0	0.1	0.1
7 Transport material	0.0	0.0	0.3	0.1
8 Wood, furniture, cellulose, paper and graphic	1.3	0.3	1.1	1.0
9 Ethanol	0.0	0.0	0.0	0.0
10 Other chemical, non- petrochemical elements	0.0	0.0	0.0	0.0
11 Petroleum refining	0.0	0.0	0.1	0.1
12 Products of petroleum refining	0.4	0.1	0.6	0.5
13 Textile, clothes and footwear	3.4	0.7	2.9	3.7
14 Sugar industry	15.0	0.0	0.1	10.4
15 Other food products	1.9	0.2	0.7	0.8
16 Other industries	0.4	0.1	0.5	0.5
17 SIUP	0.5	0.0	0.1	0.3
18 Construction	0.4	0.0	0.1	0.4
19 Private services to families	16.6	1.6	3.0	6.2
20 Other Services	30.8	2.8	10.0	18.5

Source: research results.

The highest effects upon employment occurred in the following sectors: Sector 1 – Sugarcane (showing the creation of 54 jobs in the North-Northeast and 19 jobs in the Center-South); Sector 2 – Rest of agroindustry (30 jobs in the North-Northeast and 6 jobs in the Center-South); Sector 14 – Sugar industry (15 jobs in the North-Northeast e 10 jobs in the Center-South); Sector 19 – Private services provided for families (17 jobs in the North-Northeast and 6 jobs in the Center-South); and Sector 20 – Other services (30 jobs in the North-Northeast and 18 jobs in the Center-South).

The results of inter-regional effects upon final demand for sugar upon the employment level also showed that a greater impact occurs when the shock is given upon the North-Northeast). The sectors that presented an increase of more than two jobs in the North-Northeast due to a demand increase in the Center-South were the following: Sector 1 – Sugarcane (creation of four new jobs) and Sector 2 – Rest of agroindustry (creating five new jobs). An increase in the number of jobs generated in the Center-South due to an increase in the demand of the North-Northeast was observed in the following sectors: 1 – Sugarcane (4 additional jobs); 2 – Rest of agroindustry (an increase of 5 new jobs); 13 – Textile, clothing and footwear (an increased of 3 jobs); 19 – Services provided for families (increased of 3 jobs) e 20 – Other services (20 jobs created).

The results presented in Table 4 are related to an increase in ethanol demand upon employment in both of the evaluated regions. The intra-regional impacts were higher when observed for the own ethanol sector and in the following sectors: 1 – Sugarcane (direct, indirect and induced effects resulted in 22 new jobs in the Center-South and 55 in North-Northeast) and in Sector 20 – Other Services (direct, indirect and induced effects resulted in 12 new jobs and the Center-South and 19 jobs at the North-Northeast).

The values of cross impacts of an increase in ethanol demand from one region to another are described in columns four and five of Table 4. Similar to what was observed for an increase in sugar demand, inter-regional impacts upon production from the North-Northeast to the Center-South.

The sectors more affected by inter-regional employment effects of an ethanol demand shock, when evaluating between regions were: Sector 1 - Sugarcane (3.5 jobs for the Center-South and 3 jobs for the North-Northeast); Sector 2 – Rest of agroindustry (3.3 jobs in the Center-South and 4 jobs in the North-Northeast) and Sector 20 – Other services (6.3 jobs in the Center-South and 2.3 jobs in the North-Northeast).

The results also showed that the intra-regional impacts were always higher than any inter-regional impacts (for both sector related to either type of shock, that is, upon sugar and ethanol demand). These were followed by the sugarcane sector.

Table 4. Change in the employment levels of North-Northeast (NNE) and Center South (CS) economic sectors (number of jobs created) as a result of an increase by R\$ 1 million in the final demand for ethanol in each of these regions.

Sectors	Impact upon the NNE region		Impact upon the CS region	
	Increase in ethanol demand for the NNE	Increase in ethanol demand for the CS	Increase in ethanol demand for the NNE	Increase in ethanol demand for the CS
1 Sugarcane	54.5	3.0	3.5	21.8
2 Rest of agroindustry	19.4	3.8	3.4	4.0
3 Extractive	0.1	0.1	0.2	0.1
4 Metallurgy	0.1	0.1	0.3	0.2
5 Mechanics	0.2	0.0	0.3	0.4
6 Electric and electronic material	0.0	0.0	0.1	0.1
7 Transport material	0.0	0.0	0.2	0.1
8 Wood, furniture, cellulose, paper and graphic	0.6	0.2	0.6	0.5
9 Ethanol	3.4	0.0	0.0	3.3
10 Other chemical, non-petrochemical elements	0.1	0.0	0.1	0.1
11 Petroleum refining	0.0	0.0	0.0	0.0
12 Products of petroleum refining	0.3	0.1	0.4	0.4
13 Textile, clothes and footwear	1.1	0.2	1.1	0.9
14 Sugar industry	0.7	0.1	0.1	0.5
15 Other food products	1.2	0.2	0.4	0.5
16 Other industries	0.2	0.1	0.3	0.2
17 SIUP	0.4	0.1	0.1	0.3
18 Construction	0.2	0.0	0.1	0.2
19 Private services to families	10.3	1.2	1.8	3.9
20 Other Services	18.8	2.3	6.3	11.6

Source: Research results.

The same is not observed when the impact upon employment level is evaluated. In this case, the results showed that the cane sector generated a greater number of jobs than the sector which received the shock. Besides that, others that were indirectly affected also

generated a greater number of jobs than the sector subject to the shock (for example, the Rest of Agroindustry, Private services provided for families and other services). This can also be explained by the fact that these sectors demanded a higher number of jobs than the sugar and ethanol production

Figure 2 summarizes the results of an increase in the number of jobs generated in the overall economy due to a demand increase of sugar and ethanol in both regions considered for the study.

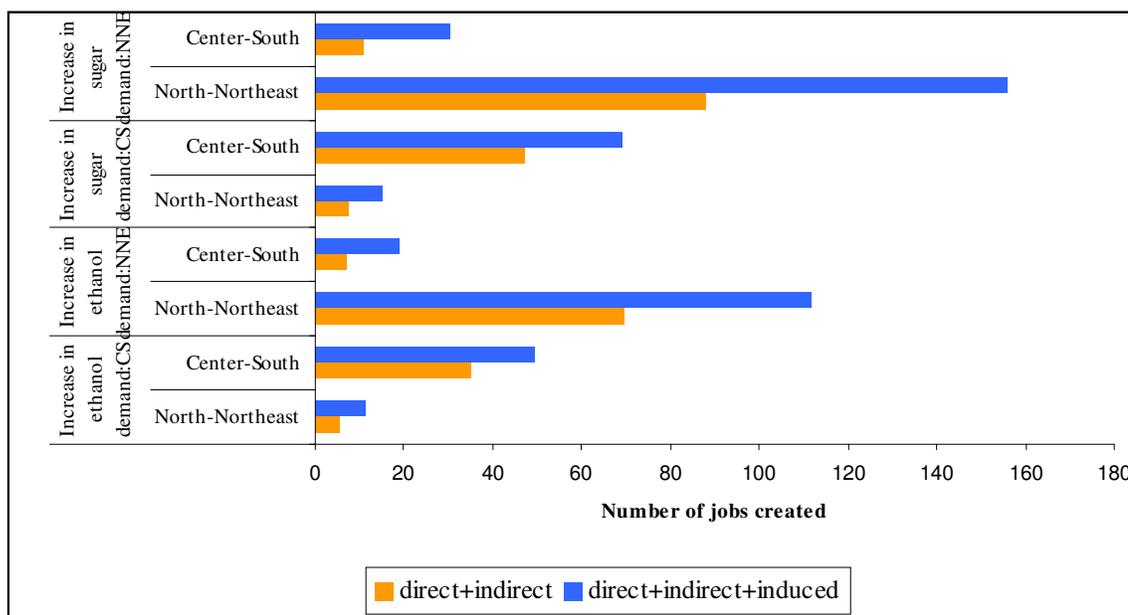


Figure 2 – Impacts of the number of jobs generated at the Center-South and North-Northeastern Brazil, due to an increase in final demand for sugar and ethanol by R\$1 million at the Center-South and North-Northeast regions.

Source: Research results.

Note: the induced effect corresponds to an increase in production as a function of the effect of an increase in family income.

It was observed that for an increase in the production value, the number of jobs generated by a shock in sugar demand was greater than that generated by a demand for ethanol. The number of jobs generated due to an increase in income is represented in Figure 2, by the difference between the columns that represent the number of employment generated by the direct, indirect and induced effects, and the columns that represent the number of direct and indirect employment. This difference shows the higher employment generation capacity when the demand shock occurs at the North-Northeast region.

The total impact (direct, indirect and induced) of a sugar demand increase by R\$ 1 million at the Center-South produced an increase of 69 jobs in this same region and 15 employments per year at the North-Northeast. This same shock in the North-Northeast increased employment by 156 jobs in this same region and by 30 jobs in the Center-South region. A slightly lower impact resulted from the simulation of a demand increase of R\$ 1 million of ethanol in the Center-South. The number of jobs increased by 49 in the same region and by 12 jobs in the other region. When the ethanol demand shock was simulated for the North-Northeast, the number of jobs in the region increased by 112 and by 19 in the Center-South.

It is important to stress that, although the number of jobs created seems relatively low in absolute terms, it results from a shock of an also relatively low magnitude for the sector (R\$1 million). An impact of this magnitude corresponds to less than 0.05 percent of Brazilian sugar exports, considering the average value of sugar exported through the last seven years.

Therefore, the results must be interpreted as an indication of the sensitivity of each region in face of a possible demand increase. In fact, it is expected that the resulting demand increase for Brazilian sugar at the international market will be more than R\$1 million, if the prevailing protectionist barriers are totally phased out. Borrell & Pearce (1999) have estimated an increase of 5 million tons of sugar by 2008 using a Global Sweetener Market (GSM) model for the year 2000. Sheales et al. (1999) estimated an increase of sugar exports in 2,2 million tons by 2005, using the SUGARBARE model for 1999 to 2005.

#### **4. CONCLUSIONS**

The relations presented in the inter-regional input-output matrix for this work indicate that shocks resulting from an increase in the North-Northeastern final demand for sugar and ethanol can have a greater relative impact in the overall Brazilian economy, when compared to a shock upon the Center-South major cane producing region. This suggests that the protectionist barriers prevailing in the international market have harmed more aggregate employment and production when the less competitive Brazilian cane, sugar and ethanol producing region, the North-Northeast, is impacted, since this industry is of fundamental importance to the regional economy.

This is an important counterargument for negotiating a reduction in protectionist measures for sugar, particularly when these are sustained by developed countries such as the

United States and the European Union. The EU argues that the economies of poor countries of the ACP would be strongly disturbed by a change in these policy measures, while the United States argues that its sugar policies are beneficial for the poor countries of Central America. The study showed that in the Brazilian economy the mostly harmed region is also the poorest region of country, where there are serious poverty and hunger problems.

The results also indicate that shocks provoked by an increase of external demand for the Brazilian sugar had a greater effect for aggregate production and employment in the Brazilian economy than the impact generated by an increase in export demand for ethanol. This demonstrates that opening ethanol markets, as an alternative for phasing out protectionist policies for sugar, must be carefully considered, since the latter may be more interesting for Brazil, considering its production structure. The ethanol option is expected to be increasingly involved, however, in the Brazilian trade negotiations for sugar and ethanol, since it has a greater appeal for developed countries that are accumulating high environmental debts.

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## ANNEX 1

Number	Name of the Sector in the Brazilian Matrix composed for this study (estimated with 1999 data)	Sectors presented in a more aggregated form than the IBGE matrix
1	Sugarcane	Agriculture and Livestock
2	Rest of Agriculture and Livestock	
3	Extractive	Mineral extractive
		Petroleum extraction and gas extraction
4	Metallurgy	Steel
		Non-ferrous Metallurgy
		Other metallurgy
5	Machines and tractors	
6	Electric and electronic material	Electric material
		Electronic equipments
7	Transport material	Cars, trucks and buses
		Other vehicles and parts
8	Wood, furniture, cellulose, paper and graphic	Wood and furniture
		Paper and graphic
9	Ethanol	Chemical elements
10	Other chemical, not petrochemical elements	
11	Petroleum refining	
12	Products of petroleum refining	Various chemicals
		Drugs and perfume
		Plastic articles
13	Textile, clothes and footwear	Textile
		Clothes
		Footwear industry
14	Sugar industry	
15	Other food products	Coffee industry
		Processed vegetal products
		Animal slaughter

*(cont.)*

Number	Name of the Sector in the Brazilian matrix composed for this study (estimated with 1999 data)	Sectors presented in a more aggregated form than the IBGE matrix
		Dairy industry
		Vegetable oils
		Other food products
16	Other industries	Non metallic industry
		Rubber industry
		Other industries
17	Public utility industrial services	
18	Construction	
19	Services to families	
20	Other services	Trade
		Transport
		Communication
		Financial institutions
		Serviços prestados às empresas
		Aluguel de imóveis
		Public administration
		Non-tradable private services

Table 1.1. Sectors included in the input-output matrix used for this paper.