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Employment generation and structural decompositon effects of the sugar and alcohol industries in Brazil

Efeitos de decomposição estrutural e geração emprego das indústrias de açúcar e álcool no Brasil

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Content

ABSTRACT:
This study analyzed the generation of employment in Sugar and Alcohol Industries as well as the Structural Decomposition of the employment variation between years 2000 and 2009, from Input-Output Matrices. It was found that the Sugar and Alcohol Industries reduced the generation of employment between years 2000 and 2009. However, these industries generated significant employments as a result of the Structural Decomposition, mainly because the economy growth that occurred during this period.
Keywords: Employment; Sugar Industry; Alcohol Industry; Input-Output Matrix.

RESUMO:
Este estudo analisou a geração de emprego em açúcar e álcool indústrias, bem como a decomposição estrutural da variação do emprego entre os anos 2000 e 2009, de matrizes de Input-Output. Verificou-se que as indústrias de álcool e açúcar reduziram a geração de emprego entre os anos 2000 e 2009. No entanto, estas indústrias gerado empregos significativos como resultado da decomposição estrutural, principalmente porque o crescimento da economia que ocorreram durante este período.
Palavras-chave: Emprego; Indústria de açúcar; Indústria do álcool; Matriz de insumo-produto.

1. Introduction

With the ongoing internationalization process in recent decades, especially in the late twentieth and early twenty-first centuries, the capitalist world has experienced an economic globalization growth and it has created links between countries and their companies. The good side is that internationalization has allowed import and export of goods, services, technologies, among others. However, financial crises in some countries have harmed the economy of other countries, making small recessions being big problems for the world economy.

In addition, positive and negative fluctuations in markets (foreign exchange, exports, imports, agreements between countries, etc.) can cause an increase or decrease in the generation of jobs in certain sectors of the economy. In the case of the Sugar and Alcohol Industries, fluctuations in commodity prices may affect financial results.

Therefore this study aims to analyze the variations of jobs in this sector and analyze its respective importance to the Brazilian economy. Thus, the following question arises: How job creation in the Sugar and Alcohol Industries occurred between 2000 and 2009?

In order to answer this question, this study was developed to investigate the generation of employment and the effects of the Structural Decomposition of employment variation in the Brazilian economy, highlighting the Sugar and Alcohol Industries. For this, it was considered the period of 2000-2009, which were the years with most recent data available when the study was designed.

From there, this work was divided into five parts, with this introduction as the first one. The second part deals with brief notes on the Sugar and Alcohol Industries. The third part discusses the materials and methods used for the generation of results. The fourth part consists of the results and discussion and the fifth and final part presents the final considerations on this research.

2. Brief notes on the sugar and alcohol sector

2.1 The sugar industry

Brazil is by far the largest producer of sugar in the world. Its production is twice higher than the production of Europe and more than four times higher than the production of the United States. Brazil is not only the largest producer but also the largest exporter of sugar in the world, followed by India that largely produces and consumes sugar, Europe, China, Thailand, United States, Mexico, Russia and Australia.

In Brazil, sugar is widely used not only in fresh consumption, but also in the sector of food and beverages. Neves and Conejero (2010) explain that the consumption of sugar in the domestic market grows together with the market of industrialized products, since these products are increasingly affordable to the Brazilian population. Industrialized products such as chocolate and soft drinks are largely consumed in Brazil compared to developed countries like Sweden and USA, and it justifies the high consumption of sugar by Brazilians.

Sugar has demonstrated its importance to the Brazilian and world populations, especially in the aspect of food security. The consumption of this product has increased from 143 million tons in 2005/2006 to 171 million tons in the 2012/2013 harvest, with projections of 204 million tons to 2021. The largest consumer countries are India (23 million tons), European Union (19 million tons), China (15 million tons), Brazil (13 million tons), USA (10 million tons), Russia (5.8 million tons), Indonesia (5.2 million tons), Pakistan (4.7 million tons), Mexico (4.5 million tons) and Egypt (2.9 million tons). This increased consumption of sugar can be explained by the increased world population, as well as the improved life quality of people around the world (NOVA CANA, 2013).

As previously mentioned, in addition to being the largest producer of sugar, Brazil is also the largest exporter of the product. Table 1 shows the ranking of the largest sugar exporters in the world.

Table 1 - The world's largest sugar exporters - in 1000 tons.

COUNTRIES/HARVESTS	2009/2010	2010/2011	2011/2012	2012/2013

Brazil	24,300	25,800	24,650	27,650
Thailand	4,930	6,642	7,898	7,000
Australia	3,600	2,750	2,800	3,100
Mexico	751	1,557	985	2,090
India	225	3,903	3,764	1,240
Guatemala	1,815	1,544	1,619	1,950
Others	8,307	8,757	9,002	10,117
Total	**48,656**	**54,701**	**55,702**	**56,561**

Fonte: USDA (2013b).

Comparing the above countries with respect to production and export, it can be observed that the largest producers could not maintain the same position in the export ranking in recent harvests, except Brazil. This can be explained by the fact that India, China and Europe have directed their production to the domestic market and imported sugar from other countries like Brazil to fulfil their domestic demand.

In addition to being a traditional exporter for centuries, Brazil has gained more strength with the deregulating of the sugar sector in 1990. Sugar exports were then liberalized from the 1994/1995 harvest. With no government intervention, the expansion of domestic production placed Brazil at the level it is today. Indeed, deregulation has provided positive results in the sugar exports from the Central-South regions of Brazil, especially because the competitiveness of these regions. The North-Northeast regions of Brazil also increased their exports as a result of the expansion of the world sugar market, with the increased import from the consumer countries (COSTA; BURNQUIST, 2003; COSTA; BURNQUIST, 2006).

Despite the positive effects generated by the sector deregulation, there are factors that can harm the export of Brazilian sugar such as tariff quotas, import tariffs and export subsidies. Neves and Conejero (2010) explain that sugar is the most protected commodity in the world so that each country develops its own means to intervene in the market. The United States, for instance, imposes fixed export quotas to certain countries. Being one of the leading importers of sugar, the United States can thus control prices and enable the production of *High Fructose Corn Syrups*, a type of sugar produced from corn. In the European Union, the price of sugar derived from sugarcane remains high by restricting imports and subsidies to their producers.

Thus, the sugar marketing among countries is impaired. Although there are many countries producing sugar derived from cane, beet and corn, the barriers imposed by the consumer countries stimulate their local production, which covers strategic and food security issues that are specific for each consumer market, thus avoiding the import of sugar from other countries like Brazil. Burnquist and Bacchi (2002, p. 139) emphasize that "the protectionism in the international sugar market has been so limiting that makes the agro industrial market the most affected of all".

However this scenario is changing. In 2003, Brazil, Australia and Thailand requested consultation with the European Communities concerning export subsidies within the World Trade Organization (WTO). The purpose was to check whether there were "export refunds" form government resources to enable export of sugar at prices below the average total costs of production, a practice that forms the so called cross-subsidization. In 2005, the WTO adopted favorable measures to Brazil and other countries, making the European Communities to change its way to market and produce sugar, reducing production quotas, reference prices and putting an end to cross-subsidies to export sugar (COSTA; Burnquist, 2006; UNICA, 2014c).

2.2 The alcohol industry

Brazil is the world's second largest alcohol producer, behind The United States. In 2013, the United States led the world alcohol production ranking with 57% of the world production, followed by Brazil (27%), Europe (6%), China (3%), India (2%) and Canada (2%).

Alcohol (ethanol) can be obtained from multiple crops. In the United States, corn is the primary source; in Brazil, sugarcane is the main source; in Europe alcohol is produced from beet and wheat; in China it is obtained from corn and wheat; in India it is derived also from the sugarcane; and in Canada, alcohol is produced from wheat and corn (RFA, 2013).

In Brazil, gasoline was strongly substituted by ethanol with the implementation of the *Proálcool* Program in 1975. A set of interests of State, sugarcane businessmen, machinery and equipment sector and the automotive industry caused *Proálcool* to introduce ethanol in the Brazilian energy matrix, taking Brazil from dependence on oil as the unique automotive fuel (BELIK, 1992; SHIKIDA, 1997; PAULILLO *et al.*,2007).

Due to the development of *Proálcool* for years, ethanol is today a substitute (hydrous ethanol) and an additive (anhydrous ethanol) for gasoline. Currently, many countries use both domestic and imported alcohol. Brazil exports alcohol to various locations in the world and its main market is the United States, which represents 57% of total Brazilian exports, despite being featured in the world production. South Korea (12%) occupies the second position of the countries that import Brazilian ethanol, followed by Netherlands (5%), Japan (4%), Jamaica (4%), Nigeria (3%), Philippines (3%), United Arab Emirates (2%), Saudi Arabia (2%) and other smaller markets (8%). In 2013, the total Brazilian exports reached 2.9 billion liters of alcohol.

Alcohol provides many benefits when compared to gasoline. Besides being an important product for exports of the agro-industrial sector, ethanol is a renewable, clean and sustainable product. When produced from sugarcane plants, Brazilian ethanol can reduce by 89% the emissions of greenhouse gases. When produced from other sources, it may also reduce emissions of greenhouse gases, but at lower levels. For example, from sugar beet, reduction is 46% and from grains is about 30%. It is noteworthy that these reductions are also a result of the technology used in vehicles that helps filter out greenhouse gases (NOVACANA, 2014).

It is also known that oil, the raw material of gasoline, is a non-renewable substance and that may come to an end if new sources are not found (the pre-salt layer located in the Brazilian continental shelf is an example of newfound oil source). On the other hand, alcohol is a renewable fuel that can be produced from cane, beet, corn, etc.; provided that there is arable land for these crops.

Another advantage is that alcohol provides better engine performance. This is due to the fact that alcohol has a higher octane number compared to gasoline, which allows a more controlled explosion of fuel into the engine. Furthermore, ethanol has a larger mass compared to gasoline and the fuel becomes more compressed within the engine, increasing the power. Thus, on average, the cars running on ethanol can be 2% more powerful than the gasoline-powered vehicles. But, depending on the vehicle model, the power increment can be zero or reach up to 9% (NOVACANA, 2014).

Another benefit of ethanol is that the production process allows generating electricity from the waste (bagasse and straw). Electricity is obtained by burning straw and bagasse in boilers, in which vapors are produced to move a turbine that transforms mechanical energy into electricity. After this process, the Plants use the electrical energy produced in their activities and the surplus is sold to electricity companies (VIAN, 2003).

However, in recent times, the alcohol market has weakened with the State controlling gas prices. The gas price has remained fixed due to State subsidies and the price of hydrous alcohol has often fluctuated above 70% of the price of gasoline.

> […] lack of planning is seriously affecting this sector. This is due to a set of factors such as: investments on ethanol by mills and distilleries resulting from its resumption in the *flex-fuel* market are losing strength due to the international financial crisis of 2008, which jeopardized alcohol production and the consequent ability to cover costs; the ill-fated gas price control policy, set to stop inflationary pressures (including the end of the contributions of Intervention in the Economic Domain – CIDE that had ensured the ethanol competitiveness previously); strong interest on pre-salt that targets petroleum-based fuels; the bad climatic conditions that negatively affected the recent sugarcane harvests and consequently, the ethanol industry (SHIKIDA, 2014).

Therefore, continuous efforts to improve the production process, increase productivity and make better use of available raw materials are essential for the growth of the sector. Still, government measures should complement such efforts for the resumption of the sugarcane agribusiness growth. According to

the federal government, Brazil will have to produce 54.5 billion liters of ethanol by 2022, but if changes are not made, the expected may not happen.

3. Methodological procedures

Calculations of this research were done with monetary values on a single standard unit in order to enable comparisons over time and avoid deviations caused by monetary changes, zero cuts and price fluctuations. As the data from the IOTs were presented in local currency, the 2000 data were deflated in the base year set for 2009. The deflator was obtained from the IBGE using the synoptic tables of the National Accounts, which brings the annual percentage change in the price levels for each sector. Thus, a price index was defined to turn all current monetary values into constant values for the base year of 2009.

Although NEREUS data include 42-56 sectors within the analyzed period, the analysis was done on 56 sectors, as they consider a greater dismemberment among Agriculture, Industry and Services. In addition, the Sugar Industry has been added to the tables of the 56 sectors, with the exception of the Food and Beverage Sector. The Other Services Sector, although calculated in the same way as the others, was removed from the analysis for not interfering in the other sectors of the economy. In total, the analysis considered 56 sectors.

3.1 Research characteristics

This work is a descriptive study covering general aspects of a social context. From a descriptive study, it is possible to understand the different forms of phenomena, as well as their ordering and classification. In addition, descriptive results can explain links between cause and effect of phenomena and how the variables influence or cause them (OLIVEIRA, 2001).

This research was based on both qualitative and quantitative approaches. The qualitative phase can describe the complexity of a case or problem, analyze the interaction of certain variables, understand and classify dynamic processes experienced by social groups, contribute to the change process, formulate opinions of certain groups and interpret characteristics of the behavior of individuals. The quantitative phase seeks to quantify data by collecting information, which are processed and analyzed by statistics, commonly from the simplest to the most complex techniques (OLIVEIRA, 2001).

Furthermore, this study uses literary and documentary surveys of public domain. The literature review on the theme was made in books, articles, theses, dissertations, among others. From documents, secondary data like tables of production, uses and resources were obtained to produce the research results (MARCONI; LAKATOS, 2009).

3.2. Data source

National Input-Output Tables (IOTs) were used in this study for years 2000 and 2009. They were estimated by the methodology described by Guilhoto and Sesso Filho (2005), which uses preliminary data of the National Accounts of the Brazilian Institute of Geography and Statistics (IBGE). However, a breakdown of sectors was made to the analysis of the Sugar and Alcohol Industry. Originally, the Sugar Industry was presented separately only in the IOT with 42 sectors, while the Alcohol Industry was presented separately only in the IOT with 56 sectors. Thus, the Sugar Industry was separated from the Beverage and Food Sectors and the IOT with 56 sectors got 57 sectors for analysis.

3.3 The input-output matrices

For a better understanding of this study, here is an explanation of the origin of the Input-Output Tables for the 2000 and 2009 years, which were prepared by Guilhoto and Sesso Filho (2005) and made available by the Regional Economics and Urban Center of the University of São Paulo (NEREUS).

The first matrix is related to production, made from the activities' production within the National Accounts, with values addressed at basic prices, which account for production values. The matrix of uses and resources considers values at market prices that therefore need to be transformed into basic prices. This is because data on the use of goods and services are based on the consumer's price. Therefore, it is necessary to subtract the values concerning import, taxes and trade and transport margins from the matrix of market prices, thus forming a new matrix of use at basic prices. Both matrices are available from the IBGE (Guilhoto, 2011).

From the matrices of production and uses and resources, developed with data from the National Accounts, an Input-Output Table is estimated. Table 1 shows schematically an example of an input-output table for an economy with two sectors.

Table 2 – Example of an input-output table for an economy with two sectors

	Sector 1	**Sector 2**	**Families' consumption**	**Government**	**Investment**	**Export**	**Total**
Sector 1	*Z11*	*Z12*	*C1*	*G1*	*I1*	*E1*	*X1*
Sector 2	*Z21*	*Z22*	*C2*	*G2*	*I2*	*E2*	*X2*
Import	*M1*	*M2*	*Mc*	*Mg*	*Mi*		*M*
Taxes	*T1*	*T2*	*Tc*	*Tg*	*Ti*	*Te*	*T*
Added value	*W1*	*W2*					*W*
Total	*X1*	*X2*	*C*	*G*	*I*	*E*	

Source: Guilhoto (2011, p. 15).

Where: *Zij* is the cash flow between sectors *i* and *j; Ci* is the household consumption of products of the sector *i*; *Gi* is the government spending within the sector *i; Ii* is the demand for investment goods produced in the sector *i*; *Ei* is the total exported by the sector *i; Xi* is the total production of the sector *i; Ti* is the total net indirect taxes paid by *i; Mi* is the imports by the sector *i; Wi* is the added value generated by the sector *i.*

From Table 1 a number of formulas are modified. The results of the calculations give the basic models necessary for the analysis of input-output in the Leontief national system:

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

3.3.1. Generators

From the technical coefficients and the Leontief inverse matrix, it is possible to estimate the number of direct and indirect jobs, imports, taxes, wages, value added or other variable of interest, for each monetary unit produced for the final demand, in each economic sector (Miller and Blair, 2009):

$$GV_j = \sum_{i=1}^{n} b_{ij} v_i \qquad (2)$$

Where: is the total direct and indirect impact on the variable in question; is the *ij-th* element of the Leontief inverse matrix; is the direct coefficient of the variable in question.

The direct coefficient is obtained by dividing the variable of interest by the total production of each sector.

3.3.2 Structural Decomposition Analysis

The Structural Decomposition Analysis (SDA) is used to study the changes observed in production and employment and their relationships. These are broken down into changes in technology, in final demand and changes in dependence on imports. This analysis also compares prices temporally and thus explains pricing changes that occur over time and space (MILANA, 2001).

A relevant feature of this analysis is the ability to distinguish direct and indirect elements of sectoral changes by combining similar procedures with the techniques of input-output. This method can analyze the indirect effects on an industry undergoing structural changes as well as the productivity changes occurring in other industries, which are transmitted via intermediate input purchases (MILANA, 2001).

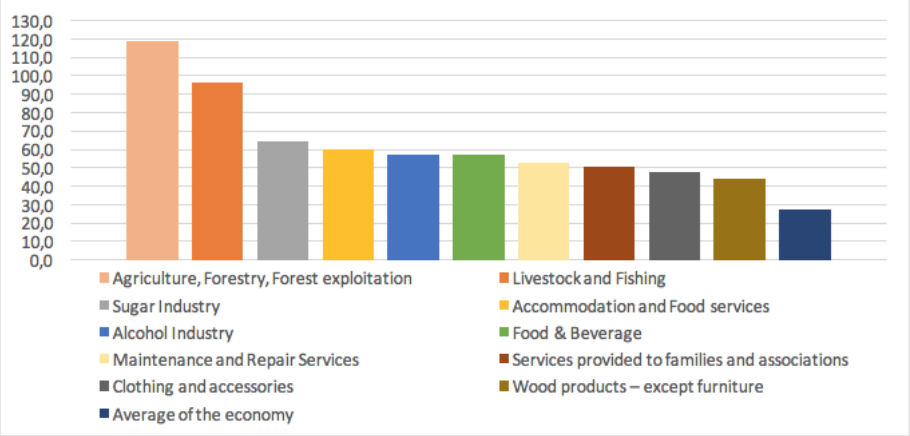
This research used a model based on Haan (2001) applied to the job market. According to Sesso Filho *et al.* (2010), all research that adopts the SDA model also uses the Input-Output Leontief Model as basis for decomposition, since it better approaches the reality at considering that job variations follow an economic growth linear function.

On this way, Sesso Filho *et al.* (2010) explain that job changes are an economic growth function that is related to gain or loss of efficiency. Job changes (in product monetary units) are determined by the work efficiency or job intensity. In addition, changes in technical coefficients of the economy, composition of the final demand structure and increased volume of the final demand are factors to be also considered.

4. Results and discussion

Analyzing the employment generators for the year 2000, the 10 sectors that are generating jobs by a R$ 1 million increase in final demand are: Agriculture, Forestry, Forest exploitation (1); Livestock and Fishing (2); Sugar Industry (3); Accommodation and Food services (4); Alcohol Industry (5); Food & Beverage (6); Maintenance and Repair Services (7); Services provided to families and associations (8); Clothing and accessories (9); Wood products – except furniture (10). Chart 1 shows the top 10 job-generating sectors in 2000 and the average of the economy.

Chart 1 - Employment Generators in 2000



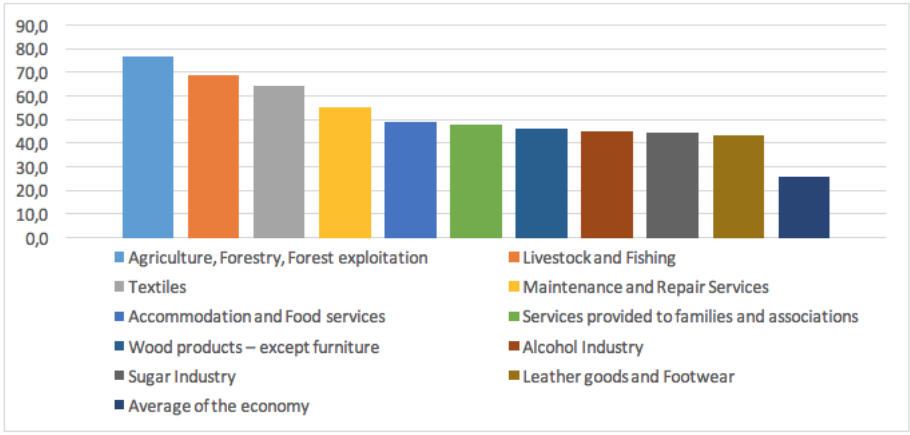
Source: Prepared by authors

The total employment generated in the Brazilian economy in 2000, amounts to 27.7 jobs averaged by sector (total generated employments divided by the number of sectors).

As the Sugar Industry raised its output for an R$ 1 million change in final demand, it gave rise to 64.3 jobs, which were split up into 4.4 direct jobs and 59.9 indirect jobs. High amounts of jobs were generated for other sectors, while little generation was observed for the Sugar Industry itself. The Alcohol Industry followed the same job generating pattern; similarly it generated more jobs for other sectors than for itself. In response to an R$ 1 million increase in final demand, the Alcohol Industry generated a total of 57.5 jobs, which were 4.3 direct and 53.1 indirect.

The major 10 sectors representing key areas of the economy in 2009 were: Agriculture, Forestry, Forest exploitation (1); Livestock and Fishing (2); Textiles (3); Maintenance and Repair Services (4); Accommodation and Food services (5); Services provided to families and associations (6); Wood products – except furniture (7); Alcohol Industry (8); Sugar Industry (9); Leather goods and Footwear (10). Chart 2 shows these key areas and the average of the economy. Chart 3 shows the top 10 job-generating sectors in 2009 and the average of the economy.

Chart 2 - Employment Generators in 2009



Source: Prepared by authors

The total employment generated in the Brazilian economy in 2009, amounts to 25.8 jobs averaged by sector. Thus, the Sugar Industry created 44.2 jobs, which were split up into 10.4 direct and 33.8 indirect jobs. However, this sector lost its 3rd position in the Brazilian economy in 2000, falling to the 9th position in 2009.

Similarly to the year 2000, it was observed that the Sugar Industry was able to generate more jobs for other sectors than for its own sector. The Alcohol Industry followed the same tendency, generating a total of 45 jobs, which were 4.9 direct (within the sector) and 40.1 indirect (in the other sectors). The Alcohol Industry also lost importance in the Brazilian economy, falling from the 5th to the 8th position. However, both the Alcohol and the Sugar Industries showed ability to generate more jobs than the average of other sectors, in the years 2000 and 2009.

According to data of Dieese (2012), the number of employed people increased to 7.6% in Brazil in the 1999-2009 period mainly because the economic growth, which will be showed later in the Structural Decomposition analysis, on the total effect on the change in final demand. Despite the decrease of the employment generators of the Sugar and Alcohol Industries, the economic growth ensured the job generation of these industries above the average of the economy.

It is known that both Sugar and Alcohol can generate significant amount of jobs, but it is also important to understand what sectors are receiving these generated jobs. Considering a constant data scale, multiplying the employment generators by 100, for each 100 monetary units on the final demand, the Sugar Industry would generate 6428.6 jobs, which would be 559.8 within the own sector and 5868.8 in other sectors of the economy. In similar proportion, the Alcohol Industry would generate 5735.4 jobs, which would be 443.1 in the own sector and 5302.3 in other sectors of the economy.

Table 3 shows the sectors that received more jobs from the Sugar and Alcohol Industries.

Table 3- Sectors favored by job creation in the Industries of Sugar and Alcohol in 2000.

Sectors	Sugar Industry	Sectors	Alcohol Industry
Agriculture, forestry, forest exploitation	4927,1	Agriculture, forestry, forest exploitation	4640,0
Livestock and Fishing	98,6	Livestock and Fishing	104,9
Metal products - except machinery and equipment	31,0	Metal products - except machinery and equipment	20,5
Alcohol Industry	21,3	Trade	158,1
Trade	315,6	Transport, storage and postal services	85,0
Transport, storage and postal services	115,5	Maintenance and repair services	22,2
Information Services	28,4	Business services	66,9
Financial intermediation and insurance	25,8	Services provided to families and associations	30,0
Maintenance and repair services	28,1	-	-
Business services	102,3	-	-
Services provided to families and associations	33,3	-	-

Source: Prepared by authors

It is noted that the Sugar Industry would generated most of its indirect jobs for the same sectors as the Alcohol Industry. However, Financial intermediation and insurance and Information Services are noteworthy, since they are not prominent in the Alcohol Industry. It is also worth mentioning that the Alcohol Industry is one of the sectors that most receives jobs from the Sugar Industry, but the reverse is not true. Furthermore, Agriculture is the sector that most receive jobs as a result of this effect, followed by Trade, either by the Sugar Industry or the Alcohol industry.

In 2009, the Sugar Industry generated a total of 4421.5 jobs, which were 1283.9 in the sector and 3137.5 in other sectors of the economy. The Alcohol Industry created a total of 4500.7 jobs, split up into 494.2 in the own sector and 4006.5 in other sectors of the economy. Table 4 shows the major sectors of the economy that received indirect jobs of the both industries.

Table 4 – Sectors favored by job creation in the Industries of Sugar and Alcohol in 2009.

Sectors	Sugar Industry	Sectors	Alcohol Industry
Agriculture, forestry, forest exploitation	2471,8	Agriculture, forestry, forest exploitation	3405,1
Livestock and Fishing	53,6	Livestock and Fishing	82,8
Metal products - except machinery and equipment	30,1	Sugar Industry	23,7
Trade	272,6	Metal products - except machinery and equipment	22,6
Transport, storage and postal services	82,0	Trade	167,3
Business services	63,5	Transport, storage and postal services	75,2
-	-	Business services	61,2

Source: Prepared by authors

The sectors favored by the employment generation from Sugar and Alcohol Industries in 2009 are the same as 2000 however, with some exceptions. It is also observed that in 2000 the Sugar Industry created more jobs for the Alcohol Industry. In reverse, in 2009 the Alcohol industry generated higher

amounts of jobs for the Sugar Industry. In general, the Sugar Industry generated more jobs than the Alcohol Industry, but this scenario was reversed in 2009. It is also important to mention that both sectors generated more jobs in 2000 than in 2009.

Table 5 shows the results for the Structural Decomposition on the change of the number of job positions by the Sugar and Alcohol Industries during the years 2000-2009. It is observed that the Sugar Industry varied to 183 thousand jobs more than the Alcohol Industry, with 240 thousand jobs and 57 thousand jobs, respectively.

Table 5 – Structural Decomposition of the change in employment during 2000-2009

Sectors	**Intensity Effect**	**Technology Effect**	**Effect of the final demand structure**	**Effect of the change in the final demand**	**Total change**
Agriculture, forestry, forest exploitation	-5665	883	1704	2646	-432
Livestock and Fishing	-1972	183	223	1165	-402
Oil and natural gas	10	33	-12	9	40
Iron ore	15	-2	-2	6	18
Other mining and quarrying	-94	43	11	43	2
Food and beverage	69	23	35	389	517
Sugar Industry	**174**	**-16**	**34**	**48**	**239**
Tobacco products	-9	0	8	4	3
Textiles	13	28	-138	192	96
Articles of apparel and clothing accessories	776	-127	-669	379	360
Leather goods and footwear	353	-48	-340	126	92
Wood products - furniture exclusive	51	-27	-124	101	2
Pulp and paper products	-68	28	43	40	43
Newspapers, magazines, records	4	-67	31	81	49
Oil refining coke	39	-21	-14	4	8
Alcohol Industry	**11**	**18**	**11**	**17**	**57**
Chemicals	6	-19	1	21	9
Resin and Elastomers	-10	7	1	5	4
Pharmaceutical products	-16	-12	23	24	18
Pesticides	5	-2	1	4	9
Perfumery, hygiene and cleaning	-32	-6	39	23	23
Paints, varnishes, enamels and lacquers	15	-17	-2	7	4
Diverse chemical products and formulas	39	-40	-10	17	6
Rubber and plastic	211	-172	-5	80	113
Cement	-6	8	-1	3	5
Other non-metallic mineral products	74	-28	-51	117	113
Steelmaking and derived products	48	-26	-12	23	32
Non-ferrous metallurgy	-1	1	4	24	28
Metal products - except machinery and equipment	156	-90	-11	150	205
Machinery and equipment, including maintenance and repairs	48	-21	89	98	214

Home appliances	-2	-3	6	11	12
Office machinery and computer equipment	0	0	27	8	34
Machinery, appliances and equipment	90	-39	-7	44	88
Electronic material and communication equipment	53	-26	-45	19	1
Appliances / medical and hospital instruments, measurement and optical	18	-9	1	25	36
Cars, trucks and utilities	-67	-2	68	18	17
Trucks and buses	-16	0	16	5	5
Parts and accessories for motor vehicles	72	-22	26	58	134
Other transport equipment	-12	11	44	18	61
Furniture and products of various industries	62	-53	-67	186	127
Gas and electricity, water, sewage and urban sanitation	-35	11	12	83	70
Construction	711	-89	-398	1332	1555
Trade	-447	-153	999	3093	3492
Transport, storage and postal services	-334	218	61	786	731
Information Services	-193	185	241	334	566
Financial intermediation and insurance	-166	24	65	198	120
Real estate and rental	-103	44	41	132	114
Maintenance and repair services	149	-109	-77	400	363
Accommodation and food services	-409	-34	399	760	716
Business services	469	66	453	932	1920
Commercial education	180	-7	41	270	483
Commercial health	152	2	-14	350	489
Services provided to families and associations	-200	-105	294	886	876
Public education	611	-4	-453	763	917
Public health	-253	0	306	271	323
Public administration and social security	207	-52	236	997	1388
Total jobs	-5221	368	3140	17827	16114

Source: Prepared by authors

The intensity effect is related to the intensity of the labor used for production and represents the relation between employment and production in both industries. The intensity effect indicates positive impacts from the employment generation by the Sugar Industry (174 thousand jobs) and by the Alcohol Industry (11 thousand jobs). The result suggests, according to Sesso Filho *et al.* (2010), that the labor productivity decreased while the factor use intensity increased.

Technology presented negative effect on the variation of job positions for the Sugar Industry (16 thousand jobs) but the effect was positive for the Alcohol Industry (18 thousand jobs). These findings suggest a technological improvement in the Sugar Industry, which reduced the number of job positions, as result. In opposite, less technology was used in the Alcohol Industry where the number of job positions was increased. This fact agrees with the considerations of Shikida(1997). The author explains that from the perspective of the entrepreneur, a plant with a distillery producing both sugar and residual ethanol is much more advantageous than an autonomous distillery producing only ethanol. Thus, technological improvements in the Sugar Industry could generate better results also for the ethanol production; however, improvements in independent alcohol distilleries do not imply any effect on the sugar production.

The final demand structure analyses changes in the final demand by family consumption, export, etc. The changes were positive for both sectors, with 34 thousand jobs for the Sugar Industry and 11 thousand jobs for the Alcohol Industry. It was observed that from the final demand structure more jobs were

required during the analyzed period, in both sectors.

As the final demand structure, the change in the final demand is related to the economic growth. Thus, it presented positive results for both sectors, with 48 thousand jobs for the Sugar Industry and 17 thousand jobs for the Alcohol Industry. These results indicate a need for increasing the number of employees to meet the final demand, in both sectors. Table 4 shows that all effects induced an increase in the number of employees in all sectors, except the technology effect on the Sugar Industry. These results agree with the analyses of job generating and employment multipliers, previously shown.

In general, from the intensity effect on the economy, it was observed that about 5.2 million jobs losses were result of the Agriculture, forestry and forest exploitation (1) and Livestock and Fishing (2), sectors that were negatively impacted. It suggests that the economy inactivated jobs due to the improved work productivity. However, the total change demonstrate that about 16 million jobs were created due to the positive effects of technology, final demand structure and change in final demand, that is, a reduction on job positions occurred due to the increased work productivity but, in contrast, the other three effects raised the number of job positions above the job losses observed in the economy.

5. Final considerations

This work aimed at analyzing the job variation in the Sugar and Alcohol Industries during the years 2000 and 2009, as well as the effects of technology and work productivity on the job variation. Therefore, the employment generators were computed for years 2000 and 2009 as well as the Structural Decomposition on the job changes for these periods.

The results of the employment generators for the year 2000 showed that the Sugar Industry was in the 3rd position on the job generating ranking, while the Alcohol Industry occupied the 5th position. However, in 2009 these industries dropped to the 9th and 8th positions, respectively. It happened due to the reduction on job generation in both industries. The Sugar Industry created 64.3 direct and indirect jobs in 2000, reducing the job positions to 44.2 in 2009. Similarly, the Alcohol Industry generated 57.4 jobs in 2000, reducing this number to 45.0 in 2009.

It was also observed that both sectors are able to create higher amounts of jobs for other sectors of economy than for their own sectors. In 2000, the Sugar Industry created 4.4 direct jobs and 59.9 indirect jobs; in 2009 the same industry created 10.4 direct jobs and 33.8 indirect jobs. The Alcohol Industry, on the same way, generated 4.3 direct jobs and 53.1 indirect jobs in 2000, and 4.9 direct jobs and 40.1 indirect jobs in 2009.

It is worth to mention that some facts that happened in the years 2000-2009 could contribute to a decrease in job generation. The first fact is the international financial crisis in 2008, which affected the Sugar and Alcohol Industries as much as the other economies (even with the strengthened effects after 2010). Another fact that impaired the Alcohol Industry was the discovery of pre-salt in 2007. Since then, the country has its policies targeted to the fossil fuel market, weakening thus the ethanol market.

However, even with this drop in employment generation, the two industries remained among the sectors that most generate jobs. Among the 56 sectors analyzed in this work, Sugar and Alcohol are among the top 10 employment generators within an economy. In addition, the Structural Decomposition points out that the economic growth of this period has created jobs in the economy, as noted in the analysis of the total effect on the change in final demand.

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