THE ECONOMIC STRUCTURE OF THE STATE OF SERGIPE IN 2006: A CONTRIBUTION BY THE INPUT-OUTPUT MATRIX

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ABSTRACT

This paper aims at constructing the Input-Output Matrices (IOM) of the State of Sergipe, so that information be offered as well as specific recommendations that may serve as inputs for the planning policies of the state. Therefore, we used the tools of the input-output analysis through the methodological variant of the modified aggregated RAS[1] for the construction of regional matrices in order to identify the technological profile of the state's economy through structural indicators of self-sufficiency, chaining and impact multipliers. The results show that the economy in Sergipe has serious problems related to the structure supply offer of inputs in vital sectors for the development of the state. In addition to that, it is sectorially concentrated, has low international insertion and a few key sectors which induce local growth. Moreover, the disconnection among the sectors that generate more output, employment and income hinder the adoption of public policies.

Key words: Input-Output Matrices; Productive Structure; Sergipe; Development.

TOPIC 25 - Extensions in Multiplier and Linkage Analysis.

[1]The method RAS begins, initially with two vectors and by the technological matrix (A). These vectors represent the sectoral output and the intermediate consumption and correspond the letters **r** and **s** respectively. According to this, the technological matrix will be pre-multiplied by the vector **r** and post-multiplied by the vector **s** (biproportional), therefore it is clear the use of the terminology RAS for this method.

INTRODUCTION

One of the major challenges in recent years confronted by most countries has been the resurgence of long-term planning, focusing on microeconomic, as a way of absorbing consistent and sustainable results for their economies.

This fact extends to sub-national instances whose flexibility to carry out structural measures is reduced. This is a result of short-term political and macroeconomic results that still influence the choices of policy makers, thus causing, in the absence of a better environment, projects that transform the society and lead to higher levels in the sense of development.

Although the state of Sergipe is the smallest federal territorial of Brazil instance, one can not disregard its importance and its possible role as a strategic region for the development of modern policies. Considering the fact that bigger territorial dimensions are not synonymous of economic power and development.

The recent process of socioeconomic transformation in Sergipe, notably in the 1990's, culminated in a certain dynamism in the industrial and services sectors, especially those connected to the extractive industry.

Even so, the state of Sergipe still lacks a set of information to guide and leverage its development process. In order to establish channels leading to effects in dynamic sectors generating employment and the adoption of programs that place the state in a modern level of competitiveness.

Thus, this research paper , by the use of the input-output analysis, pursuance to bring predictions concerning the production structure of Sergipe, by the study of structural indicators of the supply of inputs, outputs, employment and income. Thus offering grants to the deployment of development programs, as well as strategic core element to agents in the corporate segment.

This paper is organized in four sections besides this introduction. In the first section concerns the analysis of the social economic data about the economy of Sergipe. The second details the methodology that made possible the constructions of input-output matrices of Sergipe. The third section introduces and explains the structural indicators used in the study, followed by the forth sections reserved for results and discussions. By the end, the final remarks are presented.

1 CHARACTERISTICS OF THE ECONOMY OF SERGIPE[2]

It is known that Sergipe is geographically the smallest federal unit of the Brazil and that its economy still has little productive representation, both from a regional and national point of

[2] In this sections the authors thank the professor Dr. José Ricardo Lacerda de Melo, from the Federal University of Sergipe for the supply of data.

view. In 2006 the Gross Domestic Product (GDP) of Sergipe's economy, according to the Brazilian Institute of Geographic and Statistics (IBGE), was R$ 15.124 millions, representing 4,86% of the northeast region and responsible for only 0,64% of the wealth produced in Brazil. On the other hand, at the same year Sergipe became the state of the northeast region with the highest *per capita* GDP (R$ 7.559, 35); however this structure shows a high degree of sectoral concentration in the state. This fact can be explained by the reduced participation of the state in the regional population and mostly due to the presence of large companies in the state, such as the Hydroelectric Company “Vale do São Francisco”(CHESF), “Vale do Rio Doce” and PETROBRAS[3].

In the social field, the state is still short of a decent standard for its citizens. The Human Development Index (HDI) of Sergipe in 2005, calculated by the United Nations development Program (UNDP) connected to the United Nation (UN) in partnership with the João Pinheiro foundation, went from 0,742, situated below the national rate of 0,794 putting the state in the 19th place in the Brazilian ranking. This result reflects the complexity of the challenge the public entities have to face to provide ideal conditions for health, education and income to the population of Sergipe.

A worrying aspect regarding the competitiveness of Sergipe is related to educational levels. This is because, according to the National Household Sample Survey (PNAD) of 2006, from IBGE, the average years of schooling of the population of Sergipe was superior to the average of the northeast region, but still below the national average, which reduces the degree of attractiveness for investments.

Accordingly, public policies were directed to the education sector focusing primarily on vocational courses in the technology and information fields, whose areas are of extreme importance to the skills needed to current technological standards in the industry. Thus the state of Sergipe will acquire the competitive conditions to attract new companies. This will represent an important competitive edge regionally, which will imply in the diversification of its supply chain.

The process of economic transformation of the state came through the change in the agricultural profile for industrial relevance. This became a reality, from the 1990’s, though the tax incentive mechanism and the use of natural resources, which set a new stage in the economic history of the state, diversifying the productive activities and generating new opportunities.

The production of goods and services of the state of Sergipe in 2006 was concentrated in the service sector with 63,74% of the state’s GDP, followed by industry with 31,38% and agriculture with 4,88%. The textile and garment industries as well as the footwear, cement and sugar cane mills represent the more traditional sectors of the economy of Sergipe. In the first sector, the focus is the oil and various minerals extraction, especially potassium.

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[3]Excluding the capital Aracaju, the cities of Canidé do São Francisco, Rosário do Catete and Carmópolis, also localized in the state of Sergipe where the companies Chesf, Vale do Rio Doce and Petrobras respectively act, present the highest municipal GDP.

The contemporary economic debate identifies the foreign trade as an important variable to achieve economic growth and development of a given region, which is corroborated by the process of globalization and trade liberalization. Thus, when a country or state has a fair share of its industrial park orientated to the foreign markets, trade relations have a significant role in generating wealth. This is not the case for the state of Sergipe. In 2006, according to the Ministry of Development, Industry and Foreign Trade (MDIC), the degree of economic openness of the state was less then 2,2% of the GDP, the market has yet to be exploited by the entrepreneurs in Sergipe.

In this context, the economy of Sergipe was structured to serve only the domestic demand, at the local and national levels. The most notorious case in this regard is the marketing of oil and gas production as well as fertilizers, cement and textiles. The foreign market has been an strategic target for the production concentrated juice and some metal products (MELO, 2010).

Thus, one of the greater challenges of economic planning in a region is to build a model that represents, in an approximate manner, the productive structure. In this sight, the agents responsible for public policies identify the theory of input-output as an important tool in this process, even considering the difficulty in the availability of information for the full implementation of the models.

In its natural progression, the input-output models were developed with reference to the productive structure of a given country. Then the demand for local analysis led to the development of a regional model, for example a model for a region or federation unit (CONSIDERA et al., 1997).

Being a relatively small unit reinforces the idea that it becomes more “clever” plan their economic dimensions, and thus structuring its industrial park, which allows for a maximum use of resources and productive factors in the state.

2 THE INPUT-OUTPUT MATRIX OF SERGIPE’S ECONOMY

The economic model proposed by Leontief (1966) allows the construction of IOM, for which it is possible to portray the diverse relationships between sectors of a given economy, contributing to the economic planning of the governments in their various spheres (MILLER and BLAIR, 2009). In other words, the technical input-output is a linear model of output in the economic system and is represented in a simplified manner by means of tables of intersectoral flows of goods and services, which demonstrates the different inter-industrial relations and the reproducibility of the production (PRADO, 1981).

This technique has limitations and assumptions. The input-output implicitly assume a perfectly elastic supply and constant prices, while the projected changes are derived from exogenous movements in the demand (MILLER and BLAIR, 2009). Even with these limitations, the technique of input-output is very important for the development planning, especially regional development. It provides mechanisms for efficient allocation of economic resources in undeveloped areas. In this sense, it's quite clear the importance of structural relationships in the economy, which should receive the attention of policy makers (PRADO, 1981).

Considering these remarks, over time, economists have been improving the input-output technique as a way to make the models more realistic, so they could offer coherent answers on the various national and regional structures.

Concerning the methodology used to construct the regional matrices, it is recommended by the international literature the adoption of non-survey[4]. Among these indirect methods, the most suitable one is the biproportional input-output model method as described by Stone (1962) and Bacharach (1970), and adapted by Czamanski e Malizia (1969) for the estimation of regional matrices. This sort of methodology requires survey and are difficult to apply, and the attainment of data is highly expensive as well.

As we can see, the IOM of Sergipe's economy were created from the national matrix, through the added and modified RAS algorithm proposed by Leite (2009). In general, this method does not distinguish between the origin of regional and imported inputs (rest of the country or the world); in this sense, the resulting matrix can be considered a hybrid matrix (ROUND, 1983; LAHR, 1993). This assumption is literally conditioned to the lack of data concerning the market on internal roads in the country.

Since there is no data available in scale about the trade between federal units, any attempt to build an inter-regional model will have only a theoretical outcome, once this method requires a detailed and concrete level of business transactions of who buys and who sells (ISARD, 1951).

Thus, what is prioritized in the methodology is the study of the technological structure of output in the region, considering the assumptions of sector technology and market-share (LEITE, 2009; RIBEIRO, 2010; GIGANTES, 1970).

The method consists on estimating the state matrices simultaneously making sure that the matrices are coherent, consistent and compatible with the economic scenario considered in the study, taking into account the following hierarchy: country, region and state. In other words, the model is compatible. The matrices are constructed by the disaggregating the matrix of national intermediary inputs and outputs to its regional components, which in this case include the northeast region.

The northeast region's matrix, calculated from the national matrix, can be obtained in Leite (2009) or Ribeiro (2010) and the methodology for the states is similar, respecting the hierarchy established in the study.

[4] Widely used in 1980's for construction of matrices, since the requirements in relation to data, time and money were relatively low (HEWINGS, 1985).

The algorithm is defined through the pre and post-multiplication of vectors “r” (intermediary production edge of adjustment) and “s” (intermediate consumption edge of adjustment) by the matrix Q “square”, also called intermediate product and consumption, while at the same time, revised by correction factors.

In a first moment the northeast’s matrix Q “square” is obtained Q_{NE} ,from its technological matrix A_{NE} , which can be obtained as the following expression:

$$Q_{NE} = A_{NE}.\langle g_{NE} \rangle \quad (1)$$

Where, $\langle g_{NE} \rangle$ represents the diagonalized vector of northeast sectoral production.

Simultaneously, in this same step, it is possible to determine the production vectors (m_{NE}) and intermediary consumption (c_{NE}) of the region as followed:

$$m_{NE} = Q_{NE}.u \text{ e } c_{NE} = u'.Q_{NE} \quad (2)$$

Where *u* is the unitary vector or sum-vector.

In a second part the Q “square” state matrices are estimated, Q_{H*} , as a first approach, obtained by the pre-multiplication of the technological state matrix, A_{NE} , with the diagonalized sectorial production vector , g_H , in other words:[5]

$$Q_{H*} = A_{NE}.\langle g_H \rangle \quad \forall H = 1,2,...,9, \text{ States of the northeast region} \quad (3)$$

Based on this framework, the next step is to obtain the proxie of the intermediary production vector $s\,m_H$, for each state; in this case there are nine states: Alagoas, Bahia, Ceará, Rio Grande do Norte, Maranhão, Paraíba, Pernambuco, Piauí e Sergipe, whose vector is derived from the following process:

i) The intermediate state production vector, m_{H*} is temporarily calculated, through the following expression:

$$m_{H*} = Q_{H*} \cdot u \quad (4)$$

ii) Following the intermediate production vector *“proxy”* is estimated as following:

$$m_H = m_{i(H*)}.\frac{\sum c_{i(H)}}{\sum m_{i(H*)}} \quad (5)$$

[5] It is temporarily adopted the hypothesis that the regional technological structure is similar to the domestic one, besides the regional is also considered similar to the state one.

Where $c_{H,i}$ is the state intermediary consumption vector.

Equation 5 indicates the weight intermediate consumption has on the intermediate production, which translates the manufacturing-effect for all sectors requiring a specific sector. Variations in the intermediate absorption by any intermediate sector alter the intermediate production deliberately.

To obtain the state matrices Q “square” , the iterative procedures and the correction factors are established ensuring that the state matrices $Q_{(H)}^{k+3(F^{k+3})}$ do not differ significantly from $Q_{(H)}^{k+1(F^{k+1})}$, where $k = 3,4,...,n$- steps of interaction– and F the matrix containing the correction factors, as well as the sum of the matrices $Q_{(H)}^{k+3(F^{k+3})}$ equalizing $Q_{(NE)}$, as the best approximation to the real Q “square” state matrices $Q_{(H)}$, namely:

1º Part - *Step 1*:
$Q_{(H)}^{1} = \langle r_{H}^{1} \rangle . Q_{(NE)}$, following, we obtain: $Q_{(H)}^{F^1} = Q_{ij(H)}^{1} \otimes F_{ij}^{1}$

1º Part - *Step 2*:
$Q_{(H)}^{2} = Q_{(H)}^{F^1} . \langle s_{H}^{1} \rangle$, following, we obtain: $Q_{(H)}^{F^2} = Q_{ij(H)}^{2} \otimes F_{ij}^{2}$

2º Part - *step 1* :
$Q_{(H)}^{3} = \langle r_{H}^{2} \rangle . Q_{(NE)}$, following, we obtain: $Q_{(H)}^{F^3} = Q_{ij(H)}^{3} \otimes F_{ij}^{3}$

2º Part – *step 2*:
$Q_{(H)}^{4} = Q_{(H)}^{F^3} . \langle s_{H}^{2} \rangle$, following, we obtain: $Q_{(H)}^{F^4} = Q_{ij(H)}^{4} \otimes F_{ij}^{4}$

K Part - *step 1* :
$Q_{(H)}^{k+2} = \langle r_{H}^{k} \rangle . Q_{(NE)}$, following, we obtain: $Q_{(H)}^{F^{k+2}} = Q_{ij(H)}^{k+2} \otimes F_{ij}^{k+2}$

K Part - *Step 2*:
$Q_{(H)}^{k+3} = Q_{(H)}^{F^{k+2}} . \langle s_{H}^{k} \rangle$, following, we obtain: $Q_{(H)}^{F^{k+3}} = Q_{ij(H)}^{k+3} \otimes F_{ij}^{k+3}$

It is worth noticing that each round is equal to two steps (one part) of the algorithm, being adjusted by the correction factors entered into the interactive process that goes on until their convergence and stability, thus ensuring full compatibility of regional matrices.

The edges are defined as following for each round of the algorithm:

$$r_{H,i}^{(t+1)/2} = \frac{m_{H,i}^{0}}{m_{NE,i}^{t-1}} \quad \text{e} \quad s_{H,j}^{(t+1)/2} = \frac{c_{H,j}^{0}}{c_{N,j}^{t-1}} \qquad (6)$$

In general, t represents every step in each part of the interactive process.

The first table of correction factors, which adjusts all regional matrices making them compatible with the national matrix, is obtained as followed:

$$F^{t} = \{ f_{ij}^{t} \} = q_{ij(NE)} \cdot \frac{1}{\sum_{H=1}^{9} q_{ij(H)}^{t}} \text{; sendo, } i, j = 1,2...,n \text{ e } \forall H = 1,2,...,9 . \quad (7)$$

Where $i = j$, every element of the matrix, or each specific point of the matrix.

Where F^{t} represents the table with the setting values used in the matrix $Q_{(H)}^{t}$. The region's total amount of states (H) is described by *H*, which, in this study, will be equal to nine. The value *t* on the other hand represents every step of each part of the interactive process. As Ribeiro (2010) highlights, the sum varies with the number of matrices used in the study.

The table values F^{t} are calculated in a conjugated manner, on other words, there is a correspondence between the elements (*i* and *j*) in the northeast regional matrix (N) with the state's matrices (*H*). In this case, after obtaining the values of the correction table, it is possible to apply the corresponding setting values F^{t} from the table for every corresponding element from the matrix Q_{H}^{t}.

In this part, every matrix is corrected at the same time, the corrections been expressed as following:

$$Q_{(H)}^{F^{t}} = Q_{ij(H)}^{t} \otimes F_{ij}^{t} \quad (8)$$

where $Q_{(H)}^{F^{t}} = \{ q_{ij(H)}^{F^{t}} \}$ represents the table with the values corresponding to the Q "square" state matrix, adjusted and corrected for each state's sectors[6].

In this case the table is built by the multiplication by a scalar, or in a "bijective" accordance between the elements from the correction factor's table and the targeting matrices (state).

Similarly, it's possible to obtain the second table containing the correction factor of the current part, but considering a new matrix $Q_{(H)}^{t+1}$:

$$F^{t+1} \{ f_{ij}^{t+1} \} = q_{ij(NE)} \cdot \frac{1}{\sum_{H=1}^{9} q_{ij(H)}^{t+1}} ,\ i, j = 1,2...,n \text{ e } \forall H = 1,2,...,9 \quad (9)$$

[6] The symbol " $\otimes$ " represents the "tensor product". It is use implies the multiplication of a scalar by a scalar.

Where $F^{t+1} = \{ f_{ij}^{t+1} \}$ is a table containing the correction factor from the second step of each round of the interactive method.

Then we apply the second correction factor, following the same multiplicative process obtaining the new corrected table:

$$Q_{ij(H)}^{F^{t+1}} = Q_{ij(H)}^{t+1} \otimes F_{ij}^{t+1} \qquad (10)$$

At last, in every round we conclude that the matrix $Q_{(H)}^{F^{t+1}} = \{ q_{ij(H)}^{F^{t+1}} \}$ tends to the truth Q "square" regional input matrices, Q_H, for each *h* states in the region in *m* rounds.

The correction factors proposed by Leite (2009), inserted into each part of the interactive process both by pre-multiplying the matrix A by the vector r as in post-multiplication by the vectors s, intent to ensure the state's (regional's) matrices compatibility to the regional (national) matrix. In this method the state's (regional's) matrix comprising the regional (national) matrix must be calculated simultaneously in order to ensure that the sub regional matrices obtained are compatible with the regional one.

And finally in the space compatibility reference $Q_{(H)} \subset Q_{(NE)}$. At the same time, the edges $r, s \cong i$ and factor correction's tables $F^{t}, F^{t+1} = I$ accredit the convergence of the interactive method.

Thus, the Technological Matrix of each of the nine states can be obtained by pre-multiplying the state's matrix Q "square" by the state's sectoral production vector inverted diagonalized. As in this framework our interest concerns the state of Sergipe in the north east region we can obtain as follows:

$$A_{(SE)} = Q_{(SE)} . \langle q_{SE} \rangle^{-1} \qquad (11)$$

Where $A_{(SE)} = [a_{ij(SE)}]$, for $i = 1,...,n$ e $j = 1,...,n$, displays the value of the product range in the domestic industry "*i*" acquired directly for the production of a monetary unit of products from the state's sector "*j*".

After the preparation of the regional technological matrix though the modified and aggregated RAS, it's possible to perform structural analysis and develop a self-sufficiency diagram", chaining index and impact multipliers. Therefore, it is necessary to construct the Leontief Inverse Matrix whose shows the direct and indirect sectoral effects in the economy system as follows:

$$Z_{(SE)} = [I - A_{(SE)}]^{-1} \qquad (12)$$

Where , $Z_{(SE)} = [z_{ij(SE)}]$, and $i = 1,2...,n$; $j = 1,2,...,n$.

3 STRUCTURAL INDICATORS

The IOM have several pieces of information that are used as parameters for decision making by analyzing the production structure, production chains between activities and its key-sectors, besides the output, employment and income multipliers. For more complex structural analysis see Kurz, Dietzenbacher and Lager (1998); Lahr and Dietzenbacher (2001) and Hewings; Sonis and Boyce (2002).

3.1 "Self-Sufficiency Diagram"

The matrix Q "square" allows the construction of a table where the output "self-sufficiency" for each sector in the region is accounted according to the intermediate demand from other sectors in the economic area studied. This framework allows one to visualize the conditions of supply of inputs and intersectoral strategies for incentives (LEITE and PEREIRA, 2010).

Its formulation is given by the difference between the Gross Value of Production (GVP) and the intermediate local demand (DI), a sort of apparent consumption as demonstrated in the following expression:

$$Balance_i = VBP_i - DI_i \text{ where, } DI_i = \sum_{j=1}^{n} Q_{ij} \quad \text{com } j = 1,2,...,n \qquad (13)$$

The balance will be in deficit (negative) if the demand from sectors "*j*" for inputs from sector "*i*" is greater than the output produced in sector "i". In this case, it's interesting to provide incentives to this sector (location strategy).Otherwise, if the balance has got a surplus (positive), it reveals that the industry produces more than enough internally to respond to the demand from other sectors and therefore supplies the rest of the nation and elsewhere. This characterization does not mean, if the sector is in deficit or surplus, that business is conducted only between sectors in the region been studied. Thus the framework only establishes a synthetic view from the current production situation and extracts the future investments to respond the local market.

This framework seeks to indicate the region's productive capacity to meet the demand for inputs required for production in various productive sectors in the region. Superficially, this would represent the degree of external dependence (rest of the country and rest of the world) of the federal unit to develop its own internal activities. Therefore, this information is helpful in guiding public policy planning and strategic decisions of the private sector (LEITE, 2009).

3.2-Linkage indicators

Chenery e Watanabe (1958) created two indexes to analyze the power of linkages of different sectors of the productive system, whose base is the technological matrix (A): the forward analysis (W_{io}), which is linked to the destination of production and the backward analysis (W_{oj}), which refers to the use of factors. Prado (1981) suggests a percentage of 40% as a basis for analysis, that is, if the sector presents its percentage of production above 40% ($W_i > 0,4$) is intermediate; if not, it is final . If this sector presents more than 40% of its basket of intermediate input value from other sectors ($W_j > 0,4$), is secondary ;if not, is primary. Mathematically, these indices can be expressed as:

$$w_i = \sum_{j=1}^{n} a_{ij} \qquad\qquad w_j = \sum_{i=1}^{n} a_{ij} \tag{14}$$

Backward linkages Forward linkages

To capture the effects on direct and indirect relations between economic activity sectors, Rasmussen Coefficients[7] will be used to measure the dispersion power in backward linkages and the dispersion sensitivity index of forward linkages. Rasmussen's connection coefficient shows the ratio between the average impacts in a sector and the average effect for all the economy, mathematically can be written as follows:

$$u_{oj} = \frac{\frac{1}{n} z_{oj}}{\frac{1}{n^2} \sum_{i=1}^{n} z_{oj}} \tag{15}$$

Where, U_{oj} is the Rasmussen's backward linkage coefficient, Z_{oj} is a row vector , $z_{oj} = \sum_{i=1}^{n} z_{ij}$, which sums the values from the Leontief's Inverse Matrix (Z) rows along its column , showing how much is demanded by each sector in its backwards linkages.

$$u_{io} = \frac{\frac{1}{n} z_{io}}{\frac{1}{n^2} \sum_{j=1}^{m} z_{io}} \tag{16}$$

Where U_{io} is Rasmussen's forward linkages coefficient, Z_{io} is a colum vector, $z_{io} = \sum_{j=1}^{m} z_{ij}$, which sums the Leontief's Inverse Matrix (Z) colums along its rows, showing how much is offered by each sector in its forward linkage.

As the Ramsmussen's Connection Coefficients are a relation between the means, they can be classified as those above the average and those below the total average; therefore it can be analyzed using a threshold value, which usually is set at 1. When $U_{oj} > 1$, the sector has strong upstream linkage; When $U_{oj} < 1$, the sector has weak upstream linkage ; When $U_{io} > 1$, the sector has got strong downstream linkage ;and when $U_{io} < 1$, the sector has got weak forward linkage.

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[7] Rasmussen (1958).

Rasmussen's Dispertion Coefficient reflects a mesure of variation , which means that the measures of dispertion around the average are used. The dispertion coefficients search to measure which is the influence of a given sector in the other sectors in the economy. This measure goes beyond the Connection Coefficients. Matematically, the Dispertion Coefficients can be written as follows:

$$V_{oj} = \frac{\sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(Z_{ij} - \frac{1}{n}Z_{oj}\right)^2}}{\frac{1}{n}Z_{oj}} \tag{17}$$

Where V_{oj} is Rasmussen's Backward Dispertion Coefficient

$$V_{io} = \frac{\sqrt{\frac{1}{n-1}\sum_{j=1}^{n}\left(Z_{ij} - \frac{1}{n}Z_{io}\right)^2}}{\frac{1}{n}Z_{io}} \tag{18}$$

Where V_{io} is the Rasmussen's forward Dispertion Coefficient.

A joint analysis of the Connection Coefficients and Dispersion leads to the concept of key-sectors of the economy, which have a high level of linkage both forward and backward. The sectors with a strong linkage power in the Connection Coefficients $U_{oj} > 1$ and $U_{io} > 1$ can be classified by their ability to disperse, V_{oj} e V_{io}. Those are called the key sectors once they are able to leverage the economy more quickly than other sectors increasing both its demand and demand from other sectors in the economy (PRADO, 1981).

3.3 Impact multipliers

The possibility of making structural analysis and to measure the impacts of changes in final demand on some parameters in the economic system makes these indicators complementary and essential for formulating strategies for growth and development.

Using the Leontief Inverse Matrix (Z), it is possible to estimate the direct, indirect and total sectoral impacts, based on changes in the components of the final demand. Thus, important multipliers, both from the economy as from output, employment and income can be obtained. As such, output's multiplier MP_j, the main economic growth stimulator, shows how certain sector "j" can generate output in other economic sectors, or, accordingly the changing in one final demand monetary unit, compared to output in sector "j". Its definition is given as:

$$MP_j = \sum_{i=1}^{n} z_{ij} \quad (19)$$

where z_{ij} are the elements from Leontief Inverse Matrix

Employ multiplier, ME_j, shows the change in the level of employment for sector "*j*" due to a change in a final demand unit. It is defined by the following expression:

$$ME_j = \sum_{i=1}^{n} z_{ij}.e_i \quad (20)$$

Where $e_i = \dfrac{E_i}{GVP_i}$, represents the ration between the total amount of employees E_i, and the gross value of output in sector "*i*", GVP_i.

Similarly, the income multiplier, MV_j, is given by the ratio between the Added Value , AV_i, and the Gross Value of Product in sector "i", GVP_i, which is:

$$MV_j = \sum_{i=1}^{n} z_{ij}.v_i \quad (21)$$

Where , $v_i = \dfrac{AV_i}{GVP_i}$.

Therefore, while the criteria of output multiplier is quantitative, that is, taken as the main growth indicator, employment and income multipliers are the main stimulators of economic development, constituting thus qualitative indicators for the economy (LEITE; PEREIRA, 2010).

3.4 Data speccification

The data that made possible the construction of input-output matrix for the economy of Sergipe in 2006 refer to the Tables of Resources and Uses (TRUs), Regional accounts and Annual Industrial Research (PIA), all drawn up by IBGE, besides the Social Information Annual Report (RAIS), and the Ministry of Labor and Employment (MTE).

The data of the 35 sectors analyzed were derived from the disaggregation of the industrial and transformation sector, regional accounts, through proportions originated from the PIA.

4 RESULTS ANALYSIS

From the methodological variant of the RAS and the correction factors proposed in Leite (2009), it was possible to construct the IOM for the economy of Sergipe for the year 2006.

The self-sufficiency indicator, which seeks to measure the issue of supply sector, reveals that the economy of Sergipe still presents a important deficiency in some important sectors of its productive system, as shown in table 1.

Table 1 - "Self-sufficiency in Sergipe in 2006 - R$ Million

Economic Activity Sectors	Total Output	Intermediate Demand	Superávit / Déficit
1 - Agriculture , Forestry , Logging	449,34	338,53	110,82
2 - Livestock and Fiching	464,86	201,20	263,67
3 - Oil extraction and Related Services	1.976,74	337,71	1.639,03
4 - Other Mineral Extraction	**11,05**	**68,80**	**-57,75**
5 - Food and Drinks	1.076,69	563,97	512,71
6 - Tabacco	19,99	1,27	18,72
7 - Textille	491,81	211,06	280,76
8 - Clothing sector	66,91	16,73	50,17
9 - Leather and Footwear	193,38	42,00	151,38
10 - Wood Products	**5,22**	**64,30**	**-59,08**
11 - Cellulose and Paper	**53,94**	**90,55**	**-36,61**
12 - Editorial and Graphic	**44,61**	**107,69**	**-63,08**
13 - Chemical and Petrochemical	**612,69**	**674,06**	**-61,37**
14 - Rubber and Plastic	**108,72**	**180,16**	**-71,45**
15 - Cement and Nonmetallic Mineral	567,94	326,35	241,59
16 - Metal Products- except Machinery and Equipment	199,06	178,44	20,62
17 - Machinery, Equipment and Appliences	**107,71**	**143,98**	**-36,27**
18 - Office and Computer Science	**1,04**	**12,05**	**-11,01**
19 - Machinery and Appliences	**10,50**	**144,18**	**-133,68**
20 -Hospital Equipments	**1,35**	**16,71**	**-15,36**
21 - Vehicles	**13,46**	**111,20**	**-97,73**
22 - Transport Equipments	17,56	16,68	0,88
23 - Various Industries	63,33	52,20	11,13
24 - ISPU	1.844,43	836,44	1.007,99
25 - Civil Construction	1.560,45	205,73	1.354,72
26 - Trade	1.948,59	136,53	1.812,06
27 - Transport and storage	1.360,64	544,49	816,15
28 - Information	**604,02**	**616,31**	**-12,29**
29 - Financial	758,84	624,94	133,90
30 - Housing	1.228,35	221,30	1.007,06
31 - Food and Accommodation	473,75	93,54	380,21
32 - Business Services	**594,33**	**825,18**	**-230,85**
33 - Health and Education	424,16	37,49	386,68
34 - Other Services	544,58	81,61	462,97
35 - Public administration	4.645,62	61,34	4.584,28

Source: Own eleboration.

Of the 35 sectors analyzed, 13 showed deficit results; mostly in processing industry. The largest negative index was the business service sector, followed by machinery and appliances which means that, apparently, the sectors do not have sufficient production to meet the demand from all sectors in the economy of Sergipe.

The other sectors in deficit, as other Mineral Extractives, Wood Products, Cellulose and Paper, Editorial and Graphic, Chemical and Petrochemical, Rubber and Plastic, Machinery, Equipment and Appliances, Office and Computer Sciences, Hospital Equipment, Vehicles and Information also deserve attention, revealing the non-maturation of important activities of the productive system of Sergipe, which prevents further advances in the economic growth of the state.

Thus this analysis points sectors that could be targeted by tax-induced policies in order to promote a balanced economic growth. Moreover, still allows the allocation of investments more efficiently by the private sector, not only spatially but also for each sector.

The simple linkage index of Chenery and Watanabe (1958) show that Sergipe produces predominantly final and secondary use goods and services, that is, the intermediary consumption in this sectors is high, but the output destination is, mostly, to meet the final demand, as shown in Table 2.

Tabela 2 – Simple linkage index of Chenery and Watanabe

Economic Activity Sectors	Connection Index					
	Forward	Rank	Destination	Backward	Rank	Use
1 - Agriculture , Forestry , Logging	1,308104	2º	Intermediate	0,255645	31º	Primary
2 - Livestock and Fiching	0,234232	19º	Final	0,261745	30º	Primary
3 - Oil extraction and Related Services	0,201939	25º	Final	0,492718	13º	Secundary
4 - Other Mineral Extraction	0,214647	22º	Final	0,527003	10º	Secundary
5 - Food and Drinks	0,907905	5º	Intermediate	0,713173	4º	Secundary
6 - Tabacco	0,060514	33º	Final	0,993365	1º	Secundary
7 - Textille	1,101775	3º	Intermediate	0,622060	6º	Secundary
8 - Clothing sector	0,032931	35º	Final	0,785527	3º	Secundary
9 - Leather and Footwear	0,221366	20º	Final	0,525507	11º	Secundary
10 - Wood Products	0,480662	12º	Intermediate	0,577064	8º	Secundary
11 - Cellulose and Paper	0,623257	10º	Intermediate	0,590871	7º	Secundary
12 - Editorial and Graphic	0,209659	23º	Final	0,469272	14º	Secundary
13 - Chemical and Petrochemical	1,907159	1º	Intermediate	0,419562	19º	Secundary
14 - Rubber and Plastic	0,559303	11º	Intermediate	0,651721	5º	Secundary
15 - Cement and Nonmetallic Mineral	0,330978	17º	Final	0,404096	22º	Secundary
16 - Metal Products- except Machinery and Equipment	0,444140	13º	Intermediate	0,251204	32º	Primary
17 - Machinery, Equipment and Appliences	0,345065	16º	Final	0,301965	28º	Primary
18 - Office and Computer Science	0,061002	32º	Final	0,147394	34º	Primary
19 - Machinery and Appliences	0,371681	15º	Final	0,376179	23º	Primary
20 -Hospital Equipments	0,129984	26º	Final	0,410333	21º	Secundary
21 - Vehicles	0,387725	14º	Final	0,549846	9º	Secundary
22 - Transport Equipments	0,257122	18º	Final	0,457122	16º	Secundary
23 - Various Industries	0,106784	29º	Final	0,804289	2º	Secundary
24 - ISPU	1,044153	4º	Intermediate	0,424280	18º	Secundary
25 - Civil Construction	0,127314	27º	Final	0,417842	20º	Secundary
26 - Trade	0,205679	24º	Final	0,232373	33º	Primary
27 - Transport and storage	0,791857	7º	Intermediate	0,306129	27º	Primary
28 - Information	0,778915	9º	Intermediate	0,466574	15º	Secundary
29 - Financial	0,781811	8º	Intermediate	0,327445	24º	Primary
30 - Housing	0,215775	21º	Final	0,050090	35º	Primary
31 - Food and Accommodation	0,109310	28º	Final	0,496874	12º	Secundary
32 - Business Services	0,904309	6º	Intermediate	0,311427	26º	Primary
33 - Health and Education	0,032945	34º	Final	0,433966	17º	Secundary
34 - Other Services	0,086522	30º	Final	0,322987	25º	Primary
35 - Public administration	0,076126	31º	Final	0,275004	29º	Primary

Source: Own eleboration.

Although Sergipe's economy been a final producer of goods and services is a positive fact, once its economic activity is more connected with the final consumer, the economy of Sergipe is not capable of developing a dynamic cycle inside its productive structure.

The strong concentration of the economy in some specific sectors and the (apparent) lack of inputs in sectors considered strategic, as machinery and equipment, office and computer science and information reduce the potential of qualified labor absorption and the generation of internal income.

However, the input-output analyzed provides another interpretation is the identification of the key-sectors of a certain productive system. This is possible from a joint analysis of connection indexes, when superior to one and subjected the Rasmussen Dispersion Coefficient as shown in table 3.

Table 3 – Key sectors in the economy of Sergipe - 2006

Economic Activity Sectors	Connection Index				Dispertion Index			
	Forward	Rank	Backward	Rank	Forward	Rank	Backward	Rank
1 - Agriculture , Forestry , Logging	1,762506	2º	0,798956	31º	1,918558	34º	4,504914	3º
2 - Livestock and Fiching	0,848613	17º	0,836792	29º	4,174233	21º	4,259570	11º
3 - Oil extraction and Related Services	0,835310	18º	0,992850	15º	4,244819	20º	3,563567	24º
4 - Other Mineral Extraction	0,771994	22º	1,060392	12º	4,808327	13º	3,480059	28º
5 - Food and Drinks	**1,377742**	**8º**	**1,245130**	**4º**	**3,099004**	**27º**	**3,493413**	**27º**
6 - Tabacco	0,595992	33º	1,450775	2º	6,988543	2º	2,888337	**34º**
7 - Textille	**1,473208**	**4º**	**1,201718**	**5º**	**2,984918**	**28º**	**3,761554**	**22º**
8 - Clothing sector	0,587208	35º	1,473985	1º	7,393250	1º	2,924166	33º
9 - Leather and Footwear	0,719275	25º	1,131567	11º	5,836068	3º	3,687810	23º
10 - Wood Products	0,966500	12º	1,131624	10º	4,622112	15º	3,964596	**17º**
11 - Cellulose and Paper	**1,123501**	**10º**	**1,142286**	**7º**	**3,547075**	**25º**	**3,546861**	**25º**
12 - Editorial and Graphic	0,793923	20º	1,032843	13º	4,397287	19º	3,387114	30º
13 - Chemical and Petrochemical	2,892468	1º	0,962189	20º	1,369438	35º	4,475986	**4º**
14 - Rubber and Plastic	**1,081745**	**11º**	**1,193171**	**6º**	**3,451059**	**26º**	**3,254350**	**31º**
15 - Cement and Nonmetallic Mineral	0,810967	19º	0,946310	22º	4,415546	18º	3,786011	20º
16 - Metal Products- except Machinery and Equipment	0,950086	13º	0,793788	32º	3,658227	24º	4,436023	6º
17 - Machinery, Equipment and Appliences	0,879224	16º	0,838002	28º	3,949489	23º	4,160750	13º
18 - Office and Computer Science	0,608208	32º	0,685062	34º	5,817175	5º	5,124602	2º
19 - Machinery and Appliences	0,891604	15º	0,908426	23º	4,099351	22º	4,051024	16º
20 -Hospital Equipments	0,650330	27º	0,947073	21º	5,703808	6º	3,896330	19º
21 - Vehicles	0,932991	14º	1,132001	9º	4,747970	14º	3,901015	18º
22 - Transport Equipments	0,758316	24º	1,012584	14º	5,819069	4º	4,319943	9º
23 - Various Industries	0,640192	30º	1,399389	3º	5,591686	9º	2,541596	35º
24 - ISPU	1,721777	3º	0,965497	18º	2,370767	32º	4,358899	8º
25 - Civil Construction	0,661414	26º	0,962918	19º	5,197043	12º	3,530373	26º
26 - Trade	0,772730	21º	0,770553	33º	4,417195	17º	4,423999	7º
27 - Transport and storage	1,340130	9º	0,847442	27º	2,655369	31º	4,294943	10º
28 - Information	1,435671	6º	0,992629	16º	2,848972	29º	4,202376	12º
29 - Financial	1,380002	7º	0,860743	26º	2,724009	30º	4,467865	5º
30 - Housing	0,761386	23º	0,606321	35º	4,479431	16º	5,628977	1º
31 - Food and Accommodation	0,648543	28º	1,140837	8º	5,647555	8º	3,174198	32º
32 - Business Services	1,454042	5º	0,862235	25º	2,359497	33º	4,098226	15º
33 - Health and Education	0,591290	34º	0,974809	17º	5,652554	7º	3,400793	29º
34 - Other Services	0,642289	29º	0,883004	24º	5,237569	11º	3,775752	21º
35 - Public administration	0,638824	31º	0,816097	30º	5,282061	10º	4,107692	14º

Source: Own elaboration .

Four economic activities were classified as key sectors of the economy of Sergipe in 2006, which are: Food and Drinks; Textiles; Cellulose and Paper; and Plastic and Rubber. These sectors have a strong power of linkage both forward the productive chain and backward the productive chain, therefore, they must be considered strategic to boost economic growth (PRADO, 1981; GUILHOTO et al., 1994).

Connection indexes show how the sectors are able to leverage output, either demanding or offering input. While the numbers concerning dispersion indicate how concentrated (high level of dispersion) or how distributed (low level of dispersion) this demand or offer can be compared to other sectors in the economy.

Output multipliers reveal direct and indirect global effects from all sectors on total output in the economy. These effects arise from shocks in household's consumption, government spending, business investments and exports.

The sector of Chemical and Petrochemicals Products presented the highest output multiplier in Sergipe's economy, as shown in table 4. Each increase of 1.000 monetary units in final demand for this sector requires 5.170 monetary units of output from other sectors in Sergipe's economy.

Table 4 – Impact Multipliers of Sergipe's Economy

Economic Activity Sectors	Output		Employment		Income*	
	Unitary change R$		Every R$ 1 million on final demand		Unitary change R$	
	MPj	Rank	MEj	Rank	Mj	Rank
1 - Agriculture , Forestry , Logging	3,15	2º	51,98	6º	2,26	2º
2 - Livestock and Fiching	1,52	17º	15,77	31º	1,10	9º
3 - Oil extraction and Related Services	1,49	18º	7,52	35º	0,76	15º
4 - Other Mineral Extraction	1,38	22º	115,20	1º	0,45	31º
5 - Food and Drinks	2,46	8º	30,11	18º	0,76	14º
6 - Tabacco	1,06	33º	18,00	29º	0,16	35º
7 - Textille	2,63	4º	49,91	8º	0,79	12º
8 - Clothing sector	1,05	35º	34,70	13º	0,31	33º
9 - Leather and Footwear	1,28	25º	16,44	30º	0,53	27º
10 - Wood Products	1,73	12º	78,90	4º	0,61	22º
11 - Cellulose and Paper	2,01	10º	26,86	21º	0,54	26º
12 - Editorial and Graphic	1,42	20º	27,12	20º	0,68	19º
13 - Chemical and Petrochemical	5,17	1º	76,60	5º	2,27	1º
14 - Rubber and Plastic	1,93	11º	28,28	19º	0,34	32º
15 - Cement and Nonmetallic Mineral	1,45	19º	12,82	33º	0,64	20º
16 - Metal Products- except Machinery and Equipment	1,70	13º	19,19	27º	0,68	18º
17 - Machinery, Equipment and Appliences	1,57	16º	23,97	23º	0,73	16º
18 - Office and Computer Science	1,09	32º	90,85	3º	0,71	17º
19 - Machinery and Appliences	1,59	15º	39,03	11º	0,56	25º
20 -Hospital Equipments	1,16	27º	99,83	2º	0,52	28º
21 - Vehicles	1,67	14º	32,91	15º	0,48	29º
22 - Transport Equipments	1,35	24º	18,69	28º	0,47	30º
23 - Various Industries	1,14	30º	19,79	26º	0,22	34º
24 - ISPU	3,08	3º	41,92	9º	1,84	3º
25 - Civil Construction	1,18	26º	14,77	32º	0,61	21º
26 - Trade	1,38	21º	30,66	17º	1,02	10º
27 - Transport and storage	2,39	9º	40,29	10º	1,12	8º
28 - Information	2,56	6º	33,48	14º	1,33	6º
29 - Financial	2,46	7º	36,42	12º	1,65	5º
30 - Housing	1,36	23º	10,09	34º	1,29	7º
31 - Food and Accommodation	1,16	28º	21,17	25º	0,58	23º
32 - Business Services	2,60	5º	50,70	7º	1,76	4º
33 - Health and Education	1,06	34º	24,41	22º	0,58	24º
34 - Other Services	1,15	29º	21,87	24º	0,76	13º
35 - Public administration	1,14	31º	31,29	16º	0,81	11º

Source: Own elaboration.

* Data from RAIS/General Register of Employed and Unemployed (CAGED) was used to built a employment persons vector in 31/12/2006 for each economic sector in Sergipe's economy.

Other sectors that stand out in quantitative terms, thus generating strong impacts in the productive system of Sergipe are: Agriculture, Industrial Services and Public Utility (ISPU) and Textiles. From a qualitative point of view, aiming the developing of Sergipe's economy, the sectors which generate more employment from exogenous variations in final demand are not the same acquiring the biggest output. The sector generating more jobs in Sergipe is Other Mineral Extractives, once for each variation of R$ 1.000.000,00 in final demand generate approximately 115 direct and indirect jobs. Other sectors standing out are Hospital Equipments and Office and Computer Science with approximately 90 and 99 jobs respectively.

When it comes to added value or income generation in the economy, that is, salaries, profits, interests and rents the income multiplier indicates the change in the components arising from a unit change in any components of the final demand: changes in exports, household's consumption, investment and government spending. In this sense, once again the sectors of Chemical and Petrochemical Products have presented the highest multiplier and, therefore, confirm to be an important sector for the productive system of Sergipe. Table 4 shows that for every increase of R$ 1,00 in the final demand in this sector generates R$ 2,27 additional income in Sergipe's economy.

Given this structural configuration, agents responsible for planning policies are faced with a triple trade-off: output, employment and income. A sector can be an important generator of output, but have little impact in the generation of employment and income or vice-versa which induces to disconnected policies. However, the combination of policies and economic priorities associated with strategies from the privet sector could lead to global results in the state's economy. As we can see even if we take the key sectors as a reference, other economic activities are also very important to the state and, in this case, must be analyzed as a way to ameliorate economic dynamics in the state.

FINAL REMARKS

The objective of this study was to construct a set of relevant information concerning Sergipe's productive structure, so that it can become useful for further planning policies applied in the state.

The low insertion of Sergipe's economy in the foreign market is an important challenge for public authorities and agents of the privet sector. The formulation of a program to increase gradually the presence of Sergipe's products in the foreign market would improve the scale production and the state's intersectoral dynamic.

We also observe that the local productive activities present serious problems in the provision of input to productive sectors of the region. This factor affects new investment projects in the state, as well as the degree of development that could be potentially consolidated in the region. The concentration of wealth production in a few sectors in the state exacerbates this situation.

The promotion of an environment that can attract companies, mostly those in sectors that generate employment, absorbing, thus, a significant portion of the labor force, could lead to a more integrated and more representative state.

Finally, we conclude that even with some technical and productive deficiencies, the state of Sergipe through coordinated public policies could obtain results that may lead to higher states of development.

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