The Socio-Economic Importance and Interdependence of the Metropolitan Regions of Belém and Manaus in Brazil: An Input-Output Analysis

Gisalda C. Filgueiras
Department of Economics – Federal University of Pará
E-mail: gfilgueiras@ufpa.br

Joaquim J.M. Guilhoto
Department of Economics, FEA - University of São Paulo

Carlos R. Azzoni
Department of Economics, FEA - University of São Paulo

Carlos Alberto Gonçalves Júnior
Department of Economics, UNIOESTE (Western Paraná State University)
Doctoral Student in Economics, FEA-University of São Paulo

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Of the seven states of the North Region, Belém, the State capital of Pará, and Manaus, the State capital of Amazonas, are those with greatest economic, social and environmental dynamics. The population of these two cities amount to 3.2 million people, with an average Human Development Index (HDI) of 0.714, but with major differences in their per-capita GDP. While Manaus per-capita GDP is R$ 26,760; Belém per-capita GDP is almost half of it, i.e., R$ 14,575 (IBGE, 2014). They are also two different economies, while State of Pará is essentially an exporter of primary goods (minerals and forest products); State of Amazonas, is a major importer of industrial inputs, from the rest of the world and from the rest of the country, given that since the 1960s the city hosts the Industrial Pole of Manaus - IPM. The focus of this study is to analyze the dynamics that these two cities have among themselves, with their states, and the rest of Brazil. The basic hypothesis is that - despite their structural economic differences, these two cities differ in local economic and social development, and although they have received several tax incentives trough public policy, they have not been able to extrapolate the effects of their positive dynamic linkages to their own states and to the rest of Brazil. This relates to the fact that Pará state, being a net exporter of primary products is not able to add value to their products; this problem is accentuated by: a) the high share of informal jobs in the primary sector; and b) the introduction of Environmental Laws restricting various activities of the agricultural sector. Manaus, on the other hand, as a major importer of industrial inputs: a) ultimately lead to major leak of income abroad, since the jobs generated in the city aggregate low value added to the final goods being produced; and b) this directly influences its increase in imports, including raw and processed food products. Thus, to better understand these interconnections among the regions, it is used an inter-regional input-output (I-O) model, considering six regions (São Paulo, Belém, Rest of Pará State, Manaus, Rest of Amazonas State, and Rest of Brazil) for the year 2009. Using this I-O model, it is possible to compare the economic structure of these cities, with regard to its main indicators (employment, production and income), to better understand their strengths and weaknesses, as well as the spillover effects of the two economies, in such way that better public policies could be defined for these regions.

KEYWORDS: Input-Output, Amazon Region, Productive Structure, Brazil.

1. INTRODUCTION

This study analyzes the commercial relations among the Metropolitan Regions of Belém and Manaus, their own states, the State of São Paulo, and the rest of the country. An Inter-Regional input-output matrix was used, consisting of six regions and 47 sectors. However, to understand the dynamic involving the exchange of goods and services between the major metropolitan regions of Northern Brazil (Belém and Manaus) with São Paulo, and the rest of Brazil, it is necessary to understand the dynamics of the Brazilian regions.

Brazil is the fifth largest country by area, with 8,514,877 km², with an estimated a population of 202,033,670 in 2014. The Human Development Index (HDI) in 2010 was 0.733. The country has 26 states and a federal district (Brasília). The Gross Domestic Product (GDP) for 2012 was US$ 2,243854 million and per capita income of US$ 11,199 (IBGE, 2015).

The metropolitan regions (MR) of Belém and Manaus are located in the North Region.

The MR of Belém is formed by seven municipalities (Ananindeua, Belém, Benevides, Castanhal, Marituba, Santa Bárbara do Pará and Santa Isabel do Pará), with Belém being the state capital. Belém has a physical area of 3,565,7830 km^2 and an estimated population of 2,361,272 in 2014, which corresponds to a density of 662,203 people per km^2. The state GDP in 2012 was R$ 91,009,014 thousand Brazilian reals. The MR of Belém has contributed with 31.66% of the state GDP or, R$ 2,362,272 thousands, and the average per capita income was R$ 8,236.02. In the overall, the economy of the state of Pará is based on vegetal and mineral extractivism, and the service sector.

The MR of Manaus MR involves eight municipalities (Careiro da Várzea, Iranduba, Itacoatiara, Manaus, Manacapuru, Novo Airão, Presidente Figueiredo e Rio Preto da Eva) and Manaus is the capital of the state of Amazonas. It has a land area of 101,474,980 km^2, a population of 2,315,286 in 2014 and a demographic density of 217,903 people per km^2. The state GDP in 2012 was R$ 64,119,836 thousand reals and the participation of the MR of Manaus corresponded to 82.98%, or R$ 53,204,309 thousand while the *per capita* income was R$ 12. 623.36. This is due to the wealth generated by the Industrial Pole of Manaus concentrated in the Metropolitan Region of Manaus.

The state of São Paulo is located in the Brazilian southeast region, being the most developed state in the country and the financial center of the country.

The purpose for this study is to shed some light on the current process of economic development occurring in the country, which has not being homogenous, with growing regional inequality on account of its productive structures and availability of different natural resources.

Finally, in order to analyze the productive structure and the importance of the commercial relations between the six regions under analysis, the paper is divided into four sections, besides this introduction. The second section describes the theoretical basis and the methodology of the model, besides the sub economic characteristics of the regions being analyzed. The third section presents the results, while in the last section the final comments are made.

2. THEORICAL BASIS AND METHODOGOLY

Developed by Leontief (1951), the input-output model shows the flows of goods and services among the sectors and agents of the economy for a given year. The inter-industries flows are determined by economic as well as technological factors and can be expressed through a system of simultaneous equations (MILLER and BLAIR, 2009).

In reason of the importance of the economical flows among regions, several recent studies have been contributing in the Inter-regional analysis, using, it broadly, the model of

Leontief, of which Silva (2004) has prominence, Gonçalves Júnior and Guilhoto (s/data), whose methodology proceeds closely, given the similarity of the research type or study in subject.

Besides, as well it stresses Leite and Pereira (2010) the "analysis input-outputis considered as important analytical instrument in the identification of the interdependence among the several sectors of the economy, as well as to know the productive structure and to analyze the impacts of economical politics, be of a country, a region, a state or smaller spaces." In matrix terms the inter-industries flows in the economy can be represented by

$$AX + Y = X \tag{1}$$

where X is a vector (*n x 1*) and it contains the value of total production by sector; *Y* is also a vector (*n x 1*) and it contains the final demand values; and *A* is a (*n x n*) matrix which contains the production technical coefficient

In the model above, the final demand vector is usually considered exogenous to the system; thus, the total production vector is determined only by the final demand vector, which is given by:

$$Y = BX \tag{2}$$

$$B = \left(I - A\right)^{-1} \tag{3}$$

where B, the Leontief inverse, is a (*n x n*) matrix of direct and indirect coefficients, in which the element b_{ij} shows the total amount of production that is required from sector *i* to produce one unit of final demand of sector *j*.

From equation (3) one can estimate the output multipliers of type (I), which shows the direct and indirect effects for a given sector (MILLER and BLAIR 2009), i.e., the total amount of production generated in the economy to produce one unit of final demand of the given sector, and is given by:

$$P_j = \sum_{i=1}^{n} b_{ij} \tag{4}$$

where P_j is the output multiplier of sector *j*.

One can also estimate, for each sector in the economy, the total amount of employment, value added, emissions, etc, that is generated directly and indirectly in the economy to produce one unit of final demand of the given sector. In order to do so, one needs to calculate the direct coefficient of the variable of interest:

$$v_i = \frac{V_i}{X_i} \tag{5}$$

where v_i is the direct coefficient of the variable of interest of sector *i*; V_i is the total of the variable of interest corresponding to sector *i* (for example, total employment of sector *i*); and X_i is the value of total production of sector *i*.

Then, the total impact, direct and indirect, on the variable of interest will be given by:

$$GV_j = \sum_{i=1}^{n} b_{ij} v_i \tag{6}$$

where GV_j is the generator of the variable of interest corresponding to sector *j*, which represents the total impact, direct and indirect, on the variable of interest given a new final demand of one monetary unit in sector *j*.

Based on the Leontief system other indicators can be estimated and used to better understand the economic relations and the productive structure of a given economy. In this way, this chapter makes use of backward and forward linkages (Hirschman-Rasmussen and Pure), to better understand the productive structure of the six regions economics. These indicators are described and defined in the following sections.

2.1. THE HIRSCHMAN-RASMUSSEN APPROACH

The work of Rasmussen (1956) and Hirschman (1958) led to the development of indices of linkage that have now become part of the generally accepted procedures for identifying key sectors in the economy. Being b_{ij} a typical element of the Leontief inverse matrix, B; B^* the average value of all elements of B, and $B_{\bullet j}$ associated typical column sums, then the backward linkage index can be defined as follows:

$$U_j = [B_{\bullet j} / n] / B^* \quad (7)$$

Defining F as the matrix of row coefficients derived from the matrix of intermediate consumption, G as the Ghosh matrix given by $G = (I - F)^{-1}$ (MILLER and BLAIR, 2009), G^* as the average of all elements of G, and G_{i*} as being the sum of a typical row of G, the forward linkages can be defined as:

$$U_i = [G_{i*} / n] / G^* \quad (8)$$

The Hirschman-Rasmussen indices of linkages measure the importance of a sector in the economy in terms of buyer (backward) or supplier (forward) of inputs. The Pure linkage approach presented below is similar to the Hirschman-Rasmussen, however it also takes into consideration the total production value of each sector in the economy, i.e., the size of the sector. The sectors indicated as the most important inside the economy, using the Pure linkage, in general are sectors with a great interaction among the other sectors and with a significant level of production.

In general the Hirschman-Rasmussen are concerned mainly with the technical coefficients, while the pure linkage also take into consideration the importance of the values supplied and demanded by each economic sector.

2.2 THE PURE LINKAGE APPROACH

As presented by Guilhoto, Sonis and Hewings (2005) the pure linkage approach can be used to measure the importance of the sectors in terms of production generation in the economy. Consider a two-region input-output system represented by the following block matrix, A, of direct inputs:

$$\boldsymbol{A} = \begin{bmatrix} \boldsymbol{A_{jj}} & \boldsymbol{A_{jr}} \\ \boldsymbol{A_{rj}} & \boldsymbol{A_{rr}} \end{bmatrix} = \begin{bmatrix} \boldsymbol{A_{jj}} & \boldsymbol{A_{jr}} \\ \boldsymbol{A_{rj}} & \boldsymbol{0} \end{bmatrix} + \begin{bmatrix} \boldsymbol{0} & \boldsymbol{0} \\ \boldsymbol{0} & \boldsymbol{A_{rr}} \end{bmatrix} = \boldsymbol{A_j} + \boldsymbol{A_r} \quad (9)$$

where A_{jj} and A_{rr} are the quadrate matrices of direct inputs within the first and second region and A_{jr} and A_{rj} are the rectangular matrices showing the direct inputs purchased by the second region and vice versa.

From (7), one can generate the following expression:

$$\boldsymbol{B} = (\mathbf{I} - \boldsymbol{A})^{-\mathbf{1}} = \begin{pmatrix} \boldsymbol{B_{jj}} & \boldsymbol{B_{jr}} \\ \boldsymbol{B_{rj}} & \boldsymbol{B_{rr}} \end{pmatrix} = \begin{pmatrix} \boldsymbol{\Delta_{jj}} & \boldsymbol{0} \\ \boldsymbol{0} & \boldsymbol{\Delta_{rr}} \end{pmatrix} \begin{pmatrix} \boldsymbol{\Delta_j} & \boldsymbol{0} \\ \boldsymbol{0} & \boldsymbol{\Delta_r} \end{pmatrix} \begin{pmatrix} \boldsymbol{I} & \boldsymbol{A_{jr}\Delta_r} \\ \boldsymbol{A_{rj}\Delta_j} & \boldsymbol{I} \end{pmatrix} \quad (10)$$

where:

$$\Delta_j = \left(I - A_{jj}\right)^{-1}$$

$$\Delta_r = \left(I - A_{rr}\right)^{-1}$$

$$\Delta_{jj} = \left(I - \Delta_j A_{jr} \Delta_r A_{rj}\right)^{-1}$$

$$\Delta_{rr} = \left(I - \Delta_j A_{rj} \Delta_j A_{jr}\right)^{-1}$$

From equation (8) it is possible to reveal the process of production in an economy as well as derive the Pure Backward Linkage (*PBL*) and the Pure Forward Linkage (*PFL*), i.e.,

$$PBL = \boldsymbol{\Delta}_r \boldsymbol{A}_{rj} \boldsymbol{\Delta}_j \boldsymbol{Y}_j \quad (11)$$

$$PFL = \boldsymbol{\Delta}_j \boldsymbol{A}_{jr} \boldsymbol{\Delta}_r \boldsymbol{Y}_r \quad (12)$$

where the *PBL* will give the pure impact on the rest of the economy of the value of the total production in region, i.e., the impact that is free from a) the demand inputs that region *j* makes from region *j* , and b) the feedbacks from the rest of the economy to region *j* and vice-versa. The *PFL* will give the pure impact on region *j* of the total production in the rest of the economy.

Other advantage of the Pure linkages in relation to the Hirschman-Rasmussen linkages is that it is possible to get the Pure Total linkage in the economy (*PTL*) by adding the *PBL* and the *PFL*, given that this index are measured in current values, i.e.,

$$PTL = PBL + PFL \quad (13)$$

To facilitate a comparative analysis of the pure linkages with the Hirschman-Rasmussen linkages one can do a normalization of the pure linkages. This normalization is done by dividing the pure linkage in each sector by the average value of the pure linkage for the whole economy, in such a way that the pure linkages normalized are given by the following equations for the backward (PBLN), forward (PFLN) and total (PTLN) linkages:

$$PBLN_i = PBL_i \Big/ \left(\sum_{i=1}^{n} PBL_i \Big/ n \right) \quad (14)$$

$$PFLN_i = PFL_i \Big/ \left(\sum_{i=1}^{n} PFL_i \Big/ n \right) \quad (15)$$

$$PTLN_i = PTL_i \Big/ \left(\sum_{i=1}^{n} PTL_i \Big/ n \right) \quad (16)$$

2.3 DATABASE

Table 1 presents information on the six regions, with emphasis on the three most important ones: RMB (Belém), RMM (Manaus) and São Paulo (SP); showing their socioeconomic picture. The three main regions are formed by 660 municipalities with a population close to 50 million. São Paulo is the state with the highest HDI (0,780). The other regions being considered are: The Rest of Pará (RPA); Rest of Amazonas (RAM) and the Rest of Brazil (RBR).

Table 1: Economical and social information of the six regions, Brazil

Regions	Area km²	Pop Density (hab/km²)	Population 2014	GDP (R$ millions) 2012	Per capita GDP 2012	HDI 2010	Number of Municipalities
SP (Z-001)	248.222,362	177,40	44.035.304	1.408.904	33.624,41	0,780	645
Belém (Z-002)	3.565,78	662,20	2.361.272	28.812	8.236,02	0,660	07
RPA (Z-003)	1.244.388,540	4,59	5.712.652	62.197	11.678,96	0,650	137
Manaus (Z-004)	101.474,98	217,90	2.315.286	53.204	12.623,36	0,630	08
RAM (Z-005)	1.559.148,890	2,23	1.558.457	10.915	16.662,42	0,670	54
RBR (Z-006)	5.358.966,497	27,39	146.785.591	2.828.062	22.402,00	0,744	4.719

Source: Research data

The interregional input-output system used in this paper was derived from the NEREUS (University of São Paulo Regional and Urban Economics Laboratory) database which consists of the Brazilian Interregional Input-Output System estimate for all the 5.565 Municipalities of the Brazilian economy, at the level of 134 industries and 187 commodities, for the year of 2009.

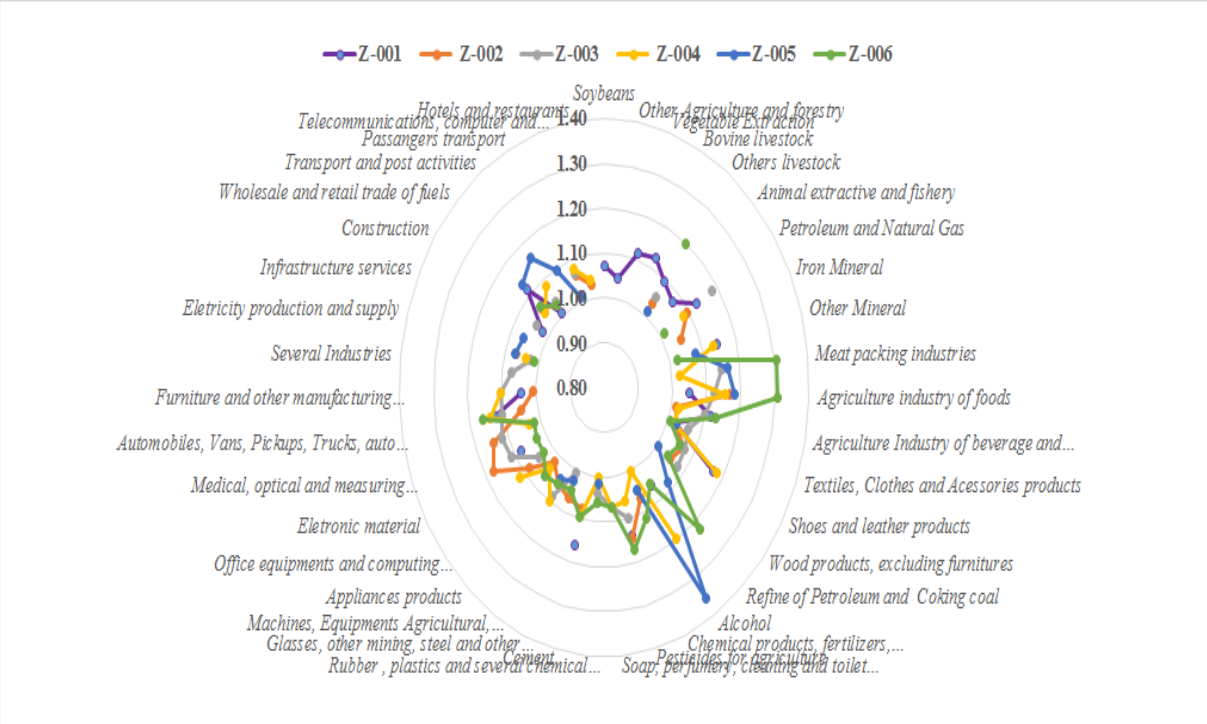
3. RESULTS AND DISCUSSIONS

This section is divided into two parts: the first one deals with the productive structure of the six regions using Rasmussen-Hirschman and pure linkage indexes. The second part proceeds with the analysis of the direct regional flows, as well as of mutiltipliers.

3.1 PRODUCTIVE STRUCTURE

The productive structure of a country or municipality can be analyzed by the identification of key sectors: this study uses two linkage methods: Hirschman-Rasmussen backward (HRBL) and forward (HRFL) linkages, as well as pure backward (PBL), pure forward (PFL) and the pure total (PTL) linkages. According to Guilhoto et al (2010), the linkage analysis aims to show how the linkages of each sector in each region occurs with the rest of the economy; revealing their dependencies, considering their backward (the amount of input needs, a sector demands from the other sectors to produce), and forward effects which reveal how much this sector is demanded by other sectors. Graph 1 shows HR backward linkage for the regions.

Graph 1: Backward HRBL linkage for each of the six Brazilian regions, 2009



Source: Research data

From a total of 47 sectors, the regions analyzes presented between 18 and 26 values in which the backward linkages is above average. The RAM (Z-005) region presented the lowest number of sectors with backward linkage (18) above average, while the rest of Brazil (Z-006) was the highest (26) also above average. However, these sectors were not the same for all regions; In the six regions, only three sectors showed backward linkages above average simultaneously: (Agriculture industry of foods, Textiles, Clothes and Accessory products, Transport and post activities). Graph 1 shows that the difference between the productive structures of the regions analyzed can be confirmed on Table 2.

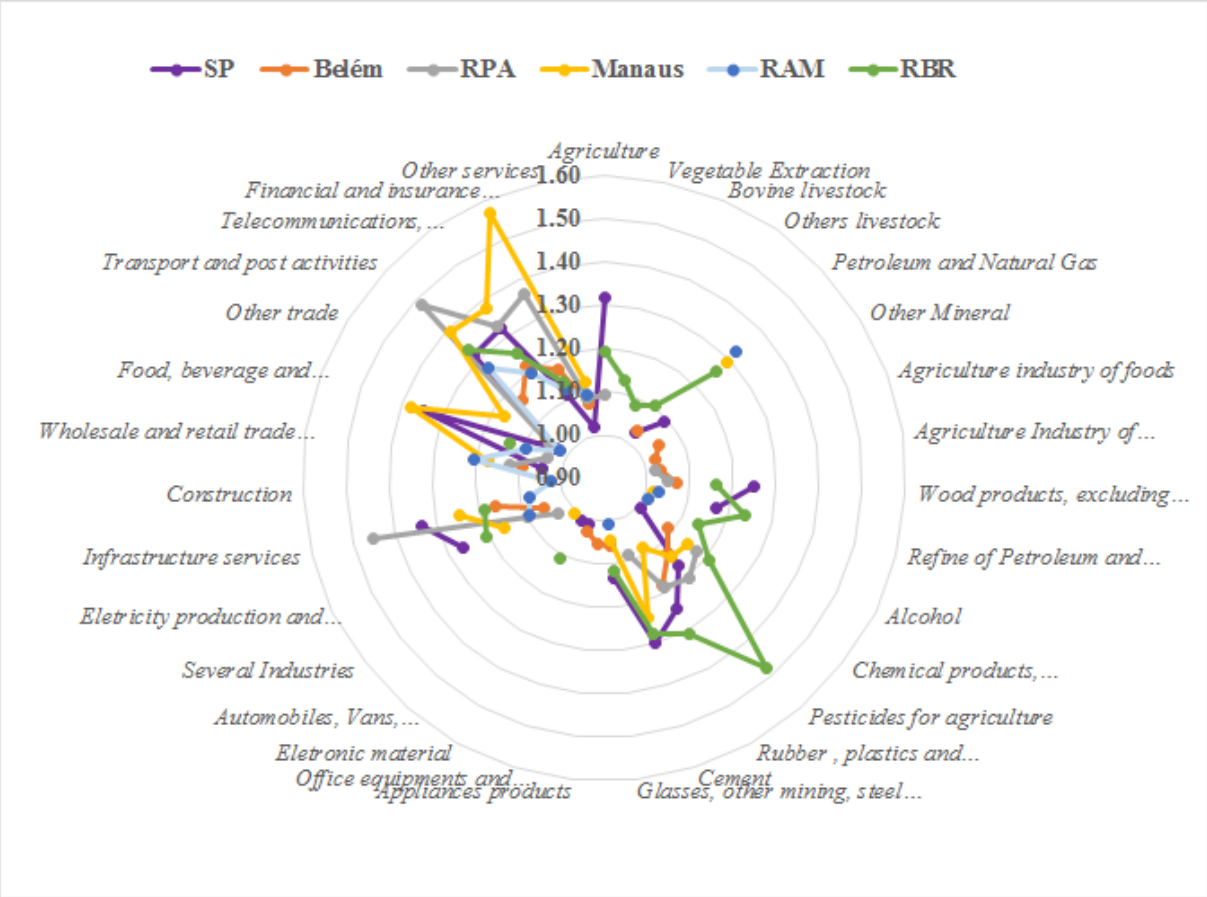
Table 2: HRBL Correlation – Isolated regions

	SP	Belém	RPA	Manaus	RAM	RBR
SP	1,00					
Belém	0.36	1,00				
RPA	0.30	**0.73**	1,00			
Manaus	0.37	**0.66**	**0.63**	1,00		
RAM	-0.02	0.03	0.17	0.42	1,00	
RBR	0.43	0.56	**0.61**	**0.64**	0.40	1,00

Source: Research data

The low similarity between the productive structures of the regions under analysis becomes more evident on Table 2. Only the Rest of Pará and Belém, and the Metropolitan Regions of Manaus and Belém presented moderate correlation between themselves and the rest of Brazil. The other values indicate a low correlation, and consequently, very different productive structures, regarding HR backward linkages. Graph 2 shows those sectors with linkage above average, by the HRFL, in which the sector is demanded by the other sectors.

Graph 2: Forward HRFL linkage for each of the six Brazilian regions, 2009



Source: Research data

The region with the lowest number of sectors with above average forward linkage was RAM (Z-005), with 14, and the highest, SP (Z-001), with 21 sectors. Manaus and Belém registered 17 and 18 respectively. Once more, these sectors were not the same for all regions and the sectors that are repeated in all five analyzed regions are: Production, distribution, and electric-power transmission; Infrastructure services; Transport and post activities; Telecommunications, computer and related activities and Financial and insurance intermediation. Table 3 shows the correlation between the productive structures regarding forward HR.

Table 3: HRFL Correlation for each region

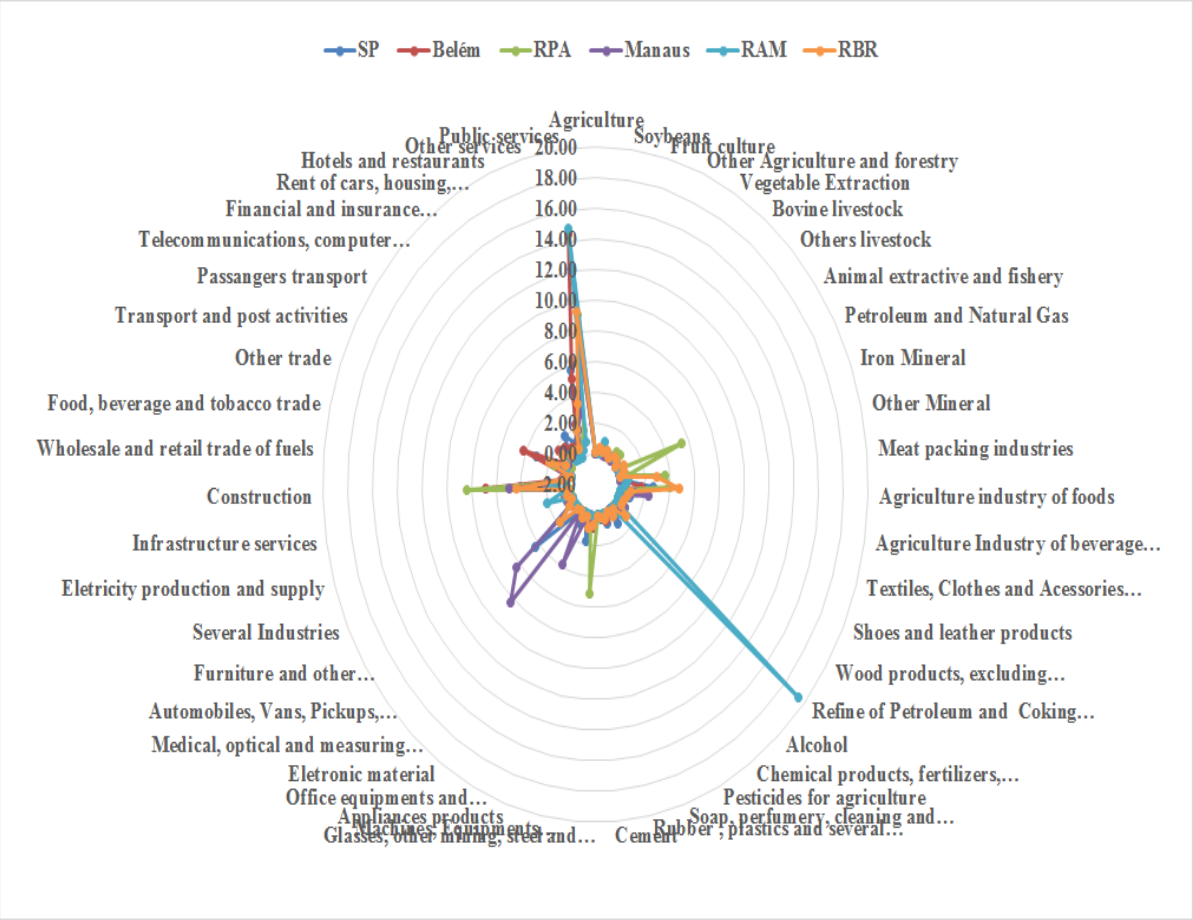
	SP	Belém	RPA	Manaus	RAM	RBR
SP	1,00					
Belém	**0.65**	1,00				
RPA	**0.76**	**0.83**	1,00			
Manaus	**0.70**	**0.63**	**0.77**	1,00		
RAM	0.49	0.48	0.53	**0.74**	1,00	
RBR	**0.84**	**0.63**	**0.65**	0.58	0.40	1,00

Source: Research data

Although the correlation values were higher than the backward HR, one cannot say that the productive structures are similar. Table 3 shows moderate correlation for HRFL among the regions that appear in bold, for a correlation above 60%, with the exception of SP and RAM; Belém and RAM; RPA and RAM and even RAM with the RBR.

Another way to analyze a productive structure of the system shown here is by determination of pure linkage indexes, developed by Guilhoto, Hewings e Sonis (GHS, 1996). Pure indexes measure the importance of a sector in terms of the production value it generates (GUILHOTO et al, 1996), so that, it is possible to determine which sectors are important between the areas in terms of interaction capacity between the sectors (Inter) and within the sectors (Intra) and the production value (SILVA, 2004). Graph 3 shows the backward effect of the pure linkage.

Graph 3: Pure backward linkage (PBL) for each of the six Brazilian regions, 2009



Source: Research data

The number of sectors with pure backward linkage with values higher than the unit diminishes considerably when comparing to HR linkages. One should stress the importance of oil refining and coal coke for Z-005 Region, besides agriculture which is important for almost all regions of the System. As for the similarity between the structures, Table 4 shows slightly higher correlation values, with similarity between the São Paulo and Belém regions, as well as with Belém and the rest of Brazil, however it continues low between the Metropolitan Regions of Belém and Manaus.

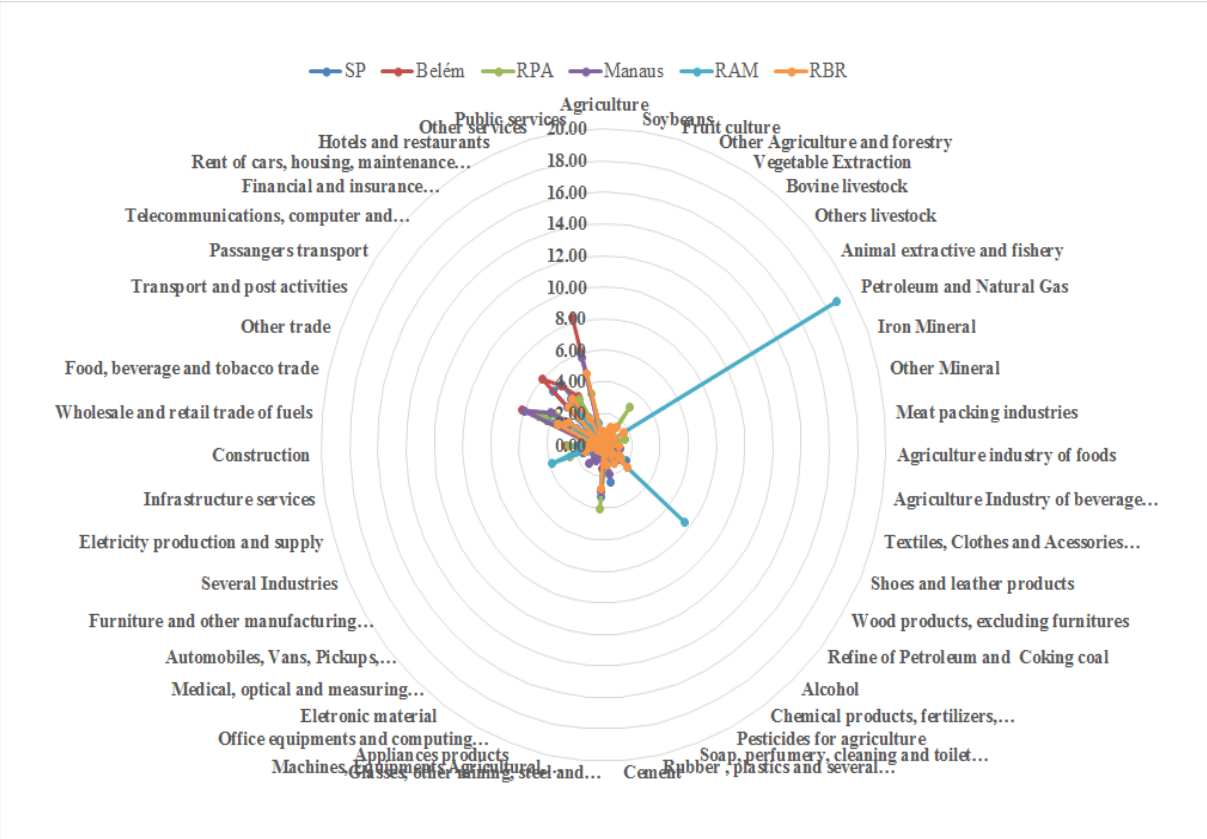
Table 4: PBL Correlation – Regions

	SP	Belém	RPA	Manaus	RAM	RBR
SP	1,00					
Belém	**0.83**	1,00				
RPA	0.58	**0.76**	1,00			
Manaus	**0.66**	0.56	0.40	1,00		
RAM	0.31	0.49	0.33	0.26	1,00	
RBR	**0.84**	**0.91**	**0.79**	0.54	0.51	1,00

Source: Research data

Graph 4 illustrates the forward effect of the pure linkage. The sector that stands out in the entire system is Oil and natural gas for Z-005 Region. It reflects oil production in Urucu Field, AM since 1988, as well as natural gas exploration in Juruá (AM). The Amazon state (AM) has 25% of the total natural gas reserve of Brazil-Petrobrás oil company, which amounts to 468.4 billion cubic meters (cbm) of gas, the state of Amazonas alone accounts for 129.54 billion cubic meters or 25%, housing the oil and natural gas refineries of the Amazon region.

Graph 4: Pure forward linkage (PFL) for each of the six Brazilian regions, 2009



Source: Research data

The Pure forward linkage (PFL) registered low in relation to PBL. As for similarity between the productive structures, it can be said that they have increased, considering the six regions in the System under analysis. Six sectors presented value above the unit at the same time: Production, distribution and electric-power transmission; Other commercial activities, Transport and post activities; Telecommunications, computer and related activities; Financial

and insurance intermediation, and Other services. Table 5 shows the correlation coefficient for productive structures in the System under analysis.

Table 5: PFL Correlation for each Region

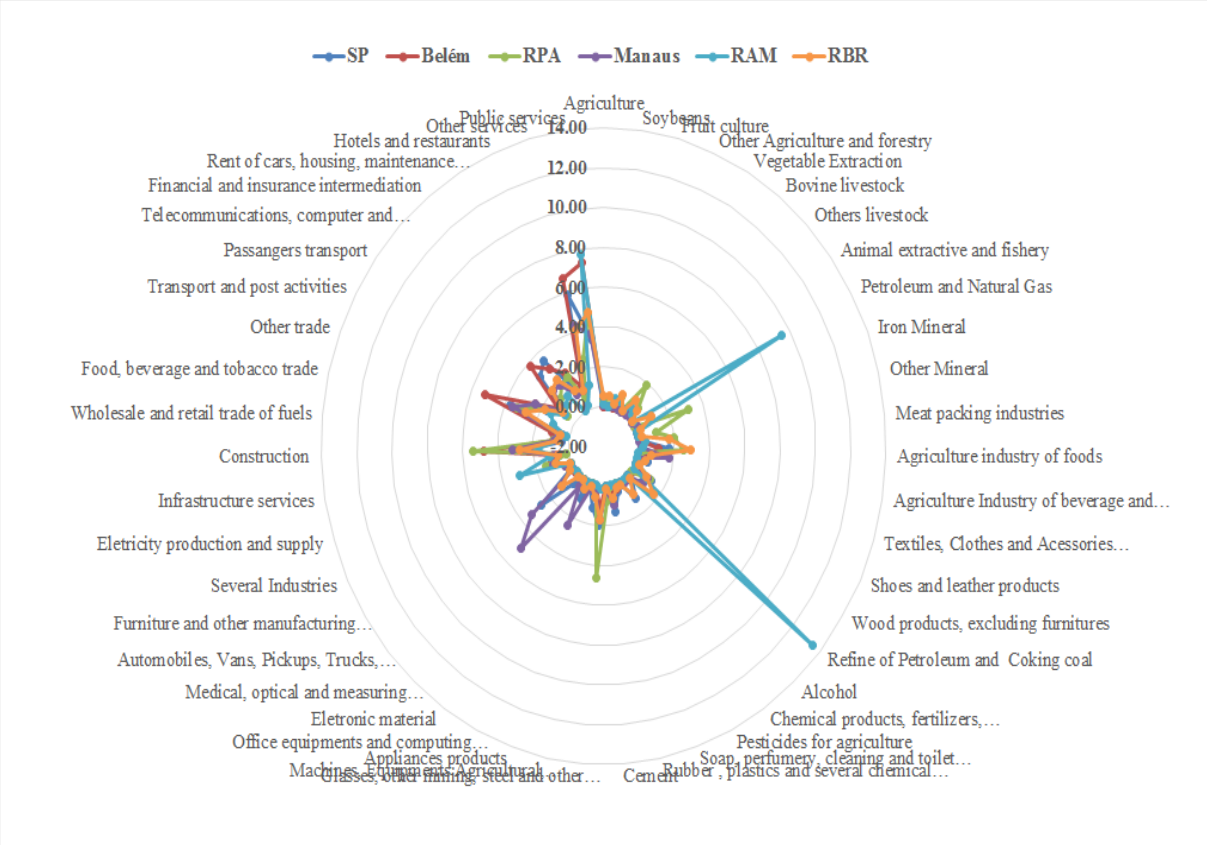
	SP	Belém	RPA	Manaus	RAM	RBR
SP	1					
Belém	**0.90**	1				
RPA	**0.73**	**0.78**	1			
Manaus	**0.91**	**0.91**	**0.77**	1		
RAM	0.08	0.08	0.04	0.12	1	
RBR	**0.93**	**0.87**	**0.80**	**0.88**	0.29	1

Source: Research data

One can see on Table 5 that, in general, the regions presented stronger inter and intra-regional relations for this index however, the productive structures of São Paulo, Belém and Manaus presented correlation above 90%.

When considering the Pure Total Linkage (PTL), according to Graph 5, the sectors with linkage above the unit for the six regions were basically the same already shown in other linkage indexes, namely (HR; PT; PF): Other commercial activities; Transport and post activities; Financial and insurance intermediation; Other services and Public Services, totalizing only five among the 47 in all six regions.

Graph 5: Total Pure Linkage (PTL) for each of the six Brazilian regions , 2009



Source: Research data

As for the coefficient correlation of this index (Table 6), remains the moderate correlation between SP and the other regions (Belém, Manaus and RBR); Belém-Manaus and Belém-RBR and Manaus with RBR, with more than 61% of correlation.

Table 6: PTL Correlation– for each Region

	SP	Belém	RPA	Manaus	RAM	RBR
SP	1,00					
Belém	**0.87**	1,00				
RPA	0.59	**0.72**	1,00			
Manaus	0**.75**	**0.69**	0.45	1,00		
RAM	0.14	0.23	0.13	0.15	1,00	
RBR	**0.85**	**0.89**	**0.75**	**0.61**	0.40	1,00

Source: Research data

As for the correlation between the regional productive structures, it is evident that, in the average the values were low for all indexes which were analyzed, indicating low similarity between the productive structures. It is also clear that both Metropolitan Regions of Manaus and Belém are more similar to that of São Paulo than to the rest of their respective states. That might be interesting because different productive structures may result in commercial advantages between the regions, in order words, it would stimulate commerce between the metropolitan regions and the rest of their respective states. In this context, the next selection is dedicated to analyzing the commercial flows, not only between the Metropolitan Regions of Belém and Manaus with the rest of the states, but also among themselves which may stimulate the regional development.

3.2 INTERREGIONAL FLOWS

This section analyzes the main direct commercial flows that occur between the six regions under study. Table 7 shows the commercial flow of products occurring between the regions. The lines show the sales (supply) that each region makes to the others. The column interprets how purchases (demand) are made from one region to the other to make their products.

Taking the regions of Belém (Z-002), as an example, it supplied goods and services to São Paulo (R$134.479 millions) but only R$8,332 million to the rest of the State of Pará. The Metropolitan Region of Manaus also bought R$ 19.265 million from SP and sold only 3.093 million to the rest of the State of Amazonas.

Table 7: Interregional flow of goods and services in millions of Brazilian Real of 2009

	SP	BELEM	RPA	MANAUS	RAM	RBR
SP		9.166	12.717	17.335	3.749	470.221
BELEM	134.479		8.332	155	25	4.807
RPA	3.295	9.070		264	31	8.566
MANAUS	19.265	541	9.208		3.093	21.650
RAM	4.041	35	50	8.990		2.074
RBR	272.548	8.599	14.674	14.131	6.785	

Source: research data

This shows that 90,99% of the sales from the Metropolitan Region of Belém are made to SP, and the remaining (9,01%) to the other regions. In order words, despite their proximity to each other, the Northern Regions (Belém, Manaus, RPA e RAM), have little commercial flow integration. Similar situation concerns Manaus that sells more to SP than to Belém and other closer regions.

Table 8 shows all commercial transactions of goods and services, that take place between the regions to feed the sectorial production of each region, but does not include imports from other countries, and the amounts spent with labor and cost of capital (GUILHOTO et al, 2010). It interpretation is done in the column, which shows what each regions buys within and outside its own region to produce goods and services.

Considering Manaus as an example, it buys from itself to produce goods and services R$ 18.290 million or 45% and R$ 13.015 million (32%) from other regions, and 9.528 million (23%) from RBR, due to its internal production needs.

Table 8: Flow of Intermediate Consumption in million reals of 2009

	SP	BELEM	RPA	MANAUS	RAM	RBR
SP	597.252	2.696	3.813	11.445	927	228.558
BELEM	1.198	5.767	3.715	122	17	2.406
RPA	2.631	1.355	7.221	212	17	4.764
MANAUS	12.978	131	127	18.290	1.138	7.045
RAM	2.931	24	33	1.236	1.164	1.541
RBR	188.951	3.057	6.077	9.528	2.323	1.126.656
TOTAL	**805.942**	**13.032**	**20.986**	**40.833**	**5.585**	**1.372.203**
SP	74.11%	20.69%	18.17%	28.03%	16.59%	16.66%
BELEM	0.15%	44.25%	17.70%	0.30%	0.31%	0.18%
RPA	0.33%	10.42%	34.41%	0.52%	0.30%	0.44%
MANAUS	1.61%	1.01%	0.61%	44.79%	20.38%	0.51%
RAM	0.36%	0.18%	0.16%	3.03%	20.83%	0.11%
RBR	23.44%	23.45%	28.96%	23.33%	41.58%	82.11%

Source: research data

From the above regions, the one with the most deficit is RAM, whose internal production depends essentially on the other regions (42%) and RBR (42%), totalizing 84%. Regions of Belém and Manaus achieve self-sufficiency in 44% of their needs (Table 8).

Table 9 shows the participation of the sums required for each region, but are related with the final demands for goods and services by the families, government, inventory, and gross capital formation, therefore, all that forms the final demand.

Table 9: Final Domestic Demand Flows in million Real of 2009

	SP	BELEM	RPA	MANAUS	RAM	RBR
SP	650.598	6.471	8.903	5.890	2.823	241.662
BELEM	133.280	11.362	4.617	33	8	2.401
RPA	665	7.715	25.446	52	14	3.802
MANAUS	6.287	409	9.081	16.877	1.955	14.605
RAM	1.110	11	17	7.754	476	533
RBR	83.597	5.542	8.597	4.603	4.463	1.447.263
TOTAL	**875.537**	**31.510**	**56.661**	**16.980**	**9.739**	**1.448.058**
SP	74.31%	20.54%	15.71%	0.03%	28.99%	0.02%
BELEM	15.22%	36.06%	8.15%	0.19%	0.08%	0.00%
RPA	0.08%	24.48%	44.91%	0.31%	0.14%	0.00%
MANAUS	0.72%	1.30%	16.03%	99.39%	20.07%	0.00%
RAM	0.13%	0.03%	0.03%	0.05%	4.89%	0.04%
RBR	9.55%	17.59%	15.17%	0.03%	45.83%	99.95%

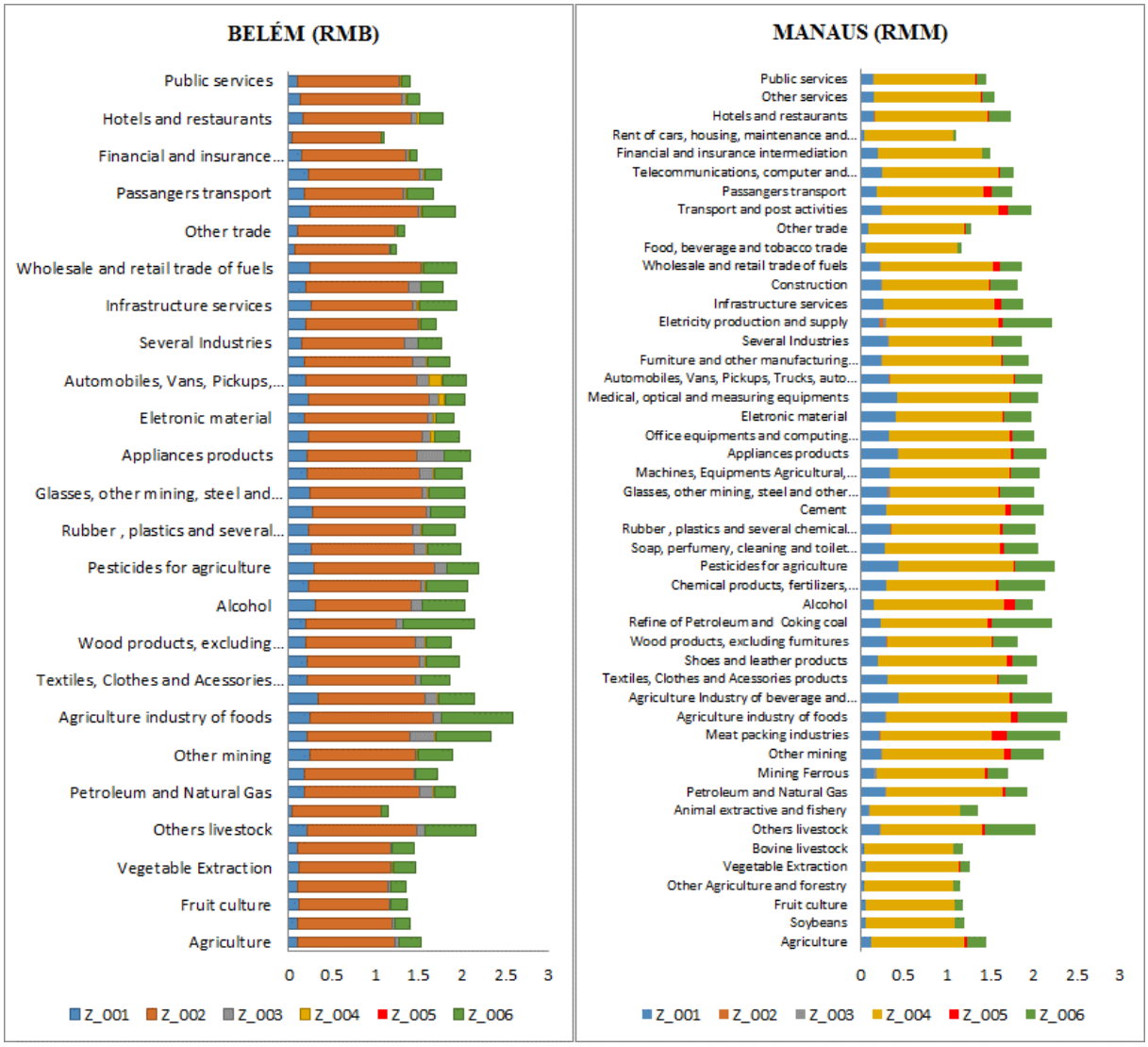
Source: research data

Table 9 indicates that the consumption pattern for the regions located in the North (Belém, Manaus, RPA) is similar, except for RAM, whose final demand comes from other regions (49%) and RBR (46%). The region of SP, for its economic importance in the nation scenario, meets 74% of its own demand. This similar pattern considered how much the Northern regions bought from themselves, and how much they bought outside the region.

The multiplier can also give an indication of the relationship between the regions as it shows when production remains in the region and when it is transferred to other regions due to an increase in final demand.

Graph 6 shows the multiplier of production for the metropolitan regions of Belém and Manaus, and its respective transferences.

Graph 6: Production multiplier for the metropolitan regions of Belém and Manaus



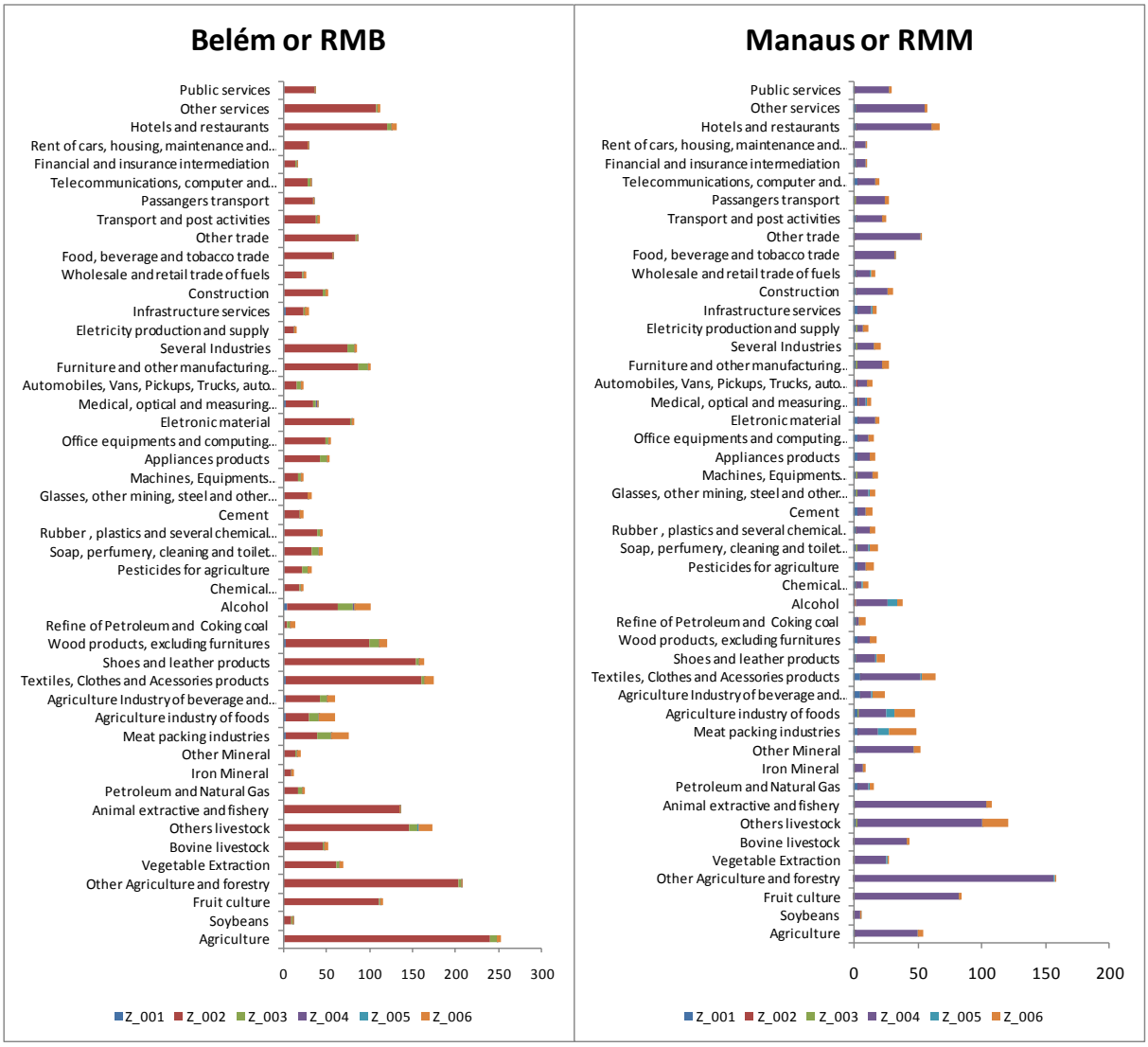
Source: research data

It is evident from Graph 6 that the metropolitan regions of Belém and Manaus have little transference of the production multiplier among them, as well as with the rest of their states. The largest transfer occurs to São Paulo and the Rest of Brazil. In Belém and Manaus, the largest production multipliers are sectors of food agroindustry, as well as others related to livestock farming.

The graph above shows that the changes in final demand caused by an investment in a sector can modify production, income and employment in the economy. However, the alteration of change in demand in the Metropolitan Region of Belém impacts itself followed by, RBR and SP. As result, the transference effect to closer regions (Manaus and RPA are minimal). Similar situation can be seen for Manaus, whose alteration in final demand impacts Manaus, RBR and SP more directly. Besides, impacts of different intensity can be observed for other sectors.

For employment multiplier, Graph 7 shows the sectors that generate more jobs when for a change of one unit in the final demand. Again, the Regions of Belém (Z-002) and Manaus (Z-004) are used as example.

Graph 7: Generator of employment in the Metropolitan Regions of Belém and Manaus



Source: research data

In the Region of Belém, the main generators of employments are: Agriculture; Other agriculture and forestry; Other livestock; Animal extractive and fishing. In the Region of Manaus, the sectors are basically the same, therefore a certain similarity in the employment generators for the two regions. In Manaus, the largest employers are: Other agriculture and forestry; Other livestock; Animal extractive and fishing and Fruticulture. Once again, it is observed that the impact in the generation of jobs is internal, within the region itself and that the transfer, of little intensity, occurs in distant regions such as RBR and SP. As an example, the sector concerning other activities related to agriculture (Graph 7) of Belém Region (Z-002), for every one million reals increase required in production demand of the sector under analysis, it would create 173 total employments within its own sector, 143 in the region and 30 in other regions (transfer effect). Another important analysis concerning inter regional flow is the Value Added (VA), as seen on Table 10.

Table 10: Value Added of the six Brazilian regions

	SP	Belém	RPA	Manaus	RAM	RBR
SP	65.77%	0.53%	0.91%	0.61%	0.13%	32.04%
Belém	4.80%	58.41%	22.44%	0.29%	0.07%	13.99%
RPA	5.35%	4.24%	75.14%	0.31%	0.06%	14.89%
Manaus	19.40%	0.69%	1.08%	43.47%	4.83%	30.52%
RAM	22.90%	0.39%	0.71%	6.93%	44.52%	24.55%
RBR	7.72%	0.35%	0.62%	0.35%	0.08%	90.88%

Source: research data

The data on Table 10, using Manaus (Z-004) as an example, informs that 19.40% of VA generated in this region is a result of the final demand of the SP (Z-001) region. In the Metropolitan Region of Belém, (Z-002) 58.41% of VA generated is aimed to meet its own demand, however, one can see once again that even with differences in the economic structures previously mentioned, the VA flows between Metropolitan Regions of Manaus and Belém, as well as within themselves and the rest of their respective states are low.

4. FINAL COMMENTS

In order to verify the productive structures, importance, and flow of economic relations between the regions analyzed, it was used the interregional input-output model for six regions and 47 sectors. Therefore, in this study, it was possible to note that the metropolitan regions of Belém and Manaus have a more intense commercial flow with SP and RBR than between themselves, despite their geographical proximity and different economic structure.

Manaus and SP have a more intense inter-sectorial flow, probably due to production and sale of electronic products. As for Belém, its intense commercial flow with SP and RBR is due to an easier access by road with the rest of the country making it easier commercial interchange between them. And, despite different structures, Belém and Manaus could complement each other with the flow of goods and services, due to their proximity, however it is necessary to create a better connection between these regions. An intermodal transport system could be a solution to increase the exchange between the metropolitan regions of Belém and Manaus.

The inter-sectorial flow showed an imbalance or differentiated patterns of trade among the Northern Regions (Belém, Manaus, RPA, RAM). The SP region demonstrated self-sufficiency and it buys 74% of its needs within the region to produce goods and services. The only region that showed internal deficiency was RAM because it buys 84% of its needs from the other regions and RBR.

Based on the backward (HRBL) and forward (HRFL) linkage of Hirschman and Rasmussen, with an average higher than the unit, an average of 27 and 24 sectors, respectively, for all regions. However, the key sectors for the regions of Belém and Manaus, amounted to five sectors only: Pesticides for agriculture; Production, supply and transmission of electric-power; Wholesale and retail trade of fuel; Cargo transport, and Telecommunications, informatics and other activities.

From the pure linkage (PL), forward or backward, considering the entire system, only the SP region excelled.

As for production and employment multipliers, taking the regions of Belém and Manaus as an example, in general, we observed that some sectors are more favorable to generate employment, which was the case of the sector analyzed (Others livestock), thus the importance in learning this method to verify the impacts at the internal level (within the region) and external (outside the region). That is, one should take in consideration that a stimulus in demand in a particular sector results in different impacts, as shown in the example.

For all these reasons, we suggest that policy planning and public policies, must take into consideration this type of instrument of analysis, because this study confirmed the research hypothesis that the regions of Belém and Manaus have different structures and do little trade between themselves.

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