Geographical Indication and Centrality in The Brazilian Northeast

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ABSTRACT

This article discusses the subject of Geographical Indication and level of centrality, by using the hierarchization of municipalities from the Brazilian Northeast region as a tool for discussion and analysis. This article is mainly aimed at hierarchizing municipalities from the Brazilian Northeast region by taking into account their respective contributions to the development of non-public service products between 2002 and 2017, considering five geographical subdivisions (microregion, mesoregion, State, region and country) in the perspective of identifying the level of centrality and a relationship with Geographical Indications. This work is characterised as an exploratory-descriptive research with a quali-quantitative approach, having analysed data from the Automatic Recovery System (SIDRA, in Portuguese) from IBGE (the Brazilian Institute of Geography and Statistics) and considering 1,792 municipalities from the Brazilian Northeast. The results indicate that among the 1,792 municipalities included in the study, 1,028 (57.4% of all municipalities studied) observed an increase to their scores. In addition, the main changes that took place in these municipalities between 2002 and 2017 included the increase in the homogeneity in the region, when regarding the profile of participation in the development of non-public service products from higher geographical subdivisions. With that, it can be stated that the non-public service sector creates a level of hierarchy in the municipalities from the Brazilian Northeast in terms of their volumes, corroborating the assumption drawn in this work that the spatial layout of cities has an effect on the centralities of places, with the territory and its centrality level having an impact on Geographical Indications, as the quality and standardization of products/services represent the result of the combined effort and actions carried out by some groups of local producers in certain territories. This highlights the relationship between this group and the local tradition, typicality and culture, as well as with the physical and climate aspects of the territory, which contributes to its local development.

Keywords: Northeast Region. Hierarchization. Non-public service.

1. Introduction

Over the years, Geographical Indications (GIs) have been recognised as an important factor of local development, acting not only as a way of protecting the interests of consumers, but also adding value and protecting local products and producers, as well as regional traditions. Moreover, GIs are considered a fundamental tool to enable local development of several dimensions, namely social, economic, political and cultural development, thus, products and services are distinguished, bringing a degree of notoriety to the region.

A Geographical Indication is recognised as a factor which promotes development or a leverage instrument to development, especially at a regional scale, as it adds greater value to regional products and producers, which consequently brings economic and social development to the region [THAINES and MELEU, 2013]. The definition of a Geographical Indication with regards to the application of products has evolved as a form of identification, attributing certain properties connected to the geographical origin arising from collection or preparation practices, combined with special conditions of the locality. This concept has developed over time and has currently reached intellectual levels of great economic value [DUPIM, 2015]. Nevertheless, the registration of products with Geographical Indication has increased in Brazil, being also produced in regions where it is possible to identify unique factors related to local production, soil, climate, type of production and harvesting [MAIORKI; DALLABRIDA, 2015].

Under Jeziorny [2015] perspective, hierarchization expresses an idea of globalisation when considering regions and territories as part of a certain hierarchical level, as service providers to global and heteronomous forces, which constitute the growing desire to explain everything through the globality paradigm.

Taking into account that the hierarchization of municipalities is based on levels of centrality, what is understood by a distinct hierarchy is simultaneously defined by the combination of goods and services offered. In this perspective, hierarchy is characterised by the existence of stratified levels of central localities, considering that the centres of the same hierarchical level offer a similar combination of goods and services, acting upon equivalent areas in terms of territorial dimension and population volume, as expressed by Bessa [2012].

It is also worth pointing out that the hierarchy of cities, as reflected by Araújo [2017], at early stages, include cities that basically produce goods and services, i.e. those which are the most desired by the population for their everyday social interactions. On the other side of the spectrum are the bigger urban centres, which generate more specialised products and services for a greater territorial area.

The levels of geographical centrality are considered the pillars of essential information, describing some of the main necessary foundations for researchers and governing authorities. Through these, social and environmental issues can be identified, which lead to opposing actions to geographic circumstances of the most critical regions analysed. Thus, it is understood that the more central the location of a city, the greater the possibility of establishing a solid technical and social infrastructure, capable of tackling the needs of the population.

Aiming at providing greater explanation to the points highlighted, a descriptive-exploratory research was carried out, presenting the main concepts and analyses regarding the information collected through the processes obtained. Thus, the present research discusses the hierarchization of municipalities in the Brazilian Northeast region, taking into account their contributions to the formation of non-public service products between 2002 and 2017 in five distinct geographical subdivisions (microregion, mesoregion, state, region and country), under the perspective of the level of centrality and identifying a possible relationship with Geographical Indications.

It is also worth pointing out that the strategy of development of the Brazilian Northeast must be reflected upon a national socioeconomic development perspective, though it must ensure a territorial perspective that analyses the regional particularities and characteristics [GUIMARÃES et. al, 2014]. A centrality can be defined as one of the features of urban agglomeration, corroborating the different existing levels. One

of the main questions raised regarding centrality consist of: How to explain the differences in the levels of centrality? Santos [2008] attempts to answer this question as follows: "obviously, other cities do not offer certain services, which are concentrated within the given city; otherwise, individuals would most probably not take this route, except in a few cases".

The levels of geographical centrality are also considered important pillars of information applied in the verification of the levels of development of certain regions when compared to other parts of the country. Therefore, the understanding of the level of centrality and the hierarchical organisation of urban centres is crucial to explain the functionalities of territories based on their characteristics.

One of the methods used to discuss the level of centrality is the Principal Component Analysis (PCA), which is a statistical tool of multivariate analysis that performs a linear orthogonal transformation of a combination of original variables into a much smaller number of non-correlated variables containing a greater part of the information from the original group of variables. The extraction of the common factors of factorial analysis is carried out through a model of principal components which exhibits indicator greater than a unity [RODRIGUES, 2019].

Furthermore, PCA has been employed as a starting point of a multivariate analysis of data, as it consists of a quicker way of carrying out this type of analysis, providing a general overview of important information which are more easily analysed and understood. Thus, PCA provides a general overview of tables with data observed, identifying trends, standard deviations, groups and contrasting values [TEÓFILO, et al. 2009].

In Principal Component Analysis (PCA), eigenvalues represent the explanatory power of each component in relation to the variance of the original variables, as eigenvalues are variances of the principal components (MANLY, 2008). In turn, eigenvectors are coefficients of the standardized X variables used to calculate the scores of the principal components. Eigenvectors represent a unit module associated to each eigenvalue and the respective directions in terms of the principal components' axes [MANLY, 2008; AYRES, 2012].

Therefore, after determining the eigenvalues, the individual coefficients of each element are determined through a linear combination in which the factorial weights of the eigenvectors are considered weighting coefficients of each measurement associated to the municipalities [OLIVEIRA, 2005].

This works is characterised as exploratory-descriptive, which "reflects the lack of a construction theory, being only limited to the collection of data to increase the knowledge of a given subject or the mere confirmation of pre-established theories" [ANTUNES et al., 2004, p. 10].

2. Materials and Methods

In order to establish a theoretical-empirical explanation to the study, a quali-quantitative approach research was carried out, at an exploratory-descriptive level and based on data related to the level of relative participation in terms of the gross value added to the current price of products, excluding information regarding public services, i.e. administration, defence, education, public health and security of each municipality from the Brazilian Northeast at superior strata (Microregion, Mesoregion, State, Northeast and Brazil).

All data were obtained from Table 5938 from the Automatic Recovery System (SIDRA, in Portuguese), available online in the website of the Brazilian Institute of Geography and Statistics (IBGE, in Portuguese).

For the study, 1,792 municipalities from the Brazilian Northeast were considered, bearing in mind that the municipalities of Aroeiras do Itaim and Nazária, both in the State of Piauí were not part of the 2002 database, thus, being excluded from the present study.

In order to promote the indexation with certain methodological accuracy, a mathematical tool of data reduction was used, known as Principal Component Analysis (PCA), as the results could be affected by the scale of the original variables. This tool was applied using a correlation matrix.

The entire process of estimating the principal components, in both scenarios analysed, was carried out using the free statistical package denominated GNU Regression, Econometrics and Time-series Library (GRETL), in its version 1.9.14.

As a parameter for selecting eigenvalues, the Kaiser criterion was considered, which only considers the extraction of components with eigenvalues greater than 1.0, i.e. their relationship with the events is higher than the own original variable.

After determining the eigenvalues, the coefficients of each element were established through the linear combination in which the factorial weights of the associated eigenvector were used as weighting coefficients of each measurement related to the municipalities being studied. Aimed at reaching a greater interpretation of the preliminary results, these values were normalized.

The normalization technique used was the Range Method, which equalized the range between extreme values (maximum and minimum) of the sample or population (FÁVERO et al., 2009). By using this method, all indicators defined were within a range varying from zero to one (0 to 1), where zero (0) is the lowest value and one (1) the highest.

The practical effect of this technique is that each score represents, in terms of the general range, the percentage distance between the maximum original value and the minimum original value. Thus, each of the scores measured must be interpreted in terms of their distance in relation to the lowest value, as a percentage of the distance to the furthest element.

Therefore, a city with a score of 0.600 means that it is 60% from the distance between the extreme points, or, in alternative, it is 40% from the highest score.

Subsequently, the normalized scores enabled to hierarchize the municipalities from the Brazilian Northeast in a stable scale, for comparison purposes. The values were divided into five distinct categories, using the scores themselves as the classification criterion, being described as follows:

- Class I, score between 0.000 and 0.199;
- Class II, score between 0.200 and 0.399;
- Class III, score between 0.400 and 0.599;
- Class IV, score between 0.600 and 0.799;
- Class V, score between 0.800 and 1.000.

Finally, the descriptive statistical indicators were determined – such as the arithmetic mean, median, standard deviation and variation coefficient – of the geographical indications, municipalities and states, with the best performances, paying particular attention to the mean values of the nine federative units of the Northeast region.

This enabled to establish the rules of comparison between both periods analysed – the years of 2002 and 2017 – allowing to capture the aspects that constitute how the respective localities evolved over these fifteen years.

3. Analysis of results

The results demonstrate a pattern of centrality of the municipalities from the Brazilian Northeast over the first two decades of the 21st century. Both scenarios are duly described in the following sub-sections.

3.1 PCA 2002

The first PCA application, carried out with data from the year of 2002, demonstrated that only one component is able to absorb a wide percentage of combined variability of events. According to the results observed, this first-dimension spans 72.64% of inertia, being also understood as the combined variance of this dataset (Chart 1).

The analysis of the respective eigenvectors enables to verify that all five variables – except the weight of the municipality at a microregional level – have similar behaviours, with the weight of non-public services at regional and national levels being of greatest influence over the component identified, with factorial weights of approximately 0.480 points.

Chart 1. Analysis of the Principal Components – Application I – 2002

Analysis of the eigenvalues of the Correlation Matrix

Component	Eigenvalue	Proportion	Cumulative
1	3.6322	0.7264	0.7264
2	0.9232	0.1846	0.9111
3	0.3058	0.0612	0.9722
4	0.1384	0.0277	0.9999
5	0.0004	0.0001	1.0000

Key: PC = principal component.

Source: Developed by the authors based on data from IBGE (2019).

Accordingly, in 2002, the municipalities of Fortaleza/CE (1.000 points), Teresina/PI (0.9741), Maceió/AL (0.8978), São Luís/MA (0.8924), Natal/RN (0.8715), Aracaju/SE (0.8700), Recife/PE (0.8247), Salvador/BA (0.8170), João Pessoa/PB (0.7700) and Campina Grande/PB (0.6426) had the greatest participation of service products in the Northeast region, with strong influence in the five spatial levels analysed herein (Microregion, Mesoregion, State, Region and Country).

In addition, the municipalities of Guaiúba/CE, Santanópolis/BA, Coqueiro Seco/AL, Firmino Alves/BA, Dom Macedo Costa/BA, Pedrão/BA, Curralinhos/PI, Miguel Leão/PI, Coivaras/PI and Pau D'Arco do Piauí/PI were the last in the ranking. It is also worth pointing out that among the ten first municipalities in the ranking, only Petrolina/PE, Balsas/MA, Mossoró/RN and Arapiraca/AL had a score greater than 0.5000 points, while only the municipalities of Pau D'arco do Piauí and Coivaras, in the State of Piauí had a score of zero. Therefore, the following arrangement (Table 1) can be seen for these groups in the year of 2002:

Table 1. Frequency distribution of the classes identified - 2002

Category	Score Range	Absolute Frq.	Relative Frq.	Cumulative Rel. Frq.
Class V	0.800 – 1.000	8	0.0045	0.0045
Class IV	0.600 – 0.799	3	0.0017	0.0061
Class III	0.400 – 0.599	10	0.0056	0.0117
Class II	0.200 – 0.399	59	0.0329	0.0446
Class I	0.000 – 0.199	1712	0.9554	1.0000
		1792	**1.0000**	

Source: Developed by the authors based on data from IBGE (2019).

Still regarding the year of 2002, the average score of the municipalities from the Brazilian Northeast analysed was of 0.0446 points, with only 409 exhibiting scores greater than this average value, i.e. only 22% of this spatial divisions. The median value was of 0.0163 points and, when compared to the average, it suggests a strong asymmetric relationship between events. The top one hundred municipalities in the ranking had an average score of 0.3268 points, while the bottom one hundred exhibited an average score of 0.0015 points, resulting in an average score of 211 times less than the average value obtained by the top 100 municipalities.

On the other hand, it was observed that the last decile – which obtained the highest scores – exhibited an average score of 0.2445 points, while the four first deciles – with the lowest scores – obtained a representative score of 0.0060 points. Therefore, the top municipalities from the Brazilian Northeast present a profile of participation in the development of service products 41 times higher when compared to the last components of the sample. Through an analysis of the set of data in terms of classes, it is possible to identify more adequate relationships for the hierarchization of the cities from the Northeast of Brazil, establishing relationship levels between the respective localities.

Class V, which has the highest score, solely consists of eight state capitals of the Northeast region, with the exception of the city of João Pessoa/PB, which, together with Campina Grande/PB and Petrolina/PE, are part of Class IV. In turn, Class III consists of ten cities, including those considered the most important for their respective states, such as Feira de Santana/BA, Imperatriz/MA, Mossoró/RN and Parnaíba/PI.

Regarding Class II, it is characterised by the presence of 59 municipalities from all federative units of the Brazilian Northeast region. They are intermediate cities with some local prominence, including the cities of Delmiro Gouveia/AL, Garanhus/PE, Paulo Afonso/BA and Sousa/PB. Finally, Class I includes most cities of the Northeast region of Brazil (95.5%), consisting of 1,712 municipalities.

These numbers reinforce the perception that the non-public service sector creates a certain hierarchy in the municipalities of the Northeast region in terms of their volumes, thus, corroborating the assumption considered in the present work that the spatial arrangement of the cities reflects their respective levels of centrality.

In the year of 2002, Class V, with an average score of approximately 0.8934 points, stands out due to the mean weighting coefficient of service products at national (0.7%) and regional levels (6.0%). In turn, Class IV obtained an average score of 0.6721 points, with an average contribution of 0.2% at a national level and of 1.5% at a regional level.

Class III stands at an intermediate position, given the low national and regional prominence, with some importance at sub-regional levels, having obtained an average score of 0.4653 points. On the other hand, Class II, with an average sore of 0.2591, only includes cities with importance at the microregional stratum (social groups). Finally, Class I, with an average score of 0.0297 points, consists of cities with no economic expression in terms of non-public service products, as described in Table 2:

Table 2. Score and average relative weight of each Class in the total non-public Service products in terms of the spatial divisions considered – 2002

Category	Range	Score	Microrregion	Mesorregion	State	Region	Country
Class V	0.800 - 1.000	0.8934	0.8763	0.7774	0.5470	0.060	0.0069
Class IV	0.600 - 0.799	0.6721	0.8620	0.6959	0.2043	0.0146	0.0017
Class III	0.400 - 0.599	0.4653	0.7754	0.4630	0.0475	0.0048	0.0006
Class II	0.200 - 0.399	0.2591	0.6201	0.1442	0.0128	0.0015	0.0002
Class I	0.000 - 0.199	0.0297	0.0783	0.0120	0.0016	0.0002	0.0000

Source: Developed by the authors based on data from IBGE (2019).

Among the one hundred highest scores from the municipalities of the Northeast Region, in the same year, twenty localities are part of the State of Ceará (CE), while fifteen are included in the State of Bahia (BA), eleven in Maranhão (MA) and in Pernambuco (PE), while eight are in the State of Piauí (PI) and in the State of Rio Grande do Norte (RN) and eleven in Alagoas (AL), Paraíba (PB) and Sergipe (SE).

Under a proportional point of view, the State of Sergipe has 12% of its cities among the top one hundred in the ranking, followed by the State of Ceará, with 11% of its municipalities there included. Alagoas includes 9% of its municipalities, Pernambuco with 6%, Maranhão and Rio Grande do Norte with 5%, Piauí and Bahia with only 4%.

When considering all municipalities from the Brazilian Northeast region, in the year of 2002, the average score was of 0.0446 points. Nevertheless, when considering the analysis at a State level, it was observed that the highest average municipal score was identified in the State of Sergipe (0.0766) and the lowest in the State of Piauí (0.0304). Between these two federative units were the States of Ceará (0.0741), Alagoas (0.0562), Rio Grande do Norte (0.0473), Pernambuco (0.0459), Maranhão (0.0417), Paraíba (0.0412) and Bahia (0.0319).

Nonetheless, the degree of dispersion of these municipal scores in terms of the average is high. In the Northeast, in the given year, the standard deviation of the scores detained by the respective cities was of

0.0899 points. This variance follows the same trends as the state scores. Sergipe presents the highest standard deviation (0.1227 points), followed by Alagoas (0.1115), Ceará (0.1041), Pernambuco (0.0917), Rio Grande do Norte (0.0903), Maranhão (0.0876), Piauí (0.0855), Paraíba (0.0815) and Bahia (0.0696). However, the levels of disparity in terms of the distribution of non-public service products per Northeastern State are better illustrated through the Variation Coefficient. For the Northeast region, in 2002, this ratio was of 2.02, i.e the variance of the set of data is slightly higher than twice the average value. The greatest Variation Coefficient among the nine Northeast States was identified in the State of Piauí (2.82), followed by Bahia (2.18), Maranhão (2.10), Pernambuco (2.00), Alagoas and Paraíba (1.98), Rio Grande do Norte (1.91), Sergipe (1.60) and Ceará (1.41).

3.2 PCA 2017

The second application, referring to the year of 2017, shows the changes in the centrality profile of the municipalities from the Brazilian Northeast region. The first change can be attributed to the increase in the explanation power of the first component identified, indicating an increase in the homogeneity of the contribution levels of local non-public service products to higher spatial subdivisions – microregion, mesoregion, state, region and country. Following this application, the eigenvalues of the first dimension represents 73.33% of the combined variance (Chart 2).

Chart 2 presents the eigenvalues, proportions, cumulative proportions and eigenvectors (weight of components) calculated through the Principal Component Analysis (PCA) technique.

Analysis of the eigenvalues of the Correlation Matrix

Component	Eigenvalue	Proportion	Cumulative
1	3.6666	0.7333	0.7333
2	0.8939	0.1788	0.9121
3	0.2952	0.0590	0.9712
4	0.1437	0.0287	0.9999
5	0.0005	0.0001	1.0000

Eigenvectors (weight of components)

	PC1	PC2	PC3	PC4	PC5
Microregion	0.320	-0.790	-0.419	0.312	-0.001
Mesoregion	0.460	-0.326	0.450	-0.693	-0.006
State	0.474	0.130	0.593	0.638	0.003

Chart 2. Analysis of the Principal Components – Application II – 2017

Key: PC = principal component.

Source: Developed by the authors based on data from IBGE (2019).

The variables with higher factorial weight remained being the local contribution of products at regional and national levels, with a slight advantage to the latter. Among all results obtained, the average score of the 1,792 Northeast municipalities was of approximately 0.0477, with only 431 obtaining a score above this average value, with a median of 0.0170 points, ratifying the asymmetry of events.

In the year of 2017, the ten greatest scores were obtained by Teresina/PI (1.000), Fortaleza/CE (0.9388), Maceió/AL (0.9352), Aracaju/SE (0.8846), São Luís/MA (0.8690), Natal/RN (0.8575), João Pessoa/PB (0.7686), Recife/PE (0.7361), Salvador/BA (0.7357) and Campina Grande/PB (0.6766), which practically represent the same cities from the beginning of the century, though in alternated positions.

In turn, the ten last municipalities in the ranking are as follows: Firmino Alves (BA), Coqueiro Seco (AL), Ouriçangas (BA), Santanópolis (BA), Dom Macedo Costa (BA), Pedrão (BA), Coivaras (PI), Curralinhos (PI), Pau D'Arco do Piauí (PI) and Miguel Leão (PI). With the exception of Ouriçangas, which entered this group due to the exit of the municipality of Guaiúbas, in the State of Ceará, all other municipalities were also part of this group in the year of 2002.

It is important to highlight that among these ten cities, only five obtained a score higher than 0.5000 points: Arapiraca/AL, Petrolina/PE, Mossoró/RN, Balsas/MA and Feira de Santana/BA. In addition, only three of the bottom ten municipalities in the ranking obtained a score of zero, while the first 100 had an average score of 0.3532 points, with the bottom one hundred having a score of 0.0016 points, resulting in an average value of 219 times lower to that obtained by the top one hundred.

On the other hand, the final decile of these localities represented an average score of 0.2645 points, while the first four deciles obtained a representative score of 0.0062 points. Thus, the economic elite of the cities from the Northeast region of Brazil presented a profile of contribution to the development of non-public service products 43 times higher than that expressed by the group of the poorest municipalities of the sample.

By considering an analysis of the frequency distribution per class, for the year of 2017, the following reality can be observed (Table 3):

Table 3. Frequency distribution of the classes identified - 2017

Category	Range	Absolute Frq.	Relative Frq.	Cumulative Rel. Frq.
Class V	0.800 - 1.000	6	0.0033	0.0033
Class IV	0.600 - 0.799	6	0.0033	0.0067
Class III	0.400 - 0.599	15	0.0084	0.0151
Class II	0.200 - 0.399	65	0.0363	0.0513
Class I	0.000 - 0.199	1700	0.9487	1.0000
		1792	1.0000	

Source: Developed by the authors based on data from IBGE (2019).

Class V included only six municipalities (Teresina/PI, Fortaleza/CE, Maceió/AL, Aracaju/SE, São Luís/MA and Natal/RN) and obtained an average score of 0.9142 points. In turn, Class IV, consisting of João Pessoa/PB, Recife/PE, Salvador/BA, Campina Grande/PB, Arapiraca/AL and Petrolina/PE, obtained an average value of 0.6960 points.

Regarding Class III, with fifteen components, it is formed by the intermediate cities from the countryside, namely Mossoró/RN, Feira de Santana/BA, Parnaíba/PI, Imperatriz/MA, Juazeiro do Norte/CE and Itabaiana/SE, having obtained a representative score of 0.4721 points. On the other hand, Class II included

65 members, with an average score of 0.2618 points. In turn, Class I included the remaining 1,700 municipalities, with an average score of 0.0304 points.

The localities of Class V represent, on average, almost 9/10 of non-public service products in their respective microregions, slightly more than ¾ in their mesoregions, half in their states, with approximately 4% of the volume of the Northeast region and only 0.51% of the total volume of Brazil.

In 2017, the cities included in Class IV represent, on average terms, almost 4/5 of the same group at a micro level, as well as less than 2/3 at a meso level, 23% of products at a state level and 3.6% of products at a Northeast regional level and 0.47% at a Brazilian level.

In turn, the municipalities of Class III represent almost 4/5 of non-public service products in their respective microregions, similar to the previous Class, though they do not attain the same average participation levels in higher spatial subdivisions: 2/5 of products at a mesoregional level, 4.5% at state level, 0.5% at a regional level and less than 0.1% at a Brazilian level.

The localities included in Class II are only of representative relevance at a microregional level, as they contribute to 3/5 of non-public service products at this geographical stratum. At a mesoregional level, this level represents only 1.5%. Finally, Class I only has minor representation in the five spatial divisions considered.

Table 4. Score and average relative weight of each Class in the total non-public Service products in terms of the spatial divisions considered – 2017

Category	Range	Score	Microregion	Mesoregion	State	Region	Country
Class V	0.800 - 1.000	0.9142	0.8775	0.7593	0.5158	0.0388	0.0051
Class IV	0.600 - 0.799	0.6960	0.7896	0.6508	0.2331	0.0359	0.0047
Class III	0.400 - 0.599	0.4721	0.7856	0.4072	0.0448	0.0050	0.0007
Class II	0.200 - 0.399	0.2618	0.6055	0.1225	0.0122	0.0015	0.0002
Class I	0.000 - 0.199	0.0304	0.0746	0.0114	0.0018	0.0002	0.0000

Source: Developed by the authors based on data from IBGE (2019).

Taking into account the one hundred top scores of the Brazilian Northeast in the year 2017, 21 localities are included in the State of Ceará (CE), with other thirteen in the State of Pernambuco (PE) and in Bahia (BA), ten in the State of Maranhão (MA) and in Paraíba (PB), nine in Rio Grande do Norte (RN) and eight in Piauí (PI) and also in Alagoas (AL) and Sergipe (SE).

Under a proportional perspective, 11% of the municipalities of the States of Ceará and Sergipe are included among the top 100 scores, followed by Alagoas with 8%. Pernambuco has 7% of its municipalities among the top 100, with Maranhão and Rio Grande do Norte with the same 5%, while Piauí and Paraíba are represented by only 4% of their municipalities, with Bahia having only 3% of their total municipalities as part of this group.

In 2017, the municipalities of the Brazilian Northeast obtained an average score of 0.0477 points. In terms of federative states, the highest average score was identified in the municipalities of the State of Sergipe (0.0818) with the lowest in Piauí (0.0325). Between these two federative units were localities from the

States of Ceará (0.0793), Alagoas (0.0601), Rio Grande do Norte (0.0504), Pernambuco (0.0491), Maranhão (0.0446), Paraíba (0.0441) and Bahia (0.0342).

However, the degree of dispersion of the municipal scores in terms of the average values was high. In the Northeast, in this same year, the standard deviation of the scores obtained by the respective cities was of 0.0942 points, with this variability also following the trend of scores at a state level.

Once again, Sergipe obtained the highest standard deviation (0.1227 points), followed by Alagoas (0.1215), Ceará (0.1074), Rio Grande do Norte (0.0989), Pernambuco (0.0943), Piauí (0.0907), Paraíba (0.0888), Maranhão (0.0870) and Bahia (0.0714).

Nevertheless, the profile of dispersion of the division of non-public service products in terms of federative units in the Northeast were clearer when considering the Variation Coefficient. In the Northeast, in 2017, this coefficient was of 1.98, which indicates that the variance of the data is slightly less than twice the average value.

The maximum Variation Coefficient, among all states of the Brazilian Northeast region, was obtained by the State of Piauí (2.79), followed by Bahia (2.09), Alagoas (2.02), Paraíba (2.01), Rio Grande do Norte (1.96), Maranhão (1.95), Pernambuco (1.92), Sergipe (1.56) and Ceará (1.35).

3.3 Comparison 2002 x 2017

Before drawing any conclusions, it is important to point out that the present work uses a normalized indicator – that is, it measures how far a certain event is from extreme cases. Therefore, the higher the score, the closer the element will be from the element with the highest score and, alternatively, the lower the score, the further it will be from it.

Thus, the main change taken place between the years of 2002 and 2017 was the increase of homogeneity between the Northeast municipalities in terms of the relative participation profile in contributing to the development of non-public service products at a microregional, mesoregional, state, regional and national level.

This homogenisation can be observed through the explanatory power detained by the first component in both PCA applications carried out. In 2002, this dimension represented 72.64% of the combined variability of data, while in 2017 this proportion was of 73.33%. This shows that the reality considered herein can be better expressed by only one perspective with greater accuracy.

By analysing the eigenvector associated to the first component in both applications, it can be noted that microregional and national divisions became more prominent, while the state division had its importance reduced. As expected, the mesoregional and regional strata remained with the same level of importance. This suggests that the difference between places can be influenced by mesoregional issues rather than state issues.

It is also important to highlight that the median score calculated, which is characterised as the sample/population ratio in two similar groups, increased when comparing one application with the other. In the first application, as previously noted, this indicator was equal to 0.0163 points, increasing to 0.0170 points in the second application. This denotes an increase in the score of cities with lower economic power, which would enable a reduction in the difference between centrality levels.

This reduction, though small, can be seen by the municipalities that compose each of the classes defined in this work. In this range, the central categories (II, III and IV) increased, while the extreme categories decreased.

Of the 1,792 Northeast municipalities included in the present study, 1,028 municipalities exhibited an increase in their respective scores, which represents 57.4% of all localities. The State which observed the greatest increase was the State of Maranhão, where 70% of all cities would increase their importance in the non-public service sector. On the other hand, the lowest increase was observed in the State of Rio Grande do Norte, where only 43% of the municipalities promoted a similar increase.

In addition, this increase reached 65% of the cities in the State of Ceará, reaching 61% in Alagoas, 58% in the States of Bahia and Piauí, 53% in the States of Sergipe and Pernambuco, as well as 52% in Paraíba. It is curious to note that there is a pattern behind this mosaic: the greatest percentage increases are seen in the states with greatest territorial extension, which opens the discussion on how much influence did the transport developments have on this expansion phenomenon of service products in the hinterland of the Brazilian Northeast region.

The perception of convergence is also strengthened by the fact that the cities from all classes, except Class V, increased their contribution in the participation of non-public service products at a regional and national level. Moreover, both Class IV and Class I also increased their relevance at a State level.

The result of this study is also corroborated by the fact that while 92 municipalities are among the top 100 in both 2002 and 2017, ¾ had their scores reduced over these fifteen years. This indicates that these one hundred municipalities were shifted closer to the central range of this data set.

Thus, the results of this research are indicative of the identification of central places, as well as of the respective levels of centrality associated to each municipality, which would be suggestive of specific development actions taken in these locations, through public policies or by actions taken by interested parties. This conclusion points out that the study of centrality is a favourable mechanism for implementing a Geographical Indication (GI), as the National Institute of Industrial Property (INPI, in Portuguese) granted 75 Geographical Indications in Brazil between 2000 and 2019, including 55 Protected Geographical Indication (PGI) and 20 Protected Designation of Origin (PDO) – (11 national and 9 foreign indications).

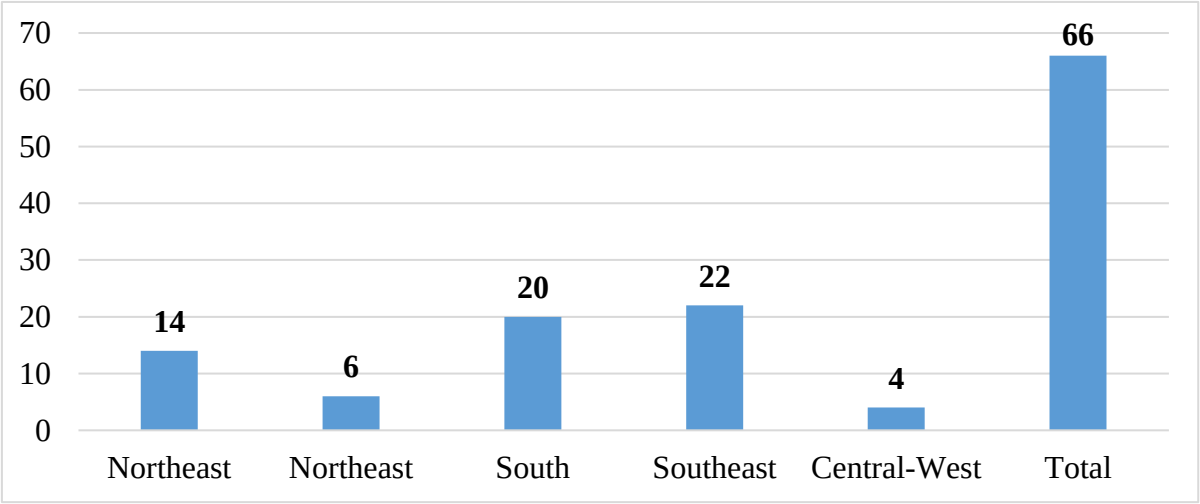

Figure 1. Graph of the total of national Geographical Indications granted between 2000 and 2016

Source: INPI – Technical Specifications of Geographical Indications, as recognised by INPI, 2019

http://www.inpi.gov.br/menu-servicos/indicacao-geografica/regulamento-de-uso-das-indicacoes-geograficas

With Figure 1, it can be noted that the South and Southeast regions of Brazil granted the most Geographical Indications within the country, with the latter granting the most, followed by the South region and the Northeast region. In turn, the North and Central-West regions of Brazil granted the lowest number of GIs.

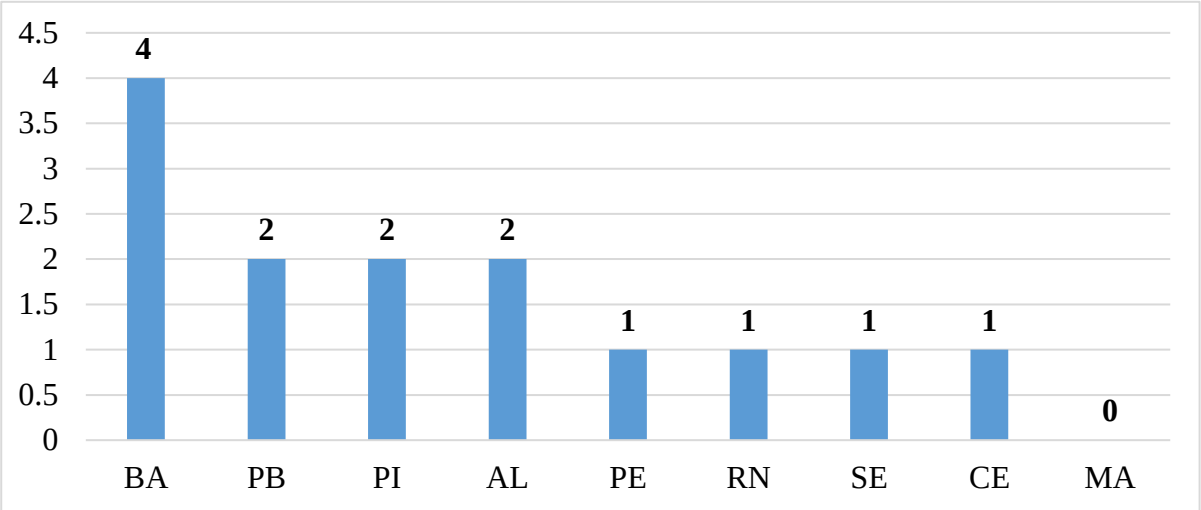

Figure 2. Graph of the total Geographical Indications per State in the Northeast Region between 2000 and 2019

Source: INPI – Technical Specifications of Geographical Indications, as recognised by INPI, 2019

http://www.inpi.gov.br/menu-servicos/indicacao-geografica/regulamento-de-uso-das-indicacoes-geograficas

In the Northeast Region, the State of Bahia (BA) granted the greatest number of Geographical Indications in the INPI database, followed by the States of Paraíba (PB), Piauí (PI) and Alagoas (AL), then by the States of Pernambuco (PE), Rio Grande do Norte (RN), Sergipe (SE) and Ceará (CE), while the State of Maranhão (MA) is only State with no GIs granted in the INPI database (Figure 2).

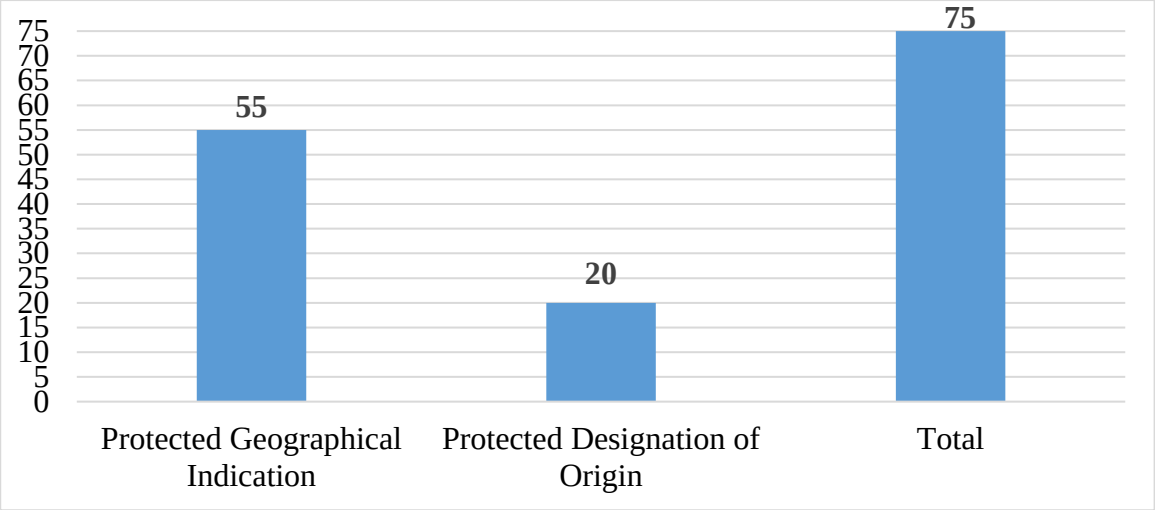

Figure 3. Graph of types of Geographical Indications granted in Brazil – 2000 to 2019

Source: INPI – Technical Specifications of Geographical Indications, as recognised by INPI, 2019

http://www.inpi.gov.br/menu-servicos/indicacao-geografica/regulamento-de-uso-das-indicacoes-geograficas

By observing Figure 3, it can be noted that the type of Geographical Indication granted in Brazil with the greatest number of registrations in percentage terms is Protected Geographical Indication (PGI), with approximately 73%, while 27% are represented by PDOs (Figure 3). One of the possible reasons for the lower percentage of DOs granted can be due to its direct relationship with the natural environment, as stated by Fabris et al. [2012], in which the product has its qualities exclusively influenced by local characteristics, in which this influence is able to be identified and measured.

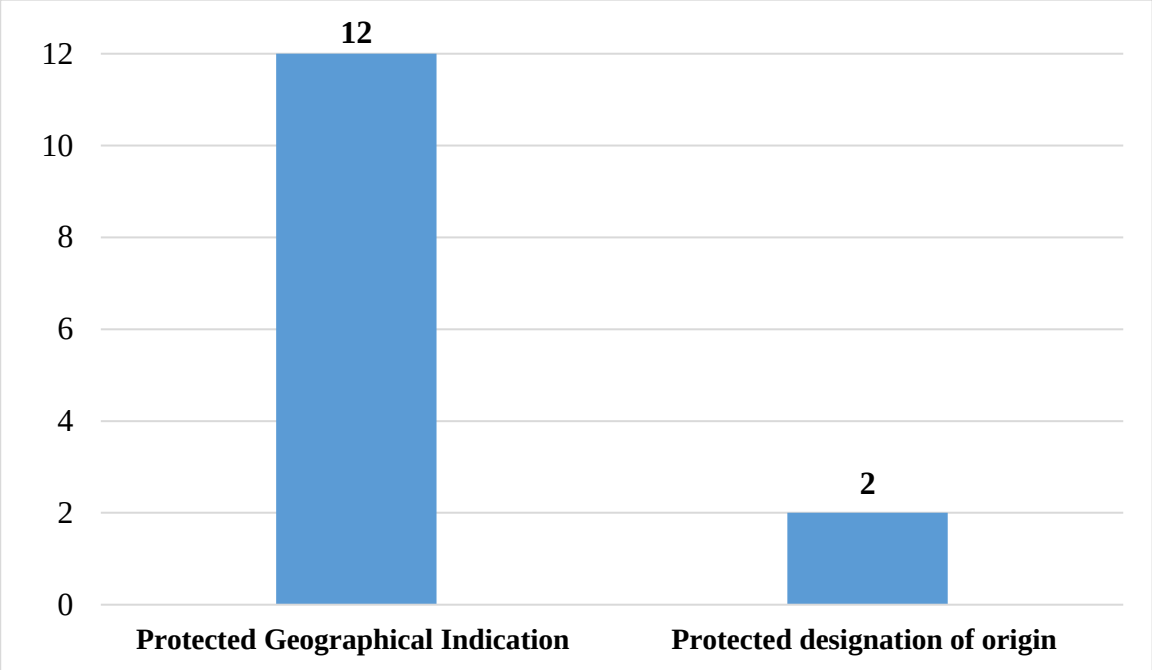

Figure 4. Graph of types of Geographical Indications granted in the Northeast Region of Brazil – 2000 to 2019

Source: INPI – Technical Specifications of Geographical Indications, as recognised by INPI, 2019

http://www.inpi.gov.br/menu-servicos/indicacao-geografica/regulamento-de-uso-das-indicacoes-geograficas

A similarity can be noted in percentage terms between the types of Geographical Indication granted in the Northeast region of Brazil and at a national level, with Protected Geographical Indication (PGI) representing 86% of all GIs granted, while Protected designation of origin (PDO) represent only 14%, as observed in Figure 4. Furthermore, it can be noted that the country has a relatively low number of GIs granted when considering its natural wealth. The two types of registration, PDO and PGI, promote greater value and protection to traditional products, which have a direct relationship with a certain locality, thus, significantly strengthening the local economy.

According to Cerdan [2014, p.48], "GIs are often originated from disadvantaged agricultural regions, where producers are not able to reduce the costs of local production. Therefore, they are forced to invest in local quality and knowledge". Thus, obtaining a GI seal can generate several advantages to a producer, as well as to consumers and to the economy as a whole, as, after granting a GI registration, the product is of greater added value, which increases the income of producers, with greater prominence to the region, among other advantages.

Maiorki and Dallabrida [2015] argue that the impact that a GI can have on the various markets can be essential to territorial development, as it englobes the GI production chain, such as: local producers, supplying companies, the transport sector, as well as the service sector. This production chain promotes regional development, as products with a GI seal take the role of the driving industry, promoting activities in the surrounding regions, besides highlighting the potential of centrality of places.

4. Final Remarks

This exploratory article was aimed at hierarchizing municipalities from the Brazilian Northeast Region in terms of their levels of contribution to the development of non-public service products between the years of 2002 and 2017, taking into account five different geographical subdivisions (microregion, mesoregion, state, region and country), in the perspective of identifying the level of centrality and a relationship with Geographical Indications.

This measurement was created based on the analysis of the data available in the Brazilian IBGE for each of the 1,792 municipalities of the Northeast Region of Brazil by carrying out two different applications of Principal Component Analysis (PCA), with the results being subsequently normalized.

An alternative perspective to the indicator proposed herein refers to the level of influence of the municipalities from the Northeast Region on the geographical regions where they are inserted. With this, Teresina, in the State of Piauí, and Fortaleza, in the State of Ceará, can be considered cities of greater economic expression when compared with their surroundings, in both periods studied (2002 and 2017).

Probably, for the same reason, Recife, in the State of Pernambuco, and Salvador, in the State of Bahia, are top of this group, as their development has already influenced their surroundings, locally decentralizing their offer of services. Likewise, Campina Grande, in the State of Paraíba, reduces the impacts that could be caused to the countryside of Paraíba by the capital city of João Pessoa, becoming an alternative urban hub to its surrounding municipalities.

The results also showed that the centrality of the cities of the Northeast Region is a highly hierarchized phenomenon, as only a handful of municipalities stand out among the group of regional localities. This reality is present both at the start and at the end of the period studied, being corroborated by the fact that the centrality of the non-public service sector is linked to the capitals of the region, with the exception of some cities in the countryside.

This hierarchization became more noticeable when separating the municipalities into classes parametrized by their respective score ranges. Therefore, both in 2002 and in 2017, approximately 95% of the cities in the Northeast region of Brazil were described by this relation, representing low levels of contribution in the development of non-public service products.

In addition, it is a reality which is difficult to change. Not surprisingly, the top ten scores and the bottom ten scores remained practically unchanged over almost two decades. Nevertheless, the States of Maranhão and Piauí observed the greatest frequency of changes, being both considered among the poorest States in the region.

Paradoxically speaking, the reduction in the average scores between 2002 and 2017, even if incrementally, can suggest a certain degree of convergence of these contribution parameters, though this reduction was not enough to dismantle the asymmetric relationships between the places.

Furthermore, it is also worth pointing out that, with the exception of the State of Ceará, the highest average scores at a state level were obtained by the smallest federative units in the region (Sergipe, Alagoas and Rio Grande do Norte), while the lowest scores were attributed to those with the greatest territorial extensions, in both periods studied. This perception is further ratified by the fact that the dispersion between the scores obtained by States of Piauí, Maranhão and Bahia is the highest.

Accordingly, the centrality of an urban centre can be measured by the fact that it is a distribution centre of goods and services in its given region, as explained by the Central Place Theory. Therefore, one way of reaching greater centrality levels would be by implementing actions aimed at strengthening this urban centre, combined with the registration of a Geographical Indication that seeks to protect and add value to its products with unique regional characteristics, consequently promoting local development.

5. Ackowledgements

To the Coordination for the Improvement of Higher Education Personnel (CAPES) for granting the Research Scholarship.

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