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Title: Disparities in Oaxaca's economic development: A regionalization proposal

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Introduction

The capitalist system as we know it today, has been in constant development and evolution going through several phases such as free competition, imperialism and neocapitalism, within the latter has developed what is now known as globalization; this last stage commonly known as globalization has been the most aggressive of capitalism and the one that has contributed the most to reproduce and increase the disparities in the economic development of regions and countries in the world. Economic disparities are usually the result of production and exchange processes between regions, countries or municipalities and occur when one or some of the members are at a disadvantage.

In this context of economic crisis (expressed through disparities) that is being experienced, regionalization stands as an interesting alternative to face these problems.

Methodology

For the development of this analysis 4 different but complementary types of methodologies were used:

- A mixed heuristic regionalization method called "regionalization algorithm“
- The scenario method
- The multi-criteria analysis method
- Econometric instruments and spatial analysis

All of this to analyze regionalization as the best alternative to reduce disparities in the economic development of the municipalities of the state of Oaxaca.

For the development of this research, the methodological steps that will be approached for the construction of the different scenarios are:

1. Decide the system on which to work (variables and relationships).
2. Decide the time space for scenarios (time of occurrence).
3. Deciding how many scenarios you want to build (three or four is ideal).
4. Determine the main variables that will structure the scenarios and discuss assumptions about the future.
5. Define the value that the variables will take in each scenario considered.
6. Decide on specific events that may occur during the temporal space of scenarios.
7. Create a job title for each scenario.
8. Outline the scenarios.

Multi-criteria analysis is based on a limited series of solution alternatives

In this method, a decision / weighting matrix is built, which according to Muñoz & Romana (2016) must always contain the following elements:

1. Decision criteria.
2. Weights.
3. Alternatives.

“Max P Regions” method

In this research, a regionalization algorithm known as “Max P Regions” is used, this has as its main hypothesis that the design of homogeneous and contiguous regions only makes sense if there are disparities between the areas, this would justify the design of more than one region and it would show evidence of spatial dependence which in turn would justify the requirement of spatial contiguity in the formation of the new regions.

Spatial analysis

The most common statistics in the analysis of spatial dependence at a global and local level, these statistics allow us to contrast the presence or absence of a spatial dependence scheme; that is, to test whether the hypothesis that a variable is completely randomly distributed in space is fulfilled or whether, on the contrary, there is a significant association of similar or dissimilar values between neighboring regions.

Results

Variable selection

In this research, the variables chosen for the construction of the regions were social, political / governmental and economic, precisely due to the existence of data through different indicators and their existence at different points in time. This analysis will begin by showing and explaining each of the selected indicators, as well as their relevance and quality as a social variable, the Human Development Index (HDI) was selected.

In order to consider the performance of each municipal government in the construction of the scenarios, for the political / governmental variable, the Municipal Functional Capacities Index (MFCI), first calculated. Regarding the economic variables: Total gross production per total employed personnel and Average value added per employed person.

Multicriteria analisis

The CRITIC method seeks to evaluate the alternatives, in order to help in the decision-making process, through the analysis of the value of the standard deviation of the criteria and their correlation coefficients. In the CRITIC methodology, the standard deviation is used as a measure of the amount of information of each criterion, therefore, the greater this, the more information each one of them will provide; However, for this analysis the standard deviation of the criteria is approached differently, since this is a measure that quantifies the dispersion of the data, in this case a greater dispersion would mean greater disparity between the HDI samples for each region analyzed. What is then sought is a low standard deviation for each established criterion.

Alternatives	Standard deviation matrix									
	Associated criteria (regions)									
		Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7	Region 8	Average S
	Traditional Regionalization	0.0537	0.055	0.1915	0.075	0.0649	0.0516	0.0412	0.0912	0.0780
	Max P Regionalization	0.0571	0.0472	0.067	0.126	0.0512	0.0981	0.0712	0.0541	0.0715
	Cluster Regionalization	0.0768	0.0915	0.0509	0.0533	0.0606	0.1772	N/A	N/A	0.0851

Alternatives	Matrix of spatial correlations									
	Associated criteria (regions)									
		Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7	Region 8	Average Rs
	Traditional Regionalization	0.405	0.28	0.293	0.147	0.475	0.394	0.231	0.604	0.354
	Max P Regionalization	0.432	0.294	0.44	0.768	0.17	0.141	0.404	0.194	0.355
	Cluster Regionalization	0.133	0.648	0.327	0.389	0.494	0.287	N/A	N/A	0.379

Best possible selection

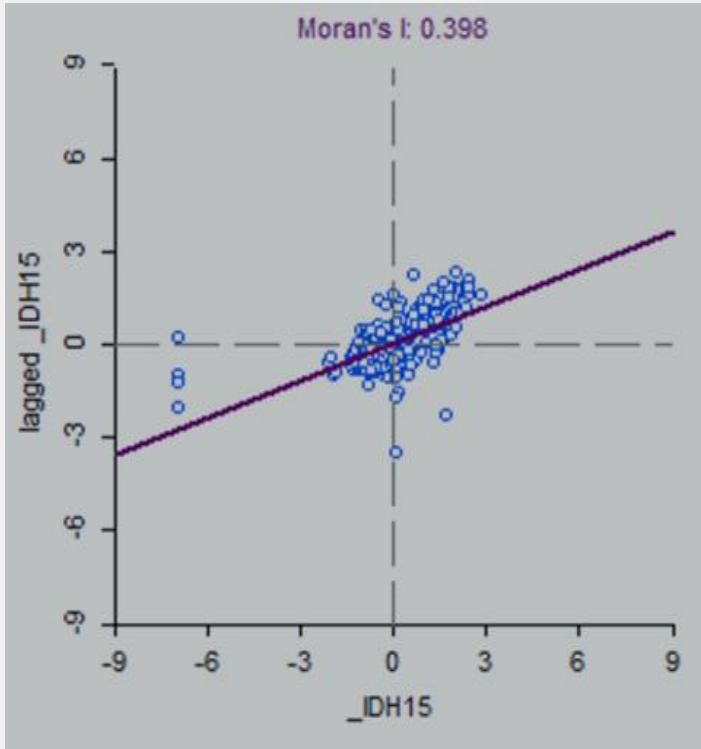
Since the choice of the best alternative (regionalization) is determined by the one that on average shows the best result with respect to the weight associated with its criteria (regions) in the matrix, it is observed that the best performance is obtained by the Max P regionalization with a average associated weight 0.0432; This indicates that for this alternative there is a better relationship between low standard deviation levels and high levels of spatial correlation of its municipalities with respect to the Human Development Index.

Alternatives	Matrix of associated weights									
	Associated criteria (regions)									
		Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7	Region 8	Average W
	Traditional Regionalization	0.0320	0.0396	0.1354	0.0640	0.0341	0.0313	0.0317	0.0361	0.0505
	Max P Regionalization	0.0324	0.0333	0.0375	0.0292	0.0425	0.0843	0.0424	0.0436	0.0432
	Cluster Regionalization	0.0666	0.0322	0.0343	0.0326	0.0307	0.1263	N/A	N/A	0.0538

Spatial analysis of the regionalization Max P

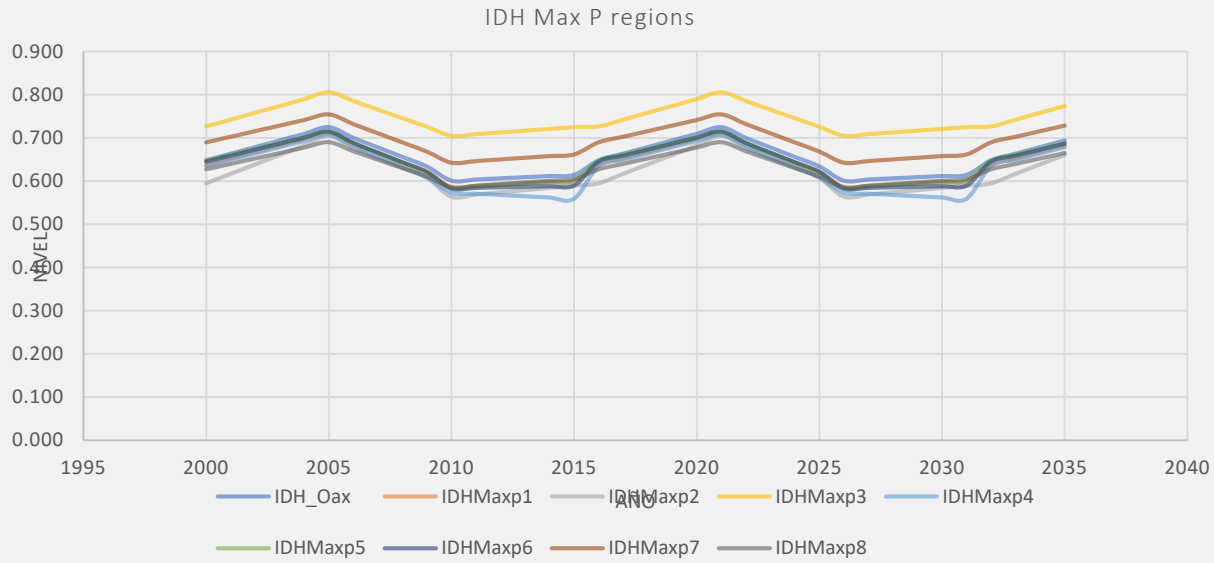
$$I = \frac{n}{s} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij} z_i z_j}{\sum_{i=1}^{n} z_i^2}$$

The global spatial correlation coefficient of the HDI in the state of Oaxaca, this presents a value of 0.398, this result indicates a correlation to be considered within the municipalities of the state, since when the neighbors with whom a municipality maintains geographic contiguity increase In one unit its HDI values, it will do so in the value presented here.



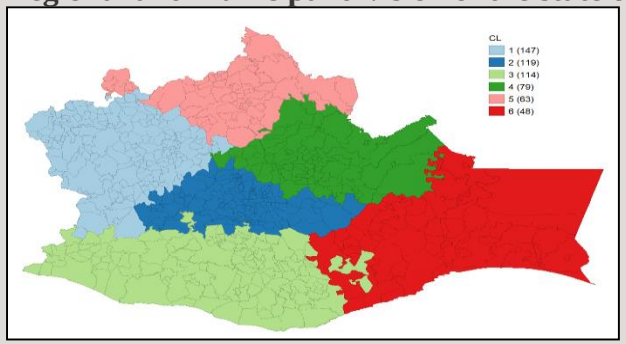
HDI projection by region

With respect to the regions, the behavior observed in the HDI at the state level reproduces something that is to be expected because it is the state that determines through its public, fiscal, economic policies, etc. the direction that development is going to take; There are two regions that with respect to their HDI levels stand out above the others, these are the Max P3 region and the Max P7 region, this is due to the municipalities that make them up, since they become some of the municipalities with the best economic performance in the state.

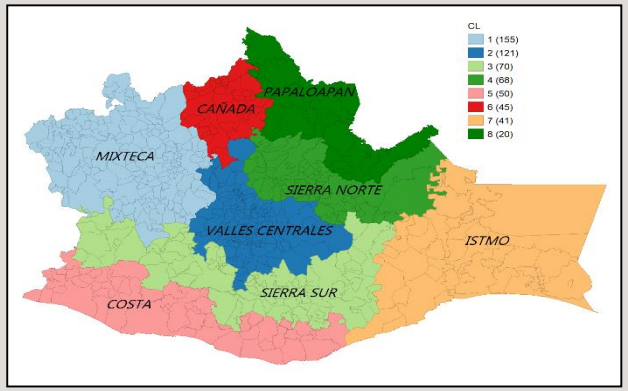


Anexos

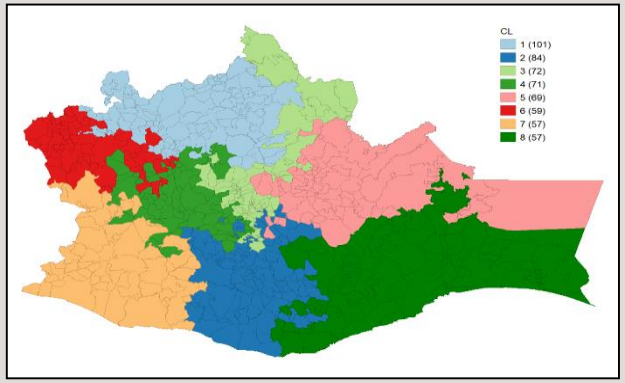
Regional and municipal division of the state of Oaxaca



Regional and municipal division by the Max P Regions method



Regional and municipal division by cluster method



HDI regressions by region

Fecha	IDH Oax	IDHMaxp1	IDHMaxp2	IDHMaxp3	IDHMaxp4	IDHMaxp5	IDHMaxp6	IDHMaxp7	IDHMaxp8
2000	0.648	0.637	0.595	0.726	0.635	0.647	0.645	0.689	0.627
2001	0.663	0.652	0.617	0.742	0.649	0.661	0.659	0.702	0.640
2002	0.679	0.667	0.639	0.758	0.664	0.674	0.673	0.715	0.652
2003	0.694	0.682	0.661	0.774	0.678	0.688	0.687	0.728	0.665
2004	0.709	0.697	0.683	0.790	0.693	0.701	0.701	0.741	0.678
2005	0.725	0.712	0.705	0.806	0.707	0.715	0.715	0.754	0.690
2006	0.700	0.687	0.676	0.786	0.680	0.688	0.688	0.732	0.669
2007	0.678	0.665	0.653	0.766	0.656	0.665	0.666	0.710	0.650
2008	0.656	0.643	0.631	0.746	0.632	0.642	0.644	0.689	0.630
2009	0.634	0.620	0.608	0.726	0.608	0.618	0.622	0.668	0.610
2010	0.601	0.586	0.564	0.705	0.573	0.584	0.583	0.642	0.585
2011	0.604	0.589	0.569	0.709	0.570	0.587	0.584	0.646	0.589
2012	0.606	0.592	0.574	0.713	0.567	0.591	0.586	0.650	0.593
2013	0.609	0.594	0.579	0.717	0.565	0.594	0.587	0.654	0.597
2014	0.612	0.597	0.584	0.721	0.562	0.598	0.588	0.658	0.601
2015	0.614	0.600	0.589	0.725	0.559	0.601	0.590	0.661	0.604
2016	0.648	0.637	0.595	0.726	0.635	0.647	0.645	0.689	0.627
2017	0.663	0.652	0.617	0.742	0.649	0.661	0.659	0.702	0.640
2018	0.679	0.667	0.639	0.758	0.664	0.674	0.673	0.715	0.652
2019	0.694	0.682	0.661	0.774	0.678	0.688	0.687	0.728	0.665
2020	0.709	0.697	0.683	0.790	0.693	0.701	0.701	0.741	0.678
2021	0.725	0.712	0.705	0.806	0.707	0.715	0.715	0.754	0.690
2022	0.700	0.687	0.676	0.786	0.680	0.688	0.688	0.732	0.669
2023	0.678	0.665	0.653	0.766	0.656	0.665	0.666	0.710	0.650
2024	0.656	0.643	0.631	0.746	0.632	0.642	0.644	0.689	0.630
2025	0.634	0.620	0.608	0.726	0.608	0.618	0.622	0.668	0.610
2026	0.601	0.586	0.564	0.705	0.573	0.584	0.583	0.642	0.585
2027	0.604	0.589	0.569	0.709	0.570	0.587	0.584	0.646	0.589
2028	0.606	0.592	0.574	0.713	0.567	0.591	0.586	0.650	0.593
2029	0.609	0.594	0.579	0.717	0.565	0.594	0.587	0.654	0.597
2030	0.612	0.597	0.584	0.721	0.562	0.598	0.588	0.658	0.601
2031	0.614	0.600	0.589	0.725	0.559	0.601	0.590	0.661	0.604
2032	0.648	0.637	0.595	0.726	0.635	0.647	0.645	0.689	0.627
2033	0.663	0.652	0.617	0.742	0.649	0.661	0.659	0.702	0.640

Conclusions

- To select the best regionalization alternative among the three analyzed, the average associated weighting coefficient was estimated, with the Max P regionalization showing the best performance with a value of 0.432, followed by the traditional regionalization with a higher value of 0.505. and finally the cluster-type regionalization which obtained the worst performance with a result of 0.538.

- The result obtained by the associated weighting coefficient of the Max P regionalization guarantees that it is in it where, by grouping the municipalities through their 8 proposed regions, the levels of disparity in economic development are reduced and, in turn, maintain a acceptable level of spatial correlation between its municipalities; In this way, it can be observed that by means of this adaptation of the CRITIC method, the proposed hypothesis is corroborated in which it is stated that by creating new regions it contributes to reducing disparities and stimulating a more balanced development, this is achieved by using of an analytical model where the optimization of the selected criteria (selected variables of the model) is prioritized, for the creation of the proposed regionalization.

- In the spatial analysis of the Max P regionalization, the levels of spatial dependence existing at the regional level are investigated in greater depth through the spatial correlation matrix already analyzed. At the global level, the spatial correlation coefficient was very close to 0.40, a value of great relevance since it reveals an important dependence between the municipalities of the state with respect to economic development.

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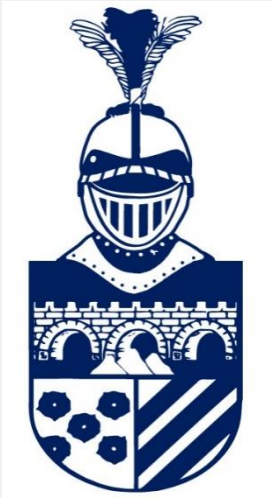

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