A Simplified Method For Analyzing Regional Competitiveness And Its Application To The Mexican Northwest Economic Region

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Abstract
This paper presents a simplified method for regional competitiveness analysis, designed to enhance the understanding of economic disparities across regions. The proposed methodology organizes regions based on key economic indicators, focusing on competitiveness, and employs quartile-based classification to highlight regional homogeneity, relative positions, and internal disparities. By utilizing box-and-whisker plots, the method allows for a clear identification of outliers and the detection of significant gaps in competitiveness within well-defined regions. The approach combines interregional analysis using general economic indicators and intraregional evaluation with sub-indices, enabling a more nuanced understanding of regional dynamics. The methodology involves ranking states by competitiveness sub-indices, followed by the creation of graphical representations such as box plots to visualize regional patterns and potential outliers. The analysis proceeds from an interregional perspective, moving toward a more detailed intraregional examination. This step-by-step process reveals the regions leading in competitiveness and those requiring greater attention for development. In addition, the radial graph is suggested as a tool to further clarify the data, offering a clearer visualization of competitiveness disparities. To demonstrate the effectiveness of this method, a practical application is provided using the "Índice para la Competitividad Estatal 2024" from the Instituto Mexicano para la Competitividad A.C. (IMCO), which allows for a comprehensive assessment of Mexico's regions. The results showcase the regions with the highest competitiveness and those facing challenges, offering actionable insights for policymakers, regional planners, and researchers. This approach serves as a valuable tool in regional economic analysis, providing an accessible, data-driven framework for identifying key areas for intervention and investment.

I.   Proposed Method

This method offers a simplified statistical and visual approach to assessing regional competitiveness, using tools such as quartile analysis and graphical diagrams. This approach makes it possible to identify patterns of homogeneity between regions, locate relative positions of competitiveness, detect outliers and analyze internal disparities within regions. At its most detailed level, the method facilitates the graphical identification of the states that stand out as leaders and those that require greater attention in terms of competitiveness.

Initially, the available information on the regions is organized according to global competitiveness indicators. The data is divided into quartiles to classify regions according to their relative positions. This preliminary analysis helps to determine the degree of homogeneity or heterogeneity between regions and to detect possible outliers, i.e. those that deviate significantly from the interquartile ranges. In this way, an initial vision of regional disparities is obtained.

Subsequently, the states of each region are grouped according to their competitiveness sub-indices, such as infrastructure, education, innovation or economic development. The states are organized in a ranking by sub-indexes and box and whisker plots are drawn up. These diagrams allow you to visualize the dispersion of data, identify outliers, and analyze how competitiveness is distributed within each region. This cross-regional analysis reveals the overall dynamics of each region in the context of the global index.

For a more specific analysis, an intra-regional breakdown is made using the competitiveness sub-indices. Each subscript is evaluated individually through the same graphical procedures. This level of detail makes it easier to identify internal disparities within regions and establish which specific variables contribute most to the observed gaps. In addition, the use of radial charts allows multiple variables to be integrated visually, highlighting both the strengths and weaknesses of each state.

This method has several advantages. Firstly, its simplicity makes it easy to apply in different contexts, as it uses basic and widely known statistical tools. Second, the visual clarity of the charts allows for quick and effective interpretation of the results, highlighting relevant patterns and trends. Finally, its flexibility makes it adaptable to different indicators or regions, which expands its usefulness as an analysis tool.
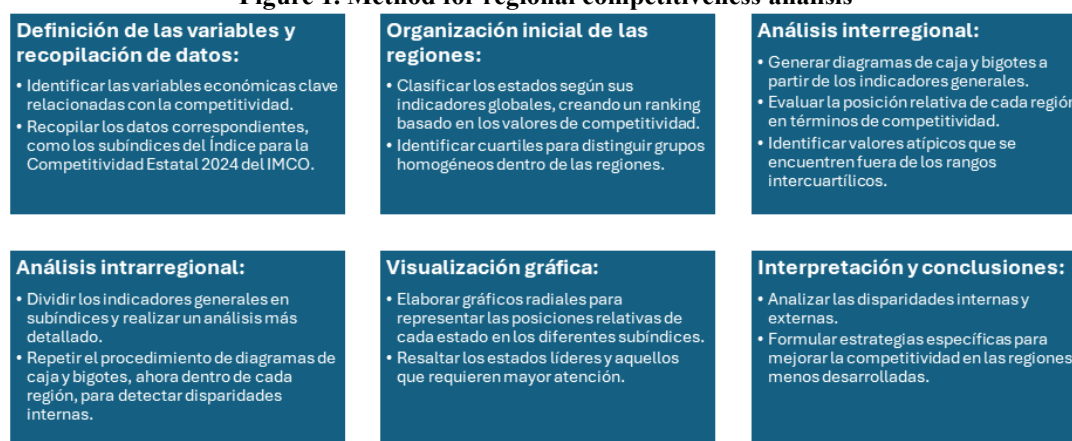
Below is an example of application using the Northwest Region of Mexico with data from the 2024 State Competitiveness Index of the Mexican Institute for Competitiveness A.C. (IMCO, 2024). This index integrates various sub-indices, such as infrastructure, education, innovation and economic development, which makes it a suitable tool to illustrate the functionality of the method.

The index data would initially be organized in an interregional ranking based on the global state competitiveness index, followed by the elaboration of box and whisker plots to evaluate dispersion and detect outliers.

Subsequently, an intraregional analysis would be carried out using the aforementioned sub-indices, complemented by radial graphs to graphically identify the leading states and those with the greatest lags. This example illustrates how the method can detect disparities and guide improvement strategies based on solid evidence.

Figure 1 shows an outline of the proposed method.

Figure 1. Method for regional competitiveness análisis

Definición de las variables y recopilación de datos:
- Identificar las variables económicas clave relacionadas con la competitividad.
- Recopilar los datos correspondientes, como los subíndices del Índice para la Competitividad Estatal 2024 del IMCO.

Organización inicial de las regiones:
- Clasificar los estados según sus indicadores globales, creando un ranking basado en los valores de competitividad.
- Identificar cuartiles para distinguir grupos homogéneos dentro de las regiones.

Análisis interregional:
- Generar diagramas de caja y bigotes a partir de los indicadores generales.
- Evaluar la posición relativa de cada región en términos de competitividad.
- Identificar valores atípicos que se encuentren fuera de los rangos intercuartílicos.

Análisis intrarregional:
- Dividir los indicadores generales en subíndices y realizar un análisis más detallado.
- Repetir el procedimiento de diagramas de caja y bigotes, ahora dentro de cada región, para detectar disparidades internas.

Visualización gráfica:
- Elaborar gráficos radiales para representar las posiciones relativas de cada estado en los diferentes subíndices.
- Resaltar los estados líderes y aquellos que requieren mayor atención.

Interpretación y conclusiones:
- Analizar las disparidades internas y externas.
- Formular estrategias específicas para mejorar la competitividad en las regiones menos desarrolladas.

Justification of the chosen area

The Northwest region of Mexico, which encompasses the states of Baja California, Baja California Sur, Sonora, Sinaloa and Nayarit (Vilalta, 2010), has been selected as an area of economic analysis due to its strategic relevance and development potential. This region stands out for having an extensive coastline that extends both in the Pacific and in the Sea of Cortez (Yurkievich & Sánchez Crispín, 2016), which gives it a privileged location for trade and the development of fishing activities. In particular, Sinaloa stands out for its robust agricultural industry, which is a fundamental pillar of the local economy, as well as for its growing fishing sector.

In addition, the region has significant potential to boost economic development thanks to its natural resources and infrastructure. In Sonora, lithium exploitation and the growth of the semiconductor industry represent a significant opportunity to attract investment and generate high value-added employment (Vivoda, Bazilian, Khadim, Ralph, & Krame, 2024). In Sinaloa, the arrival of new industries, such as chemicals (Aslan Energy, Mexinol and GPO) and aerospace (Mzt Aerospace), opens favorable prospects for economic diversification (NASA, 2024).

The Baja Californians, both Baja California and Baja California Sur, are positioned as key players due to their strategic connectivity with the United States and the Pacific, which facilitates international trade and attracts foreign investment. In addition, the region's potential to take advantage of nearshoring opportunities, with the relocation of supply chains close to the United States, is an important factor that can strengthen its economic competitiveness (Wright & Scammell, 2017).

The commitment to regional development is also manifested through concrete initiatives, such as the proposal to establish a center for innovation and creativity in the municipality of Ahome, Sinaloa (Quirino Ordaz Coppel, 2017). This project aims to foster collaboration between academic, business and government sectors, promoting the creation of new ideas and the incubation of innovative companies that contribute to the economic and social growth of the region.

Together, the combination of natural resources, strategic infrastructure, industrial opportunities and the promotion of the knowledge economy make Northwest Mexico an ideal region to carry out an economic analysis aimed at understanding its challenges and future potentialities.

In general terms, the states that make up the Northwest region of Mexico present a high level of competitiveness, placing themselves within the 85th and 95th percentiles of the distribution of the competitiveness score among the 32 states of the country (IMCO, 2024). This remarkable performance can be attributed, to a large extent, to factors such as the region's privileged geographical conditions, including its strategic location along the Pacific coast and its proximity to Mexico's northern border (Yurkievich & Sánchez Crispín, 2016). This proximity to the United States facilitates trade and the mobility of goods and services (Sánchez, 2016), as well as the flow of foreign investment, which translates into greater opportunities for economic development and the creation of high-quality jobs.

However, the competitiveness of the region does not depend exclusively on its geographical location. An equally determining factor has been the dedication and constant effort of the local population, which has contributed significantly to boosting the economy (Quirino Ordaz Coppel, 2017). The people of the region have demonstrated remarkable resilience and resilience in the face of economic and social challenges, as well as a willingness to adopt new technologies and innovative practices that have boosted competitiveness (Gómez Oliver & Granados Sánchez, 2016). The quality of its human capital, reflected in its ability to take advantage of the opportunities of the environment and in its dedication to work, is a fundamental element to understand the success of this region.

Thus, the high competitiveness of the Northwest region is not only the result of geographical and commercial advantages, but also of the commitment and proactivity of its inhabitants, who have managed to transform these advantages into an engine of economic growth and social development. This dynamism reflects the ability of the states of the region to position themselves strategically in both the national and international markets, making the most of their resources and their people.

Application of the method for the analysis of the competitiveness of the Northwest Region

To begin the analysis of our region, it is necessary to understand its position in comparison with the other regions of the country. In this sense, the State Competitiveness Index 2024, prepared by the Mexican Institute for Competitiveness (IMCO, 2024), is used. This index provides a comprehensive evaluation of the competitive performance of Mexico's 32 states, reflecting how they perform in various key dimensions that directly affect their economic and social development.

The State Competitiveness Index is made up of six sub-indices that cover fundamental aspects to evaluate the well-being and growth potential of a region. These sub-indices are:

Innovation and Economy: Measures a region's ability to generate and apply innovation, which is essential to stay competitive in a global environment. It assesses factors such as GDP growth, economic diversification, foreign direct investment, the generation of patents, and the complexity of economic sectors in innovation and technology.

Infrastructure: Assesses the quality of physical and digital infrastructure, including key elements such as telecommunications, transportation, and access to financial and technological services. These aspects are essential to improve connectivity, facilitate trade and promote regional development.

Labor Market (Labor): Analyzes the efficiency of human capital, considering the availability of skilled workers, the competitiveness of wages, and working conditions. This sub-index also assesses equal pay and the level of education, determining factors in attracting talent and encouraging investment.

Society and Environment (SMA): Measures the quality of life of the inhabitants of a region, taking into account aspects such as health, education, and environmental sustainability. A high performance in this sub-index reflects a favorable environment for attracting investment and improving social welfare.

Law: Assesses public safety, respect for the rule of law, and the quality of judicial institutions. These factors are essential to generate an environment of trust, protect property rights and attract investment.

Political System and Governments (GSP): Analyzes the efficiency of local governments, political stability, and the implementation of effective public policies. A functioning political system is crucial for competitiveness, as it promotes investment and the generation of a healthy economic development environment.

Figure 2 shows how our region is positioned in relation to the other states, according to these sub-indices. This analysis will not only allow us to identify the strengths and weaknesses of our region, but also to offer a comprehensive view of how it compares with other entities in terms of competitiveness and its capacity for economic and social growth.

Figure 2. Competitiveness position by región
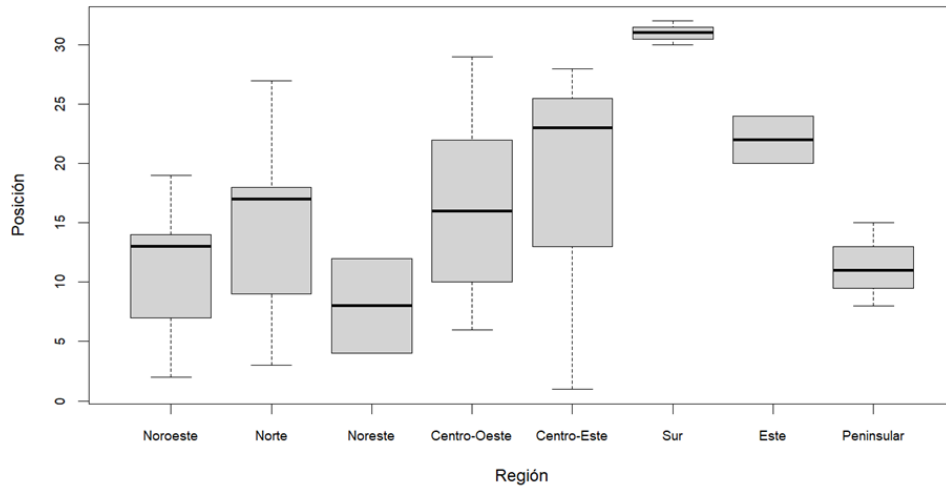
Source: Own elaboration with IMCO data (IMCO, 2024)

Figure 3. Competitiveness results map
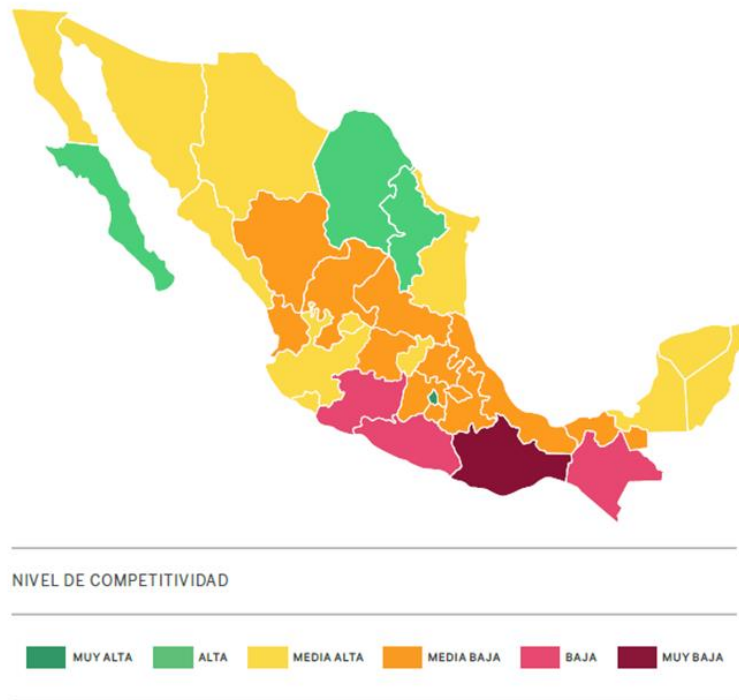
Source: Competitiveness Report 2024 (IMCO, 2024)

As can be seen, within the same region there can be notable variations in the levels of competitiveness among its states. Therefore, it is not appropriate to consider individual data from each state as a conclusive indicator of regional competitiveness. In other words, although a state may exhibit high levels of competitiveness, this does not necessarily imply that the entire region to which it belongs shares those characteristics.

A clear example of this can be seen in the Central-North zone, where the long branches in the graph of the 2024 State Competitiveness Index (IMCO, 2024) reflect a significant disparity. In this case, Mexico City (CDMX) stands out in terms of competitiveness, being much more competitive than the rest of the states that make up its region. This difference in competitiveness within the same area highlights regional variability that is not always reflected in the regional average.

On the other hand, the region with the least variability in terms of competitiveness is the South region, whose states — Chiapas, Oaxaca and Guerrero — consistently occupy the lowest positions in the State Competitiveness Index. According to IMCO data, these states are among the least competitive at the national level, which reflects a lack of dynamism in their economic and social development.

Table 1 shows an excerpt of the positions in different areas of competitiveness (in red the less well positions).

Table 1. Competitiveness Dimensions (Northwest Region)

State	Position	Innovation and Ec.	Infrastructure	Work	SMA	Right	SPG
Baja California	14	4	5	7	18	12	32
Baja California Sur	2	13	7	3	2	2	14
Sonora	7	7	9	8	3	18	26
Sinaloa	13	15	10	6	12	16	23
Nayarit	19	29	21	16	15	5	21

Source: Own elaboration with data from IMCO (IMCO, 2024)

As for the Northwest region, which is the focus of this analysis, a notable variability is observed. This phenomenon is evident when comparing the two extremes of the region: Baja California Sur, which occupies the second position nationally, and Nayarit, which is in the 19th position. This difference highlights internal disparities within the region. However, when analyzing the median positions of the states in this region, it is observed that the Northwest region is just below the Northeast and Peninsular regions, which have, as a whole, a higher level of competitiveness when evaluated by this statistical measure.

This analysis shows that the competitiveness of a region cannot be understood only through the individual values of each state, since there are internal factors that can significantly modify the overall results (Santiesteban, Martín & Leyva López, 2017). Variability within regions reflects the complexity of regional development processes and underscores the importance of considering specific sub-indices to obtain a more accurate view of competitive performance.

The following figure (Figure 3) shows the variability of the sub-indices, now only for the Northwest Region.

**Figure 3. Competitiveness position by sub-indices (Northwest Region)**
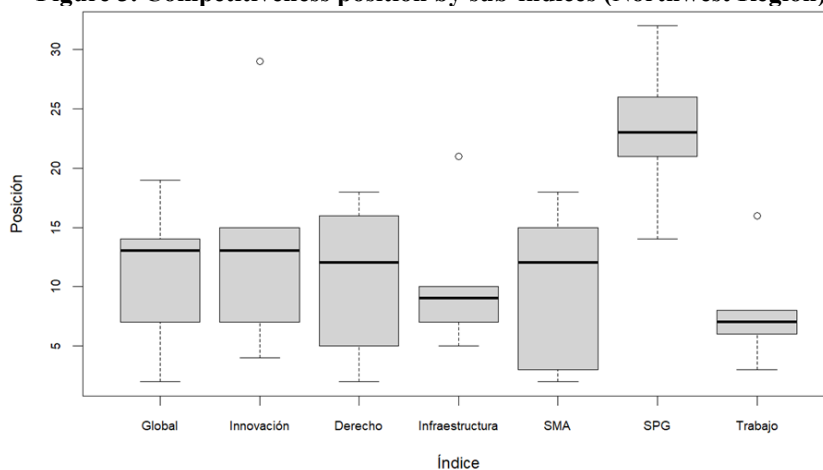
The general analysis of the northwest region, using boxplot-type graphs, allows us to observe several key aspects related to regional competitiveness. One of the main findings is that the median of indicators such as overall outcome, innovation, law, and society and environment remains relatively constant. This reflects the integrated and mutually influential dynamics of the organisms that make up the quadruple helix (academia, industry, government, and society). It should be noted that this cohesion transcends the economic and industrial, permeating even culture, traditions and gastronomy, which reinforces the distinctive character of the region.

In terms of performance, the region stands out especially in infrastructure and labor market indicators, achieving superior positions compared to other sub-indices. This is evidence of sustained economic growth and marked industrial dynamism, driven largely by its ability to take advantage of nearshoring opportunities, which strengthen cross-border value chains.

However, the Political System and Government indicator presents the weakest performance in the region. This result shows serious weaknesses in governance, exacerbated by the prevalence of problems such as organized crime, corruption and administrative inefficiency. These factors represent a significant obstacle to the full development of the region.

An additional aspect to highlight is the presence of outliers, shown in Figure 2 and broken down in Figure 4, in the innovation, infrastructure and labor market indicators. These values reflect a clear distancing of Nayarit from the other states that make up the region. This phenomenon could be attributed to its greater distance from the northern border, which limits its integration into cross-border trade flows, as well as its lower connection with other economic regions of the country.

Figure 4. Competitiveness web graph by sub-indices (Northwest Region)
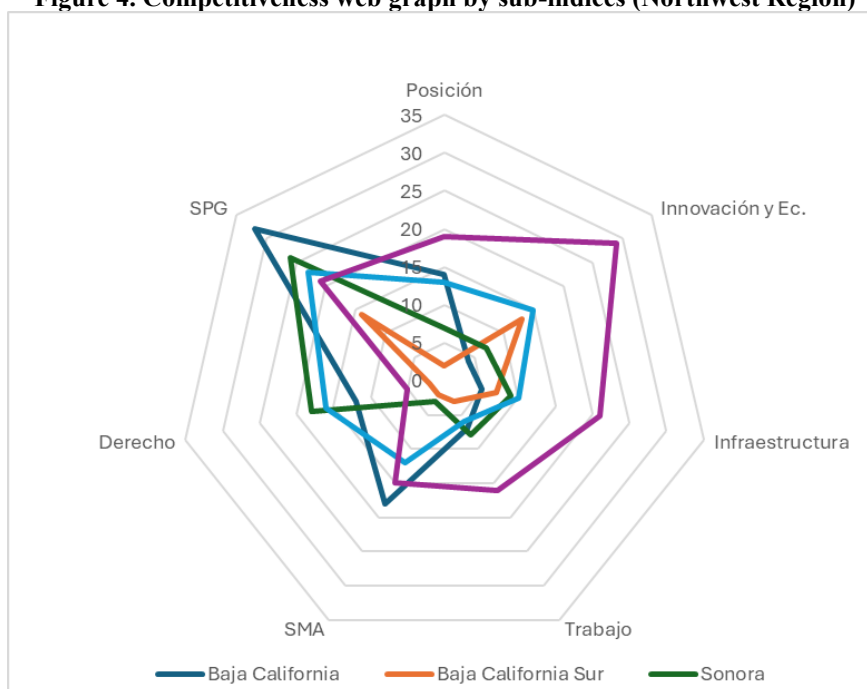
From the above, it can be seen that the northwest region shows significant strengths in infrastructure and labor dynamism, as well as critical challenges in the political sphere. The outliers evidenced in the analysis underscore the need to address regional inequalities, promoting strategies that enhance territorial cohesion and integration, on the other hand, it is clear that Baja California Sur strongly reflects its second place nationally in competitiveness.

II. Analysis Of Strengths And Weaknesses For The Northwest Region (Baja California, Baja California Sur, Sonora, Sinaloa And Nayarit)

Strengths

The economy of northwestern Mexico, which includes Baja California, Baja California Sur, Sonora, Sinaloa, and Nayarit, benefits from several strengths that are driving its development. First, the national economic recovery, reflected in the growth of GDP per capita, is also evident in the region, especially in Baja California Sur, which leads in foreign direct investment (FDI), with an average of 4.6 per thousand of GDP, the highest in the country. This indicator highlights the region's ability to attract foreign capital, particularly in sectors such as tourism and renewable energy. In addition, the strategic geographical position of these states facilitates their integration with the United States, which boosts their exports, reflected in the increase in the percentage of GDP represented by merchandise exports at the national level (from 32% to 34%). This trend could especially benefit Sonora and Baja California, which already have a strong trade relationship with their neighbor to the north.

In terms of employment, Baja California Sur also stands out for the average income of its full-time workers, the highest nationwide with $14,718, while Baja California registers $13,632. On the other hand, Sonora and Sinaloa have average incomes of $10,532 and $11,196, respectively. These income levels demonstrate a capacity to generate well-paid jobs, especially in the tourism sector and other key sectors in the region. At the national level, there is a slight improvement in labor formality, which could have positive repercussions in the region by reducing labor informality, especially in Sinaloa, where the smallest gap between men and women in this area is registered (Ramos, Gibaja-Romero, & Ochoa, 2020).

In terms of digital connectivity, Baja California stands out for its internet access of 78%, followed by Baja California Sur with 70%. These percentages indicate strong access to digital technologies that could boost the development of innovative sectors such as advanced manufacturing and digital services. In contrast, the states of Sonora (66%), Sinaloa (63%) and Nayarit (56%) have lower levels of access, indicating areas of opportunity to improve connectivity infrastructure in these states and promote greater digital integration.

In addition, life expectancy in the country has increased, reflecting advances in public health. Although the Northwest does not lead this indicator, it could take advantage of the growth in life expectancy through health policies focused on prevention and medical care. The improvement in security, reflected in a slight decrease in homicides, offers a foundation on which prevention strategies could be strengthened, something that could be beneficial for the Northwest states by improving the business environment and quality of life.

Weaknesses

Despite growth in key indicators, the entities of the Northwest face challenges related to regional disparities. The income gap remains wide, with Baja California Sur registering significantly higher incomes than the other states in the region. This reflects the need to design strategies that raise wages in the rest of the region, particularly in Sinaloa and Sonora. In terms of innovation, the economic competitiveness index has shown a setback at the national level, and the entities of the Northwest do not stand out for their diversification or productive specialization in key sectors, which could limit them in terms of competitiveness. Baja California, although leading in certain aspects, faces a critical deficit in medical and nursing personnel, which reflects the urgent need to improve the health infrastructure in the state.

Labor informality, although it has decreased at the national level, continues to be a structural problem, especially in states such as Sinaloa, where the labor informality gap between men and women is a concern. Although Baja California Sur stands out in terms of income and formal employment, the region in general faces difficulties in reducing labor informality effectively. In addition, limited access to health services and declining education coverage in the country can be especially problematic in rural and marginalized areas of the Northwest, perpetuating inequalities and limiting long-term development.

Opportunities

At the national level, international investment and openness policies could be leveraged to foster the development of key sectors in the Northwest, such as tourism, renewable energy, and advanced manufacturing, by improving regional competitiveness and attracting more foreign investment. The improvement in female labor participation also presents an opportunity to generate a more inclusive and diverse work environment in the region, especially in key sectors such as commerce and manufacturing. In addition, advances in life expectancy and overall quality of life could be used to improve health infrastructure and generate a healthier and more productive environment in the region.

In terms of security, although the homicide rate remains high, the upward trend is an opportunity to strengthen public security policies. The entities of the Northwest could take advantage of this improvement to consolidate a safer environment, which would benefit both the quality of life of the inhabitants and the attraction of investments. In the fiscal sphere, the improvement in the management of state debt, especially in Sonora and Baja California, offers an opportunity to allocate greater resources to productive and infrastructure projects. Likewise, reducing the perception of corruption at the national level can be a plus point for the region if transparent governance policies are implemented that encourage local and foreign investment.

Finally, the improvement in the perception of the quality of notarial services, although modest, presents an opportunity to improve administrative efficiency and reduce bureaucracy, which could promote competitiveness in the region and facilitate the completion of procedures for both citizens and companies.

Threats

However, the entities of the Northwest face several threats that could hinder their development. Reduced educational coverage and a shortage of medical personnel in Baja California are significant challenges that require urgent attention. If policies are not implemented to improve these sectors, the region could face a loss of key human capital. In addition, the persistence of high levels of homicides and crime, even if there is a slight improvement, remains a latent threat that could limit economic growth and quality of life in the region. In terms of debt, the increase in the cost of debt for state-owned entities is a persistent threat that could affect the ability of regional governments to finance key infrastructure and services projects without committing more resources.

The labor informality gap and the widening of gender inequality in employment are threats that could slow down the region's economic development. Without effective measures to reduce informality and improve opportunities for women in the labor market, the Northwest could lose the potential to tap into its diverse workforce and increase regional competitiveness. In terms of security, the marginal increase in crime is also a concern, as it could generate a perception of insecurity among investors and affect the population's confidence in the stability of the region, as has unfortunately happened in the State of Sinaloa in 2024, derived from a conflict between two factions of the Sinaloa Cartel (Murphy & Rossi, 2020).

III. Conclusions

The proposed method for the analysis of regional competitiveness offers a simplified but robust approach to assess economic disparities between regions, allowing not only to identify the relative positions of each one, but also to visualize internal disparities that could go unnoticed in more general analyses. The organization of statements by quartiles and subsequent evaluation using box and whisker plots allows for the detection of outliers and anomalies, providing a solid basis for the formulation of more effective development policies and strategies.

The application of this method to the analysis of competitiveness in real contexts, such as the IMCO State Competitiveness Index, demonstrates its ability to handle large volumes of economic data in a clear and

efficient way. In addition, by integrating interregional and intraregional analysis, a more detailed view of the competitive landscape within a country is obtained, highlighting not only the leading regions, but also those that require urgent attention to reduce competitiveness disparities.

In practical terms, this approach not only makes it easier to understand the factors that determine a region's economic performance, but it also becomes a valuable tool for policymakers, economic researchers, and analysts looking for accurate and visually accessible information to make informed decisions. The use of radial charts and statistical diagrams facilitates the communication of complex results, allowing the different actors involved to understand and act accordingly.

Regarding the particular results of the case study: The Northwest region of Mexico stands out as a strategic area for the economic and social development of the country, thanks to its natural, industrial and commercial strengths. Its privileged location, international connectivity and abundant resources, such as lithium in Sonora and the coast of Sinaloa, are fundamental pillars that have allowed it to consolidate its position in sectors such as agriculture, fishing, mining and advanced manufacturing. Likewise, economic diversification with the incorporation of new industries, such as chemicals and aerospace, and the use of nearshoring reinforce the region's competitive dynamism.

However, critical challenges persist that require attention to achieve full development. Among them, the disparity between the states of the region stands out, especially in areas such as digital infrastructure, innovation and governance. Nayarit, with less integration into trade flows and less connectivity, shows the need for focused strategies to balance opportunities between states. In addition, government inefficiency and insecurity represent barriers that limit investment potential and quality of life in the region.

Despite these challenges, cohesion between academia, industry, government, and civil society has strengthened their capacity to respond and adapt to a changing global environment. Initiatives such as the creation of an innovation center in Sinaloa are essential to enhance human capital and promote the knowledge economy. With comprehensive and collaborative policies, the Northwest region has the potential to consolidate itself as a model of competitiveness and balanced development in the national and international context.

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