Analysis Of Economic Specialization In The Atacama Region, Chile

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ABSTRACT

Some countries are made up of regions, which are in turn made up of provinces, and these are further divided into communes, which can be poor or rich. Some regions will experience faster economic growth, while others will not. All of these factors make it interesting to study the variables that influence regional economic growth, and to analyze how well-directed strategies seek to identify resources and opportunities, and then develop plans and economic policies in order to improve the region's competitiveness. In the search for desired regional economic growth, productive specialization emerges as a strategy that allows the region to achieve high levels of production and growth. However, many regions maintain productive specialization for years, but their Gross Domestic Product (GDP) does not increase significantly. This paper studies the contributions that the different economic sectors of the Atacama region make to the GDP, between the years 2011 and 2021. This territory is considered the gateway to the driest desert on the planet and is located north of Santiago, the capital city of Chile. The analysis uses statistical tools that, at first, calculate the absolute contributions of each productive sector to the region and the country. Then, proportional calculations are made to define the Specialization Index of each economic sector. Lastly, a Shift Share analysis estimates the economic advances or setbacks that the region has had over the 10-year horizon. This entire study is considered a basis and input when defining regional growth strategies. Additionally, it will serve to answer the following question: Has the productive specialization determined in the region allowed for greater economic growth?

Keywords: Regional economic growth, Specialization Index, Shift Share analysis. Thematic Area: National, Regional, and Local Economics.

1. INTRODUCTION

The significant inequality of economic resources among nations is a fact. However, interpretation and dramatization begin when, without prior investigation or qualification, the opinion is formed that a small country is condemned to powerlessness, dependency, and exploitation (Perroux, 1950). Therefore, economic growth is a very important topic in the territorial sphere. Regions that achieve sustained economic growth can generate higher levels of employment and thus im[1]prove the economic and social well-being of their population, also contributing to the development of the country. To explain the causes that generate high levels of regional growth, various theories have been developed, with the most significant being the theory of comparative advantage. This basic theory originated with Adam Smith and his work "An Inquiry into the Nature and Causes of the Wealth of Nations," where he discusses the logic of trade, both among individuals and among countries. The theory is based on the productive

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specialization of a country, meaning specializing in producing what the territory does best. Subsequently, David Ricardo expanded this theory to comparative advantage, which states that a region should specialize in those productive sectors in which it has a comparative advantage, i.e., those goods or services it can produce more efficiently and at a lower cost than other regions. While comparative advantages can make a difference in the development and growth of a region, it is the existing strategies the ones aimed at generating and strengthening those productive capacities, allowing for better management of market changes, transforming those advantages into long-term competitive advantages that are difficult to replicate.

It is necessary to define that in the business field, competitive advantage is the result of the firm's essential, valuable, unique, and non-substitutable resources (Barney, 1991; Tan et al., 2022; Wernerfelt, 1984). Similarly, strategies in the business domain aim to achieve the perfect combination of resources and capabilities, although there may be conceptual differences between the two terms, it is difficult to separate them especially in methodological terms (Chandler & Hanks, 1994). Resource-based capabilities are a fundamental combination for the strategy and growth performance of new companies (Zou et al., 2010).

Similarly to a company, territories possess a significant number of resources that can be transformed into sources of competitive advantage, provided that appropriate strategies are employed. In the quest to identify regional capabilities that propel a territory towards greater growth, economic specialization emerges as a valid strategy. Economic specialization and concentration are related to theories of regional economics, such as localization economies, agglomeration economies, and urbanization (Castro & Fuentes, 2017). The theoretical foundations can be traced back to location theories developed by Von Thünen for agricultural activities and Alfred Weber for industry (Hoover, 1951; Perroux, 1950). The main premise is the firm's optimization in terms of geographic location and costs. The specialization of production in territories enables trade formation (Castro Escobar, 2016). Having innovative and technological sectors can also be an effective strategy for promoting regional economic growth, contributing to entrepreneurial innovation and a highly skilled human capital (Rodríguez-Pose & Crescenzi, 2008). The development of a solid economic base and appropriate specialization can lead to greater growth and development in a region or country, making it essential to understand the factors that drive regional growth and how public policies can influence it.

Specialization can also have negative effects on less developed regions, potentially leaving them behind in terms of economic growth and employment. This is where public policies can play a key role in promoting economic diversification and job creation in these regions (Rodríguez-Pose, 2013). It is for this reason that a region highly specialized in a particular sector can become heavily dependent on that sector, making it vulnerable to market fluctuations. While specialization in a sector may limit the economic diversification of the region, such diversification can enhance regional resilience and competitiveness (Hausmann et al., 2007). Therefore, it can be argued that the key to economic success and regional prosperity lies in its political and economic institutions, offering a fresh perspective on the economic and social development of nations (Acemoglu & Robinson, 2012). It is also important to analyze the types of goods and services that a territory exports, as it is a crucial factor in its economic growth and its ability to adapt to changing global economic conditions (Hausmann et al., 2007). Economic and political factors, along with institutions and social interactions, are determining factors in the capacity of cities and regions to thrive and achieve economic growth (Storper, 2013).

2. DEVELOPMENT OF THE PROBLEM

The analysis of this study is based on the regional economic growth, with emphasis on the productive structure and the role that different economic sectors can play. When analyzing regional economies, it is important to consider both the national factors that directly or indirectly influence them and other factors that may particularly affect or condition them (Cuadrado-Roura & Maroto-Sánchez, 2012). Studies determining the dynamics originated by the spatial distribution of production in the economy have focused on analyzing the specialization of activities using statistical indicators that contrast different production typologies within a given territory and the country as a whole. Often, an interregional system is defined as the subdivision of the national economy into a limited number of contiguous regions. Regarding the methods for delimiting the boundaries of a region, they can generally be grouped under three criteria: homogeneity, nodality, and programming (Richardson, 1977). However, in this study, the administrative definitions adopted by the government agencies of Chile will be used, accepting the "fait accompli" (Richardson, 1973).

Nowadays, the regions of Chile are undergoing a process of political, administrative, and fiscal decentralization. This development requires access to more information and a range of techniques that facilitate its analysis, in order to support decision-making by competent authorities (Miranda et al., 2019). Productive specialization emerges as a strategy that enables greater regional economic growth. In this study, a 10-year horizon has been considered, starting from the year 2011 in the Atacama region, located in the northern part of the country, 800 kilometers north of Santiago, the capital city of Chile. The following hypothesis is used as a reference: "Productive specialization influences greater regional economic growth."

3. METHODOLOGY

From a methodological perspective, the analysis carried out is based on the application of various techniques. Initially, an analysis is conducted using absolute values, followed by a relative analysis.

The data is organized in a two-dimensional matrix, representing the data related to a specific productive sector (row) and a region (column) (ILPES, 1993).

Equation (1) reflects the participation of economic sector i in region j at time t.

$P_{ijt} =$ Participation of economic sector i in region j at time t
$\delta_{ij} =$ Productive sector i, in region j
$t_k =$ Time t.
$\sum_{i=1}^{n} \delta_{ij} =$ Sum of all economic sectors in region j

$$P_{ijt} = [\frac{\delta_{ij}}{\sum_{i=1}^{n} \delta_{ij}}]_{t=t_k} \quad (1)$$

Equation (2) calculates the participation of the regional economic sector in the national economic sector at time t.

$$P_{ijt} = [\frac{\delta_{ij}}{\sum_{j=1}^{n} \delta_{ij}}]_{t=t_k} \quad (2)$$

$P_{ijt} =$ Participation of economic sector i in region j at time t
$\delta_{ij} =$ Productive sector i, in region j

t_k = Time t.

$\sum_{j=1}^{n} \delta_{ij}$ = Sum of all economic sectors in all regions

The analysis of productive specialization utilizes the well-known coefficients of specialization, which compare the relative weight of a sector within a region with the sector's percentage share in the national economy. A generic expression for this index can be represented by the following equation (3):

$$IE_{ijt} = \left[\frac{\delta_{ij}}{\sum_{i=1}^{n} \delta_{ij}} \Big/ \frac{\sum_{j=1}^{m} \delta_{ij}}{\sum_{i=1}^{n} \sum_{j=1}^{m} \delta_{ij}} \right]_{t=tk} \quad (3)$$

IE_{ijt} = Specialization Index of economic sector i of region j at time t

δ_{ij} = Productive sector i, in region j

t_k = Time t.

$\sum_{i=1}^{n} \delta_{ij}$ = Sum of all economic sectors in region j

$$\sum_{i=1}^{n} \sum_{j=1}^{m} \delta_{ij}$$ = Sum of all productive sectors by region.

The result of the calculation is interpreted as follows:

➢ When the quotient is greater than 1, it can be concluded that the analyzed economic sector has a higher concentration in the region and a larger size compared to the national context.

➢ Conversely, if the quotient is equal to 1, it indicates that the sizes of the analyzed productive sector are equal in the region and the country. In other words, there is no either high or low relative concentration.

➢ Lastly, if the quotient is less than 1, it can be inferred that the economic activity does not have a strong concentration in the region.

The Geographic Association Index of sector i in region j at time t, represented by equation (4), compares locational patterns. Lower values of the indicator within the range of 0 to 1 indicate a similar distribution and, therefore, geographic association.

$$IF_{Jt} = \frac{1}{2} \sum_{i=1}^{n} \left| \left(\frac{\delta_{ij}}{\sum_{i=1}^{n} \delta_{ij}} \right) - \left(\frac{\sum_{j=1}^{m} \delta_{ij}}{\sum_{i=1}^{n} \sum_{j=1}^{m} \delta_{ij}} \right) \right|_{t=t_k} \quad (4)$$

The Shift and Share methodology is based on a simple empirical observation: growth is higher in certain sectors and regions compared to others. Thus, a particular region may exhibit a higher growth rate than the average of all regions either because it has dynamic sectors at the national

level or because its sectors (whether dynamic or not) are growing faster than the sector average in the comparison pattern (Boisier, 1980; Haddad, 1989; Lira C. & Quiroga, 2009). This analytical method allows for the disaggregation of the variation in economic variables into different components, helping to explain the conditions under which these changes have occurred (Ramajo & Márquez, 2008).

The method decomposes regional growth into its constituent factors and, in this line of analysis, distinguishes the following elements: "total effect," "differential effect," and "structural effect." In its calculation, it is necessary to define the following variation ratios, represented by equations (5), (6), and (7)

Quotient of variation of the sector on a global scale

$$rS_i = \frac{\delta_{sjt_k}}{\delta_{sjt_0}} \quad (5)$$

Quotient of variation of the region

$$rR_i = \frac{\delta_{irt_k}}{\delta_{irt_0}} \quad (6)$$

Global quotient of variation

$$rSR = \frac{\delta_{srt_k}}{\delta_{srt_0}} \quad (7)$$

The Total Effect (ETj) compares what happened in the region in year "t" with what would have happened if the region had behaved like the comparison pattern during the analysis period, as shown in equation (8).

$$ET_j = \sum_{i=1}^{n} \delta_{ijt_k} - \left[\sum_{i=1}^{n} \delta_{ijt_0} * rsR \right] \quad (8)$$

The Differential Effect (EDj) arises from the fact that each sector in a particular region behaves differently in other regions. The differential effect captures the dynamics of each sector "i" in region "j" compared to the dynamics of the same sector in the comparison pattern, as expressed in equation (9).

$$ED_j = \sum_{i=1}^{n} \left\{ \delta_{ijt_k} - \left[\delta_{ijt_0} * rS_i \right] \right\} \quad (9)$$

The Structural Effect (SEj), represented by equation (10), shows the difference in dynamics between the region and the country, resulting from a "different intersectoral structure" between them. This arises from the differences in growth rates among different sectors at the national level combined with the relative weight of these sectors in both the national and regional contexts.

$$EE_j = \sum_{i=1}^{n} \left\{ rS_i \left[\frac{\delta_{ijt_0}}{\sum_{i=1}^{n} \delta_{ijt_0}} - \frac{\sum_{j=1}^{m} \delta_{ijt_0}}{\sum_{i=1}^{n} \sum_{j=1}^{m} \delta_{ijt_0}} \right] \right\} * \sum_{i=1}^{n} \delta_{ijt_0} \quad (10)$$

4. ANALYSIS OF DATA

The regional GDP corresponds to the sum of the contributions from the production of different economic sectors within the region. The calculation of both national and regional GDP has

been conducted at factor cost, which means that indirect taxes are not considered in the calculation. This is done to facilitate the comparison between them. Additionally, the values are indexed to January 2011 and obtained from the Central Bank of Chile. Figure 1 shows the impact of the contributions from different economic sectors to the region's GDP in the years 2011 and 2021, using equation (1) in its calculation. Figure 2 shows the absolute participation of each productive sector in the regional GDP, using equation (2).
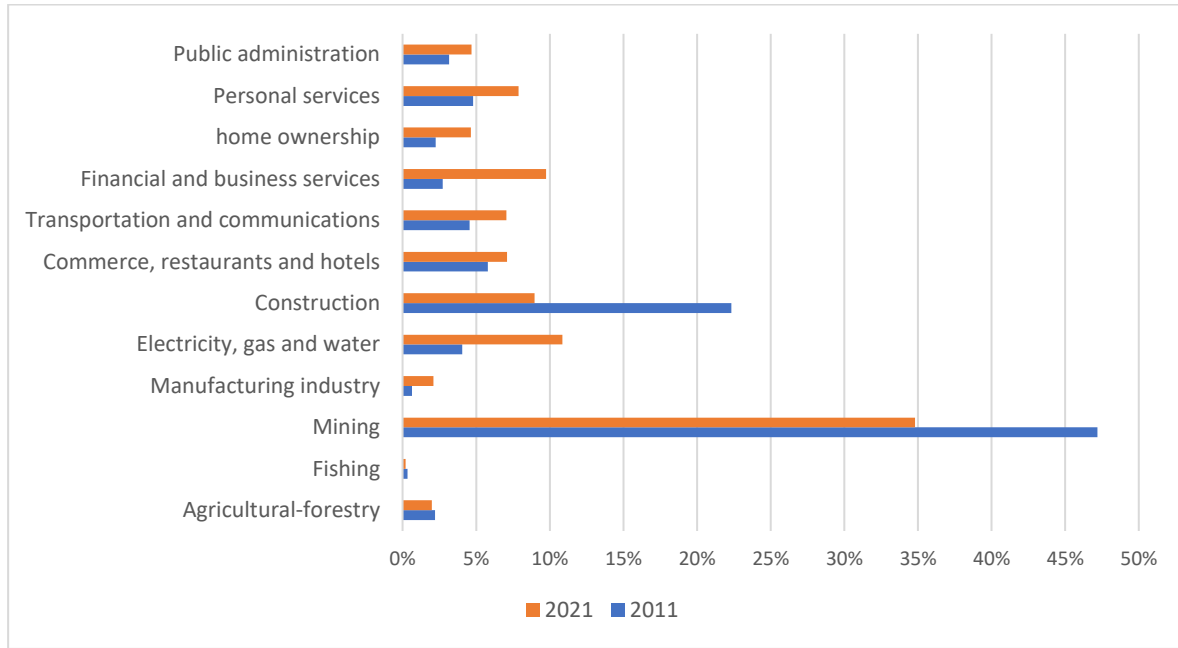

Figure 1: Economic Sector Participation in Atacama Region's GDP 2011 and 2021.
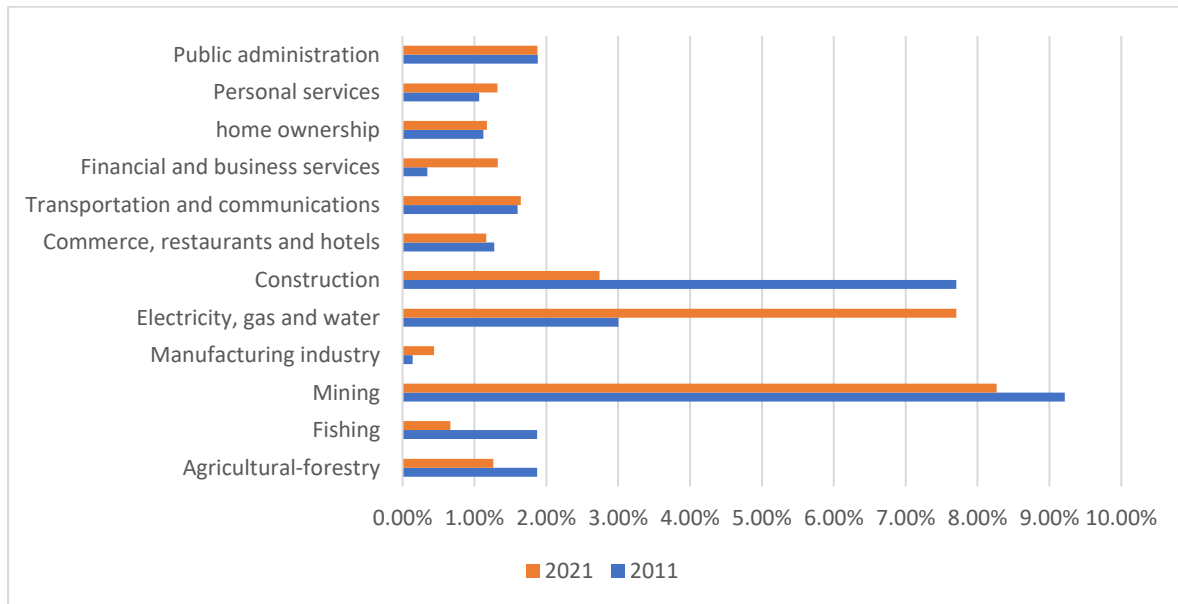

Figure 2: Participation of Atacama by Each Economic Sector in National GDP 2011 and 2021.

Figure 3 shows how the participation of Atacama's regional GDP in the proportion of the national GDP has varied in the years 2011 and 2021.
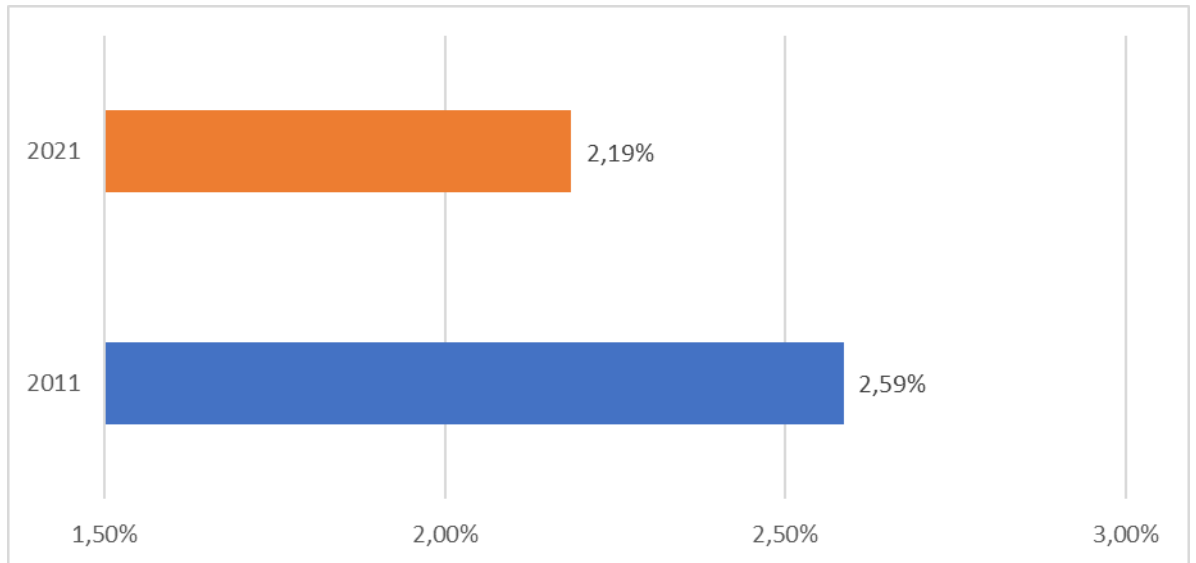

Figure 3: Regional GDP Share in National GDP 2011 and 2021.

When analyzing the values of the various Specialization Indexes, IE_{ijt}, equation (3), in the Atacama region, it can be observed that the mining sector has a strong concentration. Additionally, the construction sector and the electricity, gas, and water sector also obtain indexes slightly higher than 1, indicating that the performance of these three economic sectors is above the national average. Figure 4 shows the behavior of the Specialization Index in all the sectors in which the Atacama region excels, allowing for a comparison of different concentrations at the regional level.
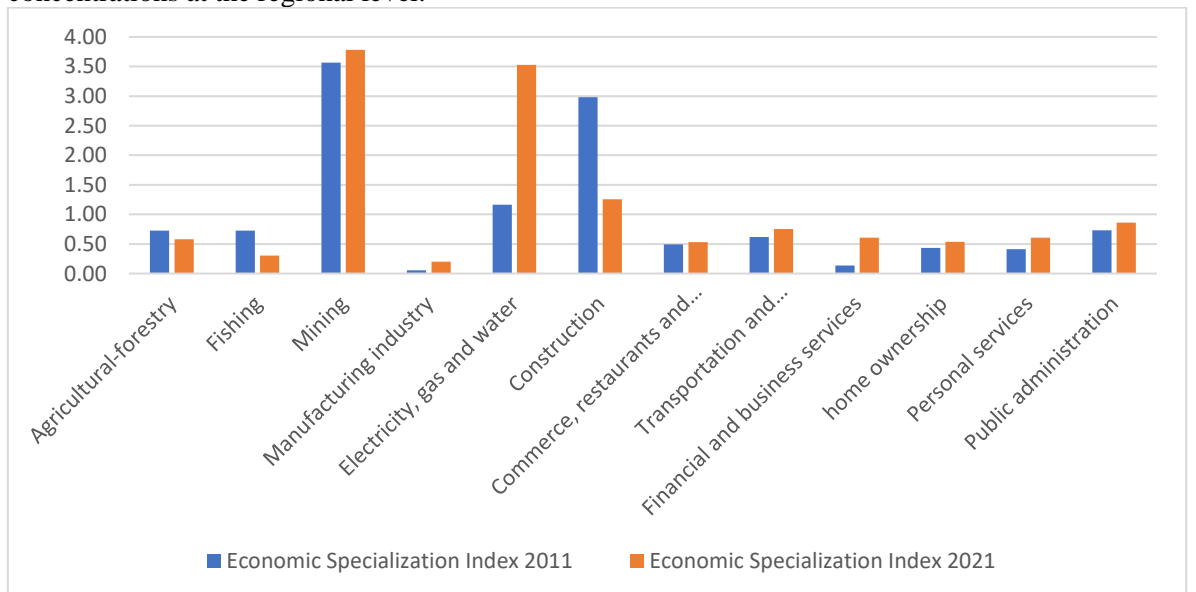

Figure 4: Economic Specialization Index 2011 and 2021.

The Geographic Association Index (equation 4) shows that the economic structure of the region exhibits a very similar behavior to the country's structure. Please refer to Figure 5.
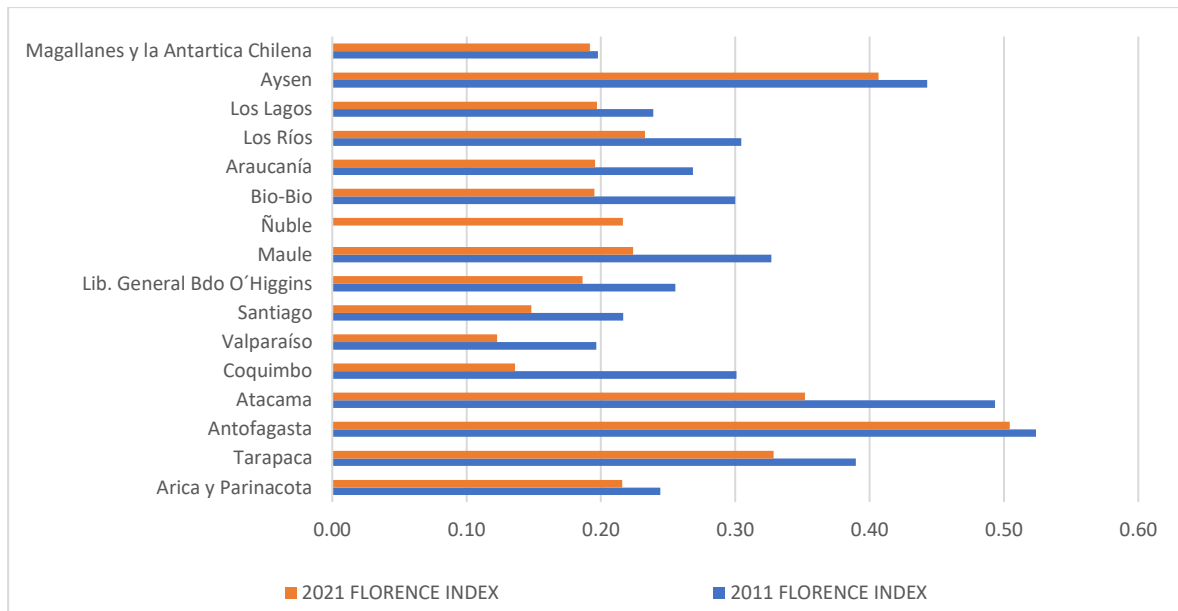
Figure 5: Geographic Association Index 2011 and 2021.

The Shift and Share analysis focuses on comparing the region's growth between the years 2011 and 2021 with what it would have been if it had behaved as the country did during the same period. The total effect (equation 8) is negative, indicating that the Atacama region lost or failed to gain 716.23 thousand million (MMM) Chilean pesos (CLP) compared to the country. This loss can be attributed to reasons related to Atacama's productive structure as well as the performance of each sector in the region compared to the sector's performance at the national level. The differential effect (equation 9) shows limited dynamism in the construction, mining, agriculture, forestry, and fishing sectors, resulting in a negative overall differential effect. The structural effect (equation 10) is also negative, indicating a lack of dynamism in the Atacama region's productive structure in 2021. Please refer to Table 1 and Table 2

Table 1: Total Effect 2011 and 2021

TYPE OF EFFECT	CLP
Total Net Effect	-716.23 MMM
Total Structural Effect	-515.19 MMM
Total Differential Effect	-201-04 MMM

Tabla 2 - Differential and Structural Effect 2011 and 2021

Series Description	Differential Effect MMM$	Structural Effect MMM$
Agriculture and forestry	-37.86	-11.38
Fishing	-15.19	-1.68

Mining	-156.51	-243.10
Manufacturing industry	55.65	-3.27
Electricity, gas, and water	258.91	-20.83
Construction	-634.78	-115.01
Commerce, restaurants, and hotels	-26.52	-29.80
Transportation and communications	7.58	-23.48
Financial and business services	280.96	-14.04
House ownership	7.74	-11.64
Personal services	59.61	-24.67
Public administration	-0.64	-16.30

5. CONCLUSIONS

The specialization index conducted for all economic sectors in the Atacama region reveals that the mining, energy, and construction sectors have a high level of specialization in the region, which has remained consistent, with varying degrees of intensity, from 2011 to 2021.

The geographical association index, Florence, indicates that the regional economic structure in 2021 exhibited a very similar pattern to the national structure. However, in 2011, there was a more differentiated regional economic structure

During the analyzed period (2011–2021) the Total Net Effect is negative, indicating that the economic growth of the region was lower than the net growth of the country.

The total effect is negative, indicating that the Atacama region experienced a loss of 716.23 MMM Chilean pesos in the regional-national comparison during the period 2011–2021. This loss can be attributed to factors related to the country's productive structure as well as the performance of each sector in the region compared to the national level.

The lower regional growth can be attributed to 28.1% due to lower dynamism in the regional productive sectors and 71.9% to the lack of dynamic sectors at the national level during the period 2011-2021.

In conclusion, productive specialization alone does not guarantee higher economic growth. The high dependency on a single economic sector and the low representation of other sectors in the region make it necessary to explore new strategies that promote greater development, both economically and socially. Diversification of the regional economy and the promotion of other sectors should be considered to achieve a more balanced and sustainable growth trajectory. This would reduce vulnerability to external shocks and contribute to a more inclusive and resilient regional economy.

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