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UNIVERSIDAD DE SONORA

Interdisciplinary Faculty of Economic and Administrative Sciences

RESEARCH

Competitiveness and Well-being in Municipalities of the Sierra Region in Sonora, Mexico

Competitividad y bienestar en municipios de la Región Sierra en Sonora, México

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Abstract

Globalization affects productive processes and intensifies competitiveness at the national, regional, and local levels. However, regardless of the scale at which competitiveness is analyzed, recent literature indicates that its primary objective should be the creation of well-being. Therefore, the objective of this study is to analyze whether competitiveness levels are reflected in the well-being of the regional population. To this end, a competitiveness index is estimated and the well-being thresholds calculated by the Consejo Nacional de Evaluación de la Política Social (Coneval, 2016) are used. The results show that the Sierra region, composed of 38 municipalities, recorded a lower competitiveness index than the state of Sonora and a higher proportion of people whose income was insufficient to achieve economic well-being. Similarly, the region had a higher percentage of people who did not surpass the minimum well-being threshold. This means that in the region, both competitiveness levels and population well-being are below those of the overall population in the state of Sonora. Nevertheless, the most important contribution is to present the analysis methodology used.

Keywords: Population, well-being, competitiveness, Sierra region, state of Sonora.

JEL Codes: R1, R5, I3, I31

Resumen

La globalización repercute en los procesos productivos e intensifica la competitividad nacional, regional y local; sin embargo, independientemente de la escala en el análisis de la competitividad, la literatura reciente indica que el principal objetivo de ésta debe ser la creación de bienestar. Por ello, en este trabajo el objetivo es analizar si los niveles de competitividad se reflejan en el bienestar de la población regional, para lo cual se estima un índice de competitividad y se utilizan las líneas de bienestar calculadas por el Consejo Nacional de Evaluación de la política Social (Coneval, 2016). Los resultados muestran que la región Sierra, integrada por 38 municipios, registró un índice de competitividad menor que el Estado de Sonora y una mayor proporción de personas cuyo ingreso le era insuficiente para alcanzar su bienestar económico y, de igual manera, la región tenía un mayor porcentaje de personas que no superaban la línea de bienestar mínimo. Esto significa que en la región los niveles de competitividad y el bienestar de población están por debajo de la competitividad y el bienestar del conjunto de la población en el estado de Sonora; sin embargo, lo más importante es mostrar la metodología de análisis utilizada.

Palabras clave: Población, bienestar, competitividad, región Sierra, Estado de Sonora.

JEL Codes: R1, R5, I3, I31

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Introduction

Within the framework of economic globalization, regions are considered the most appropriate level for measuring competitiveness, since in many countries they are the most important units for public policy formulation (Aranguren et al., 2010). According to Camagni (2002), regions are in direct competition with one another due to the free mobility of production factors, making the measurement of competitiveness at this level more relevant than at the national scale.

Nonetheless, regardless of the scale or the different definitions of the term competitiveness, several authors agree that its main goal should be the social well-being of the population: high income levels, improved quality of life, or greater prosperity (Aiginger 2006a; Grilo & Koopman 2006; Arroyo & Berumen 2003; Camberos & Huesca, 2002). This is because there is a relationship between the concept of competitiveness and a nation's ability to generate wealth for its citizens (Grilo & Koopman 2006).

In this regard, Aiginger (2006a and 2006b) argues that competitiveness should be defined as "the ability to create well-being," aiming to go beyond definitions that only focus competitive efforts on reducing production costs or maintaining favorable trade balances. From this perspective, it is clear that the analysis of competitiveness is not limited to the national or business level it is also applicable at the regional level, where an increase in competitiveness would be expected to have a positive impact on social well-being.

On the other hand, although the urbanization process in Sonora has been fueled by migrant populations from other states such as Baja California, Chihuahua, Jalisco, Michoacán, Nayarit, and Sinaloa, internally it is the municipalities in the mountainous area (zona serrana) that have historically lost population, which migrates from the Sierra to the Coast and Border regions in search of a better quality of life (Castro, 2000). Initially, this migration was driven by the agricultural prosperity of the 1960s and, in subsequent decades, by the urbanization and industrialization processes inherent to regional development in the state[1].

Moreover, Sonora is classified as a state with a medium level of migration intensity, ranking 20th out of 32 nationally (Conapo, 2012: 5, Table 3). By 2010, only one municipality had a high migration intensity index, and like the state, thirteen municipalities had medium migration intensity, five of which were located in the Sierra region: Bavispe, Tepache, Bacanora, Opodepe, and Sahuaripa. Meanwhile, 58 municipalities had low or very low migration intensity indexes (ibid, 2012: 9, Table 6).

The objective of this study is to determine the levels of competitiveness in the Sierra region and its municipalities within the state of Sonora, in order to identify whether competitiveness levels are reflected in the well-being of the regional population. To that end, two specific objectives are proposed: 1) to estimate the levels of competitiveness in the Sierra region and its 38 constituent municipalities, and 2) to comparatively analyze the municipalities that exhibit the highest and lowest levels of competitiveness and well-being in the region.

Following this introductory section, the second part briefly outlines the concept of competitiveness. The third part describes the methodological approach for measuring competitiveness and regional well-being. The fourth part presents the analysis of competitiveness levels and population well-being in the municipalities of the Sierra region in the state of Sonora. Finally, the study concludes with a summary of the main findings.

The concept of competitiveness

Porter (1990) argues that productivity is the sole foundation of national competitiveness, and that it is, in turn, the main determinant for achieving a high standard of living, with international trade playing a fundamental role in this process. However, Budd and Hirmis (2004) point out that the same author assumes that competitiveness is the ability of firms and industries to increase their market share, for which innovation is essential.

For his part, Camagni (2002) argues that David Ricardo's principle of comparative advantage does not operate at the subnational level, and that it is rather Adam Smith's principle of absolute advantage that governs production, specialization, and trade.[2] In other words, he warns that the adjustment mechanisms that function at the national level such as price and wage flexibility and the exchange rate

[1] Process in which the state's three main urban centers stand out: the cities of Hermosillo (state capital), Nogales, and Ciudad Obregón.

do not operate in the same way at the regional level.

According to this author, there are three aspects of regions that invalidate the theory of comparative advantage: a) regions are obliged to trade with one another; it is not an optional matter from which an initial trade position can be defined; b) there is free mobility of production factors between territories c) there is a single currency within the region, which renders an exchange rate between territories unjustifiable.

Therefore, reference is made to the asset endowment of a region, which although external to firms influences their establishment in a given territory. Specifically, he refers to regional externalities institutional, infrastructure-related, technological, and social that benefit firms in such a way that no other set of factors induces the distribution of productive activity (Kitson et al., 2004; Camagni, 2002).

Turok (2004) argues that regional competitiveness is not an end in itself, but rather an indication of the determinants of economic success. He assumes that cities or regions with inherent economic advantages will be more successful in engaging in competitive activities. Therefore, externalities not only explain the reason behind different productivity levels across regions but also why those differences do not diminish over time.

On the other hand, Aiginger (2006a) and Kitson et al. (2004: 993) point out that productivity alone reveals only one aspect of competitiveness. It is also important to consider the regional employment rate, so as not to fall into the error of considering a region competitive simply because it increased productivity through massive layoffs and business closures.

Therefore, Aiginger (2006a and 2006b) argues that competitiveness should be defined as "the ability to create well-being," setting aside definitions that focus competitive efforts solely on reducing production costs or maintaining favorable trade balances. This implies a reevaluation of the competitive process through variables related to well-being, with the expectation that an improvement in competitiveness will positively impact people's well-being.

Measurement of competitiveness

Competitiveness is measured by considering the regional externalities that influence the establishment of firms in a territory and that constitute a competitive advantage of one region over another by fostering economic activities. To this end, a Competitiveness Index (INCOM) is first estimated for the region and each municipality using the statistical technique of principal component factor analysis. The competitiveness levels provided by the method were calculated based on thirteen indicators obtained from different sources of information [3]. Let Iij represent the socioeconomic j for each municipality i, wherej=1,2,...,13; e i=1,2,...,72. The indicators are as follows:

*Ii1*Road Infrastructure,

*Ii2*Educational Infrastructure,

*Ii3*Hospital Infrastructure,

*Ii4*Public Transport Density,

*Ii5*Employed Population,

*Ii6*Unemployed Population,

*Ii7*Highly Skilled Workforce,

*Ii8*Medical Coverage,

*Ii9*Private Investment by Municipality,

*Ii10*Public Investment by Municipality,

*Ii11*Business Size,

*Ii12*Income by Municipality,

*Ii13*Financial System.

Based on these indicators, it is necessary to construct a summary measure that accounts for competitiveness. Thus, principal component factor

[2] The principle of comparative advantage states that countries produce and export the goods in which they are most efficient, meaning those with a relatively lower cost compared to the rest of the world; whereas absolute advantageimplies that a country tends to specialize in the production and export of goods for which it has a greater resource endowment than other countries.

[3] The data were obtained from the following sources: a) State and Municipal Database System (SIMBAD) of the National Institute of Statistics and Geography (INEGI); b) 2010 Population and Housing Census; c) Sociodemographic and Economic Information Bank of INEGI at the municipal level; d) Ministry of Public Education; and e) Ministry of Communications and Transportation

analysis is used a statistical method that transforms a set of indicators into a new one, providing a simpler interpretation of the phenomenon under study (Díaz de Rada, 2002). This requires that the original variables exhibit a high degree of correlation, which is the case for the indicators used.

The association between variables and the suitability of the factor analysis are measured by Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. The closer this measure is to one, the more common factors are present, indicating the appropriateness of factor analysis (Ibid, 2002). In Table 1, both tests demonstrate the relevance of factor analysis for studying the interrelations among the thirteen variables; the KMO statistic has a value of 0.89, qualifying as meritorious, and Bartlett's test assigns a high Chi-square value indicating reliability.

Before applying the aforementioned method to calculate the INCOM, to eliminate the effects of notably different variances, these are standardized using the arithmetic mean and standard deviation for each municipality as follows:

$$z_{ij} = I_{ij} - I_j / ds_j$$

Where:

z_{ij} :standardized indicator j $(j=1,...,13)$ for municipality i $(i=1,...,72)$,

I_{ij} : indicator j, of the unit analysis i

I_j : sample mean of each indicator j,

ds_j :typical standard deviation of economic indicator j.

These new variables have an arithmetic mean equal to zero, while the variance and standard deviation equal one. For the estimation of INCOM, the statistical software package SPSS Statistics version 22 was used, which provides standardized principal components with mean zero and standard deviation one. Thus, the INCOM values correspond to the first standardized component of each municipality, which is the linear combination of the thirteen standardized variables, that is:

Table 1. KMO and Bartlett's Test for INCOM 2010

Kaiser-Meyer-Olkin	Measure of sampling adequacy	0.892
Bartlett's test of Sphericity	Aprox. Chi-square	2501.323
	df	78
	Sig.	0

Source: Own elaboration based on INEGI, Municipal Database System (SIMBAD) 2010 and the Principal Component Statistical Method.

$$Y_{il} = INCOM_i = \sum_{j=1} c_j z_{ij} = c_1 z_{i1} + c_1 z_{i2} + \ldots + c_1 z_{i13}$$

Where:

Y_{i1}: value of municipality i in the first standardized principal component,

$INCOM_i$: value of the Muncipal Competitiveness Index in municipality i,

I_{ij}: weighting coefficient of indicator j to determine the first standardized principal component,

I_{ij}: standardized indicator j of municipality i.

To measure the degree of competitiveness of each municipality in the region, as well as the region itself, the Municipal Competitiveness Index (Table 2) is used, which includes both positive and negative values. The values obtained range from a maximum of 6.62821 to -0.46437. Higher positive values indicate a high level of regional and municipal competitiveness; conversely, the more negative the value, the lower the level of competitiveness in the region and its municipalities.

Measurement of Well-being

The next step in the methodology is to measure well-being, to see if there is a positive correlation between the competitiveness index and the level of well-being. For this purpose, the methodology developed by Coneval (2016) for the official measurement of poverty in Mexico is used. It is based on two approaches: one related to social rights, measured through social deprivation indicators that represent fundamental human rights in social development, and the economic well-being approach, measured through satisfiers acquired from the population's monetary resources and represented by well-being thresholds.

The social rights approach is measured using the following social deprivation indicators: 1)

Table 1. KMO and Bartlett's Test for INCOM 2010

INCOM 2010 Range	Competitiveness Level
[6.62821, 0.0731276]	Very High
[0.0731276, -0.2521676]	High
[-0.2521676, -0.3544517]	High
[-0.3544517, -0.4070057]	Low
[-0.4070057, -0.46437]	Very low

Source: Own elaboration based on INEGI, Municipal Database System (SIMBAD) 2010 and the Principal Component Statistical Method.

Educational backwardness, 2) access to health 3) access to social 4) quality and space 5) access to basic services in housing and, 6) access to food; meanwhile economic well-being is measured through two basic baskets, one food-based and one non-food-based, which allow estimates for both rural and urband localities.

From this, two well-being thresholds are determined: 1) Economic well-being line, which is the sum of the costs of the food and non-food[4], baskets, compared to household or individual income, enabling indentification of the population that does not have sufficient resources to acquire the goods and services required to satisfy their basic needs, even if they were to use all of their income; 2) Minimun well-being line, which corresponds to the cost of the food basket, allowing indentification of the population that, even if using all of three or more social deprivations and issuficient income to acquire the food basket (income below the minimun-well being line).

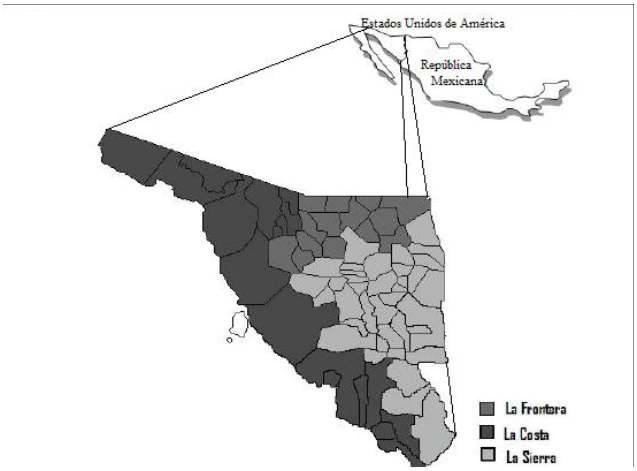
Thus, by combining the social rights approach (social deprivations) and economic well-being (income), the population in poverty is identified according to the following definitions: 1) A person is considered to be in poverty when they have at least one social deprivation and do not have sufficient income to meet their needs (their income is below the economic well-being line), and 2) A person is considered to be in extreme poverty when they have three or more social deprivations and do not have sufficient income to acquire a basic food basket (their income is below the minimum well-being line).

The Sierra Region: Competitiveness and Population Well-being

Traditionally, three major region[5] regions have been recognized in the state of Sonora: the coastal plain or coast, the border, and the sierra (Gracida J.J., 2002 and Wong, G.P., 1996), and this classification is used in this study to facilitate analysis (Map 1). The Coast is located in the western part of Sonora and extends along the Gulf of California. In the north, it includes small mountain ranges such as the Sierra Sonoyta and El Pinacate, and in the south, the Sierra del Seri, Bacatete, Álamos, and the extensive valleys of the Yaqui and Mayo rivers (Arroyo and Bracamontes, 2006).

The Sierra Region is located in the eastern part of the state. The Sierra Madre Occidental mountain range crosses the state from north to south, forming high mountains through which several rivers flow, such as the Yaqui River, the Sonora

Map 1. Regions in the State of Sonora, Mexican Republic



Source: Taken from Arroyo and Bracamontes (2006)

[4] For 2010, the economic well-being line was $2,120.04 in urban areas and $1,330.50 in rural areas, while the minimum well-being line was $978.29 in urban areas and $683.72 in rural areas (Coneval, 2016).

[5] The municipalities by region are: a) Coast: Altar, Átil, Bácum, Benito Juárez, Caborca, Cajeme, Empalme, Etchojoa, Guaymas, Hermosillo, Huatabampo, Navojoa, Oquitoa, Pitiquito, Plutarco Elías Calles, Puerto Peñasco, San Ignacio Río Muerto, San Luis Río Colorado, Sáric, and Tubutama; b) Border: Agua Prieta, Bacoachi, Benjamín Hill, Cananea, Cucurpe, Fronteras, Imuris, Magdalena, Naco, Nacozari de García, Nogales, Santa Ana, Santa Cruz, and Trincheras; c) Sierra: Álamos, Aconchi, Arivechi, Arizpe, Bacadéhuachi, Bacanora, Bacerac, Banámichi, Baviácora, Bavispe, Carbó, Cumpas, Divisaderos, Granados, Huachineras, Huásabas, Huépac, La Colorada, Mazatán, Moctezuma, Nácori Chico, Onavas, Opodepe, Quiriego, Rayón, Rosario Tesopaco, Sahuaripa, San Felipe, San Javier, San Miguel de Horcasitas, San Pedro de la Cueva, Soyopa, Suaqui Grande, Tepache, Ures, Villa Hidalgo, Villa Pesqueira, and Yécora.

River, the Magdalena River, and the Sonoyta River, all of which empty into the Gulf of California. Meanwhile, the Border Region is located in the northern part of the state and is characterized by municipalities that border the United States of America, as well as others adjacent to them.

Regional Population Distribution

The Sierra Region is made up of 38 of the 72 municipalities that constitute the State of Sonora more than half of the municipalities. Table 3 (2nd and 3rd columns) shows that 122,165 people lived in the Sierra, equivalent to 4.59% of the state's total population in 2010. The municipalities in this region are classified as rural, with fewer than 15,000 inhabitants, except for Álamos, which had a population of 25,848 and accounted for 21.16% of the region's total population. In hierarchical order, it is followed by the municipalities of Ures (7.52%), San Miguel de Horcasitas (6.86%), Cumpas (5.21%), Yécora (4.95%), Sahuaripa (4.93%), Carbó (4.38%), Rosario Tesopaco (4.28%), and Moctezuma (3.83%). These nine municipalities concentrate 63.11% of the population in the Sierra Region.

To a lesser extent, five other municipalities also contribute to the region's population: Baviácora (2.91%), Quiriego (2.75%), Arizpe (2.49%), Opodepe (2.36%), and Aconchi (2.16%), totaling 15,468 inhabitants, or 12.66% of the population in the Sierra Region. In the remaining twenty-four municipalities, only 29,601 people lived representing 24.33% of the regional population. This means that each of these municipalities had approximately 1,000 inhabitants, roughly equivalent to one percentage point per municipality in relation to the total population of the Sierra. Among the least populated municipalities are San Javier (0.53%), Onavas (0.36%), and Oquitoa (0.02%).

Regional and Municipal competitiveness

[6] This municipality has held the designation of Pueblo Mágico since 2005, and since 1984 it has hosted the Alfonso Ortiz Tirado Festival (FAOT), an internationally renowned cultural event in which other municipalities in the state also participate, bringing significant dynamism to regional tourism.

Columns 4 and 5 of Table 3 report the competitiveness indices for the state, the region, and the municipalities. These figures show that the Sierra had a Medium Competitiveness Index, which is below the High Competitiveness Index of the State of Sonora.

In terms of municipal competitiveness, only Álamos has a Very High Competitiveness Index. Meanwhile, like the state, five of the thirty-eight municipalities that make up the region Cumpas, La Colorada, Moctezuma, Sahuaripa, and Ures register High Competitiveness. Ten municipalities, like the Sierra region itself, present a Medium Competitiveness Index: Arizpe, Banámichi, Carbó, Huepac, Mazatán, Rosario Tesopaco, San Felipe de Jesús, San Miguel de Horcasitas, Villa Pesqueira, and Yécora.

Regarding municipalities with High and Medium competitiveness, it is worth noting that although they are characterized by an agricultural-livestock economic base and minimal infrastructure, the abundance of skilled and semi-skilled labor has fostered the development of the maquila industry, as in the case of Moctezuma and Ures. Their areas of influence extend to small rural communities in the Sierra and along the Sonora River, reaching all the way to Hermosillo. Additionally, they benefit from good connectivity, with roads linking them, such as the Hermosillo–Moctezuma-Huásabas highway and Federal Highway No. 16, which runs from Hermosillo to Chihuahua (Wong, G. P., 1996).

The remaining 22 municipalities are characterized by having a level of competitiveness lower than that observed at the regional and state levels. Specifically, ten municipalities had a Low Competitiveness Index: Aconchi, Arivechi, Bacerac, Baviácora, Granados, Huásabas, Quiriego, San Javier, San Pedro de la Cueva, and Soyopa; while twelve municipalities had a Very Low Competitiveness Index: Bacadéhuachi, Bacanora, Bavispe, Divisaderos, Huachinera, Nacori Chico, Onavas, Opodepe, Rayón, Suaqui Grande, Tepache, and Villa Hidalgo.

Competitiveness and Regional Well-being

In Table 3 (columns 6 to 9), when analyzing whether competitiveness in the Sierra region and its municipalities is reflected in improved population well-being, it becomes evident that

Table 3. Levels of competitiveness and well-being of the population in the Sierra Region of Sonora

State, Region, and Municipalities	Total Population	%	INCOM	Competitiveness Level	Population with the income below the economic well-being line	%	Population with the income below the minimum well-being line	%
Sonora	2,662,480	100.00	-0.00369	High	1,074,180	40.3	295,313	11.1
Sierra Region	122,165	4.59	-0.34153	Medium	65,239	53.4	27,900	22.8
Alamos	25,848	21.16	0.21503	Very high	14,322	55.4	7,180	27.8
Cumpas	6,362	5.21	-0.24755	High	2,402	*37.8*	590	*9.3*
La Colorada	1,663	1.36	-0.13135	High	985	59.2	402	24.2
Moctezuma	4,680	3.83	-0.09727	High	2,281	48.7	544	11.6
Sahuaripa	6,020	4.93	-0.22582	High	2,855	47.4	1,066	17.7
Ures	9,185	7.52	0.04622	High	3,683	*40.1*	1,062	*11.6*
Arizpe	3,037	2.49	-0.31677	Medium	1,778	58.5	691	22.8
Banámichi	1,646	1.35	-0.34178	Medium	811	49.3	271	16.5
Carbó	5,347	4.38	-0.30394	Medium	1,843	*34.5*	974	18.2
Huépac	1,154	0.94	-0.34403	Medium	364	*31.5*	85	*7.4*
Mazatán	1,350	1.11	-0.30451	Medium	641	47.5	177	13.1
Rosario Tesopaco	5,226	4.28	-0.32970	Medium	3,030	58.0	1,215	23.2
San Felipe de Jesús	396	0.32	-0.35158	Medium	158	39.9	46	11.6
San Miguel de Horcasitas	8,382	6.86	-0.27063	Medium	5,466	65.2	3,557	42.4
Villa Pesqueira	1,254	1.03	-0.31043	Medium	686	54.7	215	17.1
Yécora	6,046	4.95	-0.32787	Medium	5,021	83.0	2,907	48.1
Aconchi	2,637	2.16	-0.39259	Low	1,255	47.6	398	15.1
Arivechi	1,253	1.03	-0.39157	Low	736	58.7	275	21.9
Bacerac	1,467	1.20	-0.40053	Low	902	61.5	302	20.6
Baviácora	3,560	2.91	-0.35804	Low	1,738	48.8	522	14.7
Granados	1,150	0.94	-0.35517	Low	479	41.7	132	11.5
Huásabas	962	0.79	-0.38013	Low	458	47.6	127	13.2
Quiriego	3,356	2.75	-0.37332	Low	1,433	42.7	596	17.8
San Javier	492	0.40	-0.35627	Low	196	39.8	53	10.8
San Pedro de la Cueva	1,604	1.31	-0.36690	Low	894	55.7	286	17.8
Soyopa	1,284	1.05	-0.37025	Low	739	57.6	256	19.9
Bacadéhuachi	1,252	1.02	-0.42027	Very Low	834	66.6	346	27.6
Bacanora	784	0.64	-0.43795	Very Low	493	62.9	198	25.3
Bavispe	1,454	1.19	-0.43307	Very Low	943	64.9	368	25.3
Divisaderos	813	0.67	-0.42763	Very Low	398	49.0	112	13.8
Huachinera	1,350	1.11	-0.41753	Very Low	790	58.5	312	23.1
Nácori Chico	2,051	1.68	-0.43870	Very Low	1,438	70.1	620	30.2
Onavas	399	0.33	-0.43823	Very Low	229	57.4	85	21.3
Opodepe	2,878	2.36	-0.41920	Very Low	1,728	60.0	723	25.1
Rayón	1,599	1.31	-0.41427	Very Low	1,030	64.4	443	27.7
Suaqui Grande	1,121	0.92	-0.41630	Very Low	673	60.0	237	21.1
Tepache	1,365	1.12	-0.44737	Very Low	858	62.9	368	27.0
Villa Hidalgo	1,738	1.42	-0.44578	Very Low	669	38.5	159	9.1

Source: Source: Own estimation of competitiveness indices based on the principal components method and various INEGI databases: a) State and Municipal Basic Data System (SIMBAD); b) Population and Housing Census, 2010; c) Municipal Socio-Demographic and Economic Information Bank; d) Secretariat of Public Education; and e) Secretariat of Communications and Transport.

The well-being and minimum well-being estimates come from Coneval (2016)

there was no improvement for the Sierra. Despite having a Medium Competitiveness Index, 53.4% of the population did not reach the average well-being level; meanwhile, the state, with a High Competitiveness Index, had around 60% of its population above the average well-being threshold. On the other hand, the Medium Competitiveness level in the Sierra was not enough to meet the minimum well-being of 22.8% of the population a higher proportion than the state (11.1%). This means that 22% of the region's population had insufficient income to purchase a basic food basket that meets

minimum nutritional requirements, even if all their income were devoted to this purpose. Therefore, in terms of competitiveness and well-being, the Sierra region's population is worse off than the population of Sonora as a whole.

Among the six municipalities that stood out with a Very High and High Competitiveness Index, two had higher proportions than those observed at the regional and state levels when considering the percentage of people whose income is insufficient to achieve economic well-being: La Colorada (59.2%) and Álamos (55.45%). Similarly, Moctezuma (48.7%) and Sahuaripa (47.4%) also had higher percentages than the state. The same is true when considering the population unable to purchase a food basket that meets minimum nutritional requirements: La Colorada (59.2%)and Álamos (55.45%), followed by Moctezuma (48.7%) and Sahuaripa (47.4%), all above the state level.

This implies that only two of the six municipalities with Very High and High competitiveness levels also have the highest well-being levels. Thus, the municipalities of Ures (40.1%) and Cumpas (37.8%) have lower proportions of people compared to the state whose income does not allow them to achieve economic well-being. Similarly, these two municipalities, Ures (40.1%) and Cumpas (37.8%), have the lowest proportions of people whose income does notallow them to meet the minimum well-being threshold.

Of the ten municipalities with a Medium Competitiveness Index, five had higher proportions of people with insufficient income for economic well-being than the region and the state: Yécora (83.0%), San Miguel de Horcasitas (65.2%), Arizpe (58.5%), Rosario Tesopaco (58.0%), and Villa Pesqueira (54.7%). Meanwhile, three municipalities: Banámichi (49.3%), Mazatán (47.5%), and San Felipe de Jesús (39.9%), had higher percentages than Sonora. Only Carbó (34.5%) and Huepac (31.5%) reported a lower proportion than the state.

Among the 22 municipalities with Low and Very Low Competitiveness Indexes, very high percentages of people had income insufficient to achieve economic well-being in 21 of them. Only Villa Hidalgo (38.5%) had a lower percentagethan the state. Similarly, a high proportion of the population in 21 of these municipalities lacked the income necessary to purchase a food basket meeting minimum nutritional requirements. Again, Villa Hidalgo (9.1%) had a percentage lower than that of the state.

Conclusions and discussion

In this study, competitiveness was defined as regional externalities that can potentially attract investment and promote economic activity. The goal was to test whether competitiveness is reflected in the well-being of the regional population. To this end, the principal component method was used to estimate a Competitiveness Index, and based on the methodology developed by Coneval (2016), well-being was measured.

Based on the redefined concept of competitiveness as a foundation for increasing population well-being, this study examined the relationship between both aspects within Sonora State and the Sierra Region, made up of 38 municipalities.

The results show that the Sierra region recorded a Medium Competitiveness Index lower than that of the state and a higher proportion of people (53.4%) with insufficient income to reach economic well-being, compared to Sonora (40.3%). The Sierra also had a higher percentage (22.8%) than the state (11.1%) in terms of people below the minimum well-being line, meaning the population in the Sierra is worse off than the general population of Sonora in terms of well-being.

The evidence also shows that of the 38 municipalities in the Sierra region, only Álamos was classified as Very High in competitiveness, 5 as High, and 10 as Medium. However, when compared to their well-being levels, it was found that only four municipalities Cumpas, Carbó, and Huépac are in a better situation than the state, as they had lower percentages of people with insufficient income to reach both economic well-being and minimum well-being. Therefore, only these three municipalities simultaneously registered high competitiveness and the best well-being levels in the region under study.

This means that no clear correspondence was found between medium or high competitiveness levels and well-being, except in the municipalities of Cumpas, Ures, Carbó, and Huépac. The remaining 34 municipalities showed low levels of economic and minimum well-being.

Finally, considering efficiency criteria in public

policy, the municipalities in this region should be prioritized in various government programs for infrastructure development, improvement of public services, and poverty reduction.

References

Aiginger, K.(2006a). Competitiveness: from a dangerous obsession to a welfare creating ability with positive externalities. Journal of Industry, Competition and Trade, 6(2): 161–177.

Aiginger, K. (2006b). Revisting an evasive concept: introduction to the special issue on competitiveness.

Journal of Industry, Competition and Trade, 6(2): 63-66.

Arroyo, Jesús y Berumen S. (2003).Competitividad Implicaciones para empresas y regiones. Guadalajara/ Los Ángeles: Universidad de Guadalajara/UCLA. 520 pp.

Arroyo, Jesús y Bracamontes N. J.(2006). El Desarrollo Regional en el Estado Fronterizo de Sonora, México,

Estudios Fronterizos, Vol. 7, Núm. 14, ISSN: 0187-696, Julio-Diciembre. Pp.55-80.

Aranguren, J., Franco, S., Ketels, C., Murciego, A., Navarro, M., Wilson, J.R. (2010). Benchmarking Regional Competitiveness in the European Cluster Observatory, European Cluster Observatory, Methodology Background Paper 1. 25pp.

Budd, L. y Hirmis, A.(2004). Conceptual framework for regional competitiveness. Regional Studies, 38(9): 1015-1028.

Camagni, R.(2002). On the Concept of Territorial Competitiveness: Sound or Misleading?, Urban Studies, 39(13): 2395-2411.

Camberos, M. y Huesca, L.(2002). Cambios económicos, competitividad y bienestar de la población en la región noroeste de México en la globalización. Estudios Fronterizos, 3(6): 9-32.

Castro, L. (2000). Migración y Urbanización en Sonora, en Sonora 2000 a debate. Problemas y soluciones, riesgos y oportunidades, Cal y Arena:395-414.

Consejo Nacional de Población-Conapo [Conapo] (2013). Geografía e intensidad migratoria México-Estados unidos 2010.Boletín de Migración Internacional. Año I, Número Especial 2013 / issn 2007-6371. Pp.1-10 Consejo Nacional de Población-Conapo [Conapo] (2012). Índice Absoluto de Intensidad Migratoria. México Estados Unidos. 2000- 2010.http://www.conapo.gob.mx/work/models/OMI/Publicaciones/IAIM_MX_USA_2000- 2010/HTML/files/assets/basic-html/page-120.html

Consejo Nacional de Evaluación de la Política Social [Coneval (2016).“Líneas de Bienestar”. https://webdrp.coneval.org.mx/Medicion/Paginas/Lineas-de-bienestar-y-canasta-basica.aspx

Díaz de Rada, V. (2002). Técnicas de Análisis Multivariante para Investigación Social y Comercial. Ejemplos Prácticos utilizando el SPSS versión 11. Madrid, Editorial Ra-Ma.

Gracida, J. (2001).La llegada de la modernización a Sonora. Establecimiento del ferrocarril, 1880-1897, UNISON.

Grilo, I. y Koopman, G. (2006). Productivity and Microeconomic Reforms: Strengthening EU Competitiveness.

Journal of Industry, Competition and Trade, 6(2): 67-84.

Instituto Nacional de Estadística, Geografía e Informática [INEGI], (2016). Sistema Estatal y Municipal de Bases de Datos (Simbad).www.inegi.org.mx

Instituto Nacional de Estadística, Geografía e Informática [INEGI], (2010). Censo de Población y Vivienda 2010. www.inegi.org.mx

Kitson, M., Martin, R. y Tyler, P.(2004). Regional Competitiveness: an elusive yet key concept?, Regional Studies, 38(9): 991-999.

Porter, M. (1990). The Competitive Advantage of Nations, Harvard Business Review. 90211: 73-91. Turok, I. (2004). Cities, regions and competitiveness. Regional Studies, 38(9): 1069-1083.

Wong, P. (1996). La reestructuración secto-espacial en Sonora: una tipología regional, en Las regiones ante la globalidad, coordinado por Miguel Ángel Vázquez Ruiz, Hermosillo: Gobierno del Estado de Sonora. 87-115.

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RESEARCH

Assessment of integration level of the Cross-border Regional Innovation System for table grapes in the Sonora – Arizona region

Valoración del nivel de integración del Sistema Regional de Innovación Transfronterizo de la uva de mesa en la región Sonora - Arizona

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Abstract

The Sonora-Arizona region has a historical background and strong economic and social ties that lead to considering it as a binational region. In recent years, apart from the growth and intensification of the cross-border integration of productive activities, attempts have also been made to promote collaboration in the areas of science and technology, seeking the creation of Cross-Border Regional Innovation Systems (CBRIS). The objective of this work is to make an assessment of the level of integration of the CBRIS in a specific sector, the table grape. The assessment was carried out using the methodology originally proposed by the Organization for Economic Cooperation and Development (OECD), which is made up of ten dimensions comprising a set of variables that are considered as "proximities". The original variables were operationalized to use available secondary statistics and assess the dimensions to thereby define the level of integration. This methodological process is proposed to evaluate asymmetric regions such as this cross-border region.

Keywords: Cross-Border Regional Innovation System, Sonora-Arizona Region, "proximities", table grape.

JEL Code: F1, F15,O, O3, O31, O32, R1, R12

Resumen

La región Sonora-Arizona tiene antecedentes históricos y fuertes vínculos económicos y sociales que conllevan a considerarla como una región binacional. En años recientes, aparte del crecimiento e intensificación de la integración transfronteriza de actividades productivas particulares, también se ha intentado impulsar la colaboración en las áreas de ciencia y tecnología, buscando la creación de Sistemas Regionales de Innovación Transfronteriza (SRIT). El objetivo de este trabajo es realizar una valoración del nivel de integración del SRIT en un sector específico, la uva de mesa. La valoración se llevó a cabo mediante la metodología propuesta originalmente por la Organización para la Cooperación y el Desarrollo Económicos (OECD por sus siglas en inglés), la cual se integra por diez dimensiones, a su vez conformadas por variables que son consideradas como "proximidades". Las

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variables originales se operacionalizaron para utilizar estadísticas secundarias disponibles y valorar las dimensiones para con ello plantear el nivel de integración. Este proceso metodológico se propone para evaluar regiones asimétricas como es esta región transfronteriza.

Palabras clave: Sistema Regional de Innovación Transfronteriza, Región Sonora–Arizona, "proximidades", uva de mesa

Código JEL: F1, F15,O, O3, O31, O32, R1, R12

Introduction

Globalization and the internationalization of the economy have promoted partnerships and strategic alliances between regions to increase their levels of competitiveness, take advantage of complementarities and geographical location, access markets and sources of investment, as well as benefit from technological innovation (Perkmann & Sum, 2002: 3-21; Wong-González, 2005: 78). In the knowledge society, competitive advantage lies in innovation, which is defined as the implementation of a new or significantly improved product or process (good or service), a new marketing method, or a new organizational method in business practices, workplace organization, or external relations (OECD, 2013: 16).

The knowledge embedded in products is what makes them competitive. Innovation, by bringing a greater value proposition to the market, becomes the generator of new levels of competitiveness (Sakaiya, 1994: 73-74). It is a fact that the knowledge society has changed manufacturing systems (Chase, Jacobs, & Aquilano, 2009: 372-374), which is why regions tend to promote their knowledge-based development (Wong-González, 2005: 78).

Innovation is evaluated by the dynamism of the relationships between actors dedicated to knowledge exploration (multidisciplinary teams of researchers), knowledge exploitation (actors who interact with researchers to commercialize results), and the "expert advocates" (consultants or venture capitalists involved in production processes, service development, or marketing systems) (Cooke, 2004: 628-629).

Currently, regions have comparative and competitive advantages that are essential for their economic development and seek to enhance their advantages in natural resources or manufacturing infrastructure with new value propositions to the market. To operationalize these processes, various countries have promoted the creation of Sistemas Nacionales de Innovación (SNI) and, when limited to a region, Sistemas Regionales de Innovación (SRI) (Iammarino, 2005: 3). When these schemes are established between two (or more) nations, Sistemas Regionales de Innovación Transfronterizos (SRIT) emerge, as an effort to promote development at different levels—territorial, national, regional, or binational (Boisier, 2002: 11; OECD, 2013: 13).

The SRI emerge as a territorially focused analytical perspective, and in many cases with activity specialization linked to global, national, and other regional systems to commercialize new knowledge (Cooke & Memedovic, 2006: 3). The reasons behind the formation of an SRIT lie in the potential complementarities of knowledge and innovation that contiguous regions can obtain (Chaminade & Nielsen, 2011: 12; OECD, 2013: 25-27, 41, 44; Trippl, 2009: 153-154). These complementarities can stimulate innovation activities and be economically beneficial for the regions involved. For example, in the European Union (EU), the creation of Eurorregions is encouraged to promote a policy of European cohesion through greater innovation and with regional «smart specialization» strategies supporting knowledge-based development (OECD, 2013: 74).

Studies in Europe on SRIT indicate that it is necessary to assess the following factors to define the dimensions that measure the integration of a cross-border region (Trippl, 2006: 7-13): (1) the scientific base and innovation infrastructure; (2) the business strategies of companies, cross-border clusters, and knowledge bases; (3) cross-border innovation interactions; (4) socio-institutional actors; and (5) innovation policies.

With the aim of measuring the degree of integration between two regions in different nations, cross-border regions have been studied, particularly European SRIT (K.-J. Lundquist & Trippl, 2009: 3, 11-25; Nauwelaers, Maguire, & Marsan, 2013: 10-40; OECD, 2013: 17; Trippl, 2006: 6-15), and a methodological model provided by the OECD (2013: 145-160) has been developed, in which ten dimensions are defined to evaluate different proximities through the variables that compose them.

In a trend similar to that of Europe, several regional initiatives have been identified on the Mexico–United States border that seek to promote binational integration and innovation processes through cross-border associative regions or economic and commercial corridors (Conferencia de Gobernadores Fronterizos, 2009; Conferencia de Gobernadores Fronterizos & Wong-González, 2007: 108-109; Pavlakovich-Kochi, 2006: 49-51; Wong-González, 2005: 81-82). One effort occurred between Universities of Arizona and Sonora, businesspeople, and government officials from Sonora and Arizona upon the entry into force of the North American Free Trade Agreement in 1994, with the project Visión Estratégica del Desarrollo Económico de la Región Sonora-Arizona (VEDERSA), which sought to go beyond traditional cultural and social ties and strengthen interactions in the fields of economy, trade, and investment (Wong-González, 2005: 91).

The attributes and conditions are particularly relevant in the context of the cross-border space of the Sonora-Arizona Megaregion, considered as an asymmetric region regarding many factors. This asymmetry compels reconsideration of the region's future, considering that the formation of an SRIT is an alternative regional development path based on innovation and cooperation ("High Road" Path), unlike the development path based on exploiting the differentiation in factor costs ("Low Road" Path) (Trippl, 2006: 8-9), which has traditionally been followed in this type of cross-border region between countries with different levels of development, such as Mexico and the United States.

The objective of this article is to carry out an assessment of the integration level of the SRIT for table grapes in the Sonora-Arizona region, considered an asymmetric region due to its development levels. The assessment will be conducted through an adaptation of the methodology defined by the OECD (2013: 145-160), where dimensions are composed of variables that represent "proximities," which are evaluated using publicly available statistics. This is a first attempt to assess the integration of this region.

The Sonora-Arizona Region: Brief overview

It should be considered that the Sonora-Arizona region has an economic and social history that has led it to be regarded as a binational region despite its asymmetry. In fact, despite the significant national differences and the existence of an international political border, some analysts consider that in this cross-border space, a regional identity has been preserved that constitutes a binational cultural region (Gomezcésar Hernandez, 1995: 11-13). Three historical stages can be distinguished (Bracamonte-Sierra, 2019: 31-32): until 1930 with a mining-livestock export model, from 1940 to 1970 with a primary export model focused on agriculture, and since 1970 an export-oriented manufacturing model with maquiladoras expanding into technology-based industries such as aerospace, ICT, and biotechnology development. The economy of Sonora has been much more dependent on the maquiladora sector and the automotive industry (Pavlakovich-Kochi, 2006: 4).

As the maquiladora sector expanded in Sonora and the rest of Mexico, so did the trade of goods between Arizona and Mexico. Even before the entry into force of the North American Free Trade Agreement (NAFTA) in 1994, Mexico was already Arizona's main foreign trade partner. By leveraging family and business ties on both sides of the border, the fresh produce industry became a unique cross-border agro-industrial block (Alisha, Kim, & Pavlakovich-Kochi, Vera, 2019: 84).

Geographical proximity and the presence of superior North American capital accelerated the process of Sonorans' approach to the material culture of the Anglos. Of particular importance was the introduction of the railroad, large-scale copper mining on both sides of the border, and the colonization of the agricultural valleys in southern Sonora, where farmers emerged using production techniques similar to those of North Americans. Furthermore, due to its social and cultural significance, the history of several indigenous ethnic groups of Sonora also plays a role, as in 1995 a third of the Yaqui tribe, almost all of the Pápagos (Tohono O'odham), and the majority of the Cucapá population lived in Arizona (Gomezcésar Hernandez, 1995: 18, 22).

As shown in Table 1, the two states exhibit asymmetries in various variables. Sonora barely reaches 38% of the surface area of its neighboring state. Regarding population, although in 2016 Arizona had 6.93 million inhabitants and Sonora 2.85 million (2015), their proportion relative to the country was practically the same, 2.14% and 2.38%

respectively. With a very different GDP, Sonora surpasses Arizona in exports to the neighboring country. Table 2 and Figure 1 show that the largest cities in Arizona are Phoenix and Tucson, with a combined population of 5.17 million in 2012, while Hermosillo and Ciudad Obregón together had 1.19 million inhabitants in Sonora in 2010 (Gibson, Pavlakovich-Kochi, Wong-González, Jaewon, & Wright, 2016: 42).

Table 1. Comparative data of Sonora and Arizona

Concept	Arizona	Sonora
Surface area km2	475,030	179,354
Inhabitants (2016, 2015)	6,931,071	2,850,330
Percentage of population relative to the country (2016, 2015)	2.14%	2.38%
Students in state universities in Arizona 2012	139,603	
Total students in universities in Sonora 2010-2011		80,716
Percentage of population in universities	2.0%	2.8%
GDP (Millions of Dollars 2013)	274,734	36,389
Exports to the neighboring country (millions of Dollars 2013)	6,992	14,045

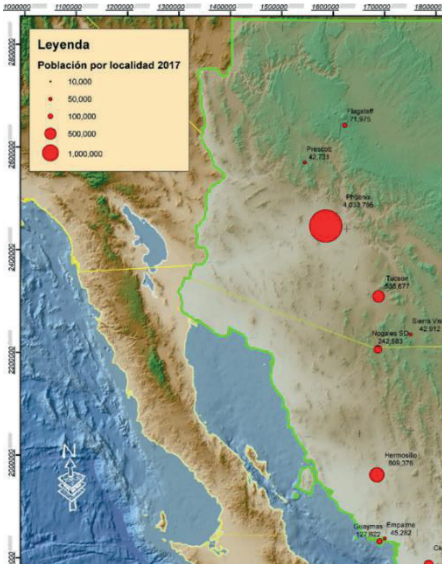
Source: Own elaboration based on data from Wilson et al. (2015), and individual pages of the institutions.

Table 2. Population of the main cities in the Sonora-Arizona region for 2012- 2020.

County/Municipality	Arizona	Sonora
Flagstaff	65,870	
Prescott	7,866	
Phoenix	4,192,887	
Tucson	980,263	
Sierra Vista	43,888	
Nogales	20,837	220,292
Hermosillo		784,642
Guaymas/Empalme		203,430
Ciudad Obregón		409,310
Navojoa		157,729
Álamos		25,848
Total	**5,311,611**	**1,801,251**

Source: Gibson, Pavlakovich-Kochi, Wong-González, Lim & Wright (2016)

Figure 1. Sonora-Arizona Megaregion



Source: Own elaboration based on data from population.

The Gross Domestic Product of Sonora represents between 11.5% and 15.2% of Arizona's GDP.[1] Comparing the GDP of the border states on both sides of the border, it is observed that Texas in the United States and Nuevo León in Mexico are the most outstanding. In exports to Mexico, Texas accounts for 76% of the total of the four American states, while Chihuahua constitutes 25% and Sonora 10% of the exports of Mexican states to the United States (see Table 3).

Table 3. State GDP and exports (2013, Millions of Dollars)

State	State GDP	State exports to Mexico	State exports to USA
California	2,212,991	23,510	
Arizona	274,734	6,992	
Nuevo Mexico	90,828	720	
Texas	1,557,193	100,030	
Baja California	34,030		25,396
Sonora	36,389		14,045
Chihuahua	34,044		34,490
Coahuila	40,011		25,924
Nuevo León	85,827		20,421
Tamaulipas	35,682		18,079
Total		**131,252**	**138,355**

Source: (Wilson et al., 2015) https://www.wilsoncenter.org/publication/competitive-border-communities-mapping-and-developing-us-mexico-transborder-industries

[1] Based on information from the University of Arizona's economic indicators, https://azmex.eller.arizona.edu/

In terms of formal integration, state governments and the Arizona-Sonora and Arizona-Mexico Commissions have played a highly relevant role (Wong-González, 2005 and 2019). The states of Sonora and Arizona initiated formal relations in 1959 through the Sonora-Arizona Economic and Social Promotion Committee and the Arizona-Mexico West Trade Commission, predecessor organizations of the current binational commissions. Within these commissions, joint working meetings were held to analyze and discuss issues of interest in the areas of education, health, communications, and economy. As previously indicated, in anticipation of the formation of a free trade zone in North America through the signing of NAFTA, as well as due to the growing process of globalization, in the early 1990s Sonora and Arizona decided to elevate the strategic partnership to a higher level of integration and formalization, proposing to conceive themselves as a single economic region that would allow them to take advantage of location advantages and economic complementarities before NAFTA. Thus, a Strategic Vision for the Economic Development of the Sonora-Arizona Region was designed (Pavlakovich-Kochi, 2006; Wong-González, 2005 and 2019).

More recently, the governments of Sonora and Arizona decided to transform the cross-border cooperation model then in force. In June 2016, the governors of both states announced the formalization and promotion of the formation of a binational Megaregion that seeks to leverage shared economic strengths and ongoing collaboration, allowing them to enhance their competitive position at a global scale. Among other aspects, it aims to increase flows of trade and investment and promote the cultural wealth of both states. The scope of action of the states of Sonora and Arizona around the Megaregion has led to the deployment of a broad exercise of regional cross-border paradiplomacy (Wong-González, 2019).

To apply the methodological process to evaluate the degree of integration of the SRIT for table grapes in the region, this article analyzes the case of table grapes produced in Sonora and distributed worldwide through distributors located in Nogales. Currently, Sonoran farmers have developed or contracted the creation of new varieties to extend market windows, that is, they have sought technology in various academic and technological development institutions in different countries, more than in the region under study.

Integration assessment

Innovation systems are generally confined to regions, since the set of actors produces generalized and systemic effects that stimulate the region's companies to develop specific forms of capital, derived from social relations, norms, values, and interactions within the community in order to reinforce innovation capacity and regional competitiveness (Doloreux & Parto, 2004: 3). That is, innovation systems appear as networks where actors exchange codified and tacit knowledge in their activities (Kraemer-Mbula & Wamae, 2012: 45). Recently, international integration and globalization processes have induced the formation of SRIT in subnational spaces of neighboring countries (OECD, 2013: 13-14).

For some analysts, these forms of cooperation through SRIT constitute the latest and most advanced form of cross-border construction based on the success of incremental integration schemes, and their complexity makes the evaluation of cross-border integration complicated and only recently studied (K.-J. Lundquist & Trippl, 2009: 1, 2011: 8-13; K. Lundquist & Trippl, 2011: 12-21; Trippl, 2009: 151).

A key concept and category for the analysis of the degree of integration of an SRIT is “proximity.” In this sense, considering the multiplicity of factors to assess SRIT, dimensions have been derived that evaluate functional proximity and relational proximity (Boschma, 2005: 64-72; K.-J. Lundquist & Trippl, 2009: 10, 2011: 3-6; Trippl, 2009: 7-13). Functional proximity refers to geographic proximity in interactive learning and innovation, which is neither a necessary nor sufficient condition for learning to take place, but too little or too much proximity can harm the process (Boschma, 2005: 3). It is, in summary, the geographic or physical dimension of distance understood through travel times and transportation costs, rather than kilometers traveled. Relational proximity is a general term for all types of non-spatial proximity, including cognitive, cultural, institutional, social, organizational, and technological (Makkonen & Rohde, 2016: 1626).

The analysis process to evaluate integration of an SRIT is based on ten dimensions defined by the OECD (2013: 20, 37, 61), in the document “Regions and Innovation: Collaborating Across Borders,” which are the following: 1. Geographic accessibility,

2. Socio-cultural proximity, 3. Institutional context conditions, 4. Cross-border integration, 5. Economic specialization, 6. Business innovation model, 7. Knowledge infrastructure, 8. Innovation system interactions, 9. Governance, and 10. Policy mix. These dimensions form the methodological basis of this article.

To understand the dynamics of an SRIT, it is necessary to clarify that the dimensions originate as a logical consequence when measuring the degree of interaction of the proximities that compose them (Boschma, 2005: 71). When there are regions with different economies and levels of development, degrees of border difference, complementarity or asymmetry—in terms of economic equality/inequality, political compatibility/incompatibility, and cultural and national identities—determine the potential of the different types of cross-border relationships, which are in turn affected by the degree of "openness" of the border in question (Trippl, 2006: 10). In summary, the dimensions derive from the concept of functional proximities (physical or geographic) and relational proximities (intangible based on degree of similarity and affinity) (OECD, 2013: 37).

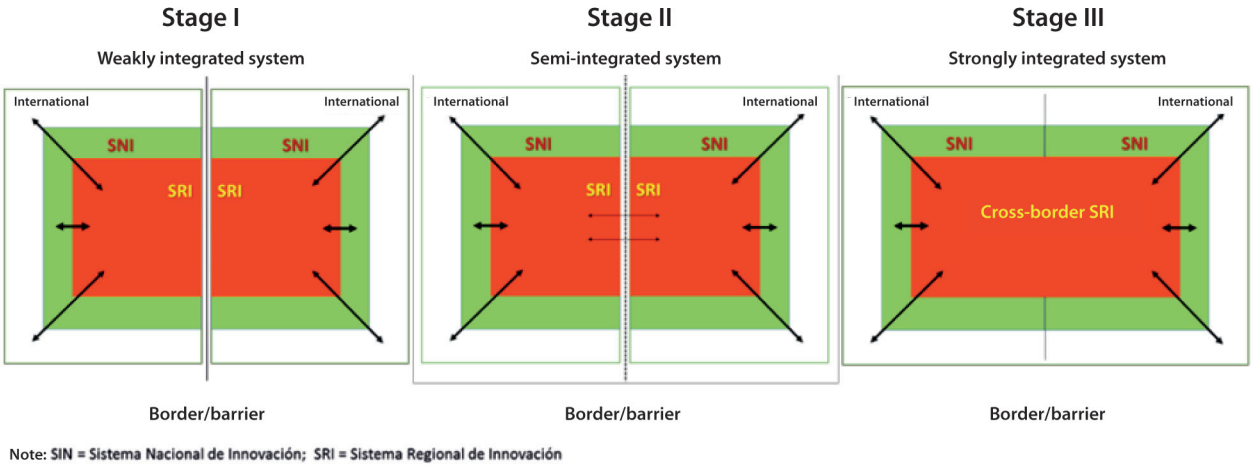
Methodology

The methodological model used in this work is described by the OECD (2013: 145-160), where the dimensions are integrated by variables with semantic differential questions to be evaluated by experts according to their experience. The ten dimensions are disaggregated into variables to measure proximity and thus assess the degree of integration of two border states or regions hosting an SRIT, as shown in Figure 2 (K.-J. Lundquist & Trippl, 2011: 35; OECD, 2013: 39). When there is full integration in all dimensions, physical and/or economic borders disappear, even though national innovation systems remain different. Three stages are identified: 1. Weakly integrated system, 2. Semi-integrated system, and 3. Strongly integrated system (K. Lundquist & Trippl, 2011: 10-13; OECD, 2013: 39). Thus, an SRIT overcomes the obstacles associated with an international border to reach a more integrated system.

In this work, the variables originally defined by the OECD (2013) were taken and operationalized to measure them using publicly available statistics rather than expert perception. These are presented in Table 4. The model was applied to the Sonora-Arizona Megaregion and specifically to the SRIT of table grapes, a Sonora product marketed to 36 countries through distributors in Nogales, Arizona. There are 39 variables (or proximities) that make up the adaptation of the dimensions of the OECD model (2013: pp. 145-160).

For the evaluation of each variable, it was considered that proximity is defined as balanced actions or flows between both states, for which the Likert scale was used (Matas, 2018: pp. 41-43), based on available published statistics. Since there are no recorded experiences of evaluations made with this type of variables for Mexico or the United States, the operationalization was carried out under the authors' criteria, and its assessment was done on a Likert scale from 1 to 7, where 1 is very unbalanced and 7 is very balanced.

Figure 2. Stages of integration of Cross-Border Regional Innovation Systems



Source: (K.-J. Lundquist & Trippl, 2011: 35; OECD, 2013b: 39)

Table 4. Dimensions, proximities, and variables used in the SRIT of table grapes in the Sonora-Arizona region

Dimension	Proximity	Variable
1. Geographic accessibility. Assesses total population by state, major localities and settlement density in the region, as well as crossings, travel times and types of transport used: car, airplane, cargo, charter, etc.; accessibility between nodes.	**Geographic proximity.** The similarities between regions and balanced flows define a geographic proximity based on communication, transport, and people.	1.1 Population by main localities and by state 1.2 Passenger transport 1.3 Cargo transport companies in Sonora with service to Arizona 1.4 Cargo crossings 1.5 Crossing frequency and fluidity
2. Sociocultural proximity. Measured by the balance of flows, their direction, tourism and event attendance, perception of closeness between societies, and shared cultural identity.	**Value proximity.** (The values of societies are different). Proximity of shared identity is defined by education, cultural and labor flows, as well as consumption trends (what is bought in Arizona vs. Sonora). Relational proximity(Sonora is closer to Arizona than to other Mexican states due to purchases, events, work, and other aspects).	2.1 International norms and certifications 2.2 Sonora-Arizona Commission - Specialized Committees 2.3 Sonora-Arizona Commission - Subcommittees and calls 2.4 Sonora-Arizona Megaregion
3. Contextual and environmental conditions. Refers to the economic, budgetary and political context for decision-making. Differences in rules and taxes have an impact.	**Institutional proximity.** Importance of differences between formal institutions like taxes, regulations, and also differences in culture and language.	3.1 Cross-border trade and investment facilities 3.2 Sonora-Arizona Commission: Agriculture and Transport 3.3 Alignment of government support and programs 3.4 Agricultural production and trade 3.5 Foreign direct investment (FDI) 3.6 Agricultural treaties
4. Knowledge integration. Cross-border workers. Participation in binational research, alignment of public policies, salaries, foreign direct investment.	**Cognitive proximity.** The closeness and complementarity in industrial structures and knowledge bases (also known as "related variety" and "proximate diversity").	4.1 Characteristics of AALPUM creation 4.2 GDP and employment
5. Economic specialization. Dominant economic sectors by state and comparison, Employment and GDP percentages, Product variety	**Cognitive Proximity.** The proximity and complementarity within industrial structures and knowledge bases (also referred to as "related variety" and "proximate diversity").	5.1 GDP and Employment 5.2. Agricultural Production in Sonora and Arizona 5.3 Production costs of table grapes 5.4 Wages and salaries by sector 5.5 Agricultural sector patents 5.6 Sonoran companies developing new varieties
6. Innovation business model. Patents, innovative companies on both sides, knowledge-intensive companies, innovation financing initiatives.	**Relational proximity.** Structures, relations, and processes that give rise to social dynamics, governance structures, regulations, and cultural identities that sustain the basis of social action.	6.1. Distribution companies in Nogales, Arizona, with Sonoran capital 6.2. Logistics of the table grape industry 6.3. The Current Technological Innovation System in Sonora 6.4. Technology transfer centers and extension programs
7. Knowledge infrastructure. Quality of educational institutions on both sides, "Third mission" among universities, scientific fields on both sides, map of key institutions.	**Cognitive proximity.** Proximity and complementarity both in industrial structures and knowledge bases (also known as "related variety" and "cognitive proximity").	7.1. Budgets of educational and research institutions 7.2. Schools of agriculture 7.3. Institutional agricultural research 7.4. AALPUM research project 7.5. Sonora-Arizona Inter-University Alliance Fund
8. Interactions of the innovation system. Balance of student flows, R&D staff, joint patents, joint publications, venture capital investments, innovation interactions.	**Functional proximity.** Specific to the innovation system and comprises the differences or asymmetries between regions in innovation capacity.	8.1. International students 8.2. Joint publications 8.3. Agricultural patents 8.4. Technological development support through PEI-CONACYT 8.5. Scholarships

9. Government. Level and balance of cross-border, local, regional, national, and international political commitment.	**Relational proximity.** Structures, relations, and processes that give rise to social dynamics, governance structures, regulations, and cultural identities that sustain the basis of social action.	9.1. Research and education budgets 9.2. Safe corridors
10. Political mix. Participation among actors on both sides. Monitoring and evaluation mechanisms for cross-border initiatives.	**Relational proximity.** Structures, relations, and processes that give rise to social dynamics, governance structures, regulations, and cultural identities that sustain the basis of social action.	10.1. Collaboration in joint research

Source: Own elaboration.

Analysis of the results

Each selected variable was analyzed and evaluated separately. The results are shown in Table 5, where the average of the dimensions is 3.90, a value below 4, which is the midpoint of the Likert scale, indicating that the SRIT of table grapes in the Sonora-Arizona region has weak but existing integration. When evaluating all 39 recorded variables, the average is 4.00.

The best-evaluated dimension is 4. Cross-border integration with 4.75, where the production and export of table grapes and the characteristics of the Local Agricultural Association of Table Grape Producers (AALUMP) stand out. Next is dimension 5. Economic specialization, with 4.67, where well-rated variables include agricultural production in Sonora and Arizona, production costs of table grapes, agricultural sector patents, and Sonoran companies developing new varieties.

Table 5. Dimensions, variables, and main results of the table grape SRIT in the Sonora-Arizona region

Dimension	Variable	Observations	Variable rating	Dimension rating
1. Geographic accessibility	1.1 Population by main localities and by state	Similar population growth rates at the state level but Arizona is much more populated. Phoenix grows rapidly, followed by Hermosillo.	1	3.50
	1.2. Passenger transport	From Hermosillo to Phoenix: 1 daily flight (1 hr 16 min), 5 hours by car plus customs (400 km); 18 daily bus departures (8 hr 30 min plus customs). Hermosillo has various charter van and air transport companies.	1	
	1.3 Freight transport companies in Sonora serving Arizona	Optimized crossing times for fruits and vegetables from Sinaloa and Sonora. Many specialized transport companies. Table grape logistics processes stand out.	6	
	1.4. Freight crossings	Fresh exported products have a value equivalent to 28% of imports. Crossings optimized.	6	
2. Sociocultural proximity	2.1. Mobility and crossing flows	Land passenger crossings are unbalanced and there is only air connection to Hermosillo.	1	4.60
	2.2. International standards and certifications	Farmers comply with most certifications for export to the USA and 36 other countries.	7	
	2.3. Sonora-Arizona commission- Specialized committees	Committees are mostly formed by officials from both state governments with few private actors. Having a framework for resolving concerns is an advantage.	5	
	2.4. Sonora-Arizona commission- Subcommittees and calls	Very specific and limited to agreements that do not require federal government involvement.	5	
	2.5. Sonora-Arizona megaregion	Detailed studies are lacking for each defined area.	5	
3. Contextual institutional conditions	3.1. Business creation facilities, taxes, and profits	Easier to start a business in Arizona, which also has lower tax rates. In Mexico, ISR is 30% paid by the company and profit withdrawals through CUFIN are taxed at 10%.	2	2.67
	3.2. Sonora-Arizona commission: Agriculture and transport	Greater involvement of federal entities is needed.	5	
	3.3. Alignment of federal government support and programs	There is no resource support for state agreements.	1	

4. Cross-border integration	4.1. Table grape production and export	Sonoran producers reach 36 countries meeting all requirements at competitive prices.	7	4.75
	4.2. Foreign direct investment (FDI)	Sonora is among the border states with the lowest FDI.	2	
	4.3. Relevant actors	The role of distributors is not well defined. Their contribution to the innovation system is limited to short- and long-term trends.	4	
	4.4. AALUMP creation characteristics	The association helps seek markets and facilitates compliance with certifications and export requirements.	6	
5. Economic specialization	5.1. GDP and employment	Very disparate GDP due to different economic activities and differences in hourly wages.	2	4.67
	5.2 Agricultural production in Sonora and Arizona	Products are different and complementary.	6	
	5.3. Table grape production costs	High production costs, but among the highest profitability crops in Sonora.	6	
	5.4. Wages and salaries by sector	Wages in Arizona are 6 to 13 times higher than in Sonora.	1	
	5.5. Agricultural sector patents	There are grape patents like plant breeders' rights held by Mexican growers.	6	
	5.6. Sonoran companies developing new varieties	9 companies have varieties developed in California, Israel, or locally.	7	
6. Innovation business model	6.1 Distributor companies in Nogales, Arizona with Sonoran capital	Companies are from Sonora or Sinaloa but hire American personnel experienced in marketing agricultural products in the US market.	5	4.50
	6.2. Table grape industry logistics	Process is largely dominated by Sonorans.	5	
	6.3. Current technological innovation system in Sonora	Sonoran growers are world-class.	5	
	6.4. Technology transfer centers and extension programs	Centers have different research or specialization areas, so collaboration is not complete.	3	
7. Knowledge infrastructure	7.1. Budgets of educational and research institutions	Highly different budgets between Sonoran and Arizona institutions.	2	4.40
	7.2. Agricultural schools	Number of students in agricultural schools in each state is similar.	6	
	7.3. Institutional agricultural research	Centers have different research areas or specializations, limiting collaboration.	2	
	7.4. AALUMP research Project	A major effort was carried out for nearly 10 years.	6	
	7.5. Sonora-Arizona Inter-University Alliance Fund	Very well received among Sonoran researchers.	6	
8. Innovation system interactions	8.1. International students	No Arizona students identified in Sonoran institutions.	1	2.20
	8.2. Joint publications	It's unclear whether joint publications exist between researchers from both states. Researchers are scattered and production is low.	1	
	8.3. Agricultural patents	There are grape patents like plant breeders' rights held by Mexican growers.	6	
	8.4. Technological development support through PEI-CONACYT	Not applied to agricultural aspects.	1	
	8.5. Study scholarships	Only the Sonora-Arizona Commission scholarships exist.	2	
9. Government	9.1. Research and education budgets	Highly different budgets between Sonoran and Arizona institutions	1	3.50
	9.2. Secure corridors	A very effective coordinated action that receives strong follow-up in both states	6	

10. Political mix	10.1. Joint research collaboration	No joint publications but the Sonora-Arizona Inter-University Alliance is fostering relations.	3	3.00
		Averages	**3.92**	**3.78**

Source: Own elaboration.

The dimension with the lowest score is 8. Innovation system interactions, with a value of 2.20, in which only the variable Agricultural patents stands out with 6, while the rest—International students, Joint publications, Support for technological development through PEI-CONACYT, and Study scholarships—were rated very low. Next is dimension 3. Institutional context conditions with 2.67, affected by the variables: Ease of business creation, taxes and profits, and alignment of federal government supports and programs. A graphical summary of the dimension evaluations is shown in Table 6.

When evaluating the stages of SRIT integration for table grapes based on K. Lundquist and Trippl's approach (2011:5) across six dimensions, the results shown in Table 7 are obtained. As can be seen, in Stage I, "asymmetric cost system" or weakly integrated system, there are imbalances regarding salaries, institutional budgets, specialization of different research institutions, lack of support for student mobility, and lack of joint projects. In Stage II, "emerging knowledge-based system" or semi-integrated system, external factors are found such as taxes, ownership of distribution companies by Sonorans, AALUMP, Sonora-Arizona Commission, Megaregion, and passenger infrastructure between both states. In Stage III, "innovation-driven symmetric system" or strongly integrated system, factors related to table grapes and specialized fresh product freight transport infrastructure are identified.

The variables can be viewed from the general regional context or from the particular SRIT perspective. The former refer to the achievements of the region, such as improvements in the crossing of fresh products from Sonora and Sinaloa into Arizona; the creation of secure corridors, especially the Lukeville-

Table 6. Evaluation of SRIT dimensions for table grapes in the Sonora-Arizona region

1. Geographical accessibility	1. Very unbalanced	2. Mostly unbalanced	3. Slightly unbalanced	4. Undefined balance	5. Slightly balanced	6. Mostly balanced	7. Very balanced
2. Sociocultural proximity	1. Very unbalanced	2. Mostly unbalanced	3. Slightly unbalanced	4. Undefined balance	5. Slightly balanced	6. Mostly balanced	7. Very balanced
3. Contextual institutional conditions	1. Very unbalanced	2. Mostly unbalanced	3. Slightly unbalanced	4. Undefined balance	5. Slightly balanced	6. Mostly balanced	7. Very balanced
4. Cross-border integration	1. Very unbalanced	2. Mostly unbalanced	3. Slightly unbalanced	4. Undefined balance	5. Slightly balanced	6. Mostly balanced	7. Very balanced
5. Economic specialization	1. Very unbalanced	2. Mostly unbalanced	3. Slightly unbalanced	4. Undefined balance	5. Slightly balanced	6. Mostly balanced	7. Very balanced
6. Innovation business model	1. Very unbalanced	2. Mostly unbalanced	3. Slightly unbalanced	4. Undefined balance	5. Slightly balanced	6. Mostly balanced	7. Very balanced
7. Knowledge infrastructure	1. Very unbalanced	2. Mostly unbalanced	3. Slightly unbalanced	4. Undefined balance	5. Slightly balanced	6. Mostly balanced	7. Very balanced
8. Innovation system interactions	1. Very unbalanced	2. Mostly unbalanced	3. Slightly unbalanced	4. Undefined balance	5. Slightly balanced	6. Mostly balanced	7. Very balanced
9. Government	1. Very unbalanced	2. Mostly unbalanced	3. Slightly unbalanced	4. Undefined balance	5. Slightly balanced	6. Mostly balanced	7. Very balanced
10. Political mix	1. Very unbalanced	2. Mostly unbalanced	3. Slightly unbalanced	4. Undefined balance	5. Slightly balanced	6. Mostly balanced	7. Very balanced

Source: Own elaboration.

Table 7. Factors determining the leve lof SRIT integration of the Sonora-Arizona region

Dimensions of cross-border regional innovation systems	STAGE I Cost-asymmetric system (Weakly integrated)	STAGE II Emerging knowledge-based system (Semi-integrated)	STAGE III Symmetric innovation-driven system (Strongly integrated)
Economic structure / specialization pattern	Use of "low road" development; wages in Arizona are 6 to 13 times higher than in Sonora GDP and lead to very different economic activities.	It is easier to start a business in Arizona and tax rates are lower. Distribution companies are 60% owned by Sonorans and Sinaloans who dominate the process and reach 39 countries.	Sonoran companies have world-class quality as they own patents for two types of plant propagator rights of winegrowers, and 9 companies have varieties developed in California, Israel, or locally.
Scientific base / infrastructure and knowledge creation	Highly different budgets between institutions in Sonora and Arizona. Centers have different areas of research or specialization, so there is no full collaboration.	The number of students in agricultural schools is similar. A comprehensive study for AALPUM was carried out for 10 years. The Inter-University Alliance Fund Sonora-Arizona has gained greater acceptance among Sonoran universities.	Specialized farmers' associations strengthen their global presence.
Nature of links	No Arizonan students are identified in Sonoran institutions. No joint publications identified between researchers from both states; they are poorly disseminated and have low output. No financial support programs applicable to agricultural aspects. No scholarships for students except those from the Sonora-Arizona Commission.	There are patents for two types of plant propagator rights by Mexican winegrowers.	
Institutional configuration		The committees of the Sonora-Arizona Commission are a platform to solve binational concerns and issues. The creation of the Sonora-Arizona Megaregion facilitates joint promotion.	Sonoran farmers meet certifications for export to the U.S. and 36 other countries.
Political structures	Highly different budgets between institutions in Sonora and Arizona. No federal support or resources for binational state agreements.	The Sonora-Arizona Commission has been operating for 6 decades in both states.	
Accessibility	Passenger crossings are unbalanced.	Infrastructure and travel frequency from Sonora to Arizona exist.	Border crossing times for fruits and vegetables from Sinaloa and Sonora have been optimized. Numerous specialized transportation companies operate in Sonora, with particular emphasis on the logistics processes for fresh products.

Source: Own elaboration.

Sonoyta-Puerto Peñasco corridor to provide safety for American tourists traveling to this port from Phoenix or Tucson; and the designation of the megaregion as a way to give the region a promotional image or "brand." The variables or proximities that stand out relative to the table grape SRIT focus on the achievements of table grape farmers who have sought solutions in different institutions, while the negatives relate to the limited participation of distributors in Nogales, Arizona; low foreign investment in Sonora; unbalanced frequency of travel between both states; and differences in hourly wages.

Conclusions and policy implications

The results indicate that the degree of integration of the table grape SRIT in the Sonora-Arizona region is "weakly integrated," although it presents elements of the "semi-integrated" stage. The highest indicators relate to the dynamics of table grape production from the sectoral and productive specialization perspective, as well as the region's operation in terms of border port infrastructure, geographic accessibility, socio-cultural proximity, and the binational image of the Megaregion. The lowest indices were obtained in the "proximities" related to the specific elements of the formation of the table grape SRIT, such as the dimension on innovation system interactions between both states.

The analysis of the variables indicates that current innovation policies between Mexico and the United States show neither similarities nor a particular focus on cross-border innovation potential. It is perceived that efforts have been made by the border states; furthermore, national policy instruments do not allow for cross-border financing, and the national R&D and innovation councils of both countries do not work jointly. It is necessary to involve national governments more to strengthen state actions in cross-border cooperation.

The region is perceived as a logistics and transportation hub, where Arizona is the entry point for products from northwest Mexico into the United States, but there is a lack of future scenarios and plans related to local and regional transportation systems. To date, joint initiatives related to transportation, infrastructure development, and tourist security systems stand out. While data on cross-border flows of goods, people, and capital have met the area's needs, they do not cover knowledge flows. Data on knowledge potential and flows are lacking, which prevents identifying opportunities and bottlenecks for cooperation and cross-border innovation initiatives.

Based on some of the results from the aforementioned OECD study (2013), it can be argued that the case of table grapes in the Sonora-Arizona Region reflects a situation in which, for the development of cooperation projects and innovation actions, more than geographic proximity, access to the best global partners is the priority. This is because when excellence is required to compete globally, it becomes more relevant for companies to seek partners at the international level, based on always obtaining strength in specific fields of research and innovation (Ibid).

Complementary to the actions of governmental instances, it is necessary to integrate a business-academic analysis of cooperation, so the creation of a joint R&D and innovation council as a permanent "Think Tank" would be appropriate to provide an updated vision of potential R&D areas (life sciences, ICT, new materials, and electronic society).

The current governance structure of the region fundamentally includes public actors. The Sonora-Arizona Commission has little permanent staff and infrequent meetings with its counterparts from member public entities, so its role in leading the partnership and identifying successful trends is limited. It is necessary to create a vision for innovation development for the Sonora-Arizona Megaregion, involving more federal officials, businesspeople, and civil society actors, so that the Commission becomes a management entity with a broader base of regional actors on a binational scale.

A scientific bridge project is required to develop cross-border university cooperation, for science parks where key actors are universities on both sides of the border that carry out networking events, exchange office facilities, as well as students, teachers, and researchers, and conduct joint research, reports, researcher training, publications, conferences, and cooperation projects funded by national or international entities.

Insecurity in Mexico has negatively impacted, limiting educational relations, so it is advisable to use cutting-edge technology to deliver classes without the need for professors or students to travel,

and to encourage dual-degree programs, joint programs with incubator companies with mentors and joint tutors, training of incubation managers, and selection and evaluation of technological development and innovations.

The Helsinki-Tallinn region (Nauwelaers et al., 2013: pp. 5-40) in Europe is one of the regions most similar to Sonora-Arizona due to its degree of existing asymmetry. It is noteworthy that integration was facilitated by passenger ferry transportation across the Baltic Sea, especially workers from Estonia to Helsinki, Finland, and Finnish tourists to Tallinn, Estonia. Both border Russia. In this region, the Twin Cities relationships play a strong role in bilateral planning. For this reason, it is proposed to strengthen and improve the old Sister Cities ties and move from solely social, educational, and cultural relations to broader planning relations, which would allow expanding the academic-scientific and business network on both sides of the border, ultimately forming a "cross-border innovation region."

References

Alisha, Kim, & Pavlakovich-Kochi, Vera (2019). Historia en Común. Crecimiento Económico Compartido. En Mega-Región. El presente con futuro (pp. 84-87). Gobierno del Estado de Sonora, Arizona-Mexico Commission, Comisión Sonora- Arizona.

Boisier, S. (2002). Globalización, Geografía política y fronteras. In VI Congreso Nacional de Ciencia Política (pp. 1–31). Santiago de Chile.

Boschma, R. A. (2005). Proximity and innovation: A critical assessment. Regional Studies, 39(1), 61–74. https://doi.org/10.1080/0034340052000320887

Bracamonte-Sierra (2019). Un Sonora de Grandes Transformaciones. En Mega-Región. El presente con futuro (pp. 29-37).

Gobierno del Estado de Sonora, Arizona-Mexico Commission, Comisión Sonora-Arizona.

Chaminade, C., & Nielsen, H. (2011). Transnational innovation systems (CEPAL Serie Estudios y perspectivas -México 133).

Chase, R. B., Jacobs, F. R., & Aquilano, N. J. (2009). Administración de operaciones. Producción y cadena de suministros, 12 ed. McGarw Hill/ Interamericana Editores, S.A. de C.V.

Comisión Sonora-Arizona. (2019). Megaregión. El presente con futuro. (Comisión Sonora-Arizona, Ed.), Gobierno del Estado de Sonora. Gobierno del Estado de Sonora.

Conferencia de Gobernadores Fronterizos. (2009). Plan Indicativo para el Desarrollo Competitivo y Sustentable de la Región Transfronteriza México-Estados Unidos.

Conferencia de Gobernadores Fronterizos, X., & Wong-González, P. (2007). Competitividad y Áreas de Oportunidad en la Región Fronteriza México - Estados Unidos. Visión Estratégica Regional.

Cooke, P. (2004). Regional knowledge capabilities, embeddedness of firms and industry organisation: Bioscience megacentres and economic geography. European Planning Studies, 12(5), 625–641. https://doi.org/10.1080/0965431042000219987

Cooke, P., & Memedovic, O. (2006). Regional Innovation Systems as Public Goods (Working Papers, UNIDO). Vienna, Austria.

Doloreux, D., & Parto, S. (2004). Regional Innovation Systems : A Critical Review. Maastricht MERIT, 190(1), 1–26. Retrieved from http://www.ulb.ac.be/soco/asrdlf/documents/RIS_Doloreux-Parto_000.pdf

Gibson, L. J., Pavlakovh-Kochi, V., Wong-Gonzalez, P., Jaewon, L., & Wright, B. (2016). " Sun Corridor " as a Transborder Mega- Region: Revivifying Economic Development in the Arizona-Sonora Region. Studies Un Regional Development, 46(1), 41–62. Retrieved from https://www.wrsaonline.org/newsite/prelim-program/

Gomezcésar Hernandez, I. (1995). Sonora y Arizona: Apuntes apara una Historia. Estudios Sociales, V(10), 10–26. Iammarino, S. (2005). On the definition of regional system of innovation (RSI): an application to the Italian case. European Planning Studies, 13(4), 497–519.

Kraemer-Mbula, E., & Wamae, W. (2012). La innovación y la agenda de desarrollo. Estrategia de Innovación de la OCDE.

Lundquist, K.-J., & Trippl, M. (2009). Toward Cross-Border Innovation Spaces: A theoretical analysis and empirical camparison of the Oresund region and the Centropea area. SRE-Discusion 2009/5;

Lundquist, K.-J., & Trippl, M. (2011). Distance, Proximity and Types of Cross-Border Innovation Systems: A Conceptual Analysis. Regional Studies, HAL Id: ha, 1–37.

Lundquist, K., & Trippl, M. (2011). Policy options for constructing cross-border innovation systems. In Paper presented at The 6th International Seminar on Regional Innovation Policies, Lund University, Sweden (p. 19).

Makkonen, T., & Rohde, S. (2016). Cross-border regional innovation systems: conceptual backgrounds, empirical evidence and policy implications. European Planning Studies, 24(9), 1623–1642. https://doi.org/10.1080/09654313.2016.1184626

Matas, A. (2018). Diseño del formato de escalas tipo Likert: Un estado de la cuestión. Revista Electronica de Investigacion Educativa, 20(1), 38–47. https://doi.org/10.24320/redie.2018.20.1.1347

Nauwelaers, C., Maguire, K., & Marsan, G. A. (2013). The Case of Helsinki-Tallinn (Finland-Estonia) – Regions and Innovation: Collaborating Across Borders (OECD Regional Development Working Papers). https://doi.org/10.1787/5k3xvolk8knn- en

OECD. (2013). Regions and Innovation; Collaborating Across Borders. OECD Reviews of regional Innovation. OECD Publishing. https://doi.org/10.1177/0022146514533086

Pavlakovich-Kochi, V. (2006). The Arizona-Sonora Region : A Decade of Transborder Region Building. In Estudios Sociales. Revista de Investigación Científica (Vol. XIV, pp. 26–55).

Perkmann, M., & Sum, N. L. (2002). Globalization, Regionalization and Cross-Border Regions: Scales, Discourses and Governance. In M. Perkman & N. L. Sum (Eds.), Globalization, Regionalization and Cross-Border Regions (pp. 3–21). New York: Palgrave MacMillan.

Sakaiya, T. (1994). Historia del Futuro, La sociedad del conocimiento. Editorial Andres Bello.

Trippl, M. (2006). Cross-Border Regional Innovation Systems. SRE Discussion Papers 2006/05. Vienna. This.

Trippl, M. (2009). Developing cross-border regional innovation systems: Key factors and challenges. Tijdschrift Voor Economische En Sociale Geografie, 101(2), 150–160. https://doi.org/10.1111/j.1467-9663.2009.00522.x

Wilson, C., Lee, E., & Bezarez-Calderón, A. A. (2015). Competitive Border Communities. Mapping and Developing US.-Mexico transborder Industries. Washington, DC: Wilson Center.Retrieved from https://www.wilsoncenter.org/publication/competitive-border-communities-mapping-and-developing-us-mexico- transborder-industries

Wong-González, P. (2005). La emergencia de regiones asociativas transfronterizas Cooperación y conflicto en la región Sonora-Arizona. Frontera Norte, 17(33), 77–106.

Wong-González, P. (2019). Sonora-Arizona: Región Modelo de Paradiplomacia Transfronteriza. En Mega-Región. El presente con futuro (pp. 38-55). Gobierno del Estado de Sonora, Arizona-Mexico Commission, Comisión Sonora-Arizona.