

## Scientific production profile of leading universities leading universities in Latin American countries

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### Abstract

Scientific production in Latin America is mainly concentrated in Higher Education Institutions located in Brazil and Mexico, characterized by the high volume of papers published and citations received. However, universities in other countries of the region also stand out for their excellence in research. This paper describes the scientific production profile of leading universities in Latin American countries positioned in the top ten of the SCImago Journal & Country Rank. Using five indicators reported in the SIRiber 2020 Report, the profile of these leading universities is characterized with respect to Normalized Impact, Scientific Leadership, Open Access, International Collaboration and High-Quality Publications. As a result, the scientific production of this group of Latin American universities, leaders in their countries, is characterized by 50% international collaboration, especially of foreign main authors, 38% impact below the world average of citations, 45% of open access publications and 39% of Q1 publications.

**Keywords:** research and development, technical efficiency, social progress, DEA, Latin American countries.

### I. Introduction

Universities are especially recognized for their research activity, and in this sense, indicators have been developed to measure and evaluate it. Among these indicators are the traditional ones,

related to the number of research projects, generation of publications and/or patents, among others [1]. Currently, and thanks to international scientific databases, scientometric indicators are available, such as the impact of publications, international collaborative production, open

access publication, co-authorship, and the number of citations that an article has in the scientific literature, among other indicators, so this can be measured quantitatively and qualitatively at the level of countries, regions, topics, universities, and authors, which contributes to the studies and design of institutional or governmental strategies (Chua & Orozco, 2016). Several international services offer scientometric indicators that evaluate this scientific production, among these Scimago, which offers metrics and rankings based on the scientific production registered in the Scopus scientific database, published through the classifiers SCImago Journal & Country Rank (SJCR), SCImago Institute Rank (SIR) and the annual reports SIRiber where they rate the Ibero-American higher education institutions according to their works indexed in the Scopus© database, offering indicators of their four-year performance based on three fundamental factors: research, innovation and social impact [3][4].

These international evaluations of universities create a competitive environment that requires monitoring of metrics both in terms of their visibility and positioning, at the level of their research products, researchers and the institution itself, pushing universities towards the strategic development of an international profile that represents their performance for purposes of prestige, evaluations, improvement plans for the institution or for national, regional and international comparative studies [5][6][7]. On the other hand, these evaluation systems are questioned by several authors "because they are carried out using the same international standard" [8], and they add that the quality of universities cannot be determined by only one of their functions, such as research [9].

According to the SCImago Institute Rank (SIR) classification [10] for the year 2020, 317 Latin American universities are listed, associated with 48 countries categorized by their national production in Scimago Journals & Countries Ranks [11]. This paper describes the scientific production profile of the two main universities of the top ten Latin American countries reported in SJCR. The profile is designed by analyzing indicators reported in the SIRiber 2020 Report [12] in order to characterize the profile of these

leading universities, according to the number of papers indexed in the Scopus© database in the period 2014-2018.

## Nomenclature

SJCR Rank	SCImago Journal & Country Rank
SIR	SCImago Institute Rank

## I. Methodology

In order to describe the scientific production profile of the leading universities in Latin American countries, the following is done:

- a) Selection of scientometric indicators from the 2020 SIRiber Report, which classifies and presents performance indicators of Ibero-American universities on the works indexed in the Scopus© database for the period 2014-2018. Five (5) indicators are selected which are independent of the size of the institution (see Table 1).
- b) Identification of the Latin American countries that occupy the first 10 positions in the Ranking of Journals and Countries (SJCR) in its latest publication, which corresponds to 2019. Brazil, Mexico, Chile, Argentina, Colombia, Ecuador, Peru, Cuba, Uruguay and Venezuela are identified.
- c) For each country, the first two universities that lead the SIR Ranking in its latest publication (year 2020) are identified. In the case of Uruguay, only one university is ranked. There is a total of 19 universities for the study to be carried out.
- d) Data on the five indicators for each university selected as a leader in its country are compiled from the 2020 SIRiber report (see Table 2).
- e) Subsequently, the study proceeds to characterize the profile of these universities using descriptive statistics.

**Table 1.** Scientometric indicators of the Scientific Production of universities.

Label	Indicator	Description and source
NI	Normalized Impact	This indicator reflects the impact of the knowledge generated by an institution on the international scientific community. It takes as its central point the world average impact (value 1). Thus, if an institution has an NI of 0.8, it means that its production is cited 20% below the world average.
Lead	Scientific Leadership	Percentage of papers published by an institution whose principal investigator belongs to that institution.
OA	Open Access	Percentage of documents published in open access journals.
IC	International Collaboration	Percentage of an institution's production where the institutional affiliation of the authors corresponds to different institutions and at least one of them is from a different country. This indicator shows the capacity of an institution to create scientific collaboration networks.
Q1	High Quality Publications	Percentage of an institution's papers published in journals that rank in the top 25% of each knowledge category. It is considered as a reflection of the institutional capacity to achieve a high expected level of impact.

Source: Scimago, SIRIber 2020 Report

**Table 2.** Leading universities in the Top 10 Latin American countries in SJCR 2019.

Country	University	Acronym	IC	Ni	Q1	Lead	OA
Brazil	University of Sao Paulo	BRA-USP	37,07	0,77	44,43	57,73	47,01
Brazil	Universidade Estadual Paulista Julio de Mesquita Filho	BRA-UNESP	29,41	0,68	39,29	59,69	61,18
Mexico	National Autonomous University of Mexico	MEX-UNAM	42,52	0,62	44,90	57,43	40,45
Mexico	Center for Research and Advanced Studies of the IPN	MEX-CINVESTAV	41,78	0,71	44,70	51,88	30,71
Chile	University of Chile	CHL-	42,35	0,62	49,71	64,21	42,70

UCHILE									
Chile	Pontificia Catolica de Chile	Universidad	CHL-UC	57,66	0,74	54,88	54,48	50,68	
Argentina	University Aires	of Buenos	ARG-UBA	42,35	0,62	49,71	64,21	42,70	
Argentina	National La Plata	University of	ARG-UNLP	46,37	0,61	51,23	58,83	40,09	
Colombia	National Colombia	University of	COL-UNAL	40,46	0,45	26,95	64,06	47,51	
Colombia	University of	Antioquia	COL-UDEA	44,70	0,51	33,95	63,82	50,26	
Ecuador	Pontifical University of Ecuador	Catholic	ECU-PUCE	71,20	0,69	39,20	48,67	54,40	
Ecuador	University Americas, Ecuador	of the	ECU-UDLA	69,41	1,21	34,31	55,05	39,01	
Peru	Peruvian Cayetano Heredia	University	PER- CAYETAN	73,60	0,69	57,03	44,22	70,88	
Peru	Universidad Mayor de San Marcos	Nacional	PER- UNMSM	49,56	0,30	24,02	56,29	65,18	
Cuba	Marta Abreu University of Las Villas	Central	CUB-UCLV	69,48	0,59	23,41	53,04	39,56	
Cuba	University of	Havana	CUB-UH	73,34	0,36	30,33	48,04	32,57	
Uruguay	University Republic	of the	URY- UDELAR	63,65	0,72	47,74	60,09	35,57	
Venezuela	Central Venezuela	University of	VEN-UCV	53,84	0,45	29,59	51,93	42,72	
Venezuela	Universidad Andes	de los	VEN-ULA	65,02	0,45	23,47	61,39	40,69	

## 2. Results

The results are presented below when analyzing the descriptive statistics (Table 3), data correlation and dispersion in Figures 1 and 2 for the nineteen universities in the study, for the five scientometric indicators. The results are as follows:

a) Regarding international collaboration (IC): on average, 53% of its publications are made with the collaboration of researchers from universities in other countries. Two groups of universities are observed, those with between 50% and 73% of

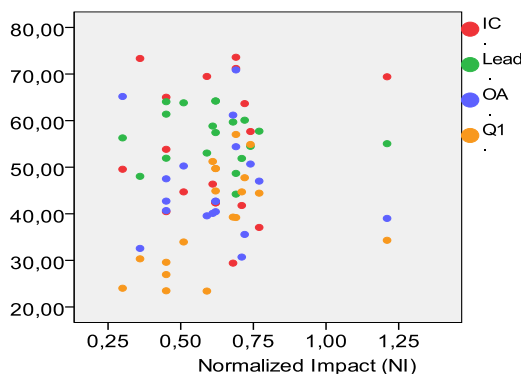
international collaboration located in Cuba, Venezuela, Ecuador, Uruguay and Peru; and those with between 30% and 50% located in Colombia, Chile, Mexico, Brazil and Argentina. This indicator presents a high negative correlation with the indicator on leadership in publications (Lead). The universities that present high international collaboration, the greater the participation of their researchers as co-authors, and not as lead authors. This is evident in universities in Cuba, Venezuela, Peru and Ecuador.

b) Regarding publication in open access (OA) journals: on average, 45% of publications are in open access journals, most universities are

between 30% to 50% in this indicator. Peru stands out in its two universities with more than 65% in open access publication.

**Table 3.** Descriptive Statistics.

Indicator	N	Minimum	Maximum	Mean	Std. Deviation	Variance
IC		29,41	73,60	53,3563	14,02944	196,825
Ni		,30	1,21	,6205	,19526	,038
Q1		23,41	57,03	39,4132	11,03363	121,741
Lead		44,22	64,21	56,5821	5,90850	34,910
OA		30,71	70,88	45,9932	10,72629	115,053



(a) Scatterplot of the indicators

	IC	Ni	Q1	Lead	OA
IC	Pearson Correlation 1	,110	-,161	-,638	-,052
	Sig. (2-tailed)	,653	,510	,003	,834
	N	19	19	19	19
Ni	Pearson Correlation	,110	1	,435	-,096
	Sig. (2-tailed)	,653	,063	,697	,646
	N	19	19	19	19
Q1	Pearson Correlation	-,161	,435	1	-,058
	Sig. (2-tailed)	,510	,063	,815	,679
	N	19	19	19	19
Lead	Pearson Correlation	-,638	-,096	-,058	1
	Sig. (2-tailed)	,003	,697	,815	,486
	N	19	19	19	19
OA	Pearson Correlation	-,052	-,113	,102	-,170
	Sig. (2-tailed)	,834	,646	,679	,486
	N	19	19	19	19

(b) Pearson's Correlation Table

**Figure 1.** Distribution and correlation of indicators.

c) The percentage of papers published by institutions whose principal investigator belongs to the same institution is above 44%, the average being 56%. This indicator has a high negative correlation with international collaboration (IC) (-0.638), i.e., to the extent that there is greater international collaboration, the main author of the papers corresponds to the collaborating institution.

d) With respect to the normalized impact (Ni, indicator of citations with respect to the world average impact represented by the value 1), which measures the impact of the knowledge generated by an institution in the scientific community, the

average value is 0.62, which means that the citations to the works of these institutions are, on average, 38% below the world average impact. Only one university in Ecuador exceeds this world average. On the other hand, there is a moderate positive correlation of this indicator with Q1 (0.435), universities with a higher level of impact in their scientific production in this group also have a higher percentage of articles in Q1 journals.

e) As for the percentage of papers published in journals indexed in Scopus located in the highest 25% of each category of knowledge (Q1), it is 39%, where the vast majority of universities do

not exceed 50% of their publications in this category. There is a moderate positive correlation of this indicator with Ni (0.435), i.e., universities with a higher percentage of articles in Q1 journals show higher levels of impact (citations) of their scientific production. In the relationship between

the *Q1* and *Ni* indicators, two groups of universities are observed: those with 40% or less of Q1 publications: universities in Venezuela, Cuba, Colombia, Ecuador and one in Peru; and those with more than 40%: Brazil, Mexico, Uruguay, Chile, Argentina and one in Peru.

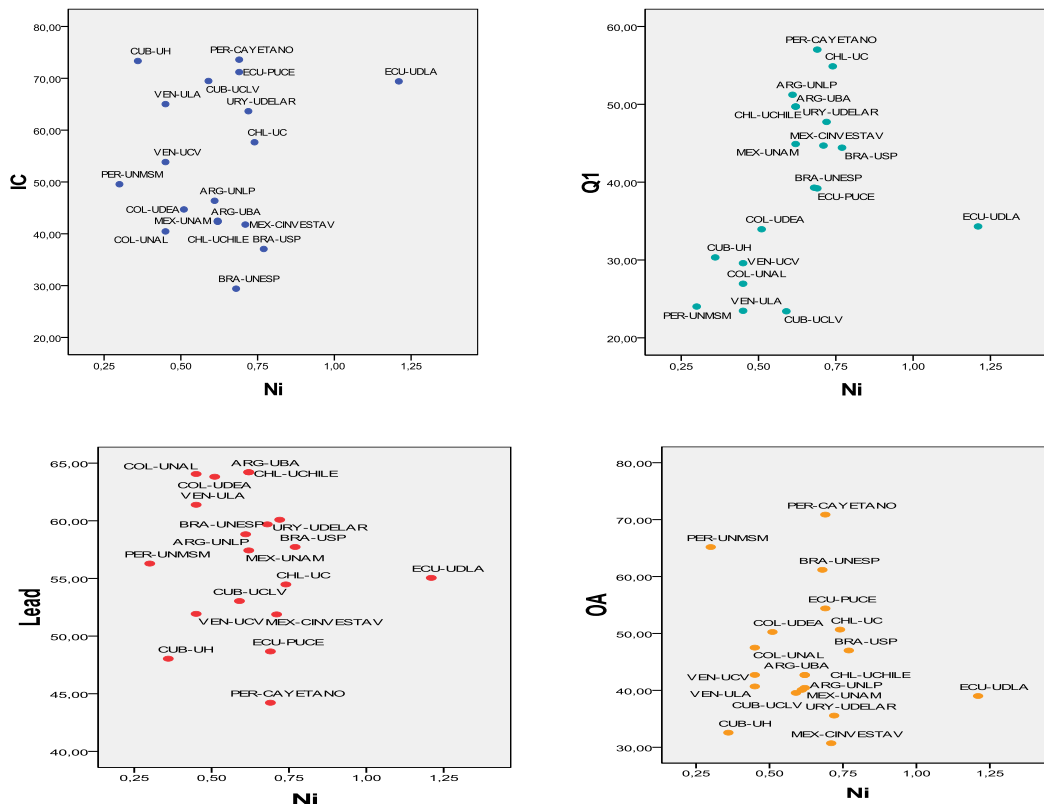


Figure 2. Scatter plots between pairs of indicators.

### 3. Conclusions

Scientometric data from 19 universities located in 10 Latin American countries that occupy the top positions in SCImago Journal & Country Rank were analyzed. Five scientometric indicators collected from the SirIber 2020 report were used, namely: Normalized Impact, Scientific Leadership, Open Access, International Collaboration and High-Quality Publications. With the analysis carried out, the performance profile of these universities with respect to their scientific production has been characterized around the five indicators mentioned above.

Brazil, Mexico, Colombia, Chile, Argentina, Cuba, Venezuela, Ecuador, Uruguay and Peru make up the group of countries included in the study. As a result, the scientific production of this group of Latin American universities, leaders in their countries, is characterized by 50% international collaboration, especially of foreign main authors, 38% impact below the world average of citations, 45% of open access publications and 39% of Q1 publications.

Two groups of universities can be observed: one made up of those located in Cuba, Venezuela, Ecuador, Uruguay and Peru that present more than

50% of their publications with collaboration of foreign researchers as main international authors; and those in Colombia, Chile, Mexico, Brazil and Argentina, which present between 30% and 50% of foreign collaboration. These last-mentioned countries coincide with those located in the first five places of the SCImago Journal & Country Rank.

The Scientific Leadership and International Collaboration indicators present a high negative correlation, which shows a high participation of researchers as co-authors in publications led by researchers from foreign universities. Likewise, the Normalized Impact and High-Quality Publications indicators show a moderate positive correlation, which indicates that there is an association between the number of citations and the number of publications in Q1 journals.

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