Analysis of variance related with scientific production and publication indicator from Latin-American countries of the group 1 of SIR Iber 2019 Ranking

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Abstract

SIR Iber 2019 report groups Ibero-American countries by their scientific production and publication capacity according to output indicator (O) of the factor of measurement: investigation. In group 1, there are the Latin-American countries: Brazil, Mexico, Argentina, Chile and Colombia. The investigation aims to analyze and compare the indicator related with scientific production and publication from Latin-American countries of the group of SIR Iber 2019 Ranking, through ANOVA statistical technique, in relation per capita, to PIB and in international collaboration, in order to confront their performances in production and publication of papers in journals indexed in SCOPUS. Countries highlight in order: Brazil, Mexico, Argentina, Chile and Colombia, with respect to the number of papers signed by authors of institutions from Latin-American every country. About the number of papers correspondents to authors from different countries, for each 100.000 citizen, in this order are grouped: Chile, Brazil, Argentina, Colombia and Mexico. The order of countries according to the number of papers in relation of PIB, in thousands of dollars, result: Chile, Brazil, Colombia, Argentina and Mexico. In relation to papers percentage signed in collaboration with another country, the order is Chile, Colombia, Argentina,

México and Brazil. In all of the analyzed indicators, a statistically significant difference exists between the averages of 5 variables, with a confidence level of 95.0%.

Keywords: indicators, Output, SIR Iber 2019, PIB, international collaboration, factor of investigation, Scopus, ANOVA

1. Introduction

The dissemination of scientific papers based on SCOPUS database [1] carries with it the use metrics related with the investigation source. This leads to organize the University Education Institution (IES) based in production and publication of papers capacity in scientific journals of recognized academic prestige [2] [3] [4]. SIR Iber Ranking classifies annually the universities with at least one (1) document published by journals indexed in SCOPUS in the analyzing five year period [5] [6] [7] ending two years before the edition of the. For example, SIR Iber 2019 report uses the five year period 2013-2017 results [7].

Since output indicator (O) as a way of determine the capacity of institutions and countries to create and publish scientific knowledge in journals indexed in SCOPUS [6] [7] [8] [9], the classification is made, besides to considerate others indicators in the factor of investigation [5] [7] [10] [11] in order to encourage the dissemination of new knowledge and visibility of universities and, as consequence, of countries.

SIR Iber 2019 report has presented the results in four (04) groups of countries in analysis [7]. The group 1 includes which has more than 50.000 publications in the considered five year period: Brazil, Spain, Portugal, Mexico, Argentina, Chile and Colombia [7]. This investigation aims to analyze and compare the indicator related with the scientific production and publication, in other words, output indicator (O) of the factor of measurement: investigation, from Latin-American countries of group 1 of SIR Iber 2019 Ranking, through ANOVA statistical technique [12] [13], in relation per capita, to PIB and in international collaboration, in order to confront their performances in production and publication of papers in journals indexed in SCOPUS.

The number of papers indicator registered by SCOPUS for each 100 investigators expressed in physical people and on a full-time equivalent from Latin-American countries in group 1 SIR Iber 2019 report, it is not analyzed by ANOVA technique because there are not available the data from Brazil in 2015, 2016 and 2017, neither Chile nor Mexico in 2019 [14].

Nomenclature	
SIR	SCimago Institution Ranking
SIR Iber	Ranking Iberoamericano de Instituciones de Educación Superior
IES	University Education Institution
PIB	Gross Domestic Product

2. Publications in journals indexed in SCOPUS, signed by authors of institutions for each Latin-American country in group 1 of SIR Iber 2019 report

Table 1 and Fig. 1 include the number of papers registered in SCOPUS, signed by authors of institutions for each Latin-American country in group 1 SIR Iber 2019 report, in 2013-2017 [15]. The gap of Brazil highlights over the other countries. Followed by Mexico, then Argentina and, in the last places, Chile and Colombia. These two countries closely match with Argentina in 2017. Table 2 includes the analysis of variance (ANOVA table) [12] [13] by analyzing the variance of data in two components: a between-groups component and a within-groups component. The F-reason is equal to 408.616: quotient between the estimated between-groups and the estimated within-groups. Because the P-value from F-test is lower than 0.05, a statistically significant difference exists between the average of 5 variables:

number of papers registered in SCOPUS, signed by authors of institutions for each Latin-American country in group 1 of SIR Iber 2019 report, in 2013-2017, with a confidence level of 95.0%.

Table 1. Number of papers registered in SCOPUS, signed by authors of institutions for each Latin-American country in group 1 SIR Iber 2019 report, in 2013-2017 [15].

Country	2013	2014	2015	2016	2017
Argentina	12.251	13.530	13.579	13.904	14.214
Brazil	64.016	68.364	70.391	74.717	78.517
Chile	9.321	11.107	11.738	13.351	13.530
Colombia	7.445	8.402	9.106	10.411	11.659
Mexico	19.553	21.379	21.618	23.041	24.357
	114.599	124.796	128.447	137.440	144.294

Fig.1. Number of papers registered in SCOPUS, signed by authors of institutions for each Latin-American country in group 1 SIR Iber 2019 report, in 2013-2017 [15].

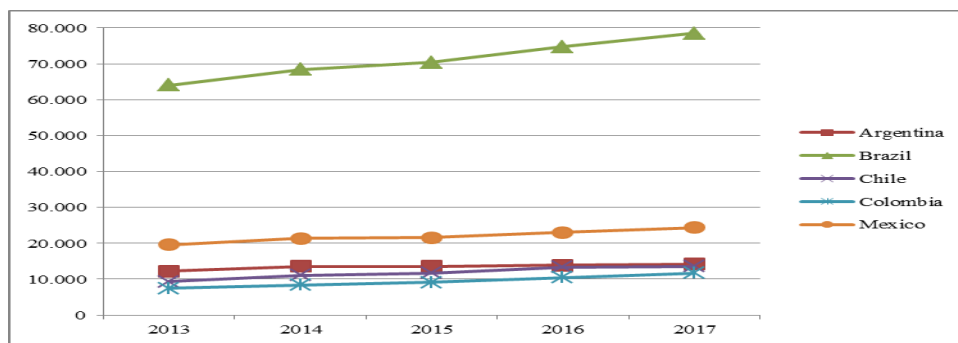Table 2. ANOVA of Number of papers registered in SCOPUS, signed by authors of institutions for each Latin-American country in group 1 SIR Iber 2019 report, in 2013-2017 [12] [13] [15].

Source	Squares Sum	FG	Square Mean	Ratio-F
Between	1,35E+10	4	3,36E+09	408,62
Within	1,65E+08	20	8,23E+06	
Total	1,36E+10	24		

Valor P = 0,0000

3. Publications in journals indexed in SCOPUS for each 100.000 habitants from Latin-American countries in group 1 of SIR Iber 2019 report

Table 3 and Fig. 2 register the number of papers corresponding to authors from different countries, registered in SCOPUS for each 100.000 habitants from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017 [16]. The gap of Chile highlights over the other analyzed countries, then

Brazil, followed by Argentina and, in fourth and fifth place, Colombia and Mexico, respectively. Table 4 presents the analysis of variance (ANOVA table) [12] [13]. In this case, F-reason is equal to 100.121. It is the quotient between the estimated between-groups and the estimated within-groups. Because the P-value from F-test is lower than 0.05, a statistically significant difference exists between the average of 5 variables: number of papers correspondent to authors of different countries, registered in SCOPUS, for each 100.000 habitants from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017, with a confidence value of 95.0%.

Table 3. Number of papers correspondent to authors of different countries, registered in SCOPUS, for each 100.000 habitants from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017 [16].

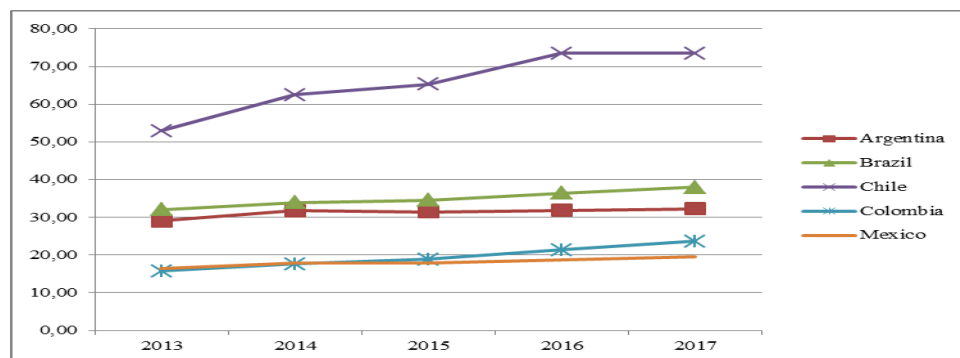| Country	2013	2014	2015	2016	2017
Argentina	29,03	31,71	31,48	31,90	32,28
Brazil	32,01	33,89	34,59	36,42	37,97
Chile	52,93	62,43	65,32	73,48	73,45
Colombia	15,80	17,63	18,89	21,36	23,65
Mexico	16,51	17,82	17,81	18,78	19,64
	2.159,27	2.177,49	2.183,10	2.197,93	2.203,99

Fig. 2. Number of papers correspondent to authors of different countries, registered in SCOPUS, for each 100.000 habitants from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017 [16].

Source	Squares Sum	FG	Square Mean	Ratio-F
Between	7,33E+03	4	1,83E+03	100,12
Within	3,66E+02	20	1,83E+01	
Total	7,69E+03	24		

Valor P = 0,0000

Table 4. ANOVA of the same papers correspondent to authors of different countries, registered in SCOPUS, for each 100.000 habitants from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017 [12] [13] [16].

4. Publications in journals indexed in SCOPUS related to PIB from Latin-American countries of group 1 of SIR Iber 2019 report

Table 5 and Fig. 3 include the number of papers registered in SCOPUS related to PIB, in thousands of dollars, from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017 [17]. Chile occupies the first place, followed by Brazil, Colombia in third place since 2015 and, in the last places, Argentina and Mexico. Table 6 presents the analysis of variance (ANOVA table) [12] [13] by analyzing the variance of data in two components: a between-groups component and a within-groups component. The F-reason is equal to 14.67: quotient between the estimated between-groups and the estimated within-groups. Because the P-value from F-test is lower than 0.05, a statistically significant difference exists between the average of 5 variables: number of papers registered in SCOPUS, related to PIB, in thousands of dollars, from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017, with a confidence level of 95.0%.

Table 5. Number of papers registered in SCOPUS related to PIB, in thousands of dollars, from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017 [17]

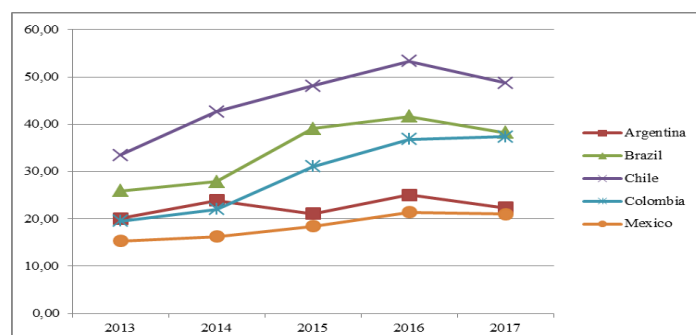| Country	2013	2014	2015	2016	2017
Argentina	20,04	23,86	21,06	25,06	22,30
Brazil	25,89	27,84	39,06	41,62	38,22
Chile	33,48	42,63	48,12	53,33	48,71
Colombia	19,50	22,05	31,03	36,81	37,39
Mexico	15,34	16,26	18,47	21,38	21,03

Fig.3. Number of papers registered in SCOPUS related to PIB, in thousands of dollars, from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017 [17]

Table 6. ANOVA of the number of papers registered in SCOPUS related to PIB, in thousands of dollars, from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017 [12] [13] [17].

Source	Squares Sum	FG	Square Mean	Ratio-F
Between	2,21E+03	4	5,53E+02	14,67
Within	7,54E+02	20	3,77E+01	
Total	2,97E+03	24		

Valor P = 0,0000

5. Publications in journals indexed in SCOPUS in international collaboration from Latin-American countries in group 1 of SIR Iber 2019 report

Table 7 and Fig. 4 presents papers percentage registered in SCOPUS, signed in collaboration with institutions of another country, from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017 [18]. In the considered five years period, Chile highlights in first place, followed by Colombia, then Argentina, Mexico in fourth place and, the last one, Brazil. The analysis of variance (ANOVA) [12] [13] is presented in Table 8. F-reason is equal to 150,503: quotient between the estimated between-groups and the estimated within-groups. Because the P-value from F-test is lower than 0.05, a statistically significant difference exists between the average of 5 variables: percentage of papers registered in SCOPUS, signed in collaboration with institutions of another country, from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017, with a confidence level of 95.0%.

Table 7. Percentage of papers registered in SCOPUS, signed in collaboration with institutions of another country, from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017 [18].

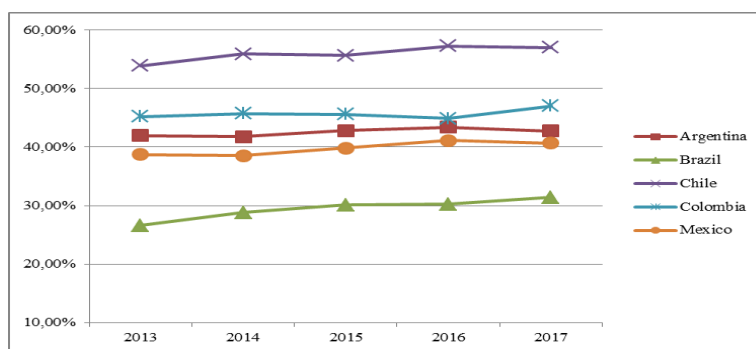| Country	2013	2014	2015	2016	2017
Argentina	41,99%	41,78%	42,81%	43,40%	42,77%
Brazil	26,61%	28,79%	30,09%	30,23%	31,38%
Chile	53,95%	55,95%	55,70%	57,32%	57,03%
Colombia	45,22%	45,77%	45,59%	44,91%	47,02%
Mexico	38,71%	38,57%	39,85%	41,12%	40,66%

Fig. 4. Percentage of papers registered in SCOPUS, signed in collaboration with institutions of another country, from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017 [18].

Tabla 8. ANOVA of the percentage of papers registered in SCOPUS, signed in collaboration with institutios of another country, from Latin-American countries of group 1 of SIR Iber 2019 report, in 2013-2017 [12] [13] [18] .

Source	Squares Sum	FG	Square Mean	Ratio-F
Between	1,96E+03	4	4,90E+02	150,5
Within	6,52E+01	20	3,26E+00	
Total	2,97E+03	24		

Valor P = 0,0000

6. Conclusions

The countries compete for the capacity of their IES has to produce and publish scientific papers. Latin-American countries of group 1 of SIR Iber 2019 analysis report, it is formed by Argentina, Brazil, Chile, Colombia and Mexico to achieve of publishing more than 50.000 papers in journals indexed in SCOPUS database in 2013 - 2017. By analyzing and compare the indicator related with the scientific production and publication, in other word, the output indicator (O) of the factor of measurement: investigation, from Latin-American countries of group 1 of SIR Iber 2019 Ranking, through ANOVA technique, related per habitant, to PIB and in international collaboration, in order to confront their performances in production and publication in journals indexed in SCOPUS, as results highlight:

- The countries are ordered in: Brazil, Mexico, Argentina, Chile and Colombia, in respect to the number of papers registered in SCOPUS, signed by authors of institutions for each Latin-American country in group 1 of SIR Iber 2019 report, in 2013-2017. A statistically significant difference exists between the averages of 5 variables.

- About the number of papers correspondents to authors from different countries, registered in SCOPUS, for each 100.000 citizen from Latin-American countries in 1of SIR Iber 2019 report, in 2013-2017, they are grouped in this order: Chile, Brazil, Argentina, Colombia and Mexico. A statistically significant difference exists between the averages of 5 variables.

- Likewise, by ordering the countries based in the number of paper registered in SCOPUS related with PIB, in thousands of dollars, from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017: Chile occupies the first place, followed by Brazil, Colombia in third place since 2015 and, in last places, Argentina and Mexico. A statistically significant difference exists between the averages of 5 variables.

- In relation to the percentage of papers registered in SCOPUS, signed in collaboration with institutions from others countries, from Latin-American countries in group 1 of SIR Iber 2019 report, in 2013-2017. In the considered five years period, Chile highlights in first place, followed by Colombia, then Argentina, Mexico in fourth place and, the last one, Brazil. A statistically significant difference exists between the averages of 5 variables.

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