Scientometrics (2015) 103:779–794
DOI 10.1007/s11192-015-1568-8

Somes patterns of Cuban scientific publication in Scopus: the current situation and challenges

Zaida Chinchilla-Rodríguez[1,3] · Ricardo Arencibia-Jorge[2,3] · Félix de Moya-Anegón[1,3] · Elena Corera-Álvarez[1,3]

Received: 24 March 2014 / Published online: 26 March 2015

Abstract Cuban scientific output is analyzed for the period 2003–2011, in Scopus database. Based on a set of bibliometric indicators, we try to shed light on the evolution of the volume of scientific output in Cuban and foreign journals, and its distribution and visibility by quartiles. Also analyzed is the citation per document received, broken down by language of publication and type of collaboration. The results reveal patterns and strategies of expansion in scientific communication that may be useful for academic and institutional decision-makers, suggesting means of amending editorial policy to improve scientific quality and international diffusion of output. It is hoped that these results will spur debate about research policies and actions to be taken to enhance the quality of research.

Keywords Cuba · Journals · Language of publication · Citation · Scientific collaboration · Scopus

✉ Zaida Chinchilla-Rodríguez
zaida.chinchilla@csic.es

Ricardo Arencibia-Jorge
ricardo.arencibia@cnic.edu.cu

Félix de Moya-Anegón
felix.demoya@csic.es

Elena Corera-Álvarez
elena.corera@csic.es

[1] Consejo Superior de Investigaciones Científicas, Instituto de Políticas y Bienes Públicos (CSIC-IPP), C/Albasanz, 26-28, Madrid 28037, Spain

[2] Departamento de Información Científica, Centro Nacional de Investigaciones Científicas, Avenida 25 y Calle 158, Cubanacán, Playa, AP 6414 La Habana, Cuba

[3] SCImago Research Group, Madrid, Spain

Mathematical subject classification 62-XX · 91-XX

JEL Classification Y1 Data · Tables and Charts

Introduction

The use of bibliographic databases to study the scientific behavior of regions, countries, institutions, research groups or researchers, is a cornerstone of the scientometric domain. The coverage analysis of these databases is probably one of the most widely debated points, because each database has their specific strength and limitations, and the scientific picture projected by each of them offers almost always different perspectives of the same phenomena (and sometimes, different patterns of the same country) (Zitt and Bassecoulard 2008).

Some authors have manifested a reluctance to use databases of international coverage for the analysis of peripheral geographic regions, because there is an important quantity of local or regional knowledge that is not recorded in these major databases (Herrero-Solana and Moya-Anegón 1999; Zitt et al. 2003; Falagas et al. 2008; Jacsó 2009; Chinchilla-Rodríguez et al. 2012). Moreover, the fact that English is the dominating language in these sources leads to a limited view of scientific output. In this context, the Cuban scientific production has been always a very attractive data source, especially since the pioneer work of Lancaster about citation patterns before and after 1959 (Lancaster et al. 1986).

On the one hand, the citation patterns of Cuban authors, the influence received from the former socialist countries of Eastern Europe, the non-correspondence between the scientific output in high visible journals and the strong policy of human capital development for Science and Technology activities, the correlation between this output and the national investments for Research and Development processes, the leading role of research areas and scientific institutions specialized in Biomedicine, and the lack of citations received by articles published in Spanish language, have been analyzed by most of research conducted during the last 30 years (Lancaster et al. 1986; Moral 1989; Meske and Fernández de Alaiza 1990; Guzmán-Sánchez et al. 1998; Torricella-Morales et al. 2000; Dorta-Contreras et al. 2008; Núñez-Jover and López-Cerezo 2008; Arencibia-Jorge et al. 2012; Chinchilla-Rodríguez et al. 2014a, 2015; Zacca-González et al. 2014).

On the other one, several studies have analyzed the contribution of Cuban scientific production through different databases. At the beginning of nineties, nine international bibliographic databases and three Cuban repertories were used to analyze Cuban scientific productivity during the period 1985–1989 (Sancho et al. 1993). During the XXI Century, Web of Science and Scopus have received the main attention by national and international researchers (Araujo-Ruíz et al. 2005; Arencibia-Jorge and Moya-Anegón 2010).

At present, with the commercial expansion of the main international databases, there are more and more peripheral journals, and Latin America is one region showing a great increase in Scopus and Web of Science (Moya-Anegón et al. 2007; Santa and Herrero-Solana 2010b). However, the presence of peripheral countries in the realms of international science seems to depend on particular subject areas (Spagnolo 1990), and/or the degree of linkage that the lines of research have with world science (Shrum 1997), rather than indicating a "regional behavior".

In the specific case of Cuba, the contribution of research published in national journals indexed by Scopus is a key factor to obtain high indexes of specialization in the category of Public Health (Arencibia-Jorge et al. 2012). The incorporation of 19 Cuban journals related

with this thematic has meant a decisive addition. This sustained presence of national journal contents in a database of extraordinary importance for the worldwide scientific community is a guarantee of international visibility for domestic scientific activity (Silva-AyÇaguer 2011). Nevertheless, the drop in impact and visibility of Cuban scientific output has been reported in several articles; on the nationwide and on the regional level, it signals a need to identify factors affecting visibility (Santa and Herrero-Solana 2010a; Zacca-González et al. 2014).

Objectives

This paper describes patterns of behavior related with Cubás scientific output registered in the Scopus database during the period 2003–2011. A set of bibliometric indicators allowed us to derive information about the evolution of scientific output in Cuban and foreign journals, in terms of volume, distribution and visibility, by quartiles. We also present an analysis of citations per document received, depending on the language of publication. These results will help bring to light patterns and strategies for the expansion of knowledge in the scientific community, and may serve as a point of reference for decision-makers in editorial circles and academic or institutional ones.

Materials and methods

The data sources used were *SCImago Journal & Country Rank* (SJR) and the *SCImago Institutions Rankings* (SIR), platforms developed by the SCImago Group based on the information contained in Scopus database (SCImago 2007; SIR 2013). This database, since its appearance in 2004, has increased its geographic and thematic coverage of journals to include peripheral regions and subject areas that were poorly covered by *Thomson Reuters* (Moya-Anegón et al. 2007), while also taking into account a greater variety of languages of publication (Arencibia-Jorge and Moya-Anegón 2010; Santa and Herrero-Solana 2010b).

Normalization

The elaboration of the set of indicators called for a thorough process of identification and disambiguation of institutions by means of the institutional affiliation of the documents indexed in Scopus. A mixed system was used—human and automatic—to group the different variants of institutional affiliation of an organism under a single identification. In this way, maximum precision of the indicators corresponding to each domain in ensured, standing as a guarantee of quality for political entities, researchers and research directors, media and the general public. In sum, anyone interested in analyzing, divulging or taking strategic decisions in view of the studies made (SCImago 2013).

Methods

The following indicators were used:

- Number of documentos (ndoc): Total number of documents per year;
- Type of collaboration, with the percentage of documents broken down by institutional or international collaboration: a) Not collaboration (NotC): documents in which a single national institution appears, regardless of how many authors participate, group or

department; b) National collaboration (NC): documents signed by more than one national institution; c) International and National collaboration (I&NC): documents in which more than one national and at least one foreign institution participants; d) International collaboration (IC) documents without national collaboration in which at least one foreign institution participates;

- Scientific leadership (%Lead): Percentage of output in which the main author ("corresponding author") belongs to the national institutions of the country (Moya-Anegón et al. 2013);
  - Citations per document (Cpd): Average number of citations received by the type of scientific output;
  - Cited Documents (%Cited Documents): percentage of documents receiving at least one citation;
  - Normalized Impact (NI): Relative number of citations received by each country, compared with the world mean for citations per document of the same type, year and category. It is calculated using the methodology "Item oriented field normalized citation score average" established by the Karolinska Intitutet of Sweden, by which citation values are normalized at the level of the individual article. The values (%) show the relationship between the mean scientific impact of a country and the worldwide average on the whole, with a score of 1. Therefore, an NI of 0.8 means that the country is cited 20 % less than the world average; a score of 1.3 means it is cited 30 % more than the world average. (Rehn and Kronman 2008);
  - Publications of High Quality (% Q1): Percentage of publications in journals included in the first quartile (25 %) according to their order in the SJR (González-Pereira et al. 2010; Guerrero-Bote and Moya-Anegón 2012);
  - Excellence with Leadership (% EwL): percentage of documents led by a country that are among the 10 % most cited documents (Bornmann et al. 2012)
- Number of journals indexed by Scopus

Results

Cuba came to publish a total of 15,053 documents in the period studied (Table 1), doubling its previous output, with an average annual growth rate of nearly 20 %. However this is a much lower percentage than the rate of growth of the main countries of the region (127.96 %). In the year 2003, Cuban science represented 2.5 % of Latin American output, and in 2011, this contribution amounted to 2.2 %. Practically 41 % of output involved international collaboration. Yet Cubás collaborative work declines at a faster rate than that of other Latin American countries with similar volumes of output (Chinchilla-Rodríguez et al. 2014a, b). This drop in foreign participation is offset by a considerable level of scientific leadership (75.9 %), the main strength behind Cubás advances in output. Another noteworthy finding is the percentage of documents published in the top journals. In the period of study, Cuba managed to publish an average of 22 % of its total output in the top journals; but as overall volume of publication increased, the number of documents in Q1 journals declined (Table 2).

This successful expansion strategy, fruitful in terms of overall production and specifically in terms of scientific leadership, does not translate as high visibility, however. In virtually all the indicators of impact, Cuba presents poor results. The citations received for Cuban output are just 1.45 % of total citation worldwide, while its production stands at

Table 1 Evolution by year of the main indicators of Cuban scientific activity, 2003–2011

Year	ndoc	GR	%ic	GR	% Lead	GR	% Q1	GR	Cites	GR
2003	1090		43.9		71.3		32.0		9748	
2004	1100	0.92	44.1	0.46	74.6	4.63	34.8	8.75	9167	−5.96
2005	1345	22.27	44.5	0.91	74.2	−0.54	30.9	−11.21	9133	−0.37
2006	1806	34.28	36.8	−17.30	79.1	6.60	21.9	−29.13	8965	−1.84
2007	1854	2.66	37.9	2.99	75.6	4.42	20.0	−8.68	7941	−11.42
2008	1779	−4.05	42.9	13.19	74.3	−1.72	22.4	12.00	6599	−16.90
2009	2034	14.33	38.9	−9.32	76.9	3.50	18.5	−17.41	5176	−21.56
2010	1879	−7.62	40	2.83	77.9	1.30	18.5	0.00	3978	−23.15
2011	2166	15.27	39.5	−1.25	77.1	−1.03	18.2	−1.62	2106	−47.06
Cuba	15,053	98.72	40.8	−10.02	75.9	8.13	22.3	−43.13	63,184	−78.40
LAC	2.34	127.96	32.85	−8.31	82.93	2.83	37.23	−29.14	1.45	−74.71
Year	cpd	GR	% Cited	GR	ni	GR	% Exc	GR	%EwL	GR
2003	8.94		72.8		0.51		3.67		1.84	
2004	8.33	−6.82	69.6	4.40	0.46	−9.80	5.11	39.24	3.01	63.59
2005	6.79	−18.49	60.6	−12.93	0.49	6.52	6.25	22.31	3.09	2.66
2006	4.96	−26.95	43.5	−28.22	0 4	−18.37	4.85	−22.40	2.14	−30.74
2007	4.28	−13.71	42	−3.45	0.39	−2.50	4.07	−16.08	1.48	−30.84
2008	3.71	−13.32	45.5	8.33	0.46	17.95	4.43	8.86	1.44	−2.70
2009	2.54	−31.54	41.3	−9.23	0.36	−21.74	3.53	−20.32	0.91	−36.81
2010	2.12	−16.54	36.8	−10.90	0.43	19.44	3.98	12.76	1.44	58.24
2011	0.97	−54.25	26.2	−28.80	0.45	4.65	3.55	−10.80	1.28	−11.11
Cuba	4.74	−89.15	41	−64.01	0.44	−11.76	4.1	−3.27	1.6	−30.43
LAC	5.84	−88.91	60.47	−46.10	0.78	−3.80	7	−15.82	4.06	−26.15

Source: SCImago Institutions Rankings

ndoc number of total documents, *%ic* percentage of international collaboration, *% lead* percentage of leadership, *%Q1* percentage of documents published in Q1 journals, *cites* number of cites received, *cpd* cites per document, *%cited* percentage of cited documents, *ni* normalized impact, *%exc* percentage of excellence, *%EwL* percentage of excellence with leadership, *GR* growth rate in period

2.34 %. Such a lack of balance between production and citation means that Cuba has little impact within the scientific community. Over time the rate of citation was seen to drop, and Cuba arrived at unexpectedly low visibility after the incorporation of its journals in the international databases (22 journals). Indeed, Cubás proportion of cited documents is the lowest registered for any Latin America country.

The indicator of normalized impact further refines our analysis, situating Cuba in the international context and eliminating bias linked with the size of each country (Rehn and Kronman 2008). In this framework, citation of Cuban scientific output is also far below the international average and moreover on the decline (from 56 to 65 % under the world mean over the period of study). A different story is told by the analysis of the highly cited documents. The percentage of excellence reflects work of high quality published within the set of 10 % of publications most highly cited in the world in their respective fields. In the Cuban domain the mean values for excellence (10 %) are not reached, and in fact it does not surpass 4.1 % of high quality, with a declining trend. Of this percentage of highly cited work, only 1.6 % is led by Cuban authors.

Table 2 Percentage of documents and cites per document by language of publication

Language	2003–2007			2007–2011		
	Output	cpd	Language	Output	cpd	GR-Output
English	56.18	10.52	English	52.65	4.36	−6.28
Spanish	43.36	0.62	Spanish	46.27	0.18	6.69
Portuguese	0.23	2	Portuguese	0.81	0.94	247.38
French	0.07	2.2	French	0.17	0.17	141.58
German	0.07	0.4	German	0.03	0.67	−59.74
Italian	0.03	4	Italian	0.03	1.33	0.66
Catalan	0.03	1.5	Catalan	0.03	1.67	0.66
Russian	0.01	3	Chinese	0.01	20	−32.89
Chinese	0.01	20	Polish	0.01	0	−32.89
Overlap	1.06			10.36		881.22

Scientific collaboration and visibility

The comprehensive analysis of the types of collaboration and their respective impact (Fig. 1) brings to light tendencies and their effects on the visibility of institutional associations, allowing us to identify more or less successful alliances and strategies. Outstanding among the sets of documents analyzed is that of documents signed by a single institution, the "without collaboration" category, which amount to nearly 50 % of Cubás output in the year 2011. Although the volume is similar to the percentage of publications in international collaboration, what deserves mention here is their low visibility. They are cited roughly 80 % less than the world mean, and as this type of output grows in volume, its citation descends. Another curious finding is that there is very scanty collaboration among Cuban institutions (national collaboration). The publications signed by more than one national institution go from just 15–10 % of output, and their impact follows suit. Early on they are cited 60 % less than the world mean, and eventually 80 % less.

However, when the documents are signed by more than one Cuban institution together with one or more foreign institutions (national and international collaboration), the situation changes and impact grows; these documents are cited just 20 % less than the world mean. Such is the situation of less than 5 % of the total documents published, however, and this trend in collaborative publication is not stable: there is a slight drop in output and a parallel descent in citation.

The fourth set of documents analyzed represents the international aperture of Cuban researchers and their relational capacity with other countries. This publication strategy is the most successful one, affording greater visibility, and citation is 10 % above the world average, while it amounts to over 40 % of Cuban output in the year 2003. In the last years, this group of documents represents 35 % of output, with citation 20 % above the world mean. Hence, this would be the most beneficial association for enhancing visibility.

Language of publication

From the year 2003 up to 2007, over 56 % of Cuban output was published in English, and 43 % in Spanish (Table 2), meaning other languages are negligible. However, the trend reverses after the year 2007, and Spanish output accelerates and overtakes English output.

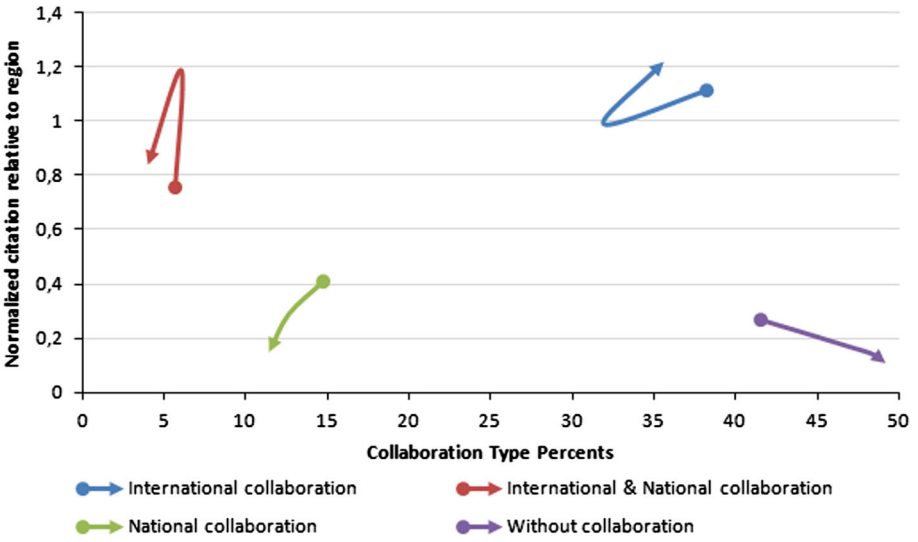

Fig. 1 Percentage and growth of output by type of collaboration and its impact

This is most likely due to greater publication in national journals and publication without collaboration. One end effect is that mean citation varies: documents published in English receive nearly 10 and 4 citations per document (cpd) more than the ones published in Spanish. In fact, the latter do not even receive one citation per document. Another noteworthy finding is the increase in publications in multilingual journals, with a figure rising from just over 1 % up to 10 %. This finding is positive, because the availability of more language options broadens the potential readership and band of reference, arriving at a larger audience in the scientific community. A similar trend is detected when Cuban output in Public Health is analyzed, and the pattern is widespread in Latin America (Zacca-González et al. 2014).

Publication and citation in national and foreign journals

Cuban output has gradually expanded in terms of the number of journals where published and also indexed in Scopus (column SP, Table 3), reaching a figure of 2759 journals altogether. The number of Cuban national journals indexed in Scopus (column CSP) has meanwhile gone from 8 in 2003, to 22 journals in the year 2011. This amounts to a 175 % increase in the number of Cuban journals with international visibility through the worlds largest scientific database.

One finding deserving mention is that this set of Cuban journals represents just 2.7 % in 2011 (column %CSP) of the total number in which Cuban researchers publish, and this small proportion accumulates a great share of Cuban research results: from 20 % in 2003 to over 40 % in 2011 (column ndoc-SP). Citations per document received in foreign publications (column cpd-SP) with respect to those received by Cuban journals (column cpd-CSP) reveals the scarce formal reference to national publications. For example, in the year 2003, 20 % of the output in Cuban journals obtained an average of 1.17 cites per document, and in that same year 80 % of output published in foreign journals harvested five times as many citations on average (column dif-cit).

Table 3 Evolution of output and citation in Cuban and foreign journals

Year	SP	CSP	% CSP	ndoc-SP	ndoc-CSP	cit-SP	% cit-CSP	cpd-SP	cpd-CSP	dif-cit
2003	473	8	1.69	1090	20.37	9743	2.66	6.36	1.17	5.19
2004	475	10	2.11	1100	25.27	9167	2.08	5.57	0.69	4. 88
2005	551	12	2. 18	1345	29.44	9133	2.05	4.92	0.47	4.45
2006	599	21	3.51	1306	45.29	8965	1.39	4.98	0.15	4. 83
2007	605	21	3.47	1353	45.87	7940	0.63	4.28	0.06	4.22
2008	710	20	2.82	1779	36.14	6599	0.70	3.46	0.07	3.39
2009	733	21	2.86	2033	40.88	5174	1.89	2.69	0.12	2.57
2010	679	21	3.09	1379	42.15	3978	1.84	1.55	0.09	1.46
2011	315	22	2.70	2165	40.46	2106	1.33	0.70	0.03	0.67
GR	72.30	175.00	59.60	98.62	98.66					

Source: SCImago Institutions Rankings

SP total source of publications, *CSP* Cuban source publications, *% CSP* percentage of CSP with respect to total SP, *ndoc-SP* total number of documents published by Cuba, *ndoc-CSP* number of documents published in CSP, *cit-SP* total cites received by Cuban scientific production in SP, *%cit-CSP* percentage of cites received by Cuban Source Publications, *dif-cit* average differences between cpd received in SP and average cpd published in CSP

Distribution by quartiles of the publishing journals

A look at the position of the publications grouped by quartile makes manifest the large concentration of journals in the fourth quartile of distribution, the one with the least citation and the least visibility and impact (Table 4). Indeed, 80 % of Cubás scientific output appears is the Q4 journals, and 4.8 % of the journals of this quartile are Cuban. In Q3, 2.76 % of the journals are Cuban and they publish 65 % of the output. As the impact of the journals rises, Cuban presence descends to the point where Q2 has only 10 Cuban journals and in Q1 there are none. Output also declines, although Cuban researchers manage to publish nearly 30 % in the Q1 journals and 45 % in Q2 journals.

When we analyze the evolution of production in light of the impact of the journal where published (Fig. 2; Table 5), we find that since 2006 the publications in Q4 journals have increased four-fold. In the year 2011, they account for nearly half of Cubás output. This increase entails a 75 % decline in the normalized impact, which means 93 % fewer citations than the world average. In the other three quartiles the percentage of production declines, yet the normalized impact of the journals rise.

The increase in Q4 documents is accompanied by a slight drop in the number of Q3 documents, and output goes from roughly 33–24 %. However, the Q3 set of publications undergoes considerable growth (59 %) in terms of normalized impact, despite being journals of limited citation (97 % below the world average). Within Q2 we find a steep increase in visibility, and although it does not reach the world mean in impact, it is much better situated than Q4 and Q3, which went from publishing 40 % of Cuban output to just 20 %.

Quite a different situation is found within the top quartile of journals (Q1, with the greatest citation in each subject areas and the greatest percentage of citations received). These journals, in 2011, received 62 % more citations than the world average. To date, Cuban documents are almost non-existent in this top quartile, but it has the most homogeneous distribution in terms of documents published in the period of study. In other

Table 4 Distribution of the percentage of journals and of documents in each quartile

	Q1		Q2		Q3		Q4	
	nj	ndoc	nj	ndoc	nj	ndoc	nj	ndoc
Cuba	0	1131	10	2114	12	3704	23	4618
Total	1259	3840	1234	4684	834	5669	483	5722
%	0.0	29.45	0.81	45.13	2.76	65.34	4.76	80.71

Source: SCImago Institutions Rankings

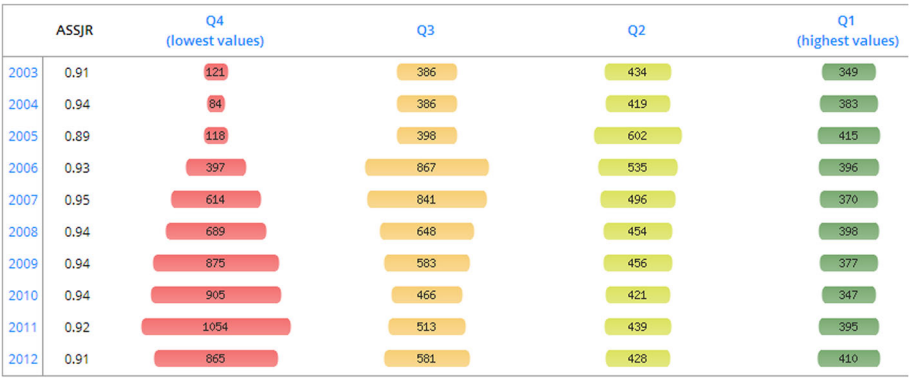

Fig. 2 Distribution of the output by quartiles of publishing journals

Table 5 Evolution of the percentage of Cuban output by quartile and normalized impact

Year	ASSJR	Q4 (lowest)		Q3		Q2		Q1(highest)	
		ndoc	NI	ndoc	NI	ndoc	NI	ndoc	NI
2003	0.91	11.10 %	0.29	35.41 %	0.17	39.82 %	0.38	32.02 %	1.09
2004	0.94	7.64 %	0.29	35.09 %	0.17	38.09 %	0.42	34 82 %	0.91
2005	0.89	8.77 %	0.35	29.59 %	0.17	44.76 %	0.42	30.86 %	1.08
2006	0.93	21.98 %	0.05	48.01 %	0.1	29.622 %	0.53	21.93 %	1.2
2007	0.95	33.12 %	0.04	45.36 %	0.11	26.75 %	0.54	19 96 %	1.24
2008	0.94	38.73 %	0.05	36 42 %	0.25	25.52 %	0.54	22.37 %	1.31
2009	0.94	43.02 %	0.08	28.66 %	0.19	22.42 %	0.49	18.53 %	1.19
2010	0.94	48.16 %	0.06	24.80 %	0.24	22.41 %	0.59	18.47 %	1.55
2011	0.92	48.66 %	0.07	23.68 %	0.27	20.27 %	0.6	18.24 %	1.62
GR	1.10	338.38	−75.86	−33.13	58.82	−49.10	57.89	−43.04	48.62

words, by increasing output in the other three quartiles, in relative terms, the proportion is lesser, and goes from publishing over 32 % of total output to just 18 %.

Country of origin of the journals where published

When we break down Cuban output according to the source country of the journal (Fig. 2), it becomes clear that Cuban researchers prefer Cuban journals—the corresponding mean citation is 0.16 cites per document. Taking second place is the United States, as 900 of its journals altogether publish 16 % of Cuban output, and 34 % of Cuban citation takes place.

On average, the documents published in these journals receive 7.83 cites apiece; that is, seven times more citation than through Cuban journals.

Other journals with high visibility are British and Dutch ones, respectively harvesting 9.6 and 8.16 citations per document. They are followed by journals from Spain, which contain 7.62 % of Cubás output but provide on average a mere 1.04 cites per document. In sum, Cuba puts out over 15 % of its scientific results by means of Ibero-American journals, these being characterized overall by a low citation level. Spanish and Brazilian journals show higher citation than the Ibero-American average (Fig. 3).

Geo-referenced citation

In turn, who do Cuban scientists tend to cite? And what is the source of citations received by Cuban researchers? It is helpful to explore the patterns of use or reference to this regard (Fig. 4).

Country	Source publications	Documents	Cites	Cites per document	Dif cpd	Benefit Rate
USA	900	16,23	34,51	7,83	7,67	48,94
GBR	688	11,07	28,86	9,6	9,44	60,00
NLD	401	8,63	19,12	8,16	8,00	51,00
DEU	184	4,87	5,31	4,01	3,85	25,06
ESP	175	7,61	2,14	1,04	0,88	6,50
BRA	80	1,43	0,70	1,8	1,64	11,25
MEX	59	2,21	0,44	0,73	0,57	4,56
CHE	46	0,70	1,31	6,92	6,76	43,25
ITA	40	0,59	0,85	5,29	5,13	33,06
CHL	34	0,70	0,11	0,59	0,43	3,69
FRA	34	0,45	0,40	3,31	3,15	20,69
VEN	30	0,92	0,14	0,58	0,42	3,63
IND	29	0,38	0,11	1,06	0,90	6,63
CAN	26	0,26	0,37	5,27	5,11	32,94
CUB	22	**37,93**	**1,68**	**0,16**	0,00	1,00
IRL	22	0,37	1,16	11,68	11,52	73,00
COL	21	0,73	0,13	0,68	0,52	4,25
AUS	17	0,10	0,08	2,78	2,62	17,38
SGP	17	0,26	0,12	1,64	1,48	10,25
ARG	16	1,50	0,35	0,86	0,70	5,38
JPN	16	0,12	0,10	2,9	2,74	18,13
AUT	15	0,31	0,60	7,21	7,05	45,06
POL	14	0,16	0,10	2,33	2,17	14,56
CHN	13	0,12	0,16	4,81	4,65	30,06

Fig. 3 Country of origin of the journals publishing Cuban scientific results, and citations per document 2003–2011. *Source*: SCImago Institutions Rankings

	2003		2007		2011		GR	
Country	Citations from	References to	Citations from	References to	Citations from	References to	Citations from	References to
USA	19,52	26,23	15,78	24,24	22,01	22,60	12,76	-13,84
CUB	23,05	11,82	21,14	9,73	20,02	7,40	-13,15	-37,39
GBR	5,50	6,69	8,16	7,54	9,25	7,01	68,18	4,78
DEU	6,15	5,80	5,71	5,74	11,10	5,38	80,49	-7,24
ESP	11,69	5,40	12,30	5,65	11,29	6,06	-3,42	12,22
FRA	4,85	4,76	4,21	4,17	7,26	4,47	49,69	-6,09
JPN	2,81	4,06	3,11	3,47	3,89	2,81	38,43	-30,79
ITA	5,95	3,99	5,75	4,10	7,45	3,78	25,21	-5,26
CAN	3,41	3,45	3,43	3,22	3,37	3,38	-1,17	-2,03
BRA	6,71	2,18	8,82	2,63	8,44	2,71	25,78	24,31
MEX	4,46	1,96	5,50	1,73	5,27	1,87	18,16	-4,59
NLD	1,55	1,94	1,97	1,86	3,27	2,20	110,97	13,40
AUS	1,69	1,83	2,60	2,01	2,85	2,06	68,64	12,57
CHE	1,26	1,56	2,13	1,94	5,41	1,90	329,37	21,79
SWE	1,12	1,44	0,97	1,54	1,90	1,52	69,64	5,56
IND	4,41	1,19	4,59	1,33	6,26	1,87	41,95	57,14
BEL	1,85	1,00	2,48	1,62	3,04	1,65	64,32	65,00
FIN	0,77	0,97	0,48	0,76	2,56	0,61	232,47	-37,11
ISR	0,61	0,81	0,48	0,86	1,04	0,79	70,49	-2,47
CHN	7,04	0,74	10,44	1,43	11,67	2,34	65,77	216,22

Fig. 4 Geographic source of the citations received and the references made in Cuban output

Over the years, Cubás scientific output makes reference to journals from a growing number of countries. The greater geographic dispersion marks access to a greater amount of information for the Cuban community. The opposite trend is detected for citation. That is, it comes from fewer countries, citations are increasingly concentrated in a small group of countries where Cuban output is more visible and more frequently consulted. In the year 2011, three-fourths of the citations came from the United States, Cuba, China, Spain and Germany. On the rise is citation from emerging countries such as China and India, but also from Brazil and Mexico.

In the year 2003, the country most often citing Cuba was Cuba. Practically 23 % of its citation can be traced to Cuban researchers. The figure corresponding to the United States is less than 20 %. These two countries thus account for 42 % of citation overall, although over the period of study the proportion descended for Cuba and rose for the United States. Another set of countries often citing Cuban production would be Spain, China, Brazil and Germany, representing 32 % of citation, whereas the group Italy, France, Mexico and India accounts for just over 25 %. In the year 2007, citation from China, Brazil, Great Britain and Spain was on the rise. In more recent years, the German, Brazilian and Chinese journals increased citation of Cuban output; meanwhile, incipient citation is seen for the cases of Swiss, Finnish, Dutch and Austrian journals.

Finally, who do Cuban researchers cite? Mainly works published in US journals, followed by Cuban journals. Over the period of study, reference to Chinese, Belgian, Indian and Brazilian journals is seen to increase. This upward trend is accompanied by a slightly downward trend concerning the US journals, which nonetheless still harvest 22 % of citation by Cuban scientists. Reference to Cuban research is also on the decline, despite the increased output by Cuba. All in all, Cuban research is cited less, implying a reduced level of self-citation; this gives way to the gradual incorporation of emerging countries and European countries in the visibility of Cuban research studies.

Discussion and conclusions

Cuban scientific output is on the rise, its international presence and scientific leadership coming to light mainly in domestic journals, in the Spanish language, and featuring a low rate of international collaboration. Notwithstanding, this increase in production translates as a lesser percentage of documents published in the top journals (Q1), a low proportion of articles of excellence, and an even lesser one of articles of excellence led by Cuban researchers. Altogether, these findings situate Cuba in a state of citation far from the world average; hence, low visibility and impact at the international level.

The question now is: Why is an increasing volume of scientific leadership not accompanied by rising performance indicators? Why is this work not cited, or ignored, at the international level? Does it not contribute to knowledge as much as the non-leadership output? In other words, could we qualify the Cuban system of scientific production and diffusion as a hermetic one?

Cubás growing leadership is seen to take place within individual institutions. Not only is there little collaboration with foreign institutions; there is likewise little collaboration among Cuban institutions. In fact, the association of Cubans with other Cubans is even lower than that of Cubans with foreigners. Still, data testify that any collaboration is better than none at all, and that benefits in relational terms and in impact depend on the type of collaboration (Leimu and Koricheva 2005). That is, although collaboration among Cuban institutions is more beneficial than a lack of collaboration, international collaboration is even more significant (Goldfinch et al. 2003; Sooryamoorthy 2009). Works undersigned by authors of other countries are cited more frequently because the participating community is greater, and this amplifies the possibilities of research attracting an audience (Schmoch and Schubert 2008; Lancho-Barrantes et al. 2012; Guerrero-Bote et al. 2013). Such findings encourage profound debate about the strategies of collaboration of Cuban researchers. There is a dire need to promote collaboration among Cuban institutions themselves, because a lack of institutional integration at the domestic level is evident when we look at citation. Previous studies also point to virtually no integration of national science, an apparent lack of consideration of contributions made by national colleagues, or a widespread disinterest in the subject matter, and all these factors are behind the lack of citation among Cubans (Dorta-Contreras 2008).

The results demonstrate different citation habits with respect to English-language publications. While much is published in the Spanish language, it is systematically cited less, and the language of output appears to be determinant for the users of international bases. If articles are not read due to an language barrier, it follows that no matter how much international visibility a paper may have (being indexed in international databases), in the end readership will still be reduced to the Spanish-speaking community. Clearly, English publication reaches a more numerous audience, and therefore means greater divulgation and use of that information. This is not an isolated case, characteristic of Latin American countries, but one described in further contexts (Van Leeuwen et al. 2001; Chinchilla-Rodríguez et al. 2014a, 2015). In general, foreign journals that publish work by Cuban researchers do so in English, and this work is more visible than that published in other languages. One factor distinguishing the behavior of researchers publishing in national versus international journals is the number of authors. There are studies demonstrating that the number of authors increases when output is in foreign journals, but this is very exceptional in Cuban journals. Such a pattern can be explained by the fact that the authors who publish in national journals are not the same individuals who publish in journals of

high impact, and collaboration involving multiple institutions is more frequent in the work later published in foreign journals (Araujo-Ruíz et al. 2005).

The recent incorporation of Cuban journals in Scopus underlines the international recognition of research carried out in Cuba, above all in biomedical research, which is responsible for most of the Cuban journals indexed in Scopus. However, this recent incorporation of more journals has made the impact drop, a phenomenon observed in other countries as well (Gómez et al. 1995; Zitt et al. 1998, 2003; Luna-Morales and Collazo-Reyes 2007; Miguel 2011). One explanation would be that this national production implies a series of patterns of publication and collaboration that do not adapt to international standards. Most journals show a tendency toward endogamic practices in their editorial committees, with a marked difference in favor of publishing articles by authors of the same country, meaning a high level of self-citation and in the national language (Santa and Herrero-Solana 2010a, b; Rodríguez-Yunta and Giménez-Toledo 2013; Collazo-Reyes et al. 2008; Collazo-Reyes 2014; Molina-Molina and Moya-Anegón 2013). It is not enough to index journals if the international scientific community does not read them or participate in them, or if they do not comply with the international standards for scientific edition. There should be a homologation of the formal aspects and an internationalization of researchers and knowledge, augmenting the scientific capacities of a country rather than summing up local journals.

This is a window of opportunity. It is not a matter of publishing in domestic journals, because in any case they will have more visibility and a greater probability of receiving citations from a broader audience. Instead, we should search for a strategy that does not discourage inclusions in international databases (Chinchilla-Rodríguez et al. 2014a, 2015). The strategy, accordingly, could be to focus on sustained growth in the levels of output, increasing the quality of publication in national journals in terms of form and content, emphasizing rigor in the arbitrating processes, improving the quality of the published contents, fomenting a culture of scientific edition that can rise above barriers impeding maximum visibility; and these patterns should be extrapolated to the rest of the Cuban journals still not appearing in international databases (Dorta-Contreras 2007, 2008; Arencibia-Jorge et al. 2012).

Cuban authors hardly cite other Cuban authors in their scientific articles, a finding reported in previous studies. Dorta Contreras asks if they are not cited because their observations do not support their hypotheses, or because there exists a generalized lack of knowledge of Cuban ecumenic contributions (Dorta-Contreras 2008). To the contrary, one significant detail is that the citation from emerging countries is on the rise, as is citation of the main countries of Europe. This positive finding signals a heightened interest in Cubás research with international visibility. A more detailed analysis of the areas concentrating the attention of the international community would reveal data of great relevance for the establishment or reinforcement of cognitive and institutional capacities.

The low index of collaboration, the high proportion of output in the Spanish language, and the increase of Cuban journals only partly explain the phenomenon. An entirely separate consideration would be the quality of contents. In the case of Cuba, there is output of excellence, and a greater accent on the production of excellence with leadership, which represents the knowledge more directly applied to progress and more highly appreciated by the scientific community, justly attributable to Cuban science (Moya-Anegón et al. 2013; Jeremić et al. 2013). In Cuba, although these capacities are low, and in an unstable period of transition, they do indeed exist. No doubt the international embargo undergone for decades has something to do with the scientific isolation reflected by data. Cuban researchers may find it difficult to leave the country, to attend international congresses and

similar events, which hinders the establishment of international ties. If collaboration is fomented on the national and international level, the possibilities of expansion and of internationalization of research underway in Cuba will increase. Such a strategy would have major implications for the capacities of scientific leadership, above all in the areas where the country is already strongly specialized and could demonstrate impact, attaining greater visibility and broader availability of Cuban scientific research contributions.

Acknowledgments This work was made possible through the Short-Term Visiting Fellows Program of the CSIC Instituto de Políticas y Bienes Públicos (IPP) Madrid, Spain.

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