CONTRIBUCIONES CORTAS

Scientific bridges between Cuba and the United States

Puentes científicos entre Cuba y los Estados Unidos

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ABSTRACT

Political differences between the governments of Cuba and United States after 1959 have left a deep trace in multiple generations of both countries, including scientists. In fact, lack of scientific bridges between Cuba and the United States is a statement widely assimilated by public opinion. The U.S. government embargo affected all the spheres of Cuban life, and Science was not an exception. However, scientific interactions never have been in a dead point. The main aim of this brief communication is to reveal the characteristics of these scientific relations, and to confirm the increase of links between the two scientific communities from a bibliometric perspective. Scopus was used as data source. SCImago Institutions Rankings, a Scopus-based tool, was used to analyze leadership and collaboration patterns. Both countries exhibited similarities in association strategies for Research & Development activities, and revealed relative independence from international links. However, the United States was the fourth scientific partner of Cuban institutions, and international collaboration between Cuban and American scientists increased during the entire study period. Well-established research networks were identified. Enhancement of research alliances in the new political context should be expected.

Key words: international collaboration; bibliometric indicators; scientific relations; Cuba; United States of America; leadership.

RESUMEN

Diferencias políticas entre los gobiernos de Cuba y los Estados Unidos después de 1959 han dejado un rastro profundo en múltiples generaciones en ambos países, incluyendo a los científicos. De hecho, la carencia de puentes científicos entre Cuba y los Estados Unidos es una declaración ampliamente asimilada por la opinión pública. El embargo, del gobierno de los EE.UU. afectó todas las esferas de la vida cubana, y la ciencia no fue una excepción. Aun así, las interacciones científicas nunca han sido un punto muerto. El objetivo principal de esta comunicación breve es revelar las características de estas relaciones científicas, y confirmar el aumento de enlaces entre ambas comunidades científicas desde una perspectiva bibliométrica. Scopus fue utilizado como fuente de datos. SCImago Institutions Rankings, una herramienta basada en Scopus, fue utilizada para analizar el liderazgo y los patrones de colaboración. Ambos países exhibieron semejanzas en estrategias de asociación para actividades de investigación y desarrollo, y revelaron una independencia relativa de enlaces internacionales. Sin embargo, Estados Unidos fue el cuarto socio científico de las instituciones cubanas, y la colaboración internacional entre científicos cubanos y americanos aumentó durante todo el período estudiado. Se identificaron redes de investigación bien establecidas. Es de esperar que en el nuevo contexto político se fortalezcan las alianzas investigativas.

Palabras clave: colaboración internacional; indicadores bibliométricos; relaciones científicas; Cuba; Estados Unidos de América; liderazgo.

INTRODUCTION

Lack of scientific bridges between Cuba and the United States is a statement widely assimilated by public opinion. Even in relevant scholarly journals, the treatment of this topic has been scarce, and the idea of Cuban science as a rare miracle behind the wall is always present. Neurosciences,[1] biotechnology,[2,3] and public health strategies,[4] have been some of the selected topics explored in a context systematically ignored. However, the perspectives dramatically changed since the historical announcement of new relations between these countries. Cuban advances in cancer vaccines and the extraordinary battle against Ebola in Africa put Cuban physicians and scientists in the eye of the Media,[5,6] and some authors have been analyzing opportunities or evidences of links between scientists from both countries in multiple research areas.[7,8]

Could the visit of former President Barack Obama be the start of a welcoming and intensive scientific partnering? Is this relationship starting from a dead point? Could the newly elected President Donald Trump stop the advances reached during the last 2 years? The main aim of this brief communication is to reveal the characteristics of scientific relations between Cuba and the United States using leadership and collaboration patterns, and to confirm the existing and increasing links between both scientific communities from a bibliometric approach.[9,10]

METHODS

Scopus, developed by Elsevier, was used as information source. SCImago Institutions Rankings (SIR), a Scopus-based tool developed by the SCImago Research Group (Spain),[11] was used to retrieve data on the international collaboration between Cuba and United States during the period 2003-2013. Characterization of papers published in association by scientists from Cuban and American institutions was performed through a set of bibliometric indicators included in the SIR Methodology:

- *Output (Ndoc):* Total number of documents published in scholarly journals indexed in Scopus.

-*Citations (Ncit):* Total number of citations received by all documents published in scholarly journals indexed in Scopus.

- Average of citations per article (Ncit/Ndoc).

- *International Collaboration (% Int Coll):* Institution's output ratio produced in collaboration with foreign institutions. The values are computed by analyzing an institution's output whose affiliations include more than one country address.[12]

- *Leadership (% Lead):* Leadership rate that indicates the percentage of an institution's output as main contributor, that is, the number of papers in which the corresponding author belongs to the institution.[13]

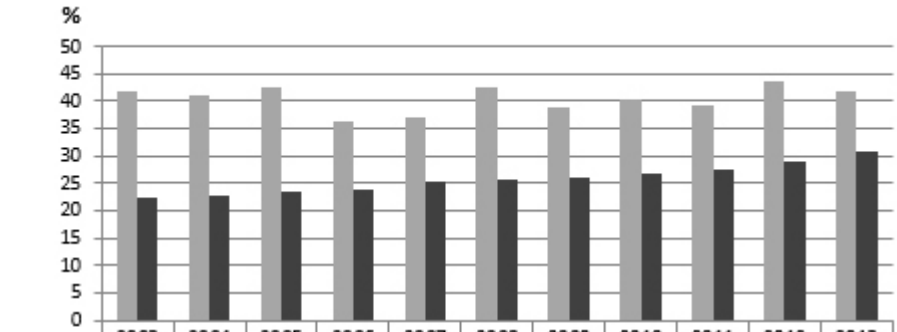
Author addresses and Scopus subject categories were the database fields analyzed.

RESULTS AND DISCUSSION

COLLABORATION PATTERNS OF BOTH COUNTRIES

If we analyze the association strategies in terms of Science and Technology, and taking into account the scientific output covered by Scopus, Cuba and the United States show similar patterns. Both countries have a low percentage of international collaboration (Fig. 1). The range of Cuban international cooperation oscillates above 40 % during the period 2003-2013, and that of the United States grew from 22.5 % in 2003 to 30.8 % in 2013. This could be due to their strong national science systems, which are characterized by relative independence from international links.

Nevertheless, behind the causes of this behavior are different motives. The United States is the world leader in Science and Technology. Thousands of American scientific institutions have worldwide prestige, with solid R&D budgets, highly qualified human resources and strong links with national enterprises. On the other hand, Cuba was an isolated country during the last four decades of the Twentieth Century, and especially since the collapse of the Soviet Union in 1989. International funds for scientific activities underwent an abrupt decline, and the national policy for Science and Technology was almost absolutely financed by the government, with a small and limited slice covered by international projects.

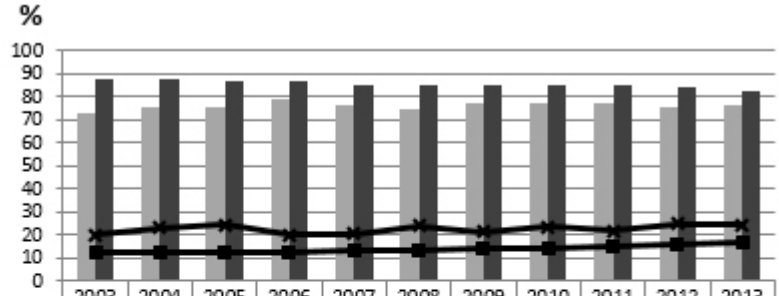


	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
IC Cuba	41,75	41,15	42,67	36,46	37,09	42,64	38,98	40,47	39,35	43,6	41,83
IC USA	22,5	22,92	23,41	23,91	25,33	25,63	26,18	26,64	27,54	29,13	30,75

Source: SciMago Research Group, based on Scopus data.

Fig. 1. International collaboration of Cuba and the United States. Scopus, 2003-2013.

Another similarity that puts in evidence their self-governing scientific policies is revealed by leadership indicators (Fig. 2). Cuban authors were leaders in more than 70 % of the articles published by Cuban institutions, which is close to the leadership behavior in the United States (more than 80 %). Furthermore, a low range of leadership in international collaboration was observed (Cuba < 25 %; USA < 20 %). Without any doubt, these similar patterns between two totally different nations are remarkable. In the Cuban case, relative independence from foreign collaboration to develop research activities is strengthened by using external links for gaining visibility. Nonetheless, leadership in more than twenty percent of articles in a developing country could be assumed as a very important success.



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Lead Cuba	72,66	75,79	75,35	79,17	76,55	74,88	77,09	77,56	77,55	75,18	76,48
Lead USA	87,95	87,61	87,09	86,4	85,04	85,11	85,3	85,11	84,68	83,71	82,73
Lead Cuba (IC)	20,19	23,13	24,19	19,94	20,7	24,12	21,29	23,58	21,91	24,97	24,23
Lead USA (IC)	12,36	12,41	12,51	12,48	12,98	13,34	13,84	14,1	14,65	15,53	16,53

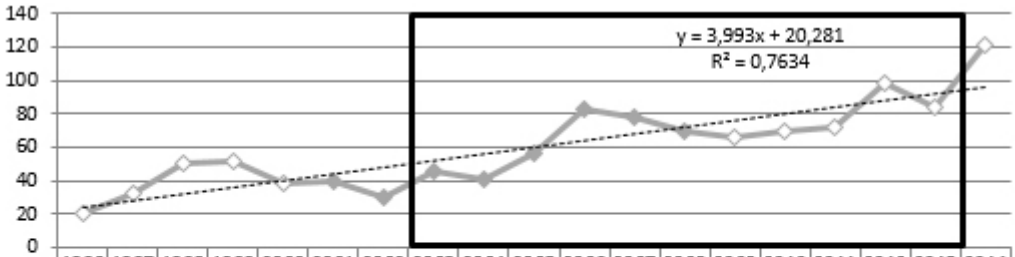
Source: SciMago Research Group, based on Scopus data.

Fig. 2. Scientific output with leadership and leaded international collaboration of Cuba and the United States. Scopus, 2003-2013.

CUBA-USA SCIENTIFIC RELATIONS

Smaller or null relations between two countries involved in one of the most relevant and long-standing political battles of the last 60 years could be expected; especially, if one of them stimulates political changes in the other using an economic embargo.

Unexpectedly, this is not the behavior observed in the scientific literature. Despite a slight drop during the first government period of President George W. Bush, scientific collaboration between researchers from Cuba and the United States has shown a linear growth trend since the signing of the Helms-Burton Act in 1996 by former president Bill Clinton (Fig. 3). Even during the period of the Republican Party government (grey dots), scientific output increased, which is a hopeful trend taking into account the recent election of Donald Trump as the 45th President of the United States. In addition, normalization of diplomatic relations was announced to the world in 2004, the year with the highest number of articles published by authors from both countries during the study period.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Cuba-USA IC	20	32	50	51	38	40	30	45	41	56	83	78	69	66	70	72	98	84	121

Source: SIR, based on Scopus data.

Fig. 3. International collaboration between Cuba and United States. Scopus, 1996-2014.

The United States was the fourth scientific partner of Cuban institutions during the period 2003-2013, producing 762 articles and receiving more than 20 citations per article in Scopus database (table 1). Despite a clear Latin American orientation in Cuban international collaboration, 17 countries match in the rank of 25 main scientific partners of both countries. In general, the impact of the United States output is higher, which is determined by different factors: language of publication, visibility of journals, and topics dealt with in papers. This is visible in the collaboration links. Nevertheless, there are some exceptions, such as Cuba's collaboration with Japan, China, India, Russia, Sweden or Switzerland, which has a similar or even greater impact than collaboration between the United States and these countries.

Output was published in 475 serials covered by 201 Scopus subject categories. Although Biomedicine and Physics involved the highest number of papers (table 2), research topic diversity was more than evident. Participation in ALICE (A Large Ion Collider Experiment) at CERN (European Organization for Nuclear Research) and relevant multinational clinical trials are among the most relevant research concerning authors from both countries.[14-18] But common topics of interest involved marine biodiversity, climate changes, natural disasters, tourism, cultural heritage, and even politics.[19] Researchers from more than 200 American institutions and more than 80 Cuban scientific centers (table 3) were identified in scientific articles, which is a sign of well-established research networks.

Table 1. Close partners in the international collaboration of Cuba and the United States (Scopus, 2003-2013)

International collaboration (Cuba)				International collaboration (EE.UU.)			
Country	Ndoc	Ncit	CitxNdoc	Country	Ndoc	Ncit	CitxNdoc
ESP	2511	25205	10,04	GBR	198115	5703070	28,79
MEX	1613	13592	8,43	DEU	180147	4984279	27,67
BRA	1258	12189	9,69	CAN	173692	4405651	25,36
USA	*762*	*16170*	*21,22*	CHN	169697	2419725	14,26
DEU	652	10551	16,18	FRA	116735	3288552	28,17
ITA	614	11432	18,62	JPN	109269	2686625	24,59
GBR	561	12218	21,78	ITA	99976	2642729	26,43
FRA	471	8941	18,98	AUS	79839	2113489	26,47
BEL	467	4407	9,44	KOR	76171	1294419	16,99
ARG	334	6310	18,89	ESP	67264	1718811	25,55
COL	312	3078	9,87	NLD	66420	2073176	31,21
CAN	309	4946	16,01	CHE	61625	1902606	30,87
VEN	247	2528	10,23	IND	43922	642010	14,62
CHL	240	2066	8,61	SWE	42626	1397489	32,78
JPN	212	5416	25,55	BRA	42173	806966	19,13
CHN	209	5880	28,13	ISR	41393	980976	23,7
NLD	203	4696	23,13	TWN	37661	603614	16,03
CHE	200	6093	30,47	RUS	34674	660143	19,04
PRT	199	2046	10,28	BEL	33265	1059215	31,84
PER	173	5100	29,48	DNK	26294	840025	31,95
IND	151	5936	39,31	MEX	24785	442265	17,84
RUS	146	4141	28,36	AUT	23403	667783	28,53
SWE	129	4136	32,06	POL	23103	549216	23,77
NOR	126	4020	31,9	SGP	21634	437086	20,2
AUT	121	2254	18,63	TUR	20920	313474	14,98

Source: SIR, based on Scopus data.

Table 2. Main subject categories that involve institutional collaboration between Cuba and the United States (Scopus, 2003-2013)

	Scopus Subject Category (n= 201)	Ndoc	Ncit	NcitxNdoc
1	Medicine	72	2739	38,04
2	Ecology, Evolution, Behavior and Systematics	67	850	12,69
3	Physics and Astronomy	45	1473	32,73
4	Public Health, Environmental and Occupational Health	44	833	18,93
5	Nuclear and High Energy Physics	40	1023	25,58
6	Animal Science and Zoology	36	134	3,72
7	Infectious Diseases	35	1156	33,03
8	Plant Science	33	404	12,24
9	Neurology (clinical)	32	854	26,69
10	Pediatrics, Perinatology and Child Health	30	121	4,03
11	Epidemiology	27	1218	45,11
12	Condensed Matter Physics	26	141	5,42
13	Genetics	24	617	25,71
14	Molecular Biology	22	678	30,82
15	Agricultural and Biological Sciences	21	340	16,19
16	Surgery	20	165	8,25
17	Biochemistry	20	827	41,35
18	Neurology	19	351	18,47
19	Oncology	18	937	52,06
20	Electronic, Optical and Magnetic Materials	18	124	6,89

Source: SIR, based on Scopus data.

CONCLUSIONS

Political differences between the governments of Cuba and the United States of America after 1959 have left a deep trace not only in the life of multiple generations in both countries, but also in world history. The U.S. government embargo affected all the spheres of Cuban life, and Science was not an exception. However, scientific interactions never have been in a dead point, which was clearly demonstrated in this brief study. Away from the Media and despite all the embargo's restrictions, scientists from both countries have been working together in multiple research fields. Both scientific communities, separated by only 90 miles, had developed a bridge a long time before the 17 of December of 2015.

The historical visit of former President Barack Obama to Havana in March of 2016 opened a new age of government relationships and scientific collaboration. Nevertheless, there are deep roots that make this process sustainable. Even under the government of the newly elected President Donald Trump, enhancement of research alliances in a new political context should be expected.

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Conflict of interests

The authors declare that conflict of interests doesn't exist in this article.

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