Trends of the scientific output in five Latin American countries: a bibliometric approach

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Introduction

Policy-makers in five Latin American countries are set to benefit from a recent study into the research output of their scientific communities (Arencibia *et al.*, 2011). The study, a collaboration between the Cuban Ministry of Higher Education (MES), the National Center for Scientific Research (CNIC) and the International Network for the Availability of Scientific Publications (INASP), sets out research trends in Cuba, Ecuador, Bolivia, Nicaragua and Honduras between 1996 and 2008 – a period of rapid growth in research output across the region. Findings will not only help decision-makers in these countries identify where their strengths lie, but will also show where policy may help fill research gaps.

The study answered six key questions:

- How have research publication patterns changed over the last ten years in the selected countries?
- What is the number of research publications produced per country per year?
- What are the top research institutions in each country, as ranked by publication output?
- What is the breakdown of research publications by subject area?
- How has this research been cited by others in their research publications?
- What are the changing patterns of international research collaboration, as indicated by multi-author publications with different country affiliation per author?

Why Latin America?

Latin America is of particular interest, not only because the five countries in the study partake in initiatives by INASP and other organisations that promote the importance of research, but because the region experienced unusually high rates of scientific research growth during the study period. During this time, scientific production increased internationally by 67.8 per cent. For Latin America, the figure was 190.5 per cent.

Furthermore, scientific production increased year on year during the study period, and almost 70 per cent of its published articles were cited at least one time. Three times more articles were published in Latin America in 2008 than in 1996, and in 2006, 2007 and 2008 it published more than 3 per cent of the world's scientific production.

A bibliometric approach

To get a more detailed understanding of developments, the study contrasted research activity and visibility in the studied countries with those of a control group of eight countries at a similar level of development in Latin America

(Guatemala and El Salvador), Asia (Bangladesh and Vietnam) and Africa (Ghana, Kenya, Rwanda and Tanzania). This enabled findings to be compared to trends not only at a regional level but also internationally.

Research took a bibliometric focus, concentrating on articles from high visibility journals taken from Scopus, the main Elsevier database for bibliometric research purposes, the scientometric tool SCImago Journal & Country Rank and the SCImago Institutions Rankings, the most recent tool created by the SCImago Research Group. Articles were assessed using:

• quantitative indicators measuring a country's entire scientific publication (including total publication output and growth rate); and

• qualitative indicators to gauge the impact of research (including average number of citations by document and H-index).

Key findings by country

Cuba: Cuban scientific production has a clear biomedical orientation. The most active and visible areas of research are pharmacology, toxicology and pharmacy, immunology and microbiology, agriculture and biological sciences, chemistry and biochemistry, genetics and molecular biology. The University of Havana is the most productive institution of the country, and the core of most productive authors shows high levels of visibility. A high proportion of the scientific production is published in Cuban less-cited journals, which is probably the cause of the low impact of the country in a high number of subject areas. Spain, Mexico and Brazil, are Cuba's main scientific partners.

Ecuador: Medicine and agriculture and biological sciences are the two main subject areas in Ecuadorian scientific production. The greatest output is in agriculture and biological sciences, environmental sciences, earth and planetary science, immunology and microbiology, and physics and astronomy. The University of San Francisco de Quito, and the Catholic University of Ecuador are the most productive institutions of the country. There is no strong core of Ecuadorian productive authors, which is the result of a high level of international collaboration where the leader authors are from international institutions. Although the Revista Ecuatoriana de Neurologia is the journal leader in the scientific production of Ecuador, a big proportion of papers is published in other well known journals. The United States of America, the United Kingdom and France are Ecuador's main scientific partners.

Bolivia: Bolivian scientific production is mainly concentrated on agriculture and biological sciences, although environmental sciences, immunology and microbiology, earth and planetary science, veterinary and social sciences are also highly productive and visible. The Major University of San Andres and the Major University of San Simon are the two most productive Bolivian institutions. The most productive authors mainly belong to these two institutions. Well known American and British journals publish a large number of Bolivian papers. The United States of America, France, Belgium and the United Kingdom are Bolivia's main scientific partners.

Nicaragua: Medicine is the most productive subject area for Nicaragua. The best performances are mainly achieved in environmental sciences, immunology and microbiology, agriculture and biological sciences, earth and planetary science, social science and medicine. The National Autonomous University of Nicaragua (León) is the most prolific institution. The majority of the most prolific authors specialize in medical sciences. Nicaraguan papers are essentially published in journals edited by the United States of America and

the United Kingdom. The United States of America, Sweden and Costa Rica are Nicaragua's most important scientific partners.

Honduras: In Honduras, agriculture and biological sciences is the most productive, active and visible research area. Other high performers include immunology and microbiology, economy, econometrics and finance, environmental sciences, neuroscience, medicine and veterinary science. The National Autonomous University of Honduras is the leader institution. The most prolific authors are headed by the Honduran neuroscientist Marco T. Medina, with an important research on epilepsy. Honduran papers are basically published in journals edited by the United States of America. However, the Spanish journal Revista de Neurología is at the top of this ranking. The United States of America is clearly the main scientific partner, followed by Mexico and Costa Rica.

Table 1. Output, international collaboration and impact of the scientific activity developed by the five countries studied (SJCR 1996-2008).

Countries	Research Output	International collaboration	H-index
Cuba	15153	58.03 %	66
Ecuador	2422	70.00 %	55
Bolivia	1584	85.61 %	43
Nicaragua	529	87.63 %	28
Honduras	394	85.20 %	28

Implications

The detailed findings of the study provide invaluable data for decision-makers within the five countries featured in the study. It is hoped that these findings will contribute to broader research into the changes in scientific output in developing countries to:

- provide data to inform future policy-making;
- create firmer links between trends in scientific output and policy decisions; and
- gauge the impact of specific policy decisions on scientific output.

However, the study also has implications for organisations across the globe, such as INASP, that are devising strategies for supporting the growth and dissemination of research in developing countries in that it demonstrates the value of bibliometric indicators in research evaluation policies.

Possible next steps include widening this research to incorporate all African partner countries or working with the Latin American countries featured here to extend the analysis conducted so far.

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