Inter-American Development Bank

Social Sector
Science and Technology Division

TECHNICAL NOTES

No. IDB-TN-129

The Productivity of Science:

An international analysis using peer-reviewed publication data

Ellen Smith

December 2009

The Productivity of Science:

An international analysis using peer-reviewed publication data

Ellen Smith

Inter-American Development Bank

(1) Introduction

(1.1) There is an increasing interest both in developed and some developing countries in the importance of scientific research in providing the foundations both for innovation and for productivity growth. However, much of the available literature concentrates on examining the effects of public funding of basic research on the innovative activities of firms, bypassing the whole question of how to measure scientific output. The main reasons for this lie in the difficulty of identifying a stable causal relationship between the resources spent on the science budget and 'intermediate' scientific output. These difficulties originate from the dynamic nature of the relationship, where there is permanent feedback between input-output; they are also exacerbated by the lack of information suitable for analysis.

(1.2) The scientific process produces several research outputs that can be classified into three very broadly defined categories (Crespi and Geuna, 2008): (1) new knowledge; (2) highly qualified human resources; and (3) new technologies. This report focuses on the determinants of the first type of research output: new knowledge. There are no direct measures of this type of research output, but several proxies have been typically used. The two most important ones that we will apply during the study are (a) publications and (b) citations. The source of these two variables is the Reuters-Thomson ISI(R) National Science Indicators (2008) database on published papers and citations.

(2) Objectives

(2.1) This study aims to give an overview of the global trends in the quantity and quality of scientific production in the last 27 years, with a special focus on Latin America and the Caribbean (LAC). The research will compare the LAC region's performance with global trends of scientific productivity. The research also produces indicators of Revealed Scientific Specialization (RSS), indicating scientific fields of advantage for the region and some selected countries. Analysis on changes in the national patterns of specialization is also included. The report identifies global dynamic and emerging areas, then looks at whether LAC countries are specializing in these areas or in areas of decreasing global importance. Finally, the report closes with a more focused analysis of the case of Costa Rica.

(3) Methodology

(3.1) Scientific productivity trends are measured using peer-reviewed publications, which are categorized into 22 major fields. This report makes extensive use of the National Science Indicators (NSI) database that contains data on the authors' country of residence, as well as on the number of times each paper is cited by other published articles. The data set is provided by Thompson Reuters, and provides annual data between 1981 and 2008.

(3.2) The first two indicators used in this analysis are Scientific Productivity and Impact. Productivity is a measure of the number of published papers per inhabitant, and Impact is the average number of citations per paper. So, while Productivity is a measure of the volume of scientific productions, Impact is an indicator of the quality of what is being published. Productivity was calculated on an annual basis (ending in 2007 because of an irregularity in the last-year data) but, because of the volatility in annual measurements of Impact (due to the well-known problem of citations right censorship – see below), this second indicator was measured on a five-year basis (beginning with 1981-1985, and ending with 2004-2008). All data were classified by region and by topical field. Finally, both indicators were standardized into relative terms by expressing the regional values as percentages of the OECD indicators, which were treated as the maximum value, or the "gold standard."

(3.3) The Relative Scientific Specialization, or RSS, is a measure of the degree of specialization of a country in a particular field. It is calculated by dividing the percent of all papers in a field from Country X by the same proportion calculated at the world level. Thus a RSS between 0 and 1 indicates that a country is relatively unspecialized in that field, while any RSS above 1 represents a relative specialization in that field; the higher the RSS above 1, the greater the degree of specialization in that field. For the purposes of this report, the RSS was calculated for the first and last five-year periods of the data set, across all fields, for a selection of Latin American countries, as well as for two global leaders (USA and Germany) and two emerging economies (South Korea and China). The RSS is defined as follows, with T representing Time (the year analyzed), F representing the Field, and C representing the Country.

$$RSS_T = \frac{Papers_{CFT}}{\sum Papers_{CT}} \Bigg/ \frac{Papers_{FT}}{\sum Papers_T}$$

(3.4) In order to identify dynamic fields we look at the variations in the share of all published papers from a specific field (S), calculated for the first and last five-year time periods for each field. The change in S from 1981-1985 to 2004-2008 was then taken as a proxy for the field's trend in global importance; those with a change in S below 0 appear to be shrinking in global importance, while those with a change in S above 0 appear to be increasing in global importance. Changes in national RSS values were then compared to changes in S values to analyze if a country's changes in specialization were in tandem with global trends, or moving in an opposite direction from the global trend.

(3.5) The NSI dataset currently covers information from over 9,000 international and regional journals and book series in every area of the natural sciences, social sciences, and arts and humanities. This figure represents a core set of scientific journals that account for an important share of the total number of publications and citations in the world. This core set is dynamic in the extent that over time some journals are added to it, while those journals that become less cited are removed. Indeed, journal evaluation and selection is an ongoing process, with journals added to and deleted from the database as frequently as every two weeks. Each year, Thomson Reuter reviews over 2,000 journal titles, and selects around 10-12% of the journals evaluated for inclusion in the Thomson Reuters database. Many factors are taken into account when evaluating journals for coverage, ranging from the qualitative to the quantitative. The journal's basic publishing standards, its editorial content, the international diversity of its authorship, and its citation data are all considered. No one factor is considered in isolation, but by analyzing the interactions between all criteria, the editor is able to determine the journal's overall strengths and weaknesses. The Thomson Reuters editors that perform the journal evaluations have educational backgrounds relevant to their areas of responsibility, as well as experience and education in information science.

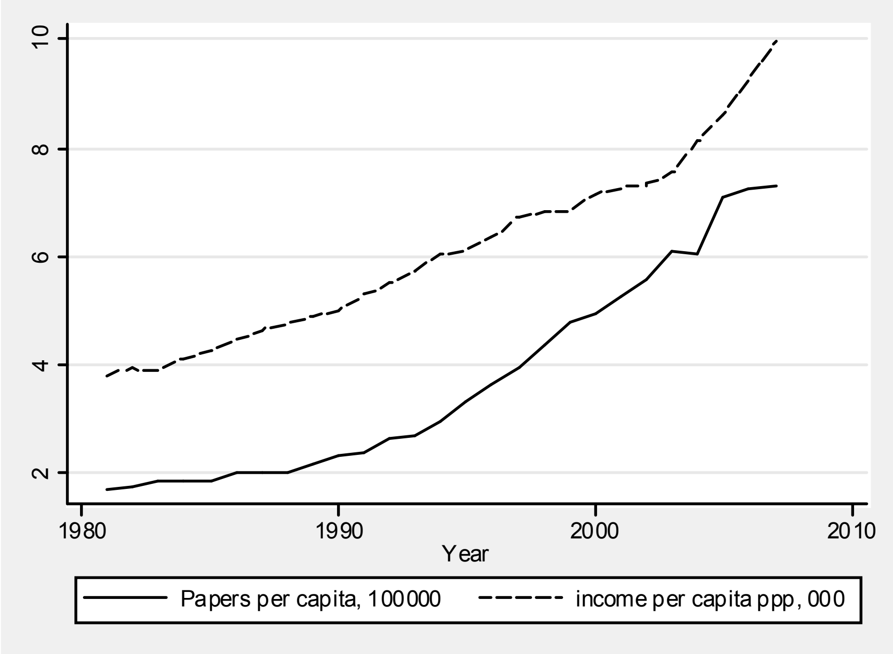
(3.6) Though the NSI dataset is one of the most comprehensive available on peer-reviewed publications from a wide range of topical fields, and the most widely used such database, it also has limitations as an unbiased measure of scientific innovation. First, the NSI data are strongly affected by the disciplinary propensity to publish in international journals, so they are a poor measure of the output from such disciplines as history or law, where the tendency is to publish in national journals or books. Second, NSI includes an almost constant number of journals/pages in its archive (journals enter and leave, but the number remains more or less constant at around 9,000; the number of journal issues per year may increase, but this applies only to a minority of journals). This clearly limits the possibility of output expansion and therefore biases any trend in of decreasing returns. Third, the NSI journal list is strongly biased towards journals published in English, which would affect the research production of those countries where English is not the native language. Therefore, because not all the publications of a given country will be included in the dataset, a problem of right censorship is introduced in the data; a consequence would be that productivity gaps between developed and developing countries might be overstated. Finally, the data is affected by the well-known problem of truncation in citations, as more recent publications have less time left to be cited. We control for this problem by measuring impact factors (citations per publication) on a five-year basis (beginning with 1981-1985, and ending with 2004-2008).

(4.) Results

(4.1) Scientific Productivity

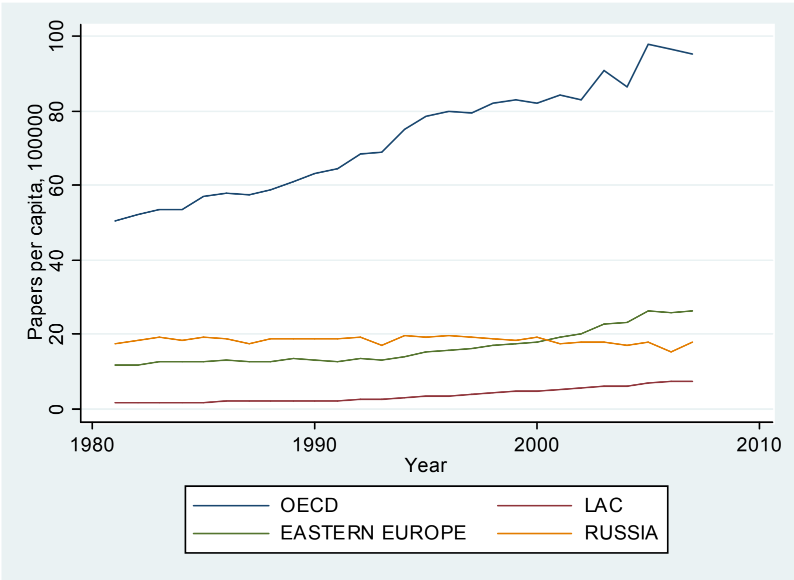
(4.1) As seen in Graph 1, on a global level LAC Scientific Productivity has increased more or less in tandem with economic growth. This is not surprising given the diffusion of the knowledge economy paradigm, regional increases in wealth, and advances in female education over this time period. However, more detailed analyses on regional and national levels, as well as analyses of indicators disaggregated by topical field, reveal great heterogeneity in the progress of scientific production. Is this a LAC specific pattern only?

Graph 1: LAC trends in per capita GDP and Scientific Productivity

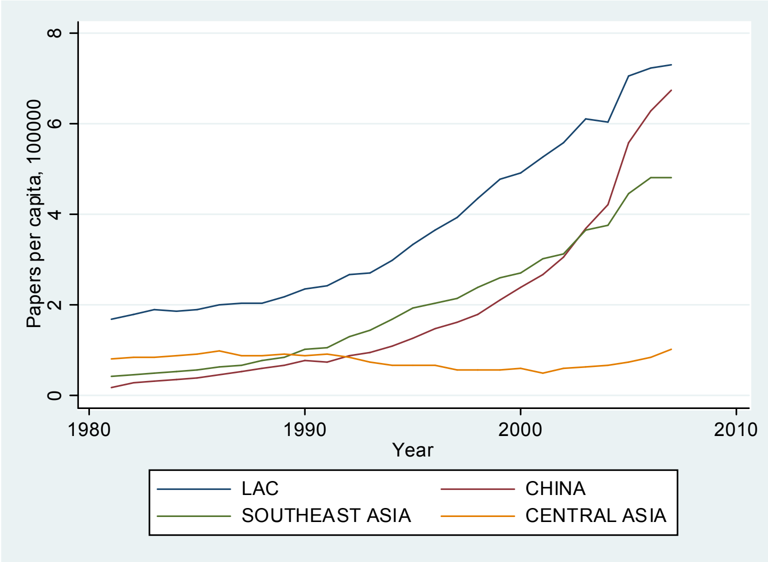


(4.2) As illustrated in graphs 2-4, Scientific Productivity over the 1981-2008 time period has increased in many regions, although Russia, Central Asia, and Sub-Saharan Africa show near stagnation. Comprised of the wealthiest and most educated countries, the OECD group unsurprisingly displays both the highest levels and the greatest absolute gain in Productivity (Graph 2). While LAC lags behind the developed world (the OECD, Eastern Europe, and Russia) in terms of its level of Productivity, it has been the leader in Productivity over the past 25 years amongst the remaining regions comprised of developing countries, though China stands poised to overcome it.

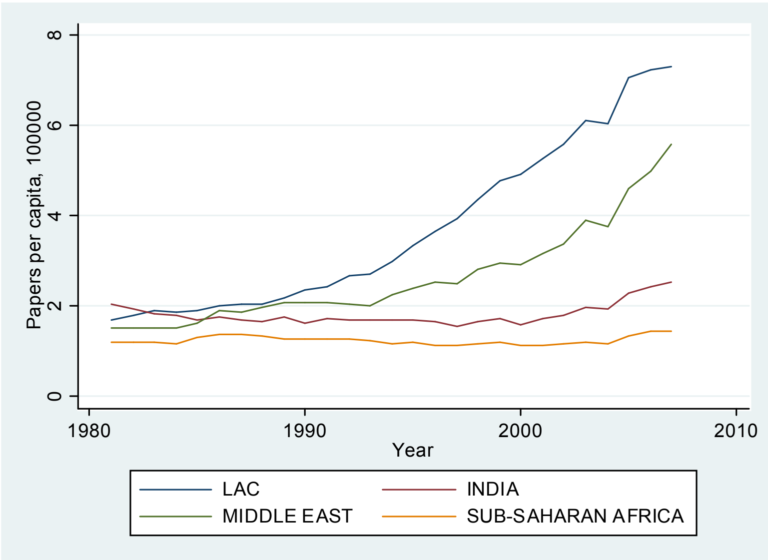
Graph 2: Scientific Productivity trends for OECD, Eastern Europe, LAC, and Russia



Graph 3: Scientific Productivity trends for LAC, Southeast Asia, China, and Central Asia



Graph 4: Scientific Productivity for LAC, Middle East, India, and Sub-Saharan Africa



(4.3) Table 1 shows the Relative Scientific Productivity with regards to the OCED. A positive change in the last column implies that the region is converging toward OECD levels. LAC has more than doubled its Relative Productivity between 1981 and 2007, trailing only the extraordinary growth of China and SE Asia. Other regions display either a smaller or negative increases in Relative Productivity over these 26 years.

Table 1: Relative Productivity (as a percentage of OECD productivity)

	1981	2007	annual growth rate
LAC	3.36	7.67	3.17%
China	0.35	7.10	11.58%
India	4.02	2.66	-1.59%
Southeast Asia	0.85	5.05	6.85%
Eastern Europe	23.36	27.81	0.67%
Central Asia	1.57	1.08	-1.44%

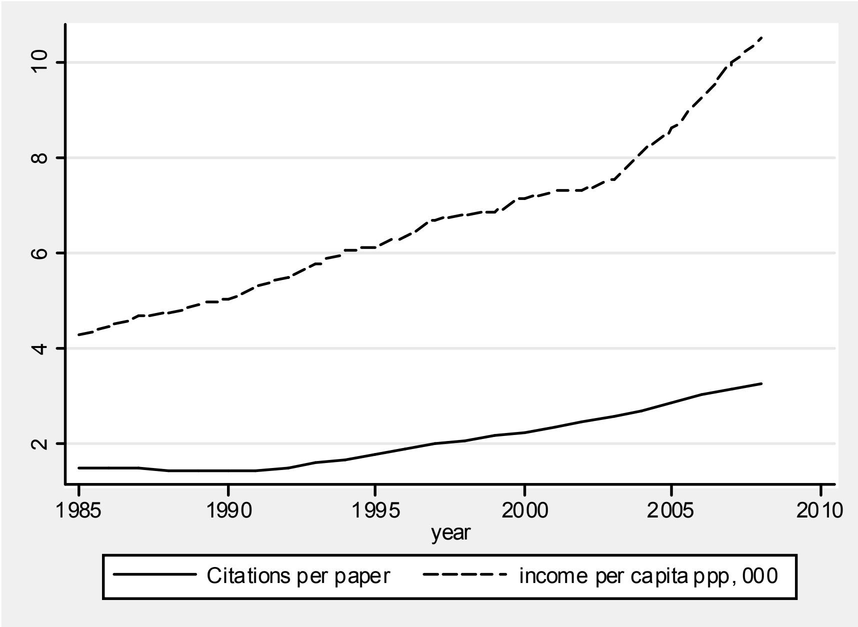
Russia	35.12	18.91	-2.38%
Middle East	2.99	5.88	2.60%
Sub-Saharan Africa	2.38	1.53	-1.70%
Other	7.52	4.99	-1.58%

(4.4) When looking at Relative Productivity by field, LAC showed the greatest increases in the fields of Materials Science, Environment/Ecology, Plant & Animal Science, Immunology, Engineering, and the smallest (or negative) increases in Relative Productivity in the fields of Multidisciplinary, Economics & Business, Molecular Biology & Genetics, Clinical Medicine, and Psychiatry/Psychology. See Annex 2 for Relative Productivity by field, for all regions, for the first and last years of the database. Annex 4 provides a ranking of the percent increases in Relative Productivity for each field, highlighting both the dominance of Asia's increased scientific proliferation, as well as the large variation between fields.

(4.2) Impact Analysis

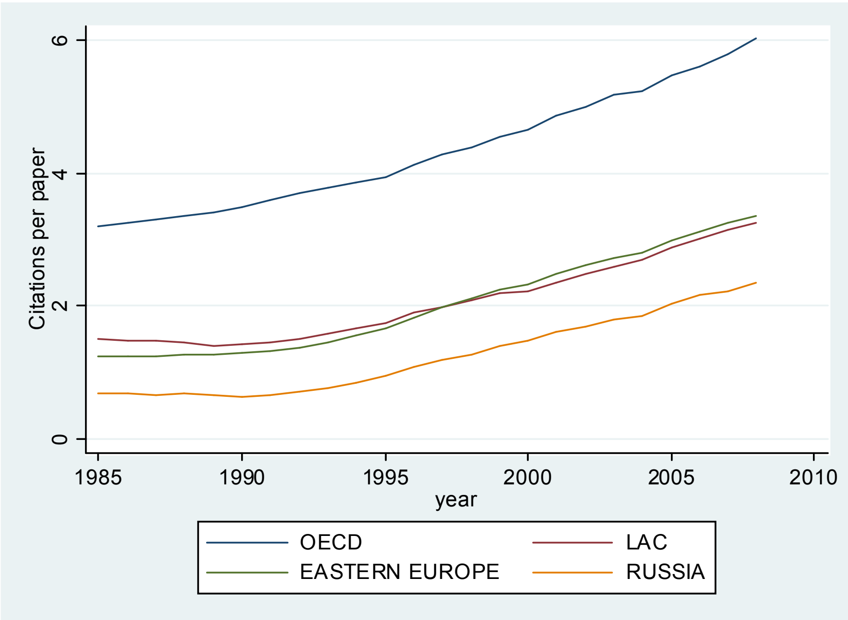
(4.5) Impact (number of citations per published paper) serves as a proxy for the quality of the papers published. This indicator goes beyond expressing the shear volume of publications by expressing a proxy of quality of publications, or how useful the information contained in published articles is to the scientific community at large. For example, a country may have a small *quantity* of scientific papers published, leading to a low Scientific Productivity indicator, yet if these few papers are cited in many other published papers, it may have a high Impact score, indicating a high level of *quality* and innovation its work. As we can see in Graph 5, LAC Impact has been increasing in recent years at a slower pace than economic growth. The fact that Impact growth is being outpaced by economic growth is worrying because we are living in an age of increasing interconnectedness of scientific fields across geographic and other boundaries. Flow of information has been greatly facilitated in recent decades by the proliferation of new communications technologies that allow for increased ease of access to electronic publications and collaborations. In fact, as we can see below, the Impact performance of LAC has been outpaced by other regions of the world as well.

Graph 5: Global trends in per capita GDP and Impact

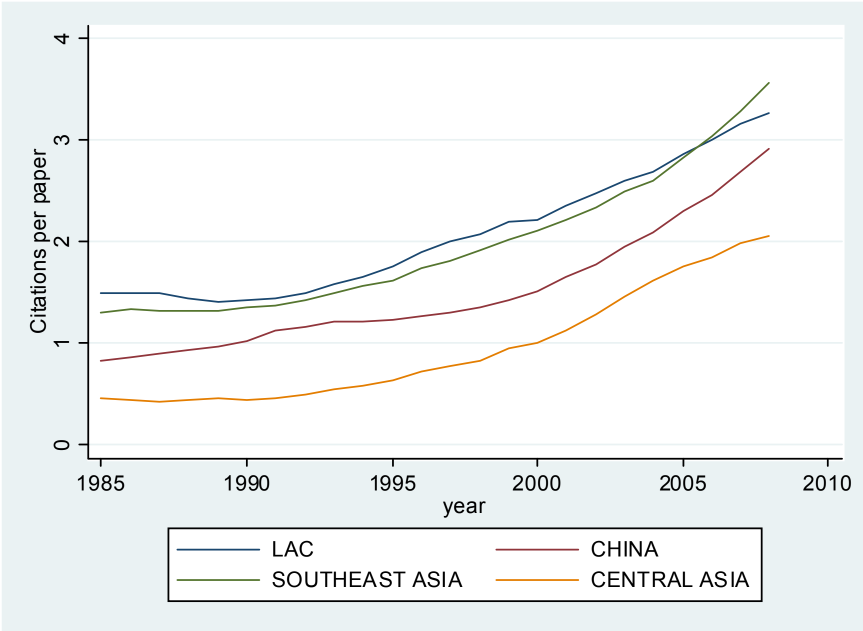


(4.6) Graphs 6-8 reveal a universal increase in Impact across all regions. However, as with Productivity, the Impact indicator is also led by the OECD region. The Impact level and trend of LAC, Eastern Europe, and SSA are nearly identical, while Russia, China, Central Asia, India, and the Middle East show similar upward trends at lower levels.

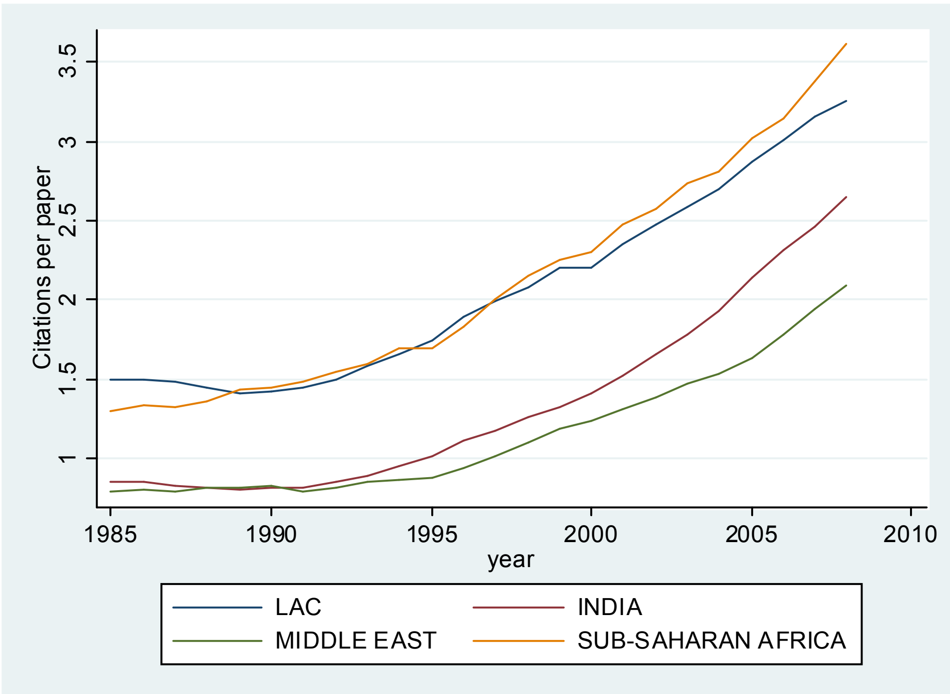
Graph 6: Impact trends for OECD, Eastern Europe, LAC, and Russia



Graph 7: Impact trends for LAC, Southeast Asia, China, and Central Asia



Graph 8: Impact trends for LAC, Middle East, India, Sub-Saharan Africa



(4.7) LAC has had a small, but positive, increase in its Relative Impact (Table 2). However, unlike Relative Productivity, it is has shown the smallest growth in Relative Impact of all the regions. This implies a decrease in the influence of papers published by Latin American authors in comparison with papers from other regions.

(4.8) LAC showed the greatest increases in Relative Impact in the fields of Multidisciplinary, Psychiatry/Psychology, Microbiology, Molecular Biology & Genetics, and Agricultural Sciences and the smallest (or negative) increases in Relative Impact in the fields of Computer Science, Materials Science, Neuroscience & Behavior, Environment/Ecology, and Plant & Animal Science. See Annex 3 for Relative Impact by field, for all regions, for the first and last years of the database. Annex 5 provides a ranking of the percent increases in Relative Impact for each field, revealing the large variation of regional changes between fields.

Table 2: Relative Impact (as a percentage of OECD Impact)

	1981-1985	**2004-2008**	**Annual Growth Rate**
LAC	46.83	54.11	0.56%
China	25.58	48.41	2.45%
India	26.58	44.03	1.94%
Southeast Asia	40.74	59.03	1.43%
Eastern Europe	38.61	55.77	1.41%
Central Asia	14.01	34.00	3.41%
Russia	21.78	39.27	2.27%
Middle East	24.70	34.73	1.31%
Sub-Saharan Africa	40.66	59.95	1.49%
Other	36.89	62.20	2.01%

(4.3) Revealed Scientific Specialization (RSS)

(4.9) As noted in the Methodology section, the RSS provides an indicator of the degree of scientific specialization of a country in a particular year. The RSS is calculated for a selection of Latin American countries, as well as two global leaders and two emerging economies for the period 2004-2008 (see Annex 6 for the period 1981-1984). The table 3 also contains the global coefficient of variations (CVs) for each field and the CVs for each country, across all fields. A CV is defined as:

$$CV = \sigma / \mu$$

where σ is the standard deviation and μ is the average. Thus the CV provides a normalized measure of the spread of a set of numbers; in other words, it expresses how spread out the values are relative to the value of the numbers. A higher CV represents a country or field with greater variation, while a lower CV represents a country or field with less variation.

Table 3: Revealed Scientific Specialization (RSS) and CV, selected countries, 2004-2008

	LAC											Leaders		Emerging		
	Argentina	Brazil	Chile	Colombia	Costa Rica	Honduras	Jamaica	Mexico	Peru	Trinidad	Uruguay	USA	Germany	China	South Korea	Global CV
Agricultural Sciences	2.55	2.69	1.85	1.95	2.84	3.21	2.28	2.27	2.43	4.27	2.74	0.72	0.74	0.60	1.04	0.97
Biology & Biochemistry	1.50	1.03	1.05	0.88	3.00	0.12	0.61	0.88	0.49	0.68	1.75	1.12	0.98	0.69	0.97	0.62
Chemistry	1.02	0.90	0.86	0.89	0.20	0.06	0.67	0.89	0.22	0.41	0.97	0.64	1.04	2.09	1.15	0.88
Clinical Medicine	0.63	0.90	0.77	0.92	0.70	1.54	2.46	0.54	1.52	1.21	0.74	1.19	1.11	0.35	0.70	0.58
Computer Science	0.37	0.68	0.91	0.43	0.10	0.24	0.22	0.70	0.25	0.29	0.56	0.92	0.97	1.31	2.28	1.04
Economics & Business	0.44	0.25	1.11	0.84	0.97	0.94	0.88	0.51	0.56	1.43	0.65	1.50	0.75	0.38	0.58	1.22
Engineering	0.59	0.73	0.71	1.19	0.17	0.27	0.25	0.93	0.28	1.15	0.36	0.85	0.74	1.34	1.65	0.83
Environment/Ecology	1.57	1.24	1.90	1.30	3.90	2.23	0.79	1.79	2.42	2.11	1.25	1.02	0.75	0.77	0.52	0.79
Geosciences	1.59	0.61	1.29	0.66	1.27	0.44	1.73	1.10	2.29	1.60	1.00	0.94	1.06	0.95	0.39	1.04
Immunology	1.06	1.00	0.44	1.75	1.23	2.12	1.20	0.90	2.89	0.75	0.77	1.32	0.96	0.38	0.52	1.62
Materials Science	0.67	0.76	0.46	0.65	0.19	0.00	0.09	1.04	0.52	0.35	0.26	0.54	0.94	2.57	2.26	1.29
Mathematics	0.86	0.84	1.72	0.80	0.30	0.00	0.76	1.14	0.23	0.27	1.17	0.87	0.92	1.47	0.80	1.27
Microbiology	1.76	1.40	0.73	1.34	1.15	0.81	0.46	1.38	2.13	0.49	2.43	1.06	1.09	0.54	1.40	0.95
Molecular Biology & Genetics	0.89	0.82	0.71	0.54	0.89	0.47	0.44	0.53	0.33	0.33	1.10	1.37	1.16	0.50	0.64	0.74
Multidisciplinary	0.71	0.98	0.38	0.38	0.68	0.00	0.30	0.57	1.00	1.28	0.48	1.08	0.77	1.91	0.35	1.87
Neuroscience & Behavior	0.78	1.17	0.62	0.37	0.34	3.02	0.17	0.83	0.42	0.52	1.36	1.33	1.21	0.36	0.56	1.04
Pharmacology & Toxicology	1.03	1.44	0.62	0.47	1.82	0.00	0.52	0.99	0.95	0.81	1.16	1.00	0.87	0.90	1.63	0.81
Physics	1.06	1.01	0.68	1.25	0.21	0.13	0.05	1.23	0.38	0.15	0.74	0.69	1.24	1.51	1.38	1.03
Plant & Animal Science	2.39	2.20	1.61	2.09	4.17	2.75	1.27	2.27	2.63	2.05	2.88	0.90	0.85	0.63	0.54	0.77
Psychiatry/Psychology	0.26	0.44	0.48	0.88	0.63	1.21	0.40	0.64	0.68	1.10	0.26	1.74	1.00	0.17	0.20	1.08
Social Sciences, general	0.39	0.81	0.84	1.10	0.84	4.07	1.83	0.79	1.33	2.72	0.43	1.80	0.51	0.23	0.32	0.96
Space Science	1.38	0.71	6.48	0.18	0.10	0.00	0.00	1.74	0.58	0.72	0.60	1.05	1.35	0.48	0.36	3.32
National CV	0.58	0.53	1.06	0.54	1.05	1.18	0.91	0.48	0.82	0.87	0.70	0.31	0.21	0.72	0.66	

(4.10) The CVs are highest in the fields requiring large initial research capabilities, such as Space Sciences and Materials Science, reflecting the fact that smaller countries often have little to no specialization in these areas. The larger, more established economies, such as Argentina and Brazil have relatively low CVs, highlighting a more consistent level of expertise across various fields, while smaller economies, such as Honduras, have a larger CV because of the heterogeneity of their specialization level in different fields. The established global leaders (USA and Germany) have the lowest CV because of their wide-ranging expertise, while the CVs of the emerging economies of China and South Korea decreased over this 23-year time period, signaling their ability to create scientific capabilities across many different fields. In both time periods, the Latin American countries were most highly specialized in Agriculture, Plant & Animal Science, and Environment/Ecology, and least specialized in Computer Science, Material Science, and Engineering. In what follows we present a more detailed analysis for some of the countries.

(4.11) Table 4 presents rankings of national scientific specializations, as measured by the RSS, for two LAC countries, two world leaders, and two emerging economies for the 2004-2008 period. These rankings and their accompanying CVs provide insight into both national specialization profiles and the spread of specialization across fields within each country. Brazil is most specialized in the natural science fields, which can be expected given Brazil's large and unique natural resource ecosystem. On the other hand, Brazil is least specialized in the more abstract fields of Economics & Business, Psychiatry/Psychology, Geosciences, and Computer Science. Brazil has a fairly low CV of 0.53, indicating a relatively small spread in its level of specialization across the fields. Chile shows a significant mix of disciplines in both its strongest and weakest fields of specialization; this profile as a country with a wide range of specializations across the disciplines is further reflected in its high CV of 1.06. Germany's specializations lie in the hard sciences, while its least specialized fields are social and agricultural sciences. Germany has the lowest CV, expressing its more consistent level of specialization across all 22 fields. The USA is most specialized in fields pertaining to human behavior, and least specialized in the natural sciences. It has a slightly higher CV than Germany due to its higher degree of specialization in its strongest fields. Both China and South Korea exhibit the strongest specializations in natural science fields, and the least specialization in human behavior fields. They also display CVs between those of the LAC countries and those of the world leaders. In other words in terms of scientific specializations, China and South Korea have managed to build strengths in a larger number of scientific disciplines than LAC.

Table 4: Specialization (RSS) Rankings, select countries, 2004-2008

		Brazil	Chile	Germany	USA	China	S. Korea
Most Specialized	1	Agricultural Sciences (2.69)	Space Science (6.48)	Space Science (1.35)	Social Sciences (1.80)	Materials Science (2.57)	Computer Science (2.28)
	2	Plant & Animal Sciences (2.20)	Environment/Ecology (1.90)	Physics (1.24)	Psychiatry/Psychology (1.74)	Chemistry (2.09)	Materials Science (2.26)
	3	Microbiology (1.44)	Agricultural Sciences (1.85)	Neuroscience & Behavior (1.21)	Economics & Business (1.50)	Multidisciplinary (1.91)	Engineering (1.65)
	4	Environment/Ecology (1.40)	Mathematics (1.72)	Molecular Biology & Genetics (1.16)	Molecular Biology & Genetics (1.37)	Physics (1.51)	Pharmacology & Toxicology (1.63)
Least Specialized	19	Computer Science (0.68)	Psychiatry/Psychology (0.48)	Environment/Ecology (0.75)	Agricultural Sciences (0.72)	Neuroscience & Behavior (0.36)	Space Science (0.36)
	20	Geosciences (0.61)	Materials Science (0.46)	Engineering (0.74)	Physics (0.69)	Clinical Medicine (0.35)	Multidisciplinary (0.35)
	21	Psychiatry/Psychology (0.44)	Immunology (0.44)	Agricultural Sciences (0.74)	Chemistry (0.64)	Social Sciences (0.23)	Social Sciences (0.32)
	22	Economics & Business (0.25)	Multidisciplinary (0.38)	Social Sciences (0.51)	Materials Science (0.54)	Psychiatry/Psychology (0.17)	Psychiatry/Psychology (0.20)
CV	-	0.53	1.06	0.21	0.31	0.72	0.66

(4.12) Table 5 shows the rankings of RSS changes between the 1981-85 period and the 2004-08 period. The field ranked 1 showed the greatest increase in RSS (value shown in parenthesis), and the field ranked 22 showed the largest decline. The change in CVs is also shown in the last row of Table 5. Again, two of Brazil's fastest growing specializations are in the life sciences (such as Plant and Animal Sciences and Environment/Ecology), while its decreases are also in two life sciences (Agricultural Science and Molecular Biology); a closer analysis reveals that, while Brazil is gaining advantages in the "basic" life sciences, it is losing momentum in the "applied" life sciences. On the other hand, Chile's increased specialization has been in natural sciences (with the exception of Geosciences), and it has been gaining advantage in two applied sciences: agriculture and computer science, while is losing track in basic sciences (Biology and Space). Germany has increased its specialization in fields related to social sciences, but decreased its specializations in the natural sciences. The US has become increasingly specialized in fields related to natural sciences, particularly applied life sciences, while China has increased its specialization in natural and more basic science fields. Interestingly, South Korea has strongly increased its specialization not only in natural applied sciences such as computer sciences, but also in more basic life sciences such as microbiology. All countries (except the USA, which remained constant) decreased their CV in this time period, indicating a more homogenous level of specialization across the 22 fields.

Table 5: Changes in specialization (RSS) rankings, select countries, 1981-85 to 2004-08

		Brazil	Chile	Germany	USA	China	S. Korea
Most Gain	**1**	Plant & Animal Science (0.70)	Mathematics (1.10)	Neuroscience & Behavior (0.56)	Multidisciplinary (0.50)	Materials Science (1.81)	Computer Science (0.87)
	2	Pharmacology & Toxicology (0.67)	Geosciences (0.86)	Economics & Business (0.45)	Molecular Biology & Genetics (0.32)	Chemistry (1.12)	Microbiology (0.65)
	3	Neuroscience & Behavior (0.61)	Agricultural Sciences (0.81)	Multidisciplinary (0.42)	Pharmacology & Toxicology (0.21)	Agricultural Sciences (0.41)	Pharmacology & Toxicology (0.50)
	4	Environment/Ecology (0.46)	Computer Science (0.57)	Psychiatry/Psychology (0.42)	Biology & Biochemistry (0.14)	Biology & Biochemistry (0.37)	Neuroscience & Behavior (0.46)
Least gain (or loss)	**19**	Space Science (-0.66)	Pharmacology & Toxicology (-0.36)	Engineering (-0.32)	Materials Science (-0.17)	Space Science (-0.60)	Engineering (-0.47)
	20	Multidisciplinary (- 0.96)	Clinical Medicine (-0.64)	Pharmacology & Toxicology (-0.45)	Economics & Business (-0.19)	Mathematics (-0.97)	Physics (-0.48)
	21	Agricultural Sciences (-1.14)	Biology & Biochemistry (-0.69)	Agricultural Sciences (-0.47)	Environment/Ecology (-0.27)	Geosciences (-1.93)	Chemistry (-1.04)
	22	Molecular Biology & Genetics (-1.31)	Space Science (-0.75)	Materials Science (-0.52)	Computer Science (-0.42)	Multidisciplinary (-6.59)	Materials Science (-1.07)
CV	**-**	-0.16	-0.34	-0.15	0.00	-0.74	-0.25

(4.4) Following the trends vs missed opportunities (RSS)

(4.13) Table 6 represents another important dimension to countries' scientific specialization patterns: whether they are following or diverging from global trends. The change in S (the share of all papers from a particular field at the world level) between the two time periods provides insight into which fields are growing and shrinking in global importance. Mapping the change in S with the change in a country's RSS produces an indicator of which of four directions a country is following vis-à-vis global trends in a specific field. The first two possibilities represent a country moving in tandem with global trends, while the second two possibilities represent a country moving against global trends:

1. If both the change in S and the country's change in RSS are positive, the country is increasing its degree of specialization in a field of increasing international importance;

2. If both the change in S and the country's change in RSS are negative, the country is decreasing its degree of specialization in a field of shrinking international importance;
3. If the change in S is negative, but the country's change in RSS is positive, the country is increasing its degree of specialization in a field of shrinking international importance;
4. If the change in S is positive, but the country's change in RSS is negative, the country is decreasing its degree of specialization in an increasingly important international field.

(4.14) These situations are ranked from most desirable to least desirable. The first can be seen as an *investment in the future (1)*, the second as recognition *of decreasing importance* (2), the third as *investing against global trends* (3), and the *fourth as missing an opportunity* (4). Select countries' positions each scientific field are noted in table 6. The Latin American countries seem to be following the global trends in the fields of Computer Science, Engineering, and Material Science.

(4.15) The LAC countries seem to largely be missing the growing importance of Space Science and Physics. All four leading and emerging countries specialize in the increasingly important fields of Molecular Biology & Genetics and Neuroscience & Behavior. The two world leaders are decreasing their specialization in the growing natural science fields of Engineering, Materials Science, and Mathematics. The two emerging Asian nations largely mirror each other's specializations, with the exceptions of Engineering, Materials Science, Physics, and Space Science; in the three former fields, China scores one while South Korea score four, while the reverse is true for Space Science.

Table 6: Δ in RSS and Δ in S

	Argentina	Brazil	USA	German y	China	South Korea
Agricultural Sciences	3	2	2	2	3	3
Biology & Biochemistry	2	3	3	3	3	3
Chemistry	2	3	3	2	3	2
Clinical Medicine	2	3	3	2	2	3
Computer Science	1	1	4	1	1	1
Economics & Business	2	2	2	3	3	2
Engineering	1	1	4	4	1	4
Environment/Ecology	1	1	4	1	1	1
Geosciences	1	4	4	1	4	4
Immunology	3	3	3	3	3	3
Materials Science	4	1	4	4	1	4
Mathematics	1	4	4	4	4	4
Microbiology	1	4	1	4	1	1
Molecular Biology & Genetics	4	4	1	1	1	1
Multidisciplinary	3	2	3	3	2	3
Neuroscience & Behavior	4	1	1	1	1	1
Pharmacology & Toxicology	2	3	3	2	2	3
Physics	4	4	4	1	1	4
Plant & Animal Science	3	3	2	2	2	3
Psychiatry/Psychology	2	2	2	3	2	2
Social Sciences, general	3	3	3	3	2	2
Space Science	4	4	4	1	4	1

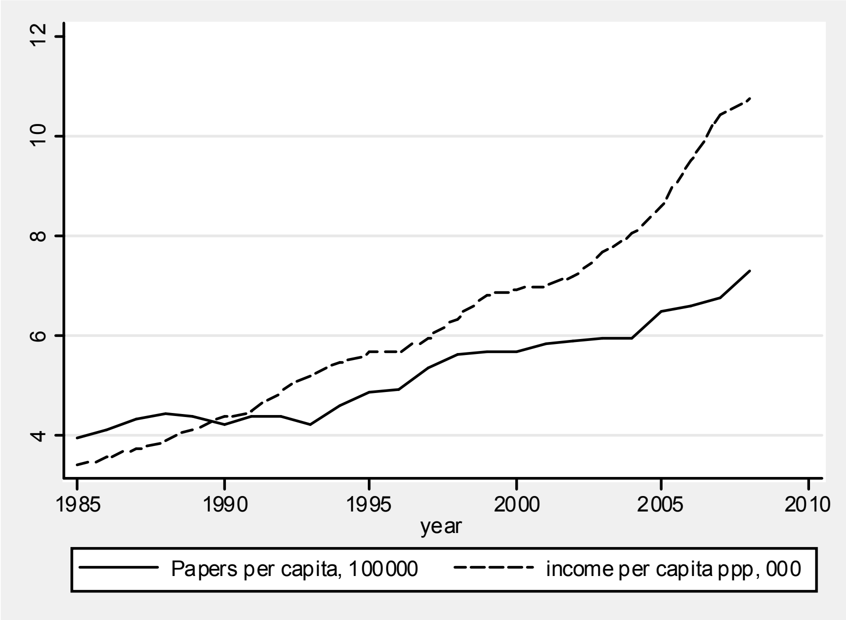
Note: the rankings represent: *investment in the future (1)*, *decreasing importance* (2), *investing against global trends* (3), *missing an opportunity* (4)

(5) The Costa Rica's case study

(5.1) Costa Rica's Scientific Productivity

(5.1.) As can be observed in Graph 9, both per capita GDP and Scientific Productivity have been steadily increasing in the period analyzed. However, per capita GDP has been increasing at a higher rate than the rate of increase of Scientific Productivity. This suggests the possibility for a shift away from a "knowledge economy" – that is, this indicator of Scientific Productivity has not increased as quickly as is the economy, suggesting that the economic growth may be increasingly taking place in areas other than the knowledge intensive ones. This performance is against the general trends both at the world level as also at the Latin American level.

Graph 9: Costa Rican trends in per capita GDP and Scientific Productivity



(5.2) The picture is similar when comparing Costa Rica internationally. Table 7 depicts Relative Scientific Productivity with each region is normalized with regards to the OECD level (the numbers are different from the ones in Table 1 because here we are using the data accumulated in 5-year intervals. Costa Rica has too few data as to carry out annual analysis). As we can see, in the year 2008, Costa Rica lagged behind Eastern Europe and Russia, but showed similar levels of Scientific Productivity as LAC and China. However, when looking at time trends, it is possible to see that Costa Rica's Relative Scientific Productivity has remained stagnant over the years. In other words, Costa Rica's scientific production has grown at approximately the same pace as the OECD countries. This performance strongly contrasts with the rest of the developing regions that were able to grow faster than the OECD. As a consequence Costa Rica is losing advantage against China, South East Asia, India and the Middle East. Costa Rica is even losing ground in comparison with the rest of LAC. Indeed, while in 1985 Costa Rica had a Scientific Productivity that was more than the double than LAC, in 2008 the figures were rather similar.

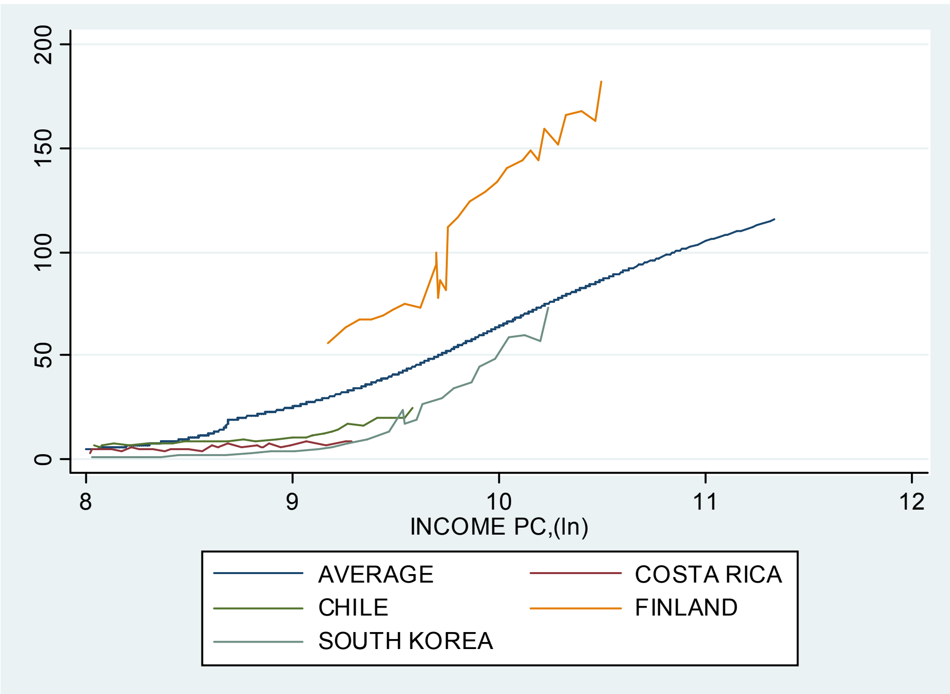
Table 7: Relative Productivity (as a percentage of OECD productivity)

	1985	2008	Annual growth rate
Costa Rica	7.46	7.60	0.08%
LAC	3.33	7.72	3.66%
China	0.55	6.45	10.70%
India	3.36	2.53	-1.23%
Southeast Asia	0.89	4.85	7.37%
Eastern Europe	22.96	28.24	0.90%
Central Asia	1.54	0.97	-2.01%
Russia	34.88	18.55	-2.75%
Middle East	2.75	5.36	2.90%
Sub-Saharan Africa	2.17	1.43	-1.81%
Other	6.54	4.42	-1.70%

(5.3) More interesting is the comparison of Costa Rica's performance with countries of similar degree of development (as captured by the income per capita). The results are shown in Graph 10. The graph compares Costa Rica's correlation between Scientific Productivity and income per capita with the same correlation for the "average" county in the sample (the blue line). The average correlation is computed by using non-parametric econometric techniques that allows the data to show the right functional form linking the two variables. Comparing Costa Rica with the average country we can see that Costa Rica Scientific Productivity is well below that it should be expected given its degree of development (as measured by income per capita). Even more worrisome is the fact that Costa Rica's performance is indeed deteriorating – at the beginning of the period it was indeed much closer to what was expected given its degree of development.

(5.4) Graph 10 also shows the performance of three comparison countries: Chile, South Korea and Finland. Chile is selected because it has a similar level of income per capita as Costa Rica, while Finland and South Korea are chosen because both have a large human capital base and Finland has strong natural resource base (two characteristics also attributed to Costa Rica). While Finland shows a Scientific Productivity pattern consistently higher than expected given its income levels, Chile and South Korea have productivity levels below expected values for their income level; however over time their productivities trend toward expected levels (more so in the case of South Korea). Moreover, while Costa Rica, Chile and South Korea had similar performance at the beginning of the period, the last two countries clearly outperformed Costa Rica towards the end of the period.

Graph 10: Costa Rican Scientific Productivity vs. different comparison countries



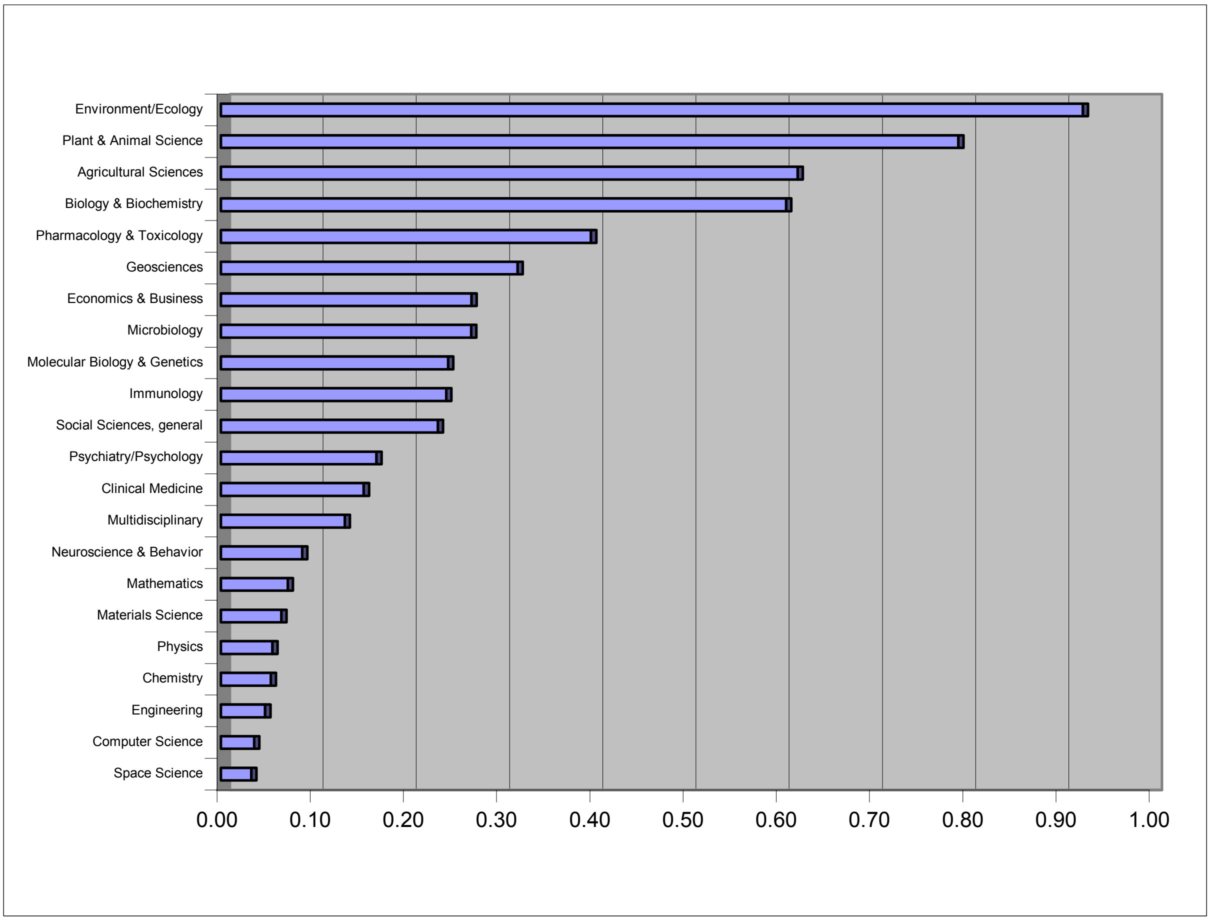
(5.5) The function shown in Graph 10 can be used to predict what should have been the expected Scientific Productivity of Costa Rica given its income level. Table 8 contrasts these predicted figures with the observed Productivity. The results indicate that by the beginning of the period Costa Rica had a Productivity level that was about 60% of what was expected given its degree of development. Productivity even grew during the first half of the 1980s, reaching a figure very close to what was expected. However, performance started to deteriorate since mid 1980s onwards. Today Costa Rica has a level of Science Productivity that is just a quarter of what is expected given its income per capita.

Table 8: Costa Rica's Observed vs Expected Productivity

Year	Observed productivity	Expected productivity	% of Expected Productivity actually observed
1981	3.10	4.91	63%
1985	4.89	5.49	89%
1990	4.03	8.11	50%
1995	5.52	13.65	40%
2000	5.77	21.57	27%
2004	6.14	25.01	25%
2008	8.39	33.28	25%

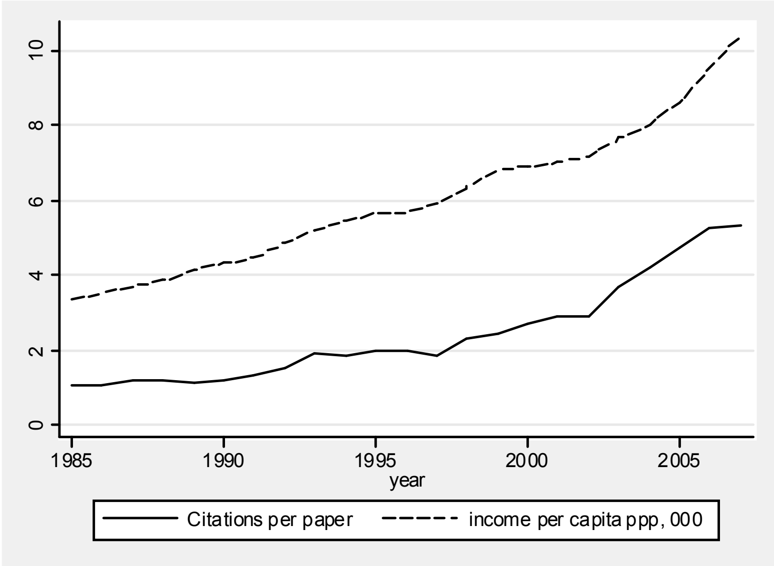
(5.6) Beneath these macro trends lies a large heterogeneity of performances across scientific disciplines. Indeed, as can be seen in Graph 11, the productivity gaps (in comparison to what was expected given country's level of development) vary greatly across fields. Graph 11 is a field-specific graphical representation of the concept in the fourth column of Table 8: each bar represents the percentage of Costa Rican expected Productivity (see above for methodology) that is actually observed, disaggregated by field. Indeed, while Costa Rica had a very strong performance in the life sciences cluster (Environment/Ecology, Plant and Animal Science, Agricultural Sciences and Biology/Biochemistry), it showed weak performances in Mathematics, Physics, Computer Science, Engineering and Space Sciences (all with performances lower than 10% of what was expected).

Graph 11: Costa Rican Percent of Expected Productivity Actually Observed, 2008



(5.7) Impact (number of citations per published paper) serves as a proxy for the quality of the papers published. This indicator goes beyond expressing the shear volume of publications by expressing a proxy of quality of publications, or how useful the information contained in published articles is to the scientific community at large. For example, a country may have a small *quantity* of scientific papers published, leading to a low Scientific Productivity indicator, yet if these few papers are cited in many other published papers, it may have a high Impact score, indicating a high level of *quality* and innovation its work. As we can see in Graph 12, Impact in Costa Rica has been increasing at a somewhat similar pace as economic growth. This suggests an increase in quality of scientific innovation concomitant with economic growth; in comparison with publications Costa Rica has indeed managed to keep track of a high quality scientific production.

Graph 12: Costa Rican trends in per capita GDP and Impact



(5.2) Costa Rica's Scientific Specialization

(5.8) Table 9 presents rankings of national scientific specializations, as measured by the RSS, for the four countries under analysis for the 2004-2008 period. As we have seen previously, Costa Rica's specialization in the natural science fields – such as Plant & Animal Science, Environment/Ecology, and Biology & Biochemistry – persists through this latest time period. This is not a surprising finding, given Costa Rica's rich natural resource landscape and historical focus on natural resources and conservation. Costa Rica also continues to be the least specialized in the natural science fields of Space Science, Computer Science, Engineering, and Material Science. South Korea focuses on the natural sciences, and is less specialized in fields of human behavior. Consistent with its low CV (implying a relatively homogenous specialization level across fields), Finland's highest and lowest RSS score are very much a mix of the various disciplines. Finland's low CV is also reflective of the relatively low RSS of its most specialized fields and the relatively high RSS of its least specialized fields. On the other hand, the two LAC countries of Costa Rica and Chile both exhibit a fairly high CV, indicating they are far more specialized in some fields than in others. South Korea's CV lies between the two extremes.

Table 9: Specialization (RSS) Rankings, Costa Rica vs. selected countries, 2004-2008

		Costa Rica	Chile	South Korea	Finland
Most Specialized	**1**	Plant & Animal Science (4.17)	Space Science (6.48)	Computer Science (2.28)	Environment/Ecology (1.87)
	2	Environment/Ecology (3.90)	Environment/Ecology (1.90)	Materials Science (2.26)	Computer Science (1.27)
	3	Biology & Biochemistry (3.00)	Agricultural Sciences (1.85)	Engineering (1.65)	Clinical Medicine (1.18)
	4	Agricultural Sciences (2.84)	Mathematics (1.72)	Pharmacology & Toxicology (1.63)	Neuroscience & Behavior (1.18)
Least Specialized	**19**	Materials Science (0.19)	Psychiatry/Psychology (0.48)	Space Science (0.36)	Mathematics (0.71)
	20	Engineering (0.17)	Materials Science (0.46)	Multidisciplinary (0.35)	Materials Science (0.68)
	21	Computer Science (0.10)	Immunology (0.44)	Social Sciences (0.32)	Chemistry (0.67)
	22	Space Science (0.10)	Multidisciplinary (0.38)	Psychiatry/Psychology (0.20)	Multidisciplinary (0.55)
CV	**-**	1.05	1.06	0.66	0.26

(5.9) Table 10 shows the largest and smallest changes in RSS scores between the first time period (1981-85) and the last time period (2004-08), as well as the change in the CV, for the four countries. Once again, Costa Rica has increased its specialization in the natural science fields, while Chile's increased specializations lie more in the fields of natural sciences. South Korea increased its specialization in Computer Science and Medicine, and decreased its specialization in natural science fields. Once again, Finland shows mixed results in its increased specializations, though it has decreased its specializations in Medicines. Interestingly, all countries except Finland decreased their CV during this time period.

Table 10: Changes in specialization (RSS) rankings, Costa Rica vs. select countries 1981-85 to 2004-08

		Costa Rica	Chile	S. Korea	Finland
Most Gain	1	Plant & Animal Science (1.55)	Mathematics (1.10)	Computer Science (0.87)	Environment/Ecology (0.88)
	2	Environment/Ecology (1.48)	Geosciences (0.86)	Microbiology (0.65)	Psychiatry/Psychology (0.75)
	3	Pharmacology & Toxicology (0.63)	Agricultural Sciences (0.81)	Pharmacology & Toxicology (0.50)	Social Sciences (0.63)
	4	Molecular Biology & Genetics (0.57)	Computer Science (0.57)	Neuroscience & Behavior (0.46)	Geosciences (0.50)
Least gain (or loss)	19	Social Sciences (-0.10)	Pharmacology & Toxicology (-0.36)	Engineering (-0.47)	Materials Science (-0.43)
	20	Psychiatry/Psychology (-0.12)	Clinical Medicine (-0.64)	Physics (-0.48)	Clinical Medicine (-0.54)
	21	Agricultural Sciences (-3.64)	Biology & Biochemistry (-0.69)	Chemistry (-1.04)	Pharmacology & Toxicology (-0.60)
	22	Multidisciplinary (-3.92)	Space Science (-0.75)	Materials Science (-1.07)	Immunology (-1.04)
CV	-	-0.29	-0.34	-0.25	0.47

(5.10) Table 11 analyzes if Costa Rica's specialization patterns are following or are against the global trends. Interestingly, Costa Rica has the lowest average score, suggesting that its specializations are the most closely aligned with global trends. The only fields in which it may be "missing an opportunity" are in the fields of Computer Science and Mathematics. Costa Rica is increasing its specialization in growing fields in an impressive 9 fields out of 22. The remaining half of the fields (11) are those of shrinking international importance.

Table 11: Δ in RSS and Δ in S. Costa Rica vs. Selected Countries

	Chile	Costa Rica	South Korea	Finland	Field avg.
Agricultural Sciences	3	2	3	2	2.5
Biology & Biochemistry	2	3	3	2	2.5
Chemistry	3	3	2	3	2.75
Clinical Medicine	2	3	3	2	2.5
Computer Science	1	4	1	1	1.75
Economics & Business	3	3	2	3	2.75
Engineering	1	1	4	1	1.75
Environment/Ecology	1	1	1	1	1
Geosciences	1	1	4	1	1.75
Immunology	3	2	3	2	2.5
Materials Science	1	1	4	4	2.5
Mathematics	1	4	4	4	3.25
Microbiology	1	1	1	4	1.75
Molecular Biology & Genetics	4	1	1	4	2.5
Multidisciplinary	2	2	3	3	2.5
Neuroscience & Behavior	4	1	1	4	2.5
Pharmacology & Toxicology	2	3	3	2	2.5
Physics	1	1	4	1	1.75
Plant & Animal Science	3	3	3	3	3
Psychiatry/Psychology	3	2	2	3	2.5
Social Sciences, general	3	2	2	3	2.5
Space Science	4	1	1	1	1.75
National Average	2.23	2.05	2.50	2.45	

(6) Preliminary Conclusions

(6.1) While LAC is increasing its Scientific Productivity, as measured in terms of peer-reviewed articles published per capita, so are most other regions of the world, thus providing the challenge of a global environment that constantly raises the bar on scientific innovation. LAC is not falling behind compared to other regions of the developing world, but it will soon be eclipsed by China and Southeast Asia, which are growing at a very fast rate. Overall LAC's Impact scores rank lower than its Scientific Productivity scores, suggesting an emphasis on volume of publications over quality or influence of its publications. In the most recent time period observed, LAC countries are most specialized in Agricultural Sciences, Plant & Animal Science, and Environment/Ecology, and least specialized in Computer Science, Materials Science, and Engineering. During the 26 years covered by the database, LAC countries have most increased their specialization in Immunology, Geosciences, and Microbiology, and most decreased their specializations in Space Science, Multidisciplinary, and Agricultural Science. LAC countries are most frequently investing in increasingly relevant fields in the cases of Computer Science, Engineering, and Environment/Ecology. However, they are also most often missing opportunities to specialize in the growing fields of Space Science, Molecular Biology & Genetics, and Physics.

(6.2) More detailed country- or field-specific analyses of this database and these indices would be possible in the future, but are not within the scope of this global interview. Furthermore, an intra-LAC analysis could further tease out the differences amongst the various LAC countries or sub-regions. Changes in these publication/innovation indicators could be evaluated with regards to the types of inputs generally assumed to increase scientific innovation, such as changing educational and economic conditions. Such analyses would evaluate the casual relationship between such input efforts or investments, treated as independent variables, and the indicators presented in this paper as dependent variables.

(6.3) While Costa Rica's Scientific Productivity has grown, it has done so at a slower pace than its economy, suggesting a possible shift away from a "knowledge economy." In a similar vein, its Relative Scientific Productivity has remained almost constant; unlike some other developing regions, its Scientific Productivity has not grown faster than that of the OECD. Furthermore, its overall and many of its field-specific Productivities are lower than would be expected given its income level. On the other hand, Costa Rica seems to have maintained a relatively high level of quality of innovation, as measured by the Impact indictor. In terms of specific fields, Costa's Rica's specialization lies in fields related to natural resources and conservation, a specialization that has both persisted through time and reflects global trends. However, it seems that Costa Rica is moving against the global trends, and therefore missing opportunities, in computer science and mathematics.

(7) Bibliographic References

Adams, J. and Griliches (1996): Research Productivity in a System of Universities, NBER Working Paper Series, 5833

Crespi, G and A. Geuna (2008): An empirical analysis of scientific production: A cross country analysis, 1981-2002, Research Policy 37, 565-579.

DTI (2003), Forward Look 2002, London DTI-OST

Hall, B. Jaffe and M Tajtemberg (2001): The NBER Patent Citations Data File:Lessons, insights and methodological tools, NBER Working Paper Series, 8498.

NSF (2002), National Science and Engineering Indicators.

Nesta, Lionel and Pari Patel. "National Patterns of Technology Accumulation: Use of Patent Statistics," Chapter 24 in *Handbook of Quantitative Science and Technology,* edited by Schmoch et. Al., Kluwer, Dordrecht, Netherlands

SALTER et al. (2000): 'Talent, Not Technology: Publicly Funded Research and Innovation in the UK', a report commissioned by the CVCP and HEFCE, SPRU, University of Sussex, Brighton, 2000. http://www.sussex.ac.uk/spru/news/talent.html

Smith, K (2006): Measuring Innovation in Fagerberg, Mowery and Nelson eds The Oxford Handbook of Innovation. Oxford University Press, UK

Annex 1: Regional Disaggregation of Countries

OECD	LAC	SE Asia	Eastern Europe	Central Asia	Middle East & North Africa	Sub-Saharan Africa	Others
AUSTRALIA	ARGENTINA	BANGLADESH	ALBANIA	AFGHANISTAN	ALGERIA	ANGOLA	BRUNEI
AUSTRIA	BAHAMAS	BHUTAN	ARMENIA	KAZAKHSTAN	BAHRAIN	BENIN	FIJI
AZERBAIJAN	BELIZE	CAMBODIA	BELARUS	KYRGYZSTAN	CHAD	BOTSWANA	FRENCH POLYNESIA
BELGIUM	BARBADOS	INDONESIA	BOSNIA & HERZEGOVINA	MONGOLIA	EGYPT	BURKINA FASO	HUNGARY
BULGARIA	BERMUDA	LAOS	CROATIA	PAKISTAN	IRAN	BURUNDI	ISRAEL
CANADA	BOLIVIA	MALAYSIA	CYPRUS	TAJIKISTAN	IRAQ	CAMEROON	LIECHTENSTEIN
DENMARK	BRAZIL	MYANMAR	CZECH REPUBLIC	TURKMENISTAN	JORDAN	CENT AFR REPUBL	MACEDONIA
FINLAND	CHILE	NEPAL	ESTONIA	UZBEKISTAN	KUWAIT	CONGO DEMOCRATIC REPUBLIC	MACEDONIA
FRANCE	COLOMBIA	NORTH KOREA	LATVIA		LEBANON	CONGO PEOPLES REP	MONACO
GERMANY	COSTA RICA	PHILIPPINES	LITHUANIA		LIBYA	COTE IVOIRE	MONTENEGRO
GREECE	CUBA	SOLOMON ISLANDS	MOLDOVA		MALTA	ERITREA	NEW CALEDONIA
ICELAND	DOMINICAN REPUBLIC	SOUTH KOREA	REP OF GEORGIA		MOROCCO	ETHIOPIA	PAPUA NEW GUINEA
IRELAND	ECUADOR	SRI LANKA	ROMANIA		OMAN	GABON	REUNION
ITALY	EL SALVADOR	TAIWAN	SERBIA		QATAR	GAMBIA	SAMOA
JAPAN	FRENCH GUIANA	THAILAND	SLOVAKIA		SAUDI ARABIA	GHANA	SEYCHELLES
LUXEMBOURG	GRENADA	VIETNAM	SLOVENIA		SYRIA	GUINEA	SINGAPORE
NETHERLANDS	GUADELOUPE		UKRAINE		TUNISIA	GUINEA BISSAU	VANUATU
NEW ZEALAND	GUATEMALA		YUGOSLAVIA		UNITED ARAB EMIRATES	KENYA	VATICAN
NORWAY	GUYANA				YEMEN	LESOTHO	
POLAND	HAITI					LIBERIA	
PORTUGAL	HONDURAS					MADAGASCAR	
SPAIN	JAMAICA					MALAWI	
SWEDEN	MARTINIQUE					MALI	
SWITZERLAND	MEXICO					MAURITANIA	
TURKEY	NETHERLANDS ANTILLES					MAURITIUS	
UK	NICARAGUA					MOZAMBIQUE	
USA	PANAMA					NAMIBIA	
	PARAGUAY					NIGER	
	PERU					NIGERIA	
	SURINAME					RWANDA	
	TRINIDAD & TOBAGO					SENEGAL	

	URUGUAY					SIERRA LEONE	
	VENEZUELA					SOMALIA	
						SOUTH AFRICA	
						SUDAN	
						SWAZILAND	
						TANZANIA	
						TOGO	
						UGANDA	
						ZAMBIA	
						ZIMBABWE	

Annex 2: Relative Productivity (papers published per inhabitant): Regional Productivity as a Percentage of OECD Productivity

	LAC			China			India			SE Asia		
	1981	2007	Annual Growth Rate	1981	2007	Annual Growth Rate	1981	2007	Annual Growth Rate	1981	2007	Annual Growth Rate
Agricultural Sciences	6.66	19.16	4.07%	0.04	5.05	18.29%	10.71	5.16	-2.81%	1.86	7.74	5.47%
Biology & Biochemistry	3.41	8.50	3.51%	0.12	4.67	14.00%	3.80	2.49	-1.64%	0.61	3.70	6.94%
Chemistry	2.66	8.34	4.39%	0.32	18.45	15.61%	7.38	6.90	-0.26%	0.69	6.65	8.70%
Clinical Medicine	3.74	5.30	1.33%	0.22	2.24	8.88%	1.34	1.13	-0.64%	0.88	3.52	5.33%
Computer Science	1.49	4.28	4.04%	0.37	7.74	11.66%	1.82	1.74	-0.18%	0.83	10.41	9.73%
Economics & Business	2.79	2.49	-0.43%	0.13	2.23	10.94%	0.47	0.58	0.82%	0.59	4.80	8.09%
Engineering	1.73	6.12	4.86%	0.42	10.10	12.21%	5.61	3.90	-1.40%	0.96	11.02	9.38%
Environment/Ecology	2.93	11.87	5.39%	0.23	5.76	12.45%	5.07	2.32	-3.01%	1.45	5.11	4.85%
Geosciences	2.27	6.70	4.17%	1.39	6.82	6.12%	5.43	2.62	-2.79%	0.67	2.77	5.47%
Immunology	2.17	7.87	4.96%	0.15	2.60	10.94%	0.58	1.32	3.16%	0.21	3.15	10.50%
Materials Science	1.80	8.13	5.79%	0.28	25.58	17.30%	5.15	6.77	1.05%	0.50	10.10	11.59%
Mathematics	2.59	8.43	4.54%	0.76	12.76	10.83%	4.25	1.69	-3.55%	1.47	4.54	4.33%
Microbiology	3.46	10.45	4.25%	0.16	4.27	12.58%	1.93	2.01	0.17%	0.69	4.97	7.62%
Molecular Biology & Genetics	4.12	4.82	0.61%	0.10	3.37	13.61%	1.79	1.08	-1.93%	0.38	2.84	7.73%
Multidisciplinary	11.84	7.76	-1.63%	2.49	14.72	6.84%	17.31	11.96	-1.42%	1.28	3.28	3.63%
Neuroscience & Behavior	2.81	6.30	3.11%	0.10	2.01	11.41%	0.56	0.54	-0.15%	0.33	1.78	6.47%
Pharmacology & Toxicology	2.82	9.79	4.78%	0.14	6.75	14.87%	2.41	3.86	1.81%	0.70	5.24	7.75%
Physics	3.92	8.49	2.97%	0.69	12.35	11.09%	5.38	3.38	-1.79%	0.63	6.35	8.87%
Plant & Animal Science	4.87	18.94	5.22%	0.47	4.76	8.89%	7.73	3.05	-3.57%	1.58	4.71	4.20%
Psychiatry/Psychology	1.82	2.70	1.52%	0.10	0.97	8.64%	0.73	0.28	-3.75%	0.37	1.76	5.99%
Social Sciences, general	1.65	4.24	3.63%	0.19	1.27	7.34%	1.49	0.56	-3.73%	1.10	2.97	3.83%
Space Science	6.47	10.07	1.70%	1.16	2.80	3.41%	1.68	1.44	-0.61%	0.25	1.82	7.65%

Annex 2 (Relative Productivity), continued

	Eastern Europe			Central Asia			Russia			Middle East			SSA		
	1981	2007	Annual Growth Rate	1981	2007	Annual Growth Rate	1981	2007	Annual Growth Rate	1981	2007	Annual Growth Rate	1981	2007	Annual Growth Rate
Agricultural Sciences	22.12	33.91	1.64%	1.06	2.94	3.94%	10.89	12.97	0.67%	7.03	8.19	0.59%	5.46	5.39	-0.04%
Biology & Biochemistry	22.00	25.10	0.51%	0.84	0.74	-0.45%	22.32	10.96	-2.74%	1.61	3.62	3.11%	1.39	1.94	1.29%
Chemistry	42.57	45.37	0.24%	4.19	2.58	-1.87%	75.26	50.77	-1.51%	5.68	12.97	3.18%	1.32	0.95	-1.28%
Clinical Medicine	10.84	21.15	2.57%	0.95	0.35	-3.83%	21.37	3.40	-7.07%	1.90	4.37	3.19%	3.11	1.35	-3.21%
Computer Science	11.34	24.53	2.97%	0.37	0.74	2.64%	2.28	9.78	5.60%	2.44	5.91	3.41%	0.93	0.44	-2.86%
Economics & Business	13.56	12.33	-0.37%	0.08	0.22	4.09%	1.54	1.20	-0.95%	0.91	0.87	-0.18%	1.19	1.17	-0.07%
Engineering	26.16	31.19	0.68%	1.26	1.52	0.73%	31.16	18.19	-2.07%	5.48	12.55	3.19%	1.71	0.84	-2.73%
Environment/Ecology	12.55	23.89	2.48%	1.05	1.16	0.40%	5.61	5.38	-0.16%	3.53	4.41	0.86%	5.70	3.98	-1.38%
Geosciences	24.39	20.39	-0.69%	2.73	1.32	-2.78%	67.76	55.51	-0.77%	2.43	4.90	2.69%	3.49	2.25	-1.68%
Immunology	16.46	14.99	-0.36%	0.10	0.24	3.48%	1.28	2.95	3.23%	0.65	2.22	4.71%	1.07	4.22	5.30%
Materials Science	56.30	57.15	0.06%	2.57	1.35	-2.48%	96.01	34.00	-3.99%	4.21	10.75	3.61%	1.02	0.69	-1.47%
Mathematics	27.29	49.52	2.29%	1.27	1.39	0.35%	27.17	39.10	1.40%	3.64	8.72	3.36%	1.41	1.13	-0.85%
Microbiology	19.89	19.17	-0.14%	0.68	0.92	1.19%	28.33	11.20	-3.57%	1.94	3.75	2.53%	1.97	2.08	0.21%
Molecular Biology & Genetics	12.52	15.94	0.93%	0.91	0.38	-3.31%	28.38	11.23	-3.57%	1.59	1.98	0.83%	0.75	0.51	-1.51%
Multidisciplinary	89.62	39.04	-3.20%	9.24	0.53	11.03%	283.88	12.76	-11.93%	3.93	4.75	0.73%	4.10	4.13	0.02%
Neuroscience & Behavior	15.50	17.51	0.47%	0.00	0.17	10.80%	11.81	8.81	-1.13%	0.47	2.47	6.40%	0.33	0.32	-0.13%
Pharmacology & Toxicology	21.58	23.95	0.40%	0.58	0.87	1.57%	18.92	1.93	-8.78%	6.37	7.51	0.64%	1.77	1.42	-0.83%
Physics	46.76	40.06	-0.60%	2.96	1.59	-2.40%	82.07	52.08	-1.75%	2.68	5.71	2.91%	0.79	0.49	-1.85%
Plant & Animal Science	21.72	30.19	1.27%	1.50	2.64	2.17%	12.22	7.62	-1.81%	4.12	5.80	1.31%	6.77	4.11	-1.92%
Psychiatry/Psychology	8.27	13.26	1.82%	0.13	0.21	1.98%	4.90	2.40	-2.75%	0.57	1.02	2.23%	1.11	0.79	-1.34%
Social Sciences, general	7.12	14.93	2.85%	0.20	0.35	2.12%	3.15	3.53	0.43%	1.45	2.23	1.65%	2.23	2.22	-0.03%
Space Science	11.71	21.61	2.36%	1.03	0.57	-2.24%	24.18	26.68	0.38%	0.78	1.39	2.21%	1.89	0.90	-2.85%

Annex 3: Relative Impact (citations per published paper): Regional Impact as a Percentage of OECD Impact

	LAC			China			India			SE Asia		
	1981-1985	2004-2008	Annual Growth Rate	1981-1985	2004-2008	Annual Growth Rate	1981-1985	2004-2008	Annual Growth Rate	1981-1985	2004-2008	Annual Growth Rate
Agricultural Sciences	35.43	50.26	1.34%	85.13	66.71	-0.94%	23.41	37.75	1.84%	64.93	77.21	0.67%
Biology & Biochemistry	36.84	46.44	0.89%	35.12	46.82	1.11%	21.49	40.89	2.48%	35.62	59.33	1.96%
Chemistry	48.18	50.09	0.15%	23.67	53.08	3.11%	33.31	50.69	1.61%	43.93	66.60	1.60%
Clinical Medicine	44.18	59.97	1.18%	36.26	57.69	1.79%	29.35	38.91	1.08%	52.57	66.61	0.91%
Computer Science	91.28	55.08	-1.94%	62.21	53.15	-0.61%	43.64	59.93	1.22%	48.71	69.88	1.39%
Economics & Business	43.29	52.35	0.73%	22.49	78.58	4.81%	45.53	44.97	-0.05%	31.77	60.67	2.49%
Engineering	73.33	78.05	0.24%	52.86	79.49	1.57%	56.78	71.18	0.87%	70.80	82.63	0.59%
Environment/Ecology	81.00	72.87	-0.41%	56.03	51.94	-0.29%	33.10	45.26	1.20%	58.31	67.26	0.55%
Geosciences	61.19	59.84	-0.09%	22.61	59.34	3.71%	24.31	36.41	1.55%	40.78	65.52	1.82%
Immunology	51.68	50.81	-0.06%	47.77	41.36	-0.55%	57.43	34.65	-1.94%	107.04	55.83	-2.50%
Materials Science	85.67	53.90	-1.78%	49.81	55.79	0.44%	54.98	58.60	0.25%	43.15	78.46	2.30%
Mathematics	66.17	75.42	0.50%	37.77	74.32	2.60%	30.65	47.62	1.69%	51.60	72.47	1.31%
Microbiology	32.35	57.11	2.19%	56.02	49.30	-0.49%	19.73	38.58	2.58%	53.87	69.60	0.99%
Molecular Biology & Genetics	20.41	35.76	2.16%	33.12	41.59	0.88%	14.87	34.62	3.25%	25.87	63.05	3.43%
Multidisciplinary	17.48	40.32	3.21%	19.12	21.99	0.54%	20.02	21.69	0.31%	26.03	52.44	2.69%
Neuroscience & Behavior	55.39	49.58	-0.43%	46.85	47.55	0.06%	31.46	36.91	0.61%	44.38	61.73	1.27%
Pharmacology & Toxicology	50.11	54.56	0.33%	20.94	54.20	3.66%	36.75	52.46	1.37%	50.15	70.25	1.30%
Physics	51.88	65.56	0.90%	27.19	53.57	2.61%	30.93	60.72	2.59%	31.74	61.65	2.55%
Plant & Animal Science	48.51	45.23	-0.27%	18.41	63.36	4.75%	24.57	31.30	0.93%	47.18	72.30	1.64%
Psychiatry/Psychology	22.65	48.39	2.92%	42.77	68.76	1.83%	29.97	74.98	3.53%	31.54	58.84	2.40%
Social Sciences, general	54.07	51.55	-0.18%	44.21	74.48	2.01%	24.87	54.52	3.02%	52.48	69.45	1.08%
Space Science	79.39	79.05	-0.02%	20.94	41.01	2.59%	19.87	44.98	3.14%	24.24	98.54	5.39%

Annex 3 (Relative Impact), continued

	Eastern Europe			Central Asia			Russia			Middle East			SSA		
	1981-1985	2004-2008	Annual Growth Rate	1981-1985	2004-2008	Annual Growth Rate	1981-1985	2004-2008	Annual Growth Rate	1981-1985	2004-2008	Annual Growt h Rate	1981-1985	2004-2008	Annual Growth Rate
Agricultural Sciences	33.29	66.00	2.63%	21.38	47.90	3.10%	7.68	27.68	4.93%	38.31	51.31	1.12%	48.81	50.59	0.14%
Biology & Biochemistry	36.39	53.12	1.46%	8.26	31.12	5.10%	19.24	42.34	3.03%	13.81	30.76	3.08%	33.39	34.69	0.15%
Chemistry	39.63	51.61	1.02%	12.53	19.79	1.76%	20.01	25.45	0.92%	29.17	40.44	1.26%	52.06	46.83	-0.41%
Clinical Medicine	35.71	57.31	1.82%	4.83	47.49	8.79%	6.51	33.76	6.33%	29.11	31.45	0.30%	45.62	75.14	1.92%
Computer Science	79.50	75.91	-0.18%	405.10	50.61	-8.00%	59.42	41.35	-1.39%	32.83	49.72	1.60%	59.64	105.58	2.20%
Economics & Business	62.72	54.89	-0.51%	25.57	23.09	-0.39%	10.09	65.05	7.17%	23.39	47.30	2.71%	19.26	35.13	2.31%
Engineering	47.33	80.29	2.03%	28.24	93.31	4.60%	22.58	58.74	3.68%	48.79	66.63	1.20%	61.78	66.89	0.31%
Environment/Ecology	53.38	54.29	0.07%	29.71	40.90	1.23%	17.01	43.68	3.63%	33.66	33.17	-0.06%	69.01	66.07	-0.17%
Geosciences	23.35	56.74	3.42%	27.15	47.32	2.14%	18.47	35.16	2.48%	31.80	35.94	0.47%	51.72	61.47	0.66%
Immunology	45.92	54.13	0.63%	142.87	31.03	-5.87%	27.45	58.13	2.89%	41.88	35.18	-0.67%	61.25	78.55	0.96%
Materials Science	24.18	45.49	2.43%	11.67	39.69	4.71%	8.92	32.04	4.92%	37.94	41.21	0.32%	72.28	61.32	-0.63%
Mathematics	57.76	66.57	0.55%	16.63	47.05	4.00%	17.72	41.02	3.23%	33.44	58.78	2.17%	56.05	70.90	0.90%
Microbiology	35.94	52.21	1.44%	4.12	40.54	8.80%	14.51	36.69	3.57%	14.70	31.77	2.96%	49.39	78.23	1.77%
Molecular Biology & Genetics	44.88	65.59	1.46%	14.02	43.21	4.33%	15.59	28.47	2.32%	19.53	38.51	2.61%	42.90	56.64	1.07%
Multidisciplinary	27.73	44.63	1.83%	18.06	21.56	0.68%	36.86	37.64	0.08%	47.16	10.29	-5.85%	72.18	31.86	-3.15%
Neuroscience & Behavior	53.58	63.29	0.64%	0.01	47.13	32.53%	15.20	21.58	1.35%	28.81	36.36	0.89%	44.71	51.04	0.51%
Pharmacology & Toxicology	39.17	70.61	2.27%	8.05	34.51	5.60%	5.34	57.13	9.12%	20.98	45.26	2.96%	34.56	47.04	1.19%
Physics	37.56	70.73	2.43%	22.88	45.99	2.69%	34.66	62.10	2.24%	22.92	38.61	2.01%	36.98	53.61	1.43%
Plant & Animal Science	49.51	52.73	0.24%	18.75	27.99	1.54%	19.40	43.52	3.11%	32.60	35.88	0.37%	48.34	59.33	0.79%
Psychiatry/Psychology	40.93	65.87	1.83%	9.10	58.33	7.15%	20.84	32.65	1.73%	56.60	59.88	0.22%	28.22	58.90	2.83%
Social Sciences, general	61.38	53.33	-0.54%	33.80	59.34	2.16%	25.72	23.88	-0.28%	43.98	51.52	0.61%	55.77	73.83	1.08%
Space Science	39.57	75.73	2.50%	10.32	40.74	5.28%	27.74	41.70	1.57%	18.34	32.31	2.18%	60.66	97.95	1.84%

Annex 4: Ranking of annual growth rate in Relative Productivity

	1	2	3	4	5	6	7	8	9
Agricultural Sciences	CHINA	SOUTHEAST ASIA	LAC	CENTRAL ASIA	EASTERN EUROPE	RUSSIA	MIDDLE EAST	SUB-SAHARAN AFRICA	INDIA
Biology & Biochemistry	CHINA	SOUTHEAST ASIA	LAC	MIDDLE EAST	SUB-SAHARAN AFRICA	EASTERN EUROPE	CENTRAL ASIA	INDIA	RUSSIA
Chemistry	CHINA	SOUTHEAST ASIA	LAC	MIDDLE EAST	EASTERN EUROPE	INDIA	SUB-SAHARAN AFRICA	RUSSIA	CENTRAL ASIA
Clinical Medicine	CHINA	SOUTHEAST ASIA	MIDDLE EAST	EASTERN EUROPE	LAC	INDIA	SUB-SAHARAN AFRICA	CENTRAL ASIA	RUSSIA
Computer Science	CHINA	SOUTHEAST ASIA	RUSSIA	LAC	MIDDLE EAST	EASTERN EUROPE	CENTRAL ASIA	INDIA	SUB-SAHARAN AFRICA
Economics & Business	CHINA	SOUTHEAST ASIA	CENTRAL ASIA	INDIA	SUB-SAHARAN AFRICA	MIDDLE EAST	EASTERN EUROPE	LAC	RUSSIA
Engineering	CHINA	SOUTHEAST ASIA	LAC	MIDDLE EAST	CENTRAL ASIA	EASTERN EUROPE	INDIA	RUSSIA	SUB-SAHARAN AFRICA
Environment/Ecology	CHINA	LAC	SOUTHEAST ASIA	EASTERN EUROPE	MIDDLE EAST	CENTRAL ASIA	RUSSIA	SUB-SAHARAN AFRICA	INDIA
Geosciences	CHINA	SOUTHEAST ASIA	LAC	MIDDLE EAST	EASTERN EUROPE	RUSSIA	SUB-SAHARAN AFRICA	CENTRAL ASIA	INDIA
Immunology	CHINA	SOUTHEAST ASIA	SUB-SAHARAN AFRICA	LAC	MIDDLE EAST	CENTRAL ASIA	RUSSIA	INDIA	EASTERN EUROPE
Materials Science	CHINA	SOUTHEAST ASIA	LAC	MIDDLE EAST	INDIA	EASTERN EUROPE	SUB-SAHARAN AFRICA	CENTRAL ASIA	RUSSIA
Mathematics	CHINA	LAC	SOUTHEAST ASIA	MIDDLE EAST	EASTERN EUROPE	RUSSIA	CENTRAL ASIA	SUB-SAHARAN AFRICA	INDIA
Microbiology	CHINA	SOUTHEAST ASIA	LAC	MIDDLE EAST	CENTRAL ASIA	SUB-SAHARAN AFRICA	INDIA	EASTERN EUROPE	RUSSIA
Molecular Biology & Genetics	CHINA	SOUTHEAST ASIA	EASTERN EUROPE	MIDDLE EAST	LAC	SUB-SAHARAN AFRICA	INDIA	CENTRAL ASIA	RUSSIA
Multidisciplinary	CHINA	SOUTHEAST ASIA	MIDDLE EAST	SUB-SAHARAN AFRICA	INDIA	LAC	EASTERN EUROPE	CENTRAL ASIA	RUSSIA
Neuroscience & Behavior	CHINA	SOUTHEAST ASIA	MIDDLE EAST	LAC	EASTERN EUROPE	CENTRAL ASIA	SUB-SAHARAN AFRICA	INDIA	RUSSIA
Pharmacology & Toxicology	CHINA	SOUTHEAST ASIA	LAC	INDIA	CENTRAL ASIA	MIDDLE EAST	EASTERN EUROPE	SUB-SAHARAN AFRICA	RUSSIA
Physics	CHINA	SOUTHEAST ASIA	LAC	MIDDLE EAST	EASTERN EUROPE	RUSSIA	INDIA	SUB-SAHARAN AFRICA	CENTRAL ASIA
Plant & Animal Science	CHINA	LAC	SOUTHEAST ASIA	CENTRAL ASIA	MIDDLE EAST	EASTERN EUROPE	RUSSIA	SUB-SAHARAN AFRICA	INDIA
Psychiatry/Psychology	CHINA	SOUTHEAST ASIA	MIDDLE EAST	CENTRAL ASIA	EASTERN EUROPE	LAC	SUB-SAHARAN AFRICA	RUSSIA	INDIA
Social Sciences, general	CHINA	SOUTHEAST ASIA	LAC	EASTERN EUROPE	CENTRAL ASIA	MIDDLE EAST	RUSSIA	SUB-SAHARAN AFRICA	INDIA
Space Science	SOUTHEAST ASIA	CHINA	EASTERN EUROPE	MIDDLE EAST	LAC	RUSSIA	INDIA	CENTRAL ASIA	SUB-SAHARAN AFRICA

Annex 5: Ranking of Annual Growth Rates in Relative Impact

	1	2	3	4	5	6	7	8	9
Agricultural Sciences	RUSSIA	CENTRAL ASIA	EASTERN EUROPE	INDIA	LAC	MIDDLE EAST	SOUTHEAST ASIA	SUB-SAHARAN AFRICA	CHINA
Biology & Biochemistry	CENTRAL ASIA	MIDDLE EAST	RUSSIA	INDIA	SOUTHEAST ASIA	EASTERN EUROPE	CHINA	LAC	SUB-SAHARAN AFRICA
Chemistry	CHINA	CENTRAL ASIA	INDIA	SOUTHEAST ASIA	MIDDLE EAST	EASTERN EUROPE	RUSSIA	LAC	SUB-SAHARAN AFRICA
Clinical Medicine	CENTRAL ASIA	RUSSIA	SUB-SAHARAN AFRICA	EASTERN EUROPE	CHINA	LAC	INDIA	SOUTHEAST ASIA	MIDDLE EAST
Computer Science	SUB-SAHARAN AFRICA	MIDDLE EAST	SOUTHEAST ASIA	INDIA	EASTERN EUROPE	CHINA	RUSSIA	LAC	CENTRAL ASIA
Economics & Business	RUSSIA	CHINA	MIDDLE EAST	SOUTHEAST ASIA	SUB-SAHARAN AFRICA	LAC	INDIA	CENTRAL ASIA	EASTERN EUROPE
Engineering	CENTRAL ASIA	RUSSIA	EASTERN EUROPE	CHINA	MIDDLE EAST	INDIA	SOUTHEAST ASIA	SUB-SAHARAN AFRICA	LAC
Environment/Ecology	RUSSIA	CENTRAL ASIA	INDIA	SOUTHEAST ASIA	EASTERN EUROPE	MIDDLE EAST	SUB-SAHARAN AFRICA	CHINA	LAC
Geosciences	CHINA	EASTERN EUROPE	RUSSIA	CENTRAL ASIA	SOUTHEAST ASIA	INDIA	SUB-SAHARAN AFRICA	MIDDLE EAST	LAC
Immunology	RUSSIA	SUB-SAHARAN AFRICA	EASTERN EUROPE	LAC	CHINA	MIDDLE EAST	INDIA	SOUTHEAST ASIA	CENTRAL ASIA
Materials Science	RUSSIA	CENTRAL ASIA	EASTERN EUROPE	SOUTHEAST ASIA	CHINA	MIDDLE EAST	INDIA	SUB-SAHARAN AFRICA	LAC
Mathematics	CENTRAL ASIA	RUSSIA	CHINA	MIDDLE EAST	INDIA	SOUTHEAST ASIA	SUB-SAHARAN AFRICA	EASTERN EUROPE	LAC
Microbiology	CENTRAL ASIA	RUSSIA	MIDDLE EAST	INDIA	LAC	SUB-SAHARAN AFRICA	EASTERN EUROPE	SOUTHEAST ASIA	CHINA
Molecular Biology & Genetics	CENTRAL ASIA	SOUTHEAST ASIA	INDIA	MIDDLE EAST	RUSSIA	LAC	EASTERN EUROPE	SUB-SAHARAN AFRICA	CHINA
Multidisciplinary	LAC	SOUTHEAST ASIA	EASTERN EUROPE	CENTRAL ASIA	CHINA	INDIA	RUSSIA	SUB-SAHARAN AFRICA	MIDDLE EAST
Neuroscience & Behavior	RUSSIA	SOUTHEAST ASIA	MIDDLE EAST	EASTERN EUROPE	INDIA	SUB-SAHARAN AFRICA	CHINA	CENTRAL ASIA	LAC
Pharmacology & Toxicology	RUSSIA	CENTRAL ASIA	CHINA	MIDDLE EAST	EASTERN EUROPE	INDIA	SOUTHEAST ASIA	SUB-SAHARAN AFRICA	LAC
Physics	CENTRAL ASIA	CHINA	INDIA	SOUTHEAST ASIA	EASTERN EUROPE	RUSSIA	MIDDLE EAST	SUB-SAHARAN AFRICA	LAC
Plant & Animal Science	CHINA	RUSSIA	SOUTHEAST ASIA	CENTRAL ASIA	INDIA	SUB-SAHARAN AFRICA	MIDDLE EAST	EASTERN EUROPE	LAC
Psychiatry/Psychology	CENTRAL ASIA	INDIA	LAC	SUB-SAHARAN AFRICA	SOUTHEAST ASIA	EASTERN EUROPE	CHINA	RUSSIA	MIDDLE EAST
Social Sciences, general	INDIA	CENTRAL ASIA	CHINA	SUB-SAHARAN AFRICA	SOUTHEAST ASIA	MIDDLE EAST	LAC	RUSSIA	EASTERN EUROPE
Space Science	SUB-SAHARAN AFRICA	SOUTHEAST ASIA	RUSSIA	MIDDLE EAST	LAC	INDIA	EASTERN EUROPE	CHINA	CENTRAL ASIA

Annex 6: Revealed Scientific Specialization (RSS) and CV, selected countries, 1981-1985

	LAC											Leaders		Emerging		
	Argentina	Brazil	Chile	Colombia	Costa Rica	Honduras	Jamaica	Mexico	Peru	Trinidad	Uruguay	USA	Germany	China	South Korea	Global CV
Agricultural Sciences	1.47	3.82	1.05	5.23	6.47	10.07	1.30	1.21	7.10	7.46	1.06	0.88	1.20	0.18	0.94	1.31
Biology & Biochemistry	1.68	1.02	1.74	0.51	2.57	0.23	0.52	0.69	1.01	0.48	0.77	0.98	0.90	0.32	0.51	0.70
Chemistry	1.35	0.55	0.82	0.21	0.15	0.00	0.57	0.68	0.04	0.20	0.21	0.62	1.25	0.97	2.19	1.08
Clinical Medicine	1.12	0.67	1.41	1.24	0.52	0.36	2.16	1.30	0.91	0.74	2.51	1.05	1.11	0.66	0.31	0.60
Computer Science	0.19	0.64	0.34	0.00	0.16	0.00	0.12	0.41	0.00	0.22	0.33	1.34	0.87	1.11	1.42	1.79
Economics & Business	0.72	0.68	0.56	1.04	0.70	3.52	0.46	1.36	1.58	0.16	0.25	1.69	0.30	0.33	0.83	1.52
Engineering	0.50	0.61	0.28	0.26	0.00	0.00	0.25	0.50	0.26	2.88	0.00	1.01	1.07	1.27	2.12	1.18
Environment/Ecology	0.39	0.79	1.35	1.11	2.42	6.32	1.32	0.95	1.00	1.62	0.22	1.30	0.73	0.59	0.49	1.62
Geosciences	0.41	0.72	0.43	0.84	0.83	0.00	0.27	1.08	3.00	1.16	0.00	1.00	0.67	2.88	0.58	1.97
Immunology	0.85	0.80	0.32	1.58	1.26	0.00	0.55	0.81	1.14	0.59	0.30	1.18	0.60	0.25	0.31	1.70
Materials Science	0.72	0.35	0.42	0.06	0.00	0.00	0.06	0.50	0.29	1.48	0.00	0.71	1.46	0.77	3.32	2.19
Mathematics	0.42	1.31	0.62	0.42	0.37	0.00	0.81	0.95	0.20	0.73	0.00	0.95	1.06	2.45	0.83	1.30
Microbiology	1.13	2.01	0.41	1.50	0.76	0.00	0.77	0.84	0.74	0.00	1.38	0.94	1.18	0.40	0.74	1.53
Molecular Biology & Genetics	0.99	2.13	1.05	0.64	0.32	0.00	0.12	1.15	0.21	0.00	2.85	1.05	1.08	0.26	0.30	1.80
Multidisciplinary	0.34	1.95	0.48	0.29	4.60	2.36	0.00	0.47	1.28	0.00	0.25	0.58	0.35	8.50	0.13	1.84
Neuroscience & Behavior	1.07	0.56	0.89	0.18	0.07	0.00	0.17	1.70	0.10	0.00	2.94	1.26	0.65	0.30	0.10	1.57
Pharmacology & Toxicology	1.23	0.77	0.98	0.55	1.19	0.00	0.13	1.10	0.34	0.12	0.90	0.79	1.33	0.95	1.14	1.19
Physics	1.09	1.46	0.37	0.44	0.14	0.20	0.30	1.41	0.14	0.25	0.17	0.78	1.11	1.45	1.86	1.35
Plant & Animal Science	0.89	1.50	1.41	2.78	2.61	4.26	1.38	1.13	2.56	1.72	1.58	0.95	0.96	1.13	0.38	0.76
Psychiatry/Psychology	0.31	0.67	0.32	2.09	0.75	0.68	0.32	0.57	1.38	0.29	0.14	1.74	0.59	0.36	0.20	1.31
Social Sciences, general	0.23	0.77	0.32	1.15	0.94	2.04	3.36	0.65	1.82	2.17	0.43	1.74	0.42	0.49	0.68	1.19
Space Science	1.90	1.37	7.23	1.24	0.00	0.00	0.12	2.07	0.21	2.15	0.00	1.12	1.02	1.08	0.29	4.53
National CV	0.56	0.69	1.40	1.09	1.34	1.90	1.18	0.44	1.36	1.49	1.27	0.31	0.36	1.46	0.92	